



Sports psychiatry: mental health and mental disorders in athletes and exercise treatment of mental disorders

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Abstract

Sports psychiatry has developed for the past 3 decades as an emerging field within psychiatry and sports medicine. An International society has been established in 1994 and also national interest groups were implemented, mostly within the national organizations for psychiatry, some also containing the topic of exercise treatment of mental disorders. Where are we now 30 years later? We systematically but also selectively review the medical literature on exercise, sport, psychiatry, mental health and mental disorders and related topics. The number of publications in the field has increased exponentially. Most topics keep remaining on the agenda, e.g., head trauma and concussion, drug abuse and doping, performance enhancement, overtraining, ADHD or eating disorders. Supported by the growing literature, evidence-based recommendations have become available now in many clinical areas. A relatively new phenomenon is muscle dysmorphia, observed in weightlifters, bodybuilders but also in college students and gym users. Further, sports therapy of mental disorders has been studied by more and more high-quality randomized controlled clinical trials. Mostly as a complementary treatment, however, for some disorders already with a 1a evidence level, e.g., depression, dementia or MCI but also post-traumatic stress disorder. Being grown up and accepted nowadays, sports psychiatry still represents a fast-developing field. The reverse side of the coin, sport therapy of mental disorders has received a scientific basis now. Who else than sports psychiatry could advance sport therapy of mental disorders? We need this enthusiasm for sports and psychiatry for our patients with mental disorders and it is time now for a broadening of the scope. Optimized psychiatric prevention and treatment of athletes and ideal sport-related support for individuals with mental disorders should be our main purpose and goal.

Keywords Sports psychiatry · Mental disorders · Elite athletes · Exercise · Physical activity · Sport therapy

Introduction

“Sports psychiatry” was first introduced in the medical literature 30 years before by J.H. Rick Massimino [1] and 5 years later Daniel Begel published “An overview of sports psychiatry” [2]. These two publications set the ground for a conceptual framework in the field and while Massimino still regards the “prescription of exercise for mental health problems” [1] as a function of sports psychiatry, Begel argues that “In any case, exercise therapy for psychiatric disorders

does not represent an application of psychiatric methods to the field of sports per se, so in this respect it is peripheral to the field of sports psychiatry” [2]. This argument was also based on the empirical situation at that time when “...the therapeutic benefits of exercise cannot as yet be claimed with certainty” [2]. In contrast, sports psychiatry in children and adolescents has always had a broader scope “... how athletics can enhance the mental and physical health of youth” [3]. Figure 1 shows the two sides of the sports psychiatry coin.

The field also developed with the establishment of The International Society for Sports Psychiatry in 1994 which “aims to carry the science and practice of psychiatry to the athletic community, so that all people may enjoy the benefits of healthy athletic participation and reach their full potential in sports...” (<https://sportpsychiatry.org>). The World Psychiatric Association now has a section on Exercise & Sports Psychiatry and national interest groups for sports psychiatry have been established, mostly within

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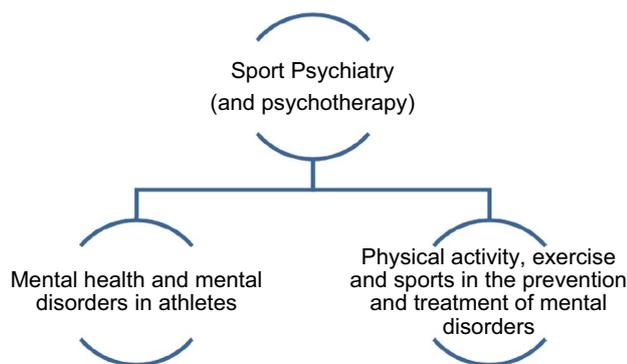


