Sports and martial arts activities for public health purposes: the musician's risk profiles and exercise-based health care as a model

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OVERVIEW

Sports and martial arts activities for public health purposes: the musician's risk profiles and exercise-based health care as a model

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Abstract
Purpose The common saying that sports promote good health is in line with main results of sports medicine, but conflicting with the high amount of sports injuries and sports-related diseases. This paper contributes to the discussion of the pros and cons of sports, particularly of the martial arts. It intends to shed light on the benefits of sports in the general public and to explore the enormous and yet unexploited potential of individually tailored sport activities for public health.
Methods Comparative analyses and meta-synthesis of empirical studies on the health benefits of sports. Musicians with very heterogeneous work-related risk profiles serve as a model for inductive generalisation.
Results For health promotion and to avoid adverse outcomes, sport activities must take one's physical status and risk profiles into account and refer to well-adjusted training zones. This encompasses musculoskeletal and biomotor factors, behavioural means to rebalance the nervous system, cardiorespiratory fitness, mental health and psychological benefits, and active pain management and pain relief.
Conclusion Sports organisations provide a wide spectrum of facilities for sports-oriented lifestyles; however, informal experience and relevant publications let us assume that they rather do not explore how to optimise preventative and health-related benefits, except for training with personal coaches. And yet, relatively simple screening methods and individually adjusted intensities, modes, and frequencies of trainings can enhance benefits and greatly contribute to public health, which would, however, require a stronger health awareness of providers and specific education of sports coaches.

Keywords Sports medicine · Performing arts medicine · Musicians' medicine · Preventive healthcare · Health benefits of sport · Martial arts

Introduction

Public health is one of the most multifarious challenges for modern societies that requires interdisciplinary efforts and involves diverse domains such as health education, epidemiology, occupational medicine, sports sciences, and cultural sciences. In this context, the common awareness of health issues, self-responsibility for health, and self-efficacy play an important role and concern life-styles, self-images, and behavioural habits.

Regarding the WHO-health definition, physiological, psychological, and somatic perspectives advocate holistic views of health and highlight sports as a viable means to promote physical fitness and social well-being and cultural activities as a most human way of psychosomatic re-balancing, self-realisation, and social inclusion.

However, playing music both in a professional way and as a form of leisure time activity can cause health problems and medical conditions. Inappropriate posture can lead to anatomical aberrations such as scoliosis. In the context of the musician's focal dystonia, small repetitive movements have been identified as pathogenic triggers. Exaggerated self-expectations are likely to cause psychological distress and symptoms akin to obsessive-compulsive disorders; and playing techniques that do not allow for bio-mechanical

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principles are supposed to entail a broad spectrum of problems such as overuse syndromes.

For both professional musicians and amateurs with high exercising intensities, individually tailored strategies to avoid such problems are a prerequisite. These comprise enhanced body-awareness, the assessment of one's individual resistance to physiological and psychological overload, the adjustment of non-pathogenic doses of exertion and strain, and preventative physical training of the body. These considerations concern sports medicine and give rise to two crucial hypotheses. Firstly, health-oriented sports can prevent the typical health problems of professional and non-professional musicians. Secondly, musicians and athletes have similar risk conditions that call for interdisciplinary research and associated preventative measures.

In a nutshell, performing artists are athletes (Dick et al. 2013). They practise hard and go to the limits of their physical and mental capacities. They perform under stressful circumstances, they have to withstand challenging situations and often experience anxiety and euphoria at the same time. In contrast to professional athletes, many of them are not trained to deal with musculoskeletal strain and do not know how to develop their psychomotor selves in order to prevent overload syndromes, stress, and pathological consequences of their biomechanical maladjustment.

This article wants to highlight the significance of specific health-oriented and preventative sports activities for musicians, who also serve as a model for somewhat comparable professions and behavioural habits. Moreover, the embodied meta-synthetic discussions touch upon the manifold circuitries that underlie viable public health strategies and involve the question of health-promoting activities that have to be adjusted according to individual states of mind and physical conditions and ought to be understood in the context of balanced psychosomatic and socio-cultural systems.

General sports medical perspectives

Sports medicine is a multifaceted discipline with a long history of interdisciplinary efforts. Among a broad spectrum of duties, it also provides preventive measures for athletes and physical exercises that are specifically tailored to promote health. This article focuses on how such benefits also apply to health issues beyond the realm of professional and elite sports, explores their potential for musicians, and suggests throughout an expanded public health-oriented scope of applied sports medicine.

