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From a first insight to a deeper knowledge of depression in elite athletes: What are the sport-specific risk factors and underlying psychological variables?

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Vollständiger Abdruck der von der Fakultät für Sport- und Gesundheitswissenschaften der Technischen Universität München zur Erlangung des akademischen Grades eines

Doktors der Philosophie (Dr. phil.)

genehmigten Dissertation.

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Prüfer der Dissertation:

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Die Dissertation wurde am 23.08.2017 bei der Technischen Universität München eingereicht und durch die Fakultät für Sport- und Gesundheitswissenschaften am 30.01.2018 angenommen.

Acknowledgments

I began work on this dissertation well before the first word of it was typed. Media reports came thick and fast on depression in elite athletes in 2009, after one of Germany best goalkeepers committed suicide. I started wondering: I had so many ideas and questions on mechanisms and circumstances that could lead to clinical mental issues in elite sports. Thanks to Jürgen, I was given the chance to plunge into a field of research I was deeply curious about. Thank you for your trust in me. For the past 5 years I have tried to gather knowledge, tried to fight a stigma, tried to help athletes, and beside all this live a life and grow a family. Many thanks must go to Raphael, my partner in crime, my daily private and professional inspiration. I could not have done this without you and never would have wanted to. Thank you Anne-Marie, for showing me that a woman can indeed excel and thrive in research and still be a great mother. Thank you to my parents, who without a doubt always supported and believed in me. And last but not least, that you to my wonderful daughter for asking “why” about a million times a day and thereby sparking my research mind-set and keeping me wondering on a daily basis.

Table of contents

1 Introduction

Postulate number 1 of the International Society of Sport Psychology position stand states:

> Alarming statistics on athletes' mental health status, demonstrating high rates of depression, injury, overtraining, and various forms of unhealthy behaviours (e.g. disordered eating, drinking, doping), call for the action of sport psychology researchers and practitioners. Through this Position Stand, the International Society of Sport Psychology wishes to attract the attention of sport psychologists as well as sport participants and stakeholders to key areas of psychological research and practice relevant to prevention of, and dealing with, athletes' mental health challenges. (Schinke, Stambulova, Si, & Moore, 2017, p. 10)

In this line of thought, there is a strong need for research in clinical sport psychology that does not merely gather information on prevalence rates and case studies of affected athletes, but also uncovers the underlying psychological variables which increase the risk for depression in elite athletes. Several cases of prominent elite athletes affected by depression have become publicly known, and psychological well-being and mental disorders have become topics of increasing public and scientific interest. However, few empirical data are available on this topic with elite athletes. The present thesis tries to uncover the sport-specific factors affecting depression in elite athletes. In doing so this thesis will first provide information on depression in the general population, and a developmental model, in order to establish a shared knowledge; it will then go into specifics regarding the targeted population of elite athletes.

1.1 Depression in the general population

1.1.1 Symptoms and prevalence rates

Depression is a concept deeply rooted in history of medical science and therefore is an obligatory part of the Diagnostic and Statistical Manual of Mental Disorders in its current fifth edition (American Psychiatric Association, 2013). The DSM-V distinguishes several depressive disorders and provides clear diagnostic criteria for each: for example, symptoms of depressed mood, anhedonia, fatigue, feelings of guilt, and/or suicidal ideation are associated with depression (Table 1). Furthermore, depression can be regarded as a multisystem disorder with affective, cognitive and physiological manifestations (Insel & Charney, 2003; Lee, Jeong, Kwak, & Park, 2010).

According to the current study of health of adults in Germany, the lifetime risk for developing a depression is 11.6% (Busch, Maske, Ryl, Schlack, & Hapke, 2013; Jacobi et al., 2014) based on self-assessment. According to this study, about 8.1% of the population 18 to 79 years old suffers from depressive symptoms (Jacobi et al., 2014). Prevalence of unipolar depression in the general population is estimated to be 7.7% in a 12-month time period; 6% for major depression; and 2% for dysthymia. Thus, the number of individuals affected by a unipolar depression in Germany in a period of 12 months is about 6.2 million (Jacobi et al., 2014).

Numerous longitudinal and cross-sectional studies have shown that women are more frequently affected by depressive disorders than men (Bennett, Ambrosini, Kudes, Metz, & Rabinovich, 2005; Jacobi, Wittchen, et al., 2004; Kessler, 2003; Kuehner, 2003). Their risk for developing a depression is twice as high, with a 12-month prevalence for unipolar depression of 10.6% compared to men with 4.8% (Jacobi et al., 2014). Women also show a significantly earlier onset of unipolar depressive disorder (Winkler, Pjrek, & Kasper, 2005), a longer episode duration (Winkler et al., 2005), and a higher risk of relapse for further depressive episodes (Kuehner, 2003).