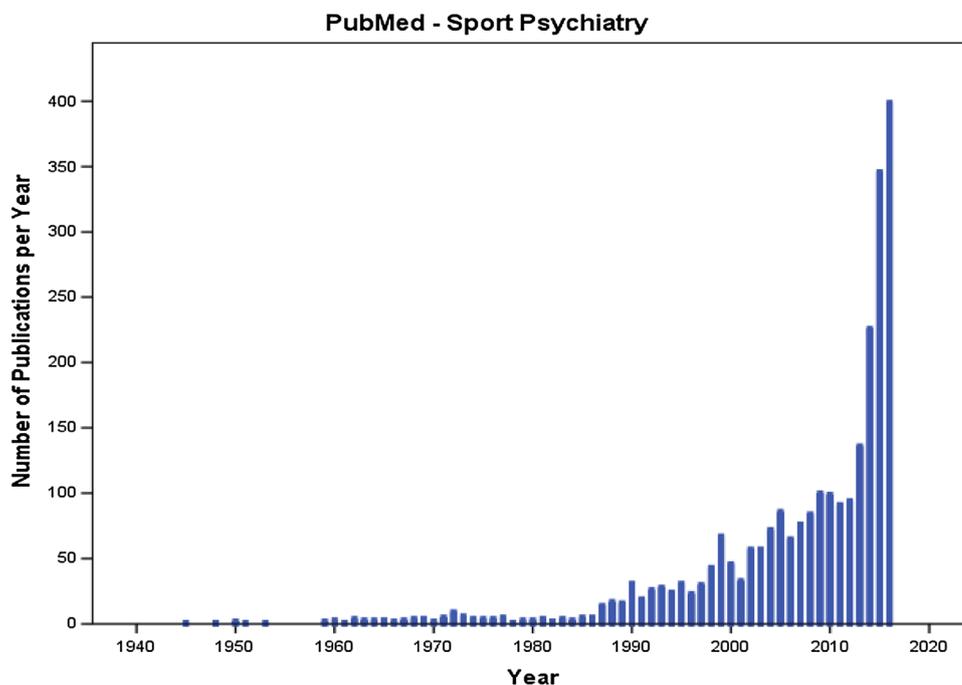
Fig. 1 The two sides of the sports psychiatry medal: Mental health and mental disorders in athletes and physical activity, exercise and sports in the prevention and treatment of mental disorders

the national psychiatric organizations, like the Sport and Exercise Special Interest Group within the British Royal College of Psychiatrists or the section for Sports psychiatry and Psychotherapy within the German Association for Psychiatry, Psychotherapy and Psychosomatics. These two national interest groups have already broadened their scope to also promote physical activity, exercise and sport interventions throughout mental health services and for subjects with mental disorders. Co-launched by the American Medical Association (AMA) and the American College of Sports Medicine (ACSM) in 1997 Exercise is medicine® is now a global initiative with 43 national centers aiming at “encouraging primary care physicians and other health care providers to include exercise when designing treatment plans for patients” (<http://www.exerc>

iseismedicine.org/support_page.php/eim-month-20170/; accessed 28th of May 2017).

This review aims at highlighting selected findings and developments in the field of sports and psychiatry of the past 30 years with the aim to further improve the prevention and treatment of mental disorders in the context of physical activity, exercise and sports. Besides empirical research reports, books, (systematic) reviews, and especially consensus papers and meta-analyses on the most relevant topics within sports psychiatry have been published the past years and will be referred to. Increased scientific activities in the field are also reflected in the number of publications, with sports psychiatry as a search term the number of, e.g., PUBMED publications increased from 26 in 1992 to 399 in 2016 (see Fig. 2). Each title and abstract of these publications was screened for relevance. Because sports psychiatry is a relatively new and developing field many relevant articles could only be found using more specific search terms. *Pubmed*, *psycinfo*, *embase* were used for article identification. It has to be admitted that the selection of manuscripts was subjective as already the number of publications identified with the different search terms increased the number which could be reviewed and presented systematically within one publication: for example, the combination of “sport” and “mental disorder” revealed 7.674 hits, “sport” and “mental health” still 3.685 hits, and “exercise” and “mental disorders” 11.092 hits in *Pubmed* (24th of April 2017). Excluded are studies on the psychological and biological characteristics of success in elite or extreme endurance athletes or studies on coaches or referees. However, the genetic, epigenetic, and metabolomic basis of elite performance is a

Fig. 2 Annual number of PubMed publications with “sports psychiatry” as search term



major topic in the intersection between sports psychiatry, sport medicine and sport psychology. This review will focus on adults, however, due to the developmental approach there are areas of agreement with child and adolescent psychiatry and psychotherapy and a close cooperation is obligatory not only for clinical reasons.

Mental health and mental disorders in athletes

Elite athletes are on the top of physical activity and performance (see Fig. 3), and it has been argued that elite competition sport may be regarded as the ‘brain’s biggest challenge’ [4]. In line, while physical fatigue has long been regarded as being based mainly on muscular and cardiovascular functioning, we now know that even during maximal exercise only about 60% of the active muscle mass is recruited [5] suggesting a “central governor model of exercise regulation’ with the brain regulating the recruitment of motor units and fatigue as a sensation to ensure that there is always a reserve before a catastrophic failure of homeostasis develops during physical activity and exercise” [6].