In this context, we highlight the assumingly enormous public health potential of organisations that provide sports facilities with public access—and yet, exploiting their inherent advantages requires staff that is educated in health-oriented applications of sports elements and sports disciplines. Long-term results of such developments, should the implementation of such policies actually happen, will be assessable only in the course of time though.

The identification of medically relevant modes of action in sports disciplines and of specific preventive and health-promoting techniques are crucial to the outcome of such programmes. Exercises have to be precisely assigned to clear-cut topics of general health promotion and the physiological and mostly musculoskeletal adjustment to bio-motor demands. Further issues depend on individual risk-profiles, on personal features of sports motivation and attitudes to healthy life styles and, in given cases, on pathological manifestations which might use sports as a sort of add-on therapy. Required research needs interdisciplinary collaboration that also encompasses sports medicine, sports therapy, sports sciences, epidemiology, and health sciences (Fig. 1).

Similarities between musicians and athletes

Already in the year 1993, Nicholas F. Quarrier spoke of the alarming amount of overuse injuries in musicians and dancers and advocated hence education programmes for primary prevention. This message did not greatly inspire an enhanced awareness of these risks, nor did it lead to a wider implementation of standardised preventive measures. One and a half decades after Quarrier's treatise, Dawn Elizabeth Bennett (2008) turns afresh to this topic and highlights the higher rate of injury amongst musicians compared to athletes.

Alice Brandfonbrener (1986), a pioneer in treating the unique medical issues of performing artists, provided a preliminary classification of health issues that typically occur in active musicians. In contrast to theoretical frameworks that refer to the organology of musical instruments (Bird 2016), this article focuses on specific public health-related strengths of sports medicine, which is, moreover, about to expose the professional musician as a high-risk athlete with a lifetime prevalence of music-related injuries of 82 and 76% experiencing a condition that negatively affects their musical performance (McFadden 2013).

There are three main reasons why this article focuses on musicians and performing artists, who are rather regarded as people who contribute to public health (Stuckey and Nobel 2009; Theorell and Kreutz 2012) than a cohort that needs specific health care:

- Musicians and performing artists are rarely considered to have high-risk professions. In general, they are not the typical population for epidemiological or public health studies.
- The complexity and the highly dissimilar modes of their professional behaviour including motor, cognitive, and affective factors and their often irregular life-styles make

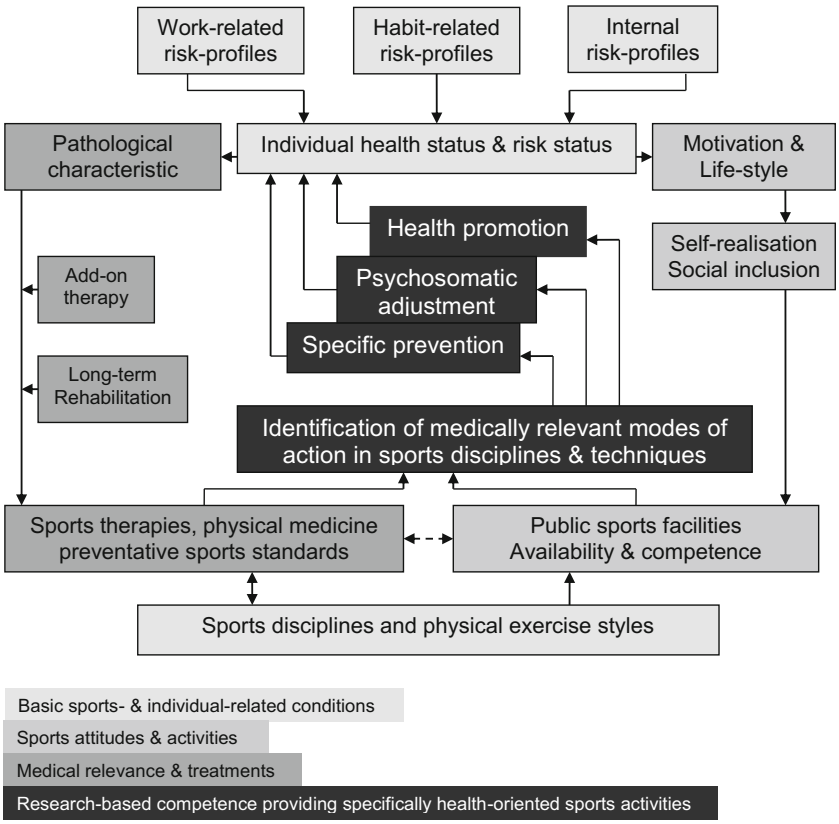

Fig. 1 Specifically selected sports for public health purposes

them an ideal model to study similar work and habitual risk profiles. Although they form a rather small 'study sample', their multifaceted profiles allow certain inductive generalisations.