Depression occurs at every age. In general, both the time of primary onset and the etiopathology of depression are highly individual. The average age of the initial manifestation of a depressive disorder was previously assumed to be between 35 and 45 years (Weissman et al., 1996). However, the current Federal Health Survey provides evidence that in Germany 50% of all depression patients had their first episode before age 31 (Jacobi, Klose, & Wittchen, 2004). In addition, a significant proportion of patients already suffer the first depressive episode in childhood or adolescence (Fava, Judge, Hoog, Nilsson, & Koke, 2000). A 10-year longitudinal study observed a significant increase in unipolar depression in adolescents between the ages of 15 and 18 (Hankin et al., 1998). Results from national and international studies reported prevalences between 15-20% until the age of 18 years, with a strong increase in prevalence during puberty (Birmaher et al., 1996; Wittchen, Nelson, & Lachner, 1998).

Family status, including the presence or absence of a trusting personal relationship, also affect the risk of unipolar depression (Jenkins & Meltzer, 1995). Separated, divorced and widowed persons and those without close relatives are more likely to develop a depression than those in stable relationships: for example, Jacobi et al. (2014) showed a significantly increased 12-month prevalence of affective disorders for this group compared to persons living in a fixed partnership: 16.3% vs. 7.1%. With regard to socioeconomic factors, higher levels of education and a secure occupational position correlate with lower depression rates (Bijl, Ravelli, & van Zessen, 1998; Jenkins & Meltzer, 1995). For example, the 12-month prevalence rate of affective disorders among Germans of low socioeconomic status is 14.0%, more than twice as high as among those with high socioeconomic status with 6.3% (Jacobi et al., 2014).

Suicide may be viewed as the most severe manifestation of depression. The suicide rate (completed suicides) increases continuously with age and is highest in the elderly; furthermore the complex interaction between genetic dispositions, early childhood experiences, somatic conditions and psychosocial factors (e.g. poverty, isolation, loss of social status) seem to

have a particular relevance for the development and progression of suicidal ideation (Beekman et al., 2002; Jansson et al., 2004; Oslin et al., 2002).

Depression does not involve a homogeneous disease pattern. Explanatory hypotheses for depression can be attributed to biological and psychological models (Aldenhoff, 1997; Hautzinger, Stark, & Treiber, 2008; Kuehner, 2003), although none of these approaches has so far provided a convincing mono-causal explanation. The heterogeneity of the symptoms of depressive disorders also makes it unlikely that one factor alone is responsible for the development of depression. Therefore, the majority of researchers are adopting multifactorial explanatory concepts such as vulnerability-stress models (Alloy et al., 2006; Hyde, Mezulis, & Abramson, 2008).

Table 1

Symptoms of a Major Depression Episode

Depressive symptoms (according to DSM V, American Psychiatric Association, 2013)
1. Depressed mood
2. Decreased interest or pleasure (Anhedonia)
3. Significant weight change (>5%) or change in appetite
4. Insomnia or hypersomnia
5. Psychomotor agitation or retardation
6. Fatigue or loss of energy
7. Feelings of worthlessness and/or guilt
8. Impaired concentration or decision making
9. Suicidal ideation

1.1.2 Vulnerability-stress model

The development of depression is most often described by a vulnerability-stress model (see Figure 1; e.g. Alloy et al., 2006; Haffel et al., 2005; Hyde et al., 2008). Here, certain vulnerabilities (genetics, social aspects, cognitive distortions, etc.) in combination with a stressor (chronic or acute) can lead to depression (Lee et al., 2010). Although there are many definitions of stress, stress is most often viewed as life events that disturb the mechanisms which maintain the stability of individuals' physiology, emotion, and cognition (Ingram & Luxton, 2005). Most research into this link finds a relationship between the experience of stressful life events and the onset of depression (Mazure, 1998).

The terms *vulnerability* and *diathesis* are often employed interchangeably. In this regard, a vulnerability is typically conceptualized as a predispositional factor. Ingram and Luxton (2005) suggest that "vulnerability is a trait, is stable but can change, is endogenous to individuals, and is usually latent." (p. 34) The idea of vulnerabilities as permanent and enduring is not always accurate, especially when psychological rather than genetic factors are considered. Ingram and Luxton (2005) point out that most psychological approaches rely on assumptions of dysfunctional learning as the genesis of vulnerability. And given such assumptions, vulnerability levels may fluctuate as a function of new learning experiences.