Most athletes start sports in childhood or adolescence. Sport specific demands accompany them during different developmental periods and the social demands vary with age and position. Injuries [7] and retirement, especially early retirement [8] may be associated with stress and physiological and psychological challenges precipitating mental disorders. Athletes are faced with sport specific mental disorders like, for example, concussion and dementia pugilistica, doping, anorexia athletica or overtraining [2]. Athletes are also not protected against the development of many common mental disorders like depression, anxiety or substance use disorders or attention deficit-hyperactivity syndrome [9], whereas schizophrenia seems to be underrepresented, most probably because of disorder-specific impairments

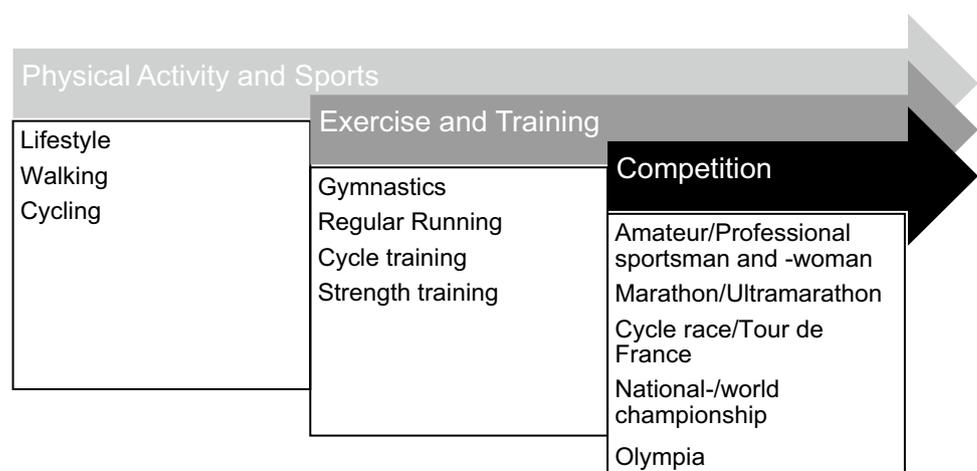
interfering with the demands of elite sports. No data are available on the prevalence of personality disorders in (elite) athletes, and no systematic data are available on bipolar disorder in elite athletes, although several high profile athletes have been diagnosed and some have been in the tabloids due to disorder-associated aberrant behavior [10].

Being part of the sports medical team, the sport psychiatrist does not only care for mental disorders in athletes but is also responsible for their prevention and de-stigmatization as well as for the promotion of mental health. Although it is now generally accepted that mental disorders may occur in elite athletes as well, for many athletes themselves mental disorders are still associated with increased (self-) stigma [11, 12]. Increasing mental health literacy is one approach which has been already studied in an exploratory trial [13] and in student athletes a web-based education and training program enhanced mental health referral knowledge and efficacy relative to a control group [14]. There is also preliminary evidence that a brief (4 h) workshop on mental health in sport may increase the knowledge of the signs and symptoms of common mental illness also increasing confidence in helping someone who may be experiencing a mental health problem in coaches, trainers and support staff [15]. However, further research and a wide range of use of anti-stigma interventions in the general population but especially in (elite) sports is needed [16].

Common mental disorders in (elite) athletes

According to studies of the past 30 years [17] and a recent meta-analysis [18], overall, depressive symptoms are not increased but also not decreased in high-performance athletes, however, sport-related differences have been reported and it has been repeatedly shown that athletes competing in individual sports were more prone to depressive symptoms than athletes competing in team sports, with attribution after failure seeming to play an important role [19]. Higher

Fig. 3 Depending on the activity level and the expertise of a subject, physical activity, exercise and sports may result in different activities, some of them are named exemplary



prevalence rates for depression diagnoses were also found in a small group ($n=50$) of swimmers competing for positions on the Canadian Olympic and World Champions teams [20]. In contrast, rugby league players have fewer depressive symptoms, but more symptoms of generalized anxiety and alcohol misuse [21]. Excessive alcohol use has been described especially in college athletes [22]. Contrary to the use pattern in the general population marijuana appears to take the place of tobacco as the second most widely used drug in athletes [23].

It seems that anxiety disorders in elite athletes have a comparable frequency as in the general population [24]. Approximately 2% of the general population have debilitating performance anxiety [25]. Within the group of anxiety disorders debilitating performance anxiety is regarded either as a specific phobia, or probably much more frequent as part and symptom of more generalized social anxiety. Adolescence and early adulthood are risk periods for the development and maintenance of anxiety disorders. Professionals working with this group should keep this in mind and are encouraged to enroll a clinical psychologist or a psychiatrist and psychotherapist early.

It was hypothesized that ADHD may be more prevalent in (elite) athletes [26], however, no reliable data are available. Some symptoms of ADHD may respond positively to sports [27] and others like, e.g., spontaneity might be associated with better performance. Although evidence-based recommendations for athletic trainers caring for ADHD athletes are now available [28], more severely impaired subjects need drug treatment, and if atomoxetine is not sufficiently effective with stimulants [29, 30] as a therapeutic use exemption on application on an individual basis being checked by the World Anti-Doping Agency and probably the competition organizer as well. Because there is still a debate on the use of stimulants in elite athletes [29, 30] atomoxetine might be preferred which, however, is in contrast to the non-athletic population.