- Even if their muscular strains are usually lower than those of athletes, they have more musculoskeletal conditions and work-related injuries, especially overuse syndromes. This sheds light on the efficacy of preventive methods in sports trainings and health benefits of sports which can be adapted for public health purposes.

Throughout this article, these three perspectives should be taken into consideration and help to approach the complexity of the topic.

Specific sports medical perspectives

Discussing sports from the perspective of pubic health touches upon a broad spectrum of topics. These include not only the social benefits and enjoyment of sports activities which proved to enhance the quality of life and are hence considered a viable means to prevent psychological conditions, but also involve the epidemiological fact that a lack of exercise is a major cause of persisting or constantly recurring illnesses (Booth et al. 2012): 'Chronic diseases are major killers in the modern era. Physical inactivity is a primary cause of most chronic diseases.'

Such results emphatically inspire research on the specific benefits of mass sports such as the comparison of cardiorespiratory and metabolic responses to alpine skiing, cross-country skiing and indoor cycling (Stöggl et al. 2016). The physiological perspectives of sports cover literally all biochemical and microbiological processes such as the impact of exercise on the regulation of immune functions (Simpson et al. 2015), which emphasises the importance of training on a regular basis and within individually adjusted training zones. In this article, we particularly encourage research on the benefits of the martial arts which are, in comparison to popular sports such as skiing, yet rather underrepresented.

Given a broad spectrum of music-related risk factors, particularly poor posture or, in clinical cases, abnormal posturing, and excessive playing force are considered main health threats. In line with this viewpoint, musculoskeletal and motor functional examinations in students of the university of music and performing arts in Munich, Germany, distinguished significantly asymmetric posture, harmful compensation patterns, altered muscle tone, insufficient muscle strength, and a lack of body-awareness as common phenomena and identified them as the most frequent direct and indirect causes of pain, motor dysfunction, and neurological issues in musicians.

Musculoskeletal system and biomechanics

There are obvious similarities between the musicians' and the athletes' orthopaedic and physical medical issues. For instance, Hotchkiss (1990) described similar elbow and wrist problems in musicians and athletes. Although a 'tennis elbow', which is a relatively frequent condition in pianists and string players, has to be carefully examined, there are afflicted musicians who just reduce their practice and/or take painkillers, ignoring that a variety of tendinopathy approaches such as the therapeutic eccentric exercise (TEE), can yield good curative results. In this context, Phil Page (2010) suggests using a flexible rubber bar, and the aforementioned studies in Munich advocate specific Judo- and Karate-based resistance training modes to intervene in such conditions.

Similarly, Bird and Pinto (2013) highlighted that although scoliosis is usually considered a condition of athletes, the abnormal sideways curve of the spine is relatively frequent among performing artists and raised the question why it is even more often a problem in musicians than in dancers. Given that these authors felt surprised, in-depth investigations shed light on a common misunderstanding of sports as a main cause of scoliosis.

On the basis of the studies in Munich, we can assume that the musicians' repetitive biased movements and asymmetric postures are more likely to entail a pathological curvature of the spine than the multifaceted and whole-body-controlled movements in a well-balanced dance performance. In accordance with sports medical findings that recommend movements such as indoor rowing as an efficient measure to treat scoliosis (Shin et al. 2015), we advocate dynamic, symmetric, 'wave-shaped', and whole-body strengthening for a spinal rebalancing in musicians. And yet, that the same sports can be both harmful and helpful reminds us of Paracelsus' famous saying that the dose makes the poison, which we consider of high relevance to public health.