Focusing on cognitive aspects of vulnerability-stress models, cognitive vulnerability-stress theories of depression have been the subject of intensive investigation (Alloy et al., 2006). These cognitive models of depression (e.g. Abramson, Alloy, & Metalsky, 1989; Beck, 1967; Ingram, Miranda, & Segal, 1998; Nolen-Hoeksema, 1991) emphasize the role of negative inferential styles, information-processing biases, maladaptive emotion-regulation strategies, and dysfunctional beliefs as vulnerabilities for depression following stressful life events. In addition, a growing body of evidence suggests that such cognitive vulnerabilities do, in fact, increase the risk for depression (e.g., Abramson et al., 1999; Alloy et al., 1999; Clark, Beck, & Alford, 1999; Ingram et al., 1998).

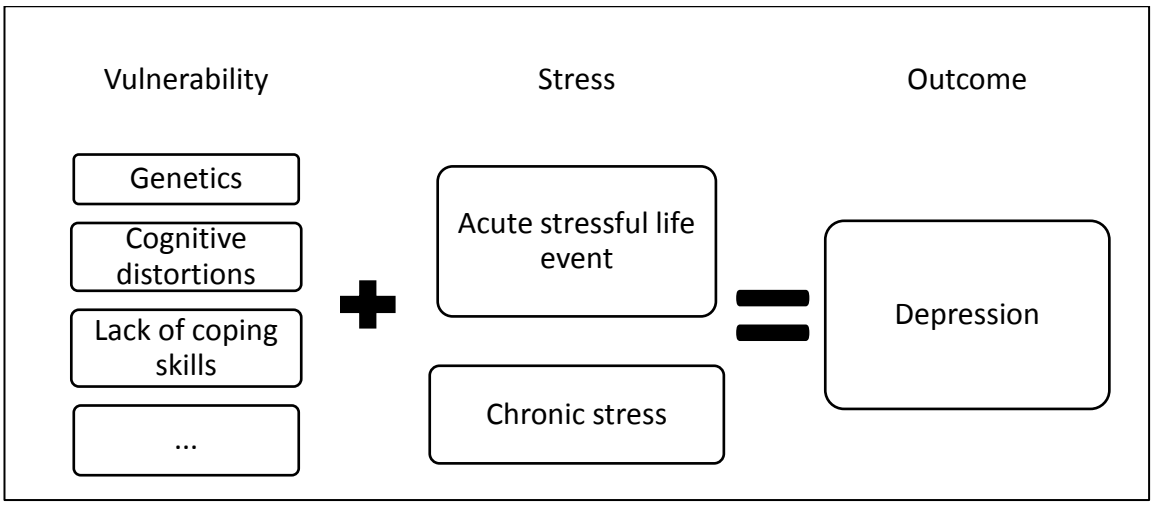

Figure 1: Simplified vulnerability-stress model in dependence on Riskind and Alloy (2006).

Taking the before mentioned information on prevalence rates, developmental and associated factors, depression in the general population is well researched and understood. This, unfortunately, cannot be said about the population of elite athletes. It is unclear how depression in athletes develops or manifests differently. The following paragraph will give an overview of the current state in research pointing out transferable or missing information and indicating future research aims.

1.2 Depression in elite athletes

1.2.1 Current research on prevalence rates

Over the last decade, data on depression in sports were provided by multiple studies across different nations. Originally, estimated prevalence rates originated from studies on American college athletes. For example, S. Armstrong and Oomen-Early (2009) found an overall prevalence rate of 34% for depression in US college students (athletes and non-athletes). Taking a closer look at college athletes, Yang et al. (2007) found that 21% of the sample showed depressive symptoms. Proctor and Boan-Lenzo (2010) reported a prevalence rate of 15% (30% for non-athletes) in their all male

sample, showing higher prevalence rates in non-athletes than in athletes. S. Armstrong and Oomen-Early (2009) found similar differences in depressive symptomatology with higher rates in non-athletes. However, Storch, Storch, Killiany, and Roberti (2005) did not find such a difference, reporting comparable prevalence rates between athletes and non-athletes in their study of college students. Taking a closer look at gender differences, which are stable within the general population, Storch et al. (2005) found female athletes had higher depression scores than either male athletes or male and female non-athletes. These findings are contradictory regarding the questions of whether athletes, especially female athletes, are less or more prone to depression than either non-athletes or male athletes.