In both sexes symptoms of eating disorders occur more often in aesthetic sports, in sports where low body weight enhances performance, which are subdivided in weight classes or in which weight is advantageous (wrestling) [31]. The past 15 years, programs for eating disorder prevention in athletes have been evaluated, with at least some success [32]. It must also be taken into account that although nearly one-third of, e.g., French elite athletes have disordered eating behavior [33], the common standard diagnostic criteria for eating disorders seem not to be adequate in this athletes and there is a hope that with DSM-5 the number of eating disorders otherwise not specified (EDNOS) will decrease [34].

Sleep and sleep disturbances exemplarily show the complex interplay of mind and body in athletes. Sport may lead to sleep disturbances, however, sleep disturbances by itself

may affect performance, increase injury risk and may be a risk factor but also a symptom of a mental disorder, and circadian misalignment may be a disadvantage in competition [35].

Treatment of common mental disorders in athletes

In 2010 Reardon and Factor [9] published a landmark systematic review on the diagnosis and treatment of mental disorders in athletes. An update on psychiatric medication in athletes was published in 2016 [36] and although many methodological concerns exist with respect to drug trials in athletes, Reardon concluded that there is “at least some guidance for clinicians wishing to make informed decisions about psychotropic prescribing for their athletes” [36]. Sport psychiatrists seem to prefer non-sedating psychotropic medication being less likely to cause weight gain or cardiac side effects, and for depression bupropion seems to be currently regarded as the treatment of first choice by sports psychiatrists [37], even despite its potential ergogenic effects [9], which caused the World Anti-Doping Agency (WADA) to put it on the Monitoring Program for possible in-competition abuse. Inhibition of hyperthermia-induced fatigue might put bupropion taking athletes at risk to harmful hyperthermia [38]. However, it is still unclear of whether this is a real or primarily a theoretical risk. Altogether, currently used psychotropic drugs are not more effective than those used 30 years before but they are much better tolerated due to reduced side effects.

Individual psychotherapy is now the first line treatment for many mental disorders like mild to moderate depression or anxiety disorders with cognitive behavioral therapy having the best empirical evidence [39]. Depending on the clinical syndrome, the sport and the life situation of the athlete also psychoeducation, counseling or family therapy might be the treatment of choice [40]. Elite athletes may have specific barriers to seek and accept psychotherapy [40], on the other hand they have strengths and capabilities making them good candidates for success in psychotherapy [41].

Sport specific mental problems and disorders in athletes

Negative-life events stress, daily hassles, or injuries are not only a risk factor for the development of mental disorders in athletes [42], the response to negative life-event stress is also the most important risk factor for injuries, with psychologically-based interventions reducing the risk of injuries at least with a moderate effect size of Cohen's $d = -0.63$ (CI = $-0.88, -0.38$) [43]. Elite athletes are confronted with sport-specific demands and, especially if successful, also with specific social demands. Many depend on their surrounding, which organizes everyday life, often

traveling a lot and the most popular having a life comparable to pop-stars.

Concussion

Sports-related concussion, a distinct subtype of mild traumatic brain injury [44] has been increasingly recognized as a major public health issue in the past 30 years. Symptoms of post-concussive syndrome include headache, dizziness, neck pain, exercise intolerance, cognitive problems and noise or light sensitivity. They are usually short lived and resolve spontaneously within 7–10 days. However, 10–20% have a protracted course with persistence of the symptoms for weeks to months [45]. The second impact syndrome is a sometimes fatal condition that results from cerebral edema following a second concussion during incomplete regression of the first concussion, with athletes younger than 20 years being at highest risk [46]. A recent meta-analysis also supported an association of ADHD and concussion [47], and first analyses suggest that ADHD is an antecedent risk factor for concussion but also complicates the course of mild traumatic brain injury [48]. Helpful guidelines for the clinical management of concussion in sports have been published in 2013 [49]. Repetitive subconcussive head impact (RSHI), for example, by heading the ball in soccer also affects the neurochemistry of the brain and may precede cortical thinning and neurocognitive changes [50, 51].

No biomarkers are available at the moment to predict the clinical course and almost all studies were retrospective in design. In 2014, the National Collegiate Athletic Association (NCAA) and the US Department of Defense (DoD) established the Concussion Assessment, Research and Education (CARE) Consortium to prospectively study the natural history of clinical and neurobiological recovery after concussion in student-athletes and military personnel with a sample of 23,533 subjects with 1,174 concussions [52]. Further prospective studies on acute traumatic brain injury (TBI) have been started in the US (TRACK-TBI) and Europe (CENTER-CBI) (see [53] for an overview).