In many cases, already the analysis of pathogentic factors gives rise to sports therapeutic ideas. Given that overuse, nerve compression, and focal dystonia are musculoskeletal core-issues of musicians, difficult repetitive movements and prolonged flexion of the head cause typical neck, shoulder, and temporomandibular problems in violinists and violists (Moraes and Antunes 2012). Different instrumental techniques and playing habits have different, but often very specific risk profiles.

Physical examinations showed that particularly deficient strength of the left deltoid muscle, which is needed to hold the instrument, causes compensation patterns and leads to shoulder-neck asymmetry, a chronic muscle hypertone, and negative impacts on the thoracic outlet. Combining Karate-techniques such as Age Uke and Gedan Barai with individually shaped resistance training of the upper limbs and front crawl are very likely to reduce symptoms. Additional body awareness-training and self-regulation of body adjustment optimise curative outcomes and help to control the potential risk of harmful overuse through such exercises.

Even if we clearly identify the primary cause of a musician's disorder such as the deficient strength of the left deltoid muscle, we still have to take the biomechanics of the whole musculoskeletal system into consideration. For instance, repetitively turning the head into a stressed position while breathing can cause a hyperextended and rotated neck position in freestyle swimmers (Yuill and Howitt 2009) and thus lead to cervicogenic headaches and temporomandibular joint discomfort. Although the swimmer's neck-rotation is quick and relatively large, it yet reminds us of the neck-head-movement of many a string player, possibly asymmetrically fixed jaw positions, and the left-sided way of clamping the neck support. This biased posture is likely to cause temporomandibular disorders (Attallah et al. 2014) and to entail complex conditions, hence the plausible application of sports medical experiences with swimmers for preventive and rehabilitative purposes in the realm of the musicians' medicine.

Such comparisons involve very specific work-related issues and pinpoint similarities between athletes and musicians that are seemingly rarely touched upon in medical circles. Similarly, temporomandibular issues of scuba divers (Koob et al. 2005) remind us of quite common problems in wind instrument players. And golfers with an adverse habitual jaw position and work-related bruxism (Ringhof et al. 2015) have problems similar to those of musicians who tend to underpin difficult passages with jaw clenching. Such health-threatening processes also might overlap with extreme masseter tensions and harmful changes in occlusion that are caused by anxiety and stress.

There are evidently very strong arguments for interdisciplinary research on athletes and musicians and collaboration of sports medicine and the medicine for the performing artists. And there are very strong arguments to implement these findings in instrumental music education and the formal training of musical techniques in the same way as we do that in professional athlete training.

Such considerations also concern athletes and musicians who strive to increase their joint mobility to enhance the quality of their performance, attempts that may cause overuse and pathological consequences such as stress changes of the wrist in gymnasts (Carter et al. 1988). For instance, training-related irregularities of the radial growth plates in younger athletes and musicians and joint hypermobility syndromes (Quarrier 2011) can cause severe functional issues and chronic pain and hence need appropriate preventive measures.

These topics also concern young learners of an instrument. Instrumental music tuition rarely considers risk factors in a way that measures up to professional training standards in sports. For children, playing an instrument is often associated with repetitive submaximal loading of the musculoskeletal

system and insufficient rest for structural adaptation. According to sports medical findings (DiFiori et al. 2014), however, these are main predictors of overuse injury. With focus on the younger generation, sports medicine warns that early sport specialisation increases the rates of overuse injury and points out that coaches should take the child's readiness for sports into account. This concerns especially the match between the level of growth and the demands of performance, a perspective that is very rarely discussed in the realm of music education and involves issues of public health.

A wealth of sports medical studies focused on target zones and thresholds of optimal training and has considerably improved training programmes. By contrast, there is a lack of studies on intensity zones that distinguish optimised stimuli for physical growth from pathogenic risks and possible tissue damage. Experiences suggest that there is most probably a relatively narrow band between activities that enhance strength, endurance, and flexibility, and those which turn out to be harmful and destructive.

Not least with regard to genetic and physiological laws, intensified efforts to identify these zones might considerably optimise trainings effects and minimise risks of overuse damage. Music education even needs the development of a common awareness of such limits and the also detrimental potential of musical training.

Behavioural impacts on the nervous system

Neurological sports medicine (Petraglia et al. 2015) has become a multifaceted discipline that involves a broad spectrum of issues such as chronic headaches, brain haemorrhage, peripheral nerve injuries, and athletes with neurological conditions. Comparably to sports-related risks, Lederman (2003) highlighted that one third of all musicians have conditions that relate to clinically relevant neurological issues. This is alarming and calls for efficient prevention strategies.