In Germany or Europe, however, little empirical data exist on this issue. Thiel, Mayer, and Digel (2010) reported that 2 to 4% of handball players and track and field athletes had depressive, melancholic, or unhappy feelings. As the authors only examined athletes from handball and table tennis, the results cannot be seen as representative. In addition, depressive feelings were not assessed through a clinically relevant and validated measurement; thus this study provided little insight into depression in German athletes. Recent results which used clinically-relevant cutoff scores and interviews (Nixdorf, Frank, Hautzinger, & Beckmann, 2013; Schaal et al., 2011) indicate depression prevalence rates between 4% and 15% in elite athletes, which seem comparable to the general population in Europe (Frank, Nixdorf, & Beckmann, 2013). Nixdorf et al. (2013) also found that junior elite athletes had higher depression scores (20%) than senior elite athletes (15%). A more recent study found that 45% of elite athletes report symptoms of anxiety or depression (Gouttebarge et al., 2016). Summarising the before mentioned different findings, all the previously mentioned studies report a clinically relevant and comparable, sometimes even elevated, prevalence of depression in elite athletes.

1.2.2 Reviews on the current state of knowledge

As mentioned before, samples of depression prevalence in elite athletes range from 4% (Schaal et al., 2011), 15% (Nixdorf et al., 2013), to 45% (Gouttebarge et al., 2016) and in some cases even up to 68% in the last 36 months (Hammond, Gialloreto, Kubas, & Davis, 2013). Obviously, there is variability in prevalence estimates, which might be due to different assessment methods (questionnaire vs. interview), different cut-off scores (lenient vs. conservative), different assessment times (period of heavy exercise, recovery, or championship) or samples (different sport disciplines, gender etc.). In fact, recent reviews of this matter (Frank et al., 2013; Wolanin, Hong, Marks, Panchoo, & Gross, 2016) suggest that depression in elite athletes may be connected to sport specific mechanisms and factors such as injuries, overtraining, or high levels of stress. Consequently, such factors should be taken into consideration while assessing depression in athletes.

1.2.3 Main factors associated with depression

As mentioned before, the development of depression is mostly described by a vulnerability-stress model (Alloy et al., 2006; Haffel et al., 2005; Hyde et al., 2008). In this regard, it is important to have a closer look at variables associated with depression in elite athletes. The following segment gives an overview of variables which have been repeatedly shown to correlate with depression in athletes.

1.2.3.1 Stress

“Participating in competitive sports often places the athlete under intense physical, psychological, and emotional demands” (Crocker & Graham, 1995, p.325). Whether one takes into consideration the important tournaments and potential sporting injuries (acute stress) or the frequency of tournaments and training sessions (chronic stress), the life of an athlete can be regarded as “stressful” (Wolanin et al., 2016). In this regard Hammond et al. (2013) reported that the most elite athletes showed an increased susceptibility to depression, particularly in relation to failed performances and stress. Nixdorf et al. (2013)

found support for this assumption, indicating high associations between chronic stress and depressive symptoms, as well as between different coping strategies and depressive symptoms in elite athletes.

Sources of chronic stress can be located in the personal environment of an athlete as well as in the specific sport discipline the athlete is competing in. Research on stressors in the context of sports shows that stressors can be found in the competitive surrounding as well as in the organization an athlete is located in (Hanton, Fletcher, & Coughlan, 2005). Organizational stressors, representing the environmental demands associated primarily and directly with the organization in which an individual operates, were shown to be multifaceted with dimensions such as interpersonal demands or stress due to roles within the sport organization (see Fletcher, Hanton, Mellalieu, & Neil, 2012). Furthermore, in addition to stressors clearly related to the sport organization or the competitive nature of elite sports, athletes are also exposed to stressors such as job insecurity, difficulties balancing sport with study commitments (Noblet & Gifford, 2002), and/or the physical demands of training (Gould, Jackson, & Finch, 1993).

The impact of chronic stress is mainly put in context with the overtraining syndrome (e.g. Kellmann, 2010; Lehmann, Foster, Gastmann, Keizer, & Steinacker, 1999) in which athletes undergoing a strenuous training schedule develop a significant decrease in performance associated with systemic symptoms or signs. These were also shown to be associated with other negative phenomena such as burnout (Lemyre, Roberts, & Stray-Gundersen, 2007). According to Angeli, Minetto, Dovio, and Paccotti (2004), overtraining is a stress-related condition that consists of alteration of physiological functions and adaptation to performance, impairment of psychological processing, immunological dysfunction and biochemical abnormalities.