Prevention of concussion and RSHI is now a primary goal of many national and international sports organizations. A first systematic review and meta-analysis suggests a protective effect of helmets in skiing/snowboarding and the effectiveness of policy eliminating body checking in youth ice hockey. Future “research should examine mouthguards in contact sport, football helmet padding, helmet fit in collision sport, policy limiting contact practice in youth football, rule enforcement to reduce head contact in ice hockey and soccer, ice surface size and board/glass flexibility in ice hockey and training strategies targeting intrinsic risk factors (eg, visual training)” [54]. Although helmets protect against devastating intracranial injury, a

considerable amount of evidence suggests that contemporary helmets do not protect against concussion [55].

Chronic traumatic encephalopathy (CTE)

Chronic traumatic encephalopathy (CTE) evolved from dementia pugilistica, described already in 1928 [56] in boxers, is suggested to be a progressive neurodegenerative consequence of repetitive mild brain injury. The interest in CTE increased again when case reports of American football players were published, followed by case series of boxers, wrestlers and American football players [57]. Using currently published consensus diagnostic criteria [58] Ling et al. described pathologically confirmed CTE in four out of six prospectively followed soccer players with dementia [59].

Overtraining

Successful training involves overload as a stimulus but must avoid the combination of excessive overload and inadequate recovery. Although there is no general accepted definition of overtraining, many refer to Kreider et al. [60]. *Overreaching* An accumulation of training and/or non-training stress resulting in short-term decrement in performance capacity with or without physiological and psychological signs of maladaptation in which restoration of performance capacity may take several days to several weeks. *Overtraining* An accumulation of training and/or non-training stress resulting in long-term decrement in performance capacity with or without physiological and psychological signs of maladaptation in which restoration of performance capacity may take several weeks to several months.

Other diseases with a performance drop like viral diseases, bacterial infection and other physical or mental conditions have to be ruled out and if a reduction of the training volume (<20%) does not result in a normalization of the reduced performance (>10%) overtraining syndrome may be diagnosed [61]. It has been suggested that overtraining should be renamed by unexplained underperformance syndrome [62, 63], however, outside the UK this suggestion has not been widely adopted.

Rest and very light training seems to be the only therapeutic strategy effecting recovery [61]. At the moment there are no accepted biomarkers for overtraining, and symptoms like fatigue and depressed mood [64] can make the dissociation to major depression difficult [65]. To prevent overtraining and injuries, the International Olympic committee just recently published a consensus statement on (training) load in sports [66].

Female athlete trias

The female athlete trias is a medical condition often found in physically active girls and women consisting of (1) low energy availability with or without disordered eating, (2) menstrual dysfunction, and (3) low bone mineral density. Early intervention is necessary to prevent the progression to serious endpoints like clinical eating disorder, amenorrhea and osteoporosis [67]. The 2014 Female Athlete Trias Coalition Consensus Statement on Treatment and Return to play of the Female Athlete Triad expert panel has proposed a risk stratification point system that takes into account the magnitude of the risk to assist the physician in decision-making regarding sport participation, clearance and return to play [68]. Future research is now needed to clarify whether these important guidelines help to improve health and to reduce the risk for injury and illness.

Doping

The annual reports of the WADA doping control tests reveal 1–2% positive results (<https://www.wada-ama.org/en/anti-doping-statistics>). In contrast, using questionnaires with randomized response technique and models of biological parameters yield an estimation of 14–39% of elite athletes who used intentionally doping [69]. Gene doping is now possible and efforts are undertaken to detect this in humans [70], but also in animals used in sports [71]. Also ‘brain doping’ using electrical stimulation with, i.e., transcranial direct-current stimulation (tDCS) might be relevant for competitions, although it is too early to know about its efficacy in athletes. Nevertheless, it seems at least worth thinking of [72].

The possible harms of doping are not restricted to elite athletes since fitness center members have an overall prevalence rate of 8.2%, with stimulants to lose weight are most common [73]. Whether harm reduction principles produce superior social outcomes as a compared to the current zero-tolerance model [74] seems at least questionable. In March 2017 the IOC came up with 12 principles for a more robust and independent anti-doping system (<https://www.olympic.org/news/declaration-of-the-ioc-executive-board-1>).