Although typical sports-related conditions such as chronic traumatic encephalopathies and neurological sequelae of traumatic brain injuries are rare in musicians, pathological events such as cerebellar hemorrhage during trumpet playing (Carlson et al. 2008) still raise serious questions about adequate prevention and rehabilitation.

In contrast, nerve compression and nerve entrapment syndromes are rather frequent in musicians (Wilson et al. 2014) and consequences are often detrimental. Research on similar conditions in athletes (Hainline 2014) points out that peripheral nerve injuries do not occur in isolation, but are often intertwined with the conditioning of the athlete and the biomechanics of the sport and may result from direct acute or repetitive compression and stretching. This, however, is also a main threat within the musician's instrumental practice; thus, there is a high probability that results in sports medicine apply to the medicine of the performing artist.

Awareness of a musician's susceptibility to neurological conditions and knowledge of how to work with children and adolescents who suffer from neural diseases is not in the least a complex challenge for instrumental music educators. This topic includes also the educational work with individuals with various rather chronic conditions such as epilepsy. Dealing with self-actualisation, sports and music also have the potential to enhance socio-cultural inclusion (Sahlin and Lexell 2015). From the perspective of the UNESCO Salamanca Statement on principles, policy and practice in special needs education, these features and advantages increase the value of sports and music in educational domains and self-evidently involve issues of public health and its general ethical philosophies.

The rather frequent and multifaceted problems of the peripheral nervous system raise the question about viable prevention through sports activities. There is robust evidence that exercises have a positive impact on the various types of peripheral neuropathy and that balance training is superior to exclusively strength, or a combination of endurance and strength training (Streckmann et al. 2014). This result advocates indirectly martial arts exercises that encompass an extreme variety of balance trainings in standardised and in reactivity-requiring situations.

Moreover, exercises also support the maintenance and regeneration of the neuromuscular junctions and even age-dependent degenerative changes can be ameliorated by physical training (Nishimune et al. 2014). Sports have proven their benefits for posttraumatic nerve regeneration (Armada-da-Silva et al. 2013), an advantage that is closely associated with exercise-induced increased levels of the neurotropic factor (Park and Höke 2014). Recent studies (Cobianchi et al. 2016) highlight the dual role of neurotropic factors and speak of the exercise-induced neuroprotection and regeneration after peripheral nerve and spinal chord injuries.

This perspective is of outstandingly high relevance to public health issues and involves both preventative measures and aspects of sports-based long-term rehabilitation. Such processes also interact with the exercise-based improvements of peripheral neuropathic pain (Toth et al. 2014). Taking the high prevalence of polymorbidity and associated public health tasks into account, exercise-based treatments such as of painful diabetic peripheral neuropathy (Yoo et al. 2013) gain momentum.

Focusing on the complex neuro-pathogenic mechanisms in musicians and generalisations, we advocate a holistic view that includes ergonomic changes of stereotype risk-movement and individually tailored sports activities that involve both preventative movements such as for specific strength training or exercises to maintain the physiologically appropriate nerve mobility, and interventions that enhance neuroprotective factors. Public sports facilities can provide these benefits but require trained staff to give appropriate advice and to recognise cases that require medical intervention.

Cardiovascular risks and target zones

Prevention is not a one-way-principle, but an act of balance that involves external and internal factors. This principle also applies to cardiovascular diseases that are, according to the WHO statistics, the number one cause of death globally. Cardiovascular prevention that is both a main epidemiological concern and a public health challenge, goes hand in hand with regular physical activity that has to match clear-cut characteristics and modalities of exercise to promote cardiovascular health.

International standards such as provided by the European Association for Cardiovascular Prevention & Rehabilitation (EACPR) define the ratio of endurance and resistance training and highlight the necessity of appropriate intensity levels for the general population (Vanhees et al. 2012a), for individuals with cardiovascular risk factors (Vanhees et al. 2012b) and for patients with cardiovascular diseases (Vanhees et al. 2012c).

Such studies apply to the whole spectrum of sports disciplines and highlight the importance of well-adjusted exercise intensities for cardiovascular health and positive effects on obesity, diabetes mellitus, hypertension and hyperlipidemia (Dhutia and Sharma 2015). Taking both clinical evidence and underlying physiological mechanisms into consideration (Wilson et al. 2016), sports medicine recommends moderate-to-vigorous levels for preventative exercise and recreational physical activities (Loprinzi 2015). While rehabilitation programmes tend to rather higher intensities (Rognmo et al. 2012), sports-cardiological studies point out that also moderate physical exercise reduces blood pressure, improves insulin sensitivity and the endothelial function (Britten et al. 2000), has positive effects on dyslipidemia and the body composition, and enhances weight reduction (Wernhart et al. 2015, p. 361).

In contrast to common opinions about the romantic life of artists, musicians have a physically and mentally strenuous job. Practising and performing require stressful mental and physical exertion and entail the risk of musculoskeletal dysfunction and pain. Although musicians tend to work at the border of overexertion, they often do not reach heart rates that are recommended for cardiovascular prevention and health promotion. This is a core aspect in public health that not only concerns musicians and performing artists but a huge part of the general population. Frequently, work-related and everyday movements do not match the characteristics of even moderate physical activity and fail the sports-cardiologic recommendations about training frequency, intensity, duration, movement modes, and the combined measure of volume or dose which is given by the multiplication of intensity and duration.

Studies on different martial arts highlight the positive effects on cardiorespiratory fitness and advantageous side-effects such as flexibility, body composition, balance control (Lan et al. 1996; Hong et al. 2000), immune capacity and mental control (Li et al. 2001) in older Tai Chi Chuan practitioners as well as in healthy adults (Zheng et al. 2015) and cardiovascular and metabolic benefits of dynamic Tae Kwon Do exercises (Toskovic et al. 2002; Kim et al. 2011) that are mirrored by changes in the anaerobic threshold and blood lactate recovery (Kim et al. 2014).

In this article we advocate Karate, although there is a huge lack of similar studies on this Japanese martial art. Training Karate, we can precisely adjust optimal heart rate zones as well as resistance trainings, particularly if we work with dynamic partner blocks or the use of physiotherapeutic rubber bands. Additionally, the wealth of ritualised fight sequences, the so-called Kata (Grupp 2007 and 2012), might enhance the motivation and sustainability of the learning incentive.

Psychiatric issues

Scientific studies and in-depth interviews in sports and music circles allow us to identify three risk profiles in athletes and musicians that are likely to entail psychiatric issues. These are, in a nutshell, high-omnipresent-performance stress, an individual work identity that dominates the self-concept, and extreme mental and musculoskeletal strain. These parameters might also apply to other professions and habitual activities and generate hence similar threats.

Sports medical research points out that athletes tend to use substances to increase strength and mind power, to produce pleasure and control mood swings, to alleviate pain and reduce stress, to enhance sociability, and to accelerate rehabilitation after injuries. Especially self-medication entails high risks and might interact with psychopathological conditions such as eating disorders, anxiety disorders, attention deficit disorders, bipolar and psychotic issues, and increased suicidal tendencies as they have been described as prevalent among athletes.

In this context, scientific results accentuate the risk of exercise addiction in both athletes and leisure exercisers. Obsessive passion for sports is a strong predictor of exercise addiction (de la Vega et al. 2016) that involves features of sports-associated impulse control disorders (Freimuth et al. 2011) and obsessive-compulsive behaviour. The multifaceted phenomena of this harmful condition call for appropriate differential diagnoses and the discovery of the bio-psychological mechanisms that might cause exercise addiction such as endorphines and euphoric feelings (Weinstein and Weinstein 2014). Discussions concerning whether exercise addiction is rather a symptom or a disorder (Szabo 2010) require interdisciplinary research and involve issues of possible co-morbidities such as eating disorders (Lichtenstein et al. 2014; Müller et al. 2015).

While most studies indicate a 3%-prevalence of (high) risk for exercise addiction (Allegre et al. 2007; Szabo et al. 2015), some authors estimate this public health threat as much higher.

A French study (Lejoyeux et al. 2008), for instance, highlighted that 42% of all clients of a fitness room presented diagnostic criteria of exercise dependence. The assumingly high prevalence of exercise addiction and the associated risks of overtraining syndromes and health damage call for the identification of appropriate training zones, a health-conscious self, and an affinity to sports that allows for one's psychophysiological status, potentials, and limits.