Muscle dysmorphia

First described among male bodybuilders who abuse anabolic steroids [75], muscle dysmorphia is characterized by the self-perception of being insufficiently large and muscular, despite the fact that in general the subject has bigger muscularity than the general population. First regarded as a reverse form of anorexia nervosa [75], the term dysmorphia was introduced, representing the relation to body dysmorphic disorder [76]. Subsequently it was also described in

weightlifter, bodybuilders not abusing steroids, but also in college students and gym users, with males being predominately studied [77]. Prevalence rates range from 5.9% in a mixed gender group of male college students, to 13.6–44% among male weightlifters and 80% in female weightlifters, and 53.6% in a mixed-gender sample of bodybuilding competitors [77]. Risk factors seem to be body dissatisfaction, body distortion, ideal body internalization, low self-esteem, perfectionism and negative affect [78]. Not surprisingly, body-builders have a higher rate of muscle dysmorphia symptomatology than non-body-building resistance trainers [79]. At the moment however, there is limited understanding of the etiology, nosology, prognosis and treatment [80].

Psychological performance enhancement

Performance enhancement techniques include motivation and goal setting, managing cognition and emotion in the competitive environment, attention focusing and mental imagery, and positive psychology, peak performance, and the athletic zone [81]. A recent meta-analysis revealed a moderate effects size of psychological and psychosocial interventions on sport performance at post-intervention, and a strong effects size at follow-up assessments, 1–4 weeks after the intervention [82].

While performance enhancement in healthy athletes is mainly a domain of sport psychology, sports psychiatry must be at least familiar with its basics. Because most (elite) athletes are familiar with (psychological) performance enhancement techniques the sport psychiatrist can build upon this knowledge as a common basis. In treating athletes with mental disorders standard psychotherapeutic and psychopharmacological interventions could be combined with psychological performance enhancement techniques further increasing the effectiveness of treatment and reducing the time for return to play.

Selected topics for future research and action

- Reduce stigma towards the diagnosis and treatment of mental disorders in athletes.
- Distinction, prevention and treatment of overtraining and depression.
- Fight doping.
- Psychological and biological basis of elite performance and its promotion.
- Further specific features of mental disorder and their treatment in athletes.
- Prevention of mental disorders in athletes.
- Genetic, epigenetic and metabolomic basis of elite performance.
- Performance enhancement.

Physical activity, exercise and sports in the treatment of mental disorders

Most in-patient treatment programs in psychiatry, at least in high-income countries offer physical activity, exercise or sports as a complementary intervention. However, only a small proportion of patients uses it [83], and most probably a much smaller proportion gets an adequate dosage of physical activity, exercise and sports [84]. We know that a too low dosage of pharmacotherapy or psychotherapy may result in ineffectiveness and the same holds true for exercise treatment of mental disorders [85]. In outpatients with mental disorders the situation is even much worse and consequently, Sarah I. Pratt and coauthors call for an increase in “US health plan coverage for exercise programming in community mental health settings for people with serious mental disorders” [86].

There are at least three good reasons for our patients with mental disorders to get into physical activity:

- Physical activity and exercise may be used to treat (symptoms of) mental disorders (see also Table 1).
- Many serious mental disorders are associated with a reduced life expectancy [87], at least in part due to cardiovascular disorders and diabetes [88], which can be positively influenced by physical activity and exercise.

- Psychotropic medication may increase sedentary behavior, increase body fat and body weight, reduce insulin sensitivity and increase lipids.

The evidence for the first point has increased dramatically in the past 30 years, and a summary description on efficacy and effectiveness in every-day clinical practice will follow.

Efficacy

The current evidence for a therapeutic effect of exercise in mental disorders is summarized in Table 1. If available recent meta-analyses were used for getting an idea of the effect size and the total number of subjects studied. We published a simpler summary table already in 2013 [103], and a large number of meta-analyses allow now to get an idea on the effect size of sport therapy in different mental disorders. The wide range of effect size calculation results, mixed study quality, and the (low) number of subjects included in the clinical trials, however, call for caution in the interpretation and generalization of the results and underscore the necessity to perform high-quality and adequately powered confirmatory RCTs for almost all mental disorders to further support our confidence on the efficacy but also the limitations of exercise treatment of mental disorders. Unfortunately, financial returns from RCTs on exercise treatment of mental disorders cannot be expected, and therefore, support

Table 1 Evidence level, effects size and number of studied subjects for exercise treatment on disease severity in adults with mental disorders according to Oxford Center for Evidence-Based-Medicine (CEBM) levels

ICD-10	Disorder	Evidence level	Effect size (g)	N	References
F0	Mild cognitive impairment	1a	−0.20	443	[89]
	Alzheimer dementia	1a	−0.83	119	[89]
F1	Alcohol dependency	1a	−0.23	531	[90]
	Nicotine dependency	1a	−0.19	3880	[90]
	Illicit drug abuse	1a	−0.66	315	[90]
F2	Schizophrenia	1a	−0.39 to −1.00	453–719	[91, 92]
F3	Unipolar depression	1a	−0.68 to −0.99	977–1487	[93, 94]
	Bipolar disorder	4	NA		[95]
F4	Anxiety disorders	1a	−1.23 ^a	134	[96]
	Panic disorder/agoraphobia	1b	−1.17 ^a	82	[96]
	Generalized anxiety disorder	1b	−0.45 ^a	30	[97]
	Social phobia	1b	−1.38 ^a	56	[98]
	Obsessive compulsive disorder	4	NA		[99]
	Posttraumatic stress disorder	1a	−0.35	200	[100]
F5	Somatiform disorder	5	NA		
	Anorexia nervosa	1b	NA	139	[101]
	Bulimia	1b	NA	88	[101]
F6	Binge eating disorder	1b	NA	211	[102]
	Borderline personality disorder	5	NA		

NA RCT or meta-analysis not available

^aPre-post effect size

from non-profit organizations like national or international research funding organizations is needed.

Most RCTs summarized in Table 1 used endurance training, mostly running, but also bicycle ergometer. Only a limited number of studies use strength training. Other interventions studied Tai Chi Chuan, Zumba, climbing or hiking. Yoga is a promising intervention, however, according to a recent review, only seven RCTs with 240 patients have been performed for depression treatment [104]. Most RCTs use ICD-10/DSM-IV criteria and in general three 30-min exercise sessions/week are intended during a period of 8–12 weeks.

The choice of the control group is crucial in exercise trials as a wait-list control group or treatment as usual is the minimum. However, the high placebo response in many mental disorders call for more sophisticated approaches like active control groups using less effective physical activity interventions or the comparison with other interventions, paralleled for time, duration and therapist contact. Blinding of the rater is possible, blinding of the subject getting the intervention is only possible with respect to the expectation if an active control group is used.

While most RCT's included in the meta-analyses of Table 1 focused on the core symptomatology of the respective mental disorders, as depression, anxiety or abstinence, further studies focused also on specific symptoms or syndromes, like cognition in schizophrenia [105] or cardiovascular risk factors in depression [106]. Further, in alcohol use disorder, exercise significantly reduces depression and improves physical fitness [107]. Although physical activity interventions are used as a skill for patients with borderline personality disorder no systematic study on the effects of exercise training in subjects with borderline personality disorder is available at the moment. In bipolar disorder only a combined lifestyle intervention including nutrition, physical activity and lifestyle has been published until now [95]. Long-term follow-up data are rare and in most studies concomitant drug treatment was allowed. Adequately powered exercise relapse prevention studies or primary prevention studies still have to be performed.

Effectiveness and everyday clinical practice

In most RCTs exercise training is used in addition to standard treatment. Exercise training may be also used to speed up or to increase the efficacy of a standard treatment as has been shown for psychotherapy in anxiety disorder patients [108–110]. More targeted combination of exercise and for example, specific psychotherapeutic interventions are studied at the moment and first preliminary results seem to be promising [110]. Also, first studies show effectiveness in real-life situations, like for example a dental practice [111].

Some argue that exercise trials are blurred by a selection bias, meaning that mostly only subjects who want to exercise are included in the trials. However, this holds true for other interventions as well. Written informed consent should ensure that, e.g., drug, psychotherapy or exercise trials only include subjects who are willing to get the intervention under study. However, there is still a feasibility problem with exercise interventions for mental disorders. (1) Guided programs are more effective, however, the supply is limited, (2) in addition to the weaker self, symptoms of mental disorders like, e.g., depression, anxiety, fatigue or difficulties concentrating may hinder exercise therapy participation, and (3) physiological changes like overweight, somatic disorders, or reduced fitness [112] need adaptations of standard training protocols. On the other hand, the effectiveness of exercise interventions in everyday clinical practice might be increased by the implementation of further supportive environmental factors, like being in nature [113] or even watching videos [114], getting natural light, being together with other people having social interaction and conversations [115] et cetera.

For the more severely impaired patients a standard (aerobic) training program might be too demanding, and low threshold interventions, like for example step counting with the aim to increase the number of daily steps subsequently might be an approach [116, 117]. Developments in technology, e.g., exergaming like Wii [118], fitness tracker, smartphone applications [119] or whole body electromyostimulation [120–122] might help to further increase physical activity and support exercise interventions in subjects with mental disorders. Also, motivational interviewing [123, 124] and other psychological techniques to increase motivation and volition for physical activity and exercise training must be further developed, evaluated and implemented [125–128]. Unfortunately, this area of research was largely ignored in the past and we are just at the beginning to understand how we can get our patients with mental disorders physically more active, besides a gifted and enthusiastic trainer. And it is up to mental service providers to implement physical activity and exercise programs into their services. Taking a pill is easy as compared to getting more active and at least at the beginning many subjects with mental disorders need support to start and maintain exercise and sports.