Performing artists have similar risk profiles, but demonstrate a different affinity to sports. In athletes, sports generate both self-concepts and pathological conditions which go hand in hand with a strong cognitive labelling of sports and exercise-related conditioning. While these aspects might invalidate sports as an appropriate psychiatric intervention in athletes, sports exercises have generally become a viable means for mood-regulation, self-efficacy, control of obsessive-compulsive behaviour, and a personality-stabilising empowerment, hence their promising potential for psychiatric prevention and mental health care also in musicians and people with comparable psychological and psychiatric risk factors.

This, however, sheds light on possible benefits of sports in public mental health. Although sports have a general positive influence on the mood (Guszkowska 2004), a special focus on health seems to enhance the sports-related enjoyment even in children (Fu et al. 2013). With regard to mental problems that go hand in hand with a loss of body awareness, inability to express problems, and inhibited self-confidence, Gandon (2015) highlighted the significant benefits of martial arts that also apply to public health issues. In this context, Tai Chi is often considered an appropriate means to modulate depression, to reduce anxiety, to enhance the global psychological well-being (Wang et al. 2014) and to support symptom management in patients with schizophrenia (Ho et al. 2014).

In the context of psychiatric and neuro-geriatric disorders, research highlights that moderate exercise improves depressive symptoms and pinpoints that these benefits even concern treatment-resistant patients with major depression (Mota-Pereira et al. 2011). Even light-intensity physical activity showed positive mental health effects among older adults (Loprinzi 2013). Moreover, physical activity is a protective factor of dementia and studies showed that the former dose-effect hypothesis does not reach statistical significance (Llamas-Velasco et al. 2015). Moderate exercise intensity levels have positive effects on the cognitive function in patients with dementia (Groot et al. 2016) and support the ability to perform activities of daily living (Forbes et al. 2013). This relates also to martial arts such as Tai Chi Chuan.

Although the practice of the martial arts and their socio-psychologically outcomes are, not in the least with regard to the younger population, controversially discussed (Vertonghen and Theeboom 2010), there is empirical evidence of advantageous effects on the mental health and quality of life in people with appropriate personal maturity (Marie-Ludivine et al. 2010). In general, studies on the connection between martial arts and psychological benefits emphasise the multidimensional mechanisms that involve principles such as self-efficacy and empowerment and training modes that influence brain plasticity and cause multifaceted physiological and mental gains (Alesi et al. 2014).

Synthesising such outcomes from the perspective of public health suggests a theoretical framework that comprises benefits for the self-image, sports-based social inclusion, skills to manage psychopathological symptoms, impacts on brain changes, biochemical influences on neurotransmitters and hormones, movement-based self-expression, and the experience of the general joy that is somewhat anthropologically associated to sports-activities. Also in this context, adequate training zones, avoidance of overuse, obsessive-compulsive traits, stress and disappointment, and compatibility with individual preferences and intrinsic motivation are probably decisive for pertinent public health outcomes.

Pain relief and further anaesthesiological issues

Pain in athletes and musicians is a complex phenomenon that involves musculoskeletal injuries, central nervous pain processing, and self-image-related attitudes. Particularly in musicians, pain covers a wide range from hypersensitivity and related panic attacks to the neglect-like dissociation of pain.

In musicians, sports-based health promoting and pain preventing exercises have begun to gain ground, but are still in *statu nascendi*. Exercises for work-specific fitness such as the strengthening of the deltoid muscle in viola players, warming-up to prepare the muscles for practising and rehearsing, control of flexibility and prevention of hypermobility, adjustment of the posture, support of spinal alignment and a balanced shoulder girdle have contributed to pain-control in musicians. Additionally, an increased capacity of the perceptual discrimination accuracy for muscular reactions to work-related exertion greatly facilitates the recognition of early onsets of overuse traumata and painful sequelae.

Of course, pain-management through sports and physical exercises is a wide field and looks back to a successful, non-pharmacological and non-surgical history. In the context of low back pain, which is a major concern of public health and a core risk of musicians, and in particular in sciatica, physical activity-based interventions have yielded convincing results (Fernandez et al. 2016). Similarly, physical activity is helpful in chronic neck pain (Gialanella et al. 2016), in knee pain that might, for instance, concern pianists (Jones et al. 2015), and many issues in the broad spectrum of chronic pain (Govenden and Serpell 2014).