When exercise treatment in subjects with mental disorders is recommended the prescribing clinician must inform the patient on:

- Discipline.
- Duration, frequency, intensity.
- Targeted symptom(s).
- Contraindications (severe somatic disorders, drug treatment).

comparable to drug or psychotherapy treatment. In line, in most situations and at least in chronic disorders, the effects of drug or (exercise) therapy can only be maintained if the treatment is continued [85]. Prescribing exercise has been used and evaluated in different areas of medicine [129] and has been also suggested for subjects with mental disorders [130]. If somatic disorders are considered, exercise treatment of mental disorders is generally well tolerated and safe. Injury prevention, however, should have first priority.

Possible side-effect: exercise addiction/dependence

Exercise addiction is a behavioral addiction with a prevalence of approximately 3% in the exercising population [131]. It is characterized by salience, mood modification, tolerance, withdrawal symptoms, (inter-)personal conflict and relapse. Elite athletes score different on exercise dependence scales questioning the validity of reported high prevalence rates [132].

Selected topics for future research

- Dose–response relationship and optimal dosage and discipline according to disorder (severity).
- Type of training: Endurance and/or strength.
- Improving the efficacy by training modification including context and surrounding.
- Disorder, severity, age and gender specific features.
- Long-term effects.
- Technical support like activity trackers, apps, electromyostimulation.
- Mechanisms of action.
- Increasing motivation and volition.
- Optimized combination with other interventions.
- Individualized exercise prescription.
- Contra-indications.
- Prevention of mental disorders.

Conclusions

The past 30 years have been successful in establishing sports psychiatry as a discipline within psychiatry and sports medicine. Within the main fields of sports psychiatry the evidence basis is much better now, as the frequency of common mental disorders in athletes of different disciplines have been described as well as risk factors. Chronic traumatic encephalopathy has been described also in American football players and wrestlers and prospective as well as preventive studies against concussion in sports have been started. Evidence-based consensus guidelines for major sport psychiatric topics like concussion [49], overtraining [66], female athlete trias [133] or ADHD in athletes [28] reflect the significance

of the discipline. While in the general population the stigma of at least some mental disorders has decreased over the past decades, in sports psychiatry we are still at the very beginning. Doping is still also a serious problem, and new molecular techniques might also confront us with gene doping in the near future.

Also, exercise treatment of mental disorders has now an empirical basis, which in turn is incorporated in evidence-based guidelines, first starting with, for example, depression [134]. In some areas, new approaches to combine exercise treatment with psychotherapy are tested and further strategies to enhance the effectiveness of exercise treatment of mental disorders are investigated [109, 110]. Looking for research funding for exercise treatment of mental disorders we too often were confronted with two arguments: (1) it is all to clear that exercise and sports help, why should we invest in this area? or (2) with respect to the bad empirical evidence from high quality studies how can you plan such a big and expensive study! We now have arguments against both niggles and at least some applications for funding have been already successful the past years.

Knowing the subjective perspective in the selection and presentation of the literature within this article there is one central aim in the context of physical activity, exercise, sports and mental disorders: to improve the prevention and treatment of subjects with mental disorders, being (elite) athletes or couch potatoes, and everybody in between is also welcome. We now have good empirical evidence for the efficacy of sports therapy in many mental disorders and broadening the scope now and to (re-) integrate physical activity, exercise and sports therapy of mental disorders as a relevant topic within sports psychiatry, the other side of the coin (Fig. 1) looks like a prototypical win–win situation. The arguments seem to be overwhelming:

1. Sports medicine also covers the use of physical activity and exercise in the treatment of physical disorders. Why should sports psychiatry solely focus on athletes?
2. (Self-)Stigma is still a highly important topic. For elite athletes with mental disorders but also for subjects with mental disorders. Combining anti-stigma activities for both groups is expected to work synergistically and reduce barriers and prejudice of affected subjects within their surrounding but also in the general population.
3. The empirical basis of sports psychiatry would increase dramatically.
4. Psychiatric experts for sports should give emotional and intellectual input to both sides of the medal.

The reader is free to add further arguments on top. Only the most striking are named.

Grown up and accepted after more than 30 years, sports psychiatry now has a solid scientific basis and is still a fast

developing field within psychiatry. The other side of the coin, exercise and sport therapy of mental disorders also has an empirical basis now. Who else than sports psychiatrists' could and should advance sport therapy of mental disorders? We need this enthusiasm for sports and psychiatry also for our patients with mental disorders and it is time now for a broadening of the scope. Optimized prevention and treatment of athletes and non-athletes with mental disorders should be our primary purpose and goal.

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