The target of this paper, however, is obviously not to give a review over physiotherapeutic approaches to alleviate various pain conditions, but to encourage the identification of sports-

based practices that equal the effect of physiotherapeutic and sports therapeutic methods and to focus on prevention and early, secondary rehabilitation, thus measures that inhibit the progress of pathological processes and support the remission of symptoms.

Recently, there are strong movements to explore the role of physical activity and exercises to control and alleviate neuropathic pain (Cooper et al. 2016). They encourage specific public sports activities in the same way as aerobic exercises that proved to be 'the best option in migraine prophylaxis' and neck-shoulder-exercises to deal with chronic tension-type headache (Daenen et al. 2015). However, efficient application of sports exercises has to be as specific as treatments provided by physical medicine and has to take the individual's motivation for specific sport disciplines into consideration. Although this topic is of high relevance to public health, this domain seems to be extremely undeveloped and needs interdisciplinary research. Analysing movement patterns in the martial arts, especially in non-combat modes such as the Karate Kata, suggests their high potential to serve as a pertinent movement repertoire for these preventative and public health purposes.

In contrast to many a musician's standpoint rejecting sports-typical strengthening because of assumed harmful influences on micro motor-patterns, damaging strain on joints and tendons, alleged risks of decreased sense of touch, and the prevalence of injuries, research on sports-based programmes for musicians highlights benefits and emphatically advocates individually tailored exercises. The aforementioned study with a total of 644 students of the university of music and performing arts in Munich brought about a viable Karate-based procedure for preventing overuse- and pain-syndromes in musicians. In contrast to the common musicians' fears and prejudices we were speaking of, no negative impacts or side-effects on the playing technique or performance skills were discovered. These findings qualify misinterpretations that exercise-induced hypoalgesia (Koltyn 2002; Koltyn et al. 2014; Kami et al. 2016), which is a very promising approach in sports-based pain-therapy as well, does not harm the general somatosensory capacities.

Sports in large-scale public health

As a *pars pro toto*, focal dystonia is a frequent and pernicious condition in musicians. Although focal dystonia is relatively rare among athletes, Cutsforth-Gregory and Bower (2015) say that certain occupations are associated with focal forms of dystonia and describe this condition in runners. This view characterises precisely the final aim of this sport-medicine-based paper, *expressis verbis* the possibility to generalise all these perspectives and to apply them in the wider domain of public health.

In this context, uncomplicated feasibility, modes of implementation, and sustainability play a crucial role for a life-long maintenance of health, work-force, and life-quality. Therefore, three moments seem to be of vital importance—a profound sensory awareness of biomechanically and ergonomically adequate postures and movements; the standardised and yet dynamically adjustable application of preparatory activities such as specific warm-up and stretching; and the competence to exercise clear-cut motor-patterns to reduce muscular tension, to align and re-balance the anatomical geometry of the body, and to strengthen specific body parts. The enhanced involvement of martial arts in public health practices might provide viable means.

Of course, this article is far from being the first paper highlighting the role of sports in public health. Blair (2009) considered physical inactivity to be the biggest public health problem of the 21st century and Donaldson (2000) calls sport and exercise a public health challenge. For decades, the maintenance and promotion of health has been a core perspective of physical education (Sallis and McKenzie 1991). And it is a crucial concern in epidemiology such as with regard to cardiovascular health and risks in adults (Haskell et al. 2007) and cardio-protective life-styles in people with (former) manifest cardiac conditions (Mastnak 2015a, b). These recommendations are answered by a huge spectrum of health-oriented sports activities such as in German sports associations (Breuer and Wicker 2008) or particularly the 'Gesundheitssport Karate – das Zertifikat' [health sports Karate – the certificate-programme] provided by the Deutscher Karate Verband e.V. (n.y.) [German Karate association], for instance.

From the perspective of sports in public health, athletes and musicians can serve as a model with high physiological strain, unbalanced stances and demanding repetitive movements, insufficient muscular recovery, and mental stress. For centuries sports medicine has been studying these threats and has developed effective preventive and curative means. Due to similar pathogenic conditions and the possibility of specific generalisations, we understand sports medicine and associated activities as a sense-making complement to general public health. Both extensive accessibility to sports programmes and precisely individually tailored programmes are important for optimal and sustainable outcomes.

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Compliance with ethical standards

Conflict of interest The author states that there are no conflicts of interest.

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