It is still unknown which concrete sources of chronic stress are relevant for depression in athletes. There is little research regarding the contributions of different major stressors to experiences of chronic stress in athletes (e.g., high training loads, combining an athletic career with school or university, pressure from surroundings). With the previously mentioned vulnerability-stress model

in mind, identifying chronic stressors in athletes and analysing their connection to depression seems important.

1.2.3.2 Coping strategies

Coping is considered to be a personal skill or a group of strategies used to handle stress and deal with negative events (Schmidt & Caspar, 2009). Kohlmann and Eschenbeck (2009) described some of the aspects of coping: (a) reducing the impact of harmful surrounding conditions; (b) improving the chances of recovery; (c) adapting to negative events or circumstances; (d) maintaining a positive self-perception; (e) supporting the safekeeping of emotional balance; and (f) enabling satisfying social contacts. Wingenfeld et al. (2009) pointed to a significant difference in the use of coping strategies among healthy and depressed individuals. The authors revealed a positive correlation between depressive symptomatology and emotion-based coping strategies, and a negative correlation with problem-based coping strategies.

With regards to the previously mentioned high level of (chronic) stress it can been postulated that coping strategies, in addition to excellent motor and sporting skills, are vitally important to a successful athletic career. Adequate coping skills may not prohibit the manifestation of a depression in athletes but might decrease its likelihood. Lending support to this hypothesis, Nixdorf et al. (2013) as well as Crocker and Graham (1995) found correlations between coping strategies and depressive symptomatology. Nixdorf et al. (2013) more specifically showed that the frequent use of negative coping strategies (escape, resignation, and self-pity) correlated with high levels of depressive symptomatology and positive strategies (situation control and addressing oneself in encouraging tones) showed correlations with low levels of depressive symptomatology.

1.2.3.3 Recovery

In order to win competitions, achieve goals, and improve performances, athletes have to push themselves more and more toward their limits. Increased training loads connected with physical and psychological stress tend to be common in professional athletes' exercise plans. Yet, with increasing exercise loads, recovery becomes more important for athletes' well-being, an aspect that is not always recognized.

Recovery can be described as an inter- and intra-individual process that occurs over time for the reestablishment of performance abilities (Kellmann, 2002). This process, which includes psychological, physiological, and social factors, varies from person to person and situation to situation, and underlies intentional regulations. Beckmann (2002) described recovery as a process of self-regulation in which the subject should achieve detachment from a past activity followed by engagement in a new activity. The author argues that, because of the complex relationship between recovery and stress, it is important to fully disconnect from the stressful activity. If this disconnection from a stressful activity fails, an imbalance arises and recovery can be impaired. According to this assumption, in the end the system may collapse and illness, depression, burnout, or overtraining may result. Athletes who do not recover from exhaustion may experience symptoms such as frequent minor infections, sore muscles, change in sleep quality, loss of energy, loss of competitive drive, loss of libido, loss of appetite and weight, mood disturbance, anxiety, and irritability (Budgett, 1990; Budgett et al., 2000). As mentioned above, overtraining is a well-known syndrome among athletes, and it is evident that the intense exercise and the lack of adequate recovery can lead to physical symptoms (such as reduced energy and performance), as well as to psychological symptoms. O'Connor, Morgan, Raglin, Barksdale, and Kalin (1989) showed a connection between intense exercise loads in the corresponding training period and changes in tension, depression, anger, vigour, fatigue, and mood. The connection to depressive symptoms may thus seem obvious when one takes a closer look at the symptoms of Major Depressive Disorder (American Psychiatric Association, 2013) and of overtraining syndrome.

L. E. Armstrong and Van Heest (2002) outline the overlapping symptoms of the two syndromes, such as depressed mood, change in appetite, change in weight, diminished ability to concentrate, psychomotor agitation, loss of energy, sleep disturbances, and change in sleep quality. Puffer and McShane (1992) also pointed to these overlapping connections, and noted that although depression may occur in the absence of physiological fatigue, the most common syndrome seen in competitive athletes is depression along with physiological exhaustion. These findings suggest the possibility that for some individuals, there may be a connection between depressive symptoms and an imbalance of exhaustion and recovery.

More recently Nixdorf et al. (2013) found that high levels of depressive symptomatology correlated with negative stress-recovery states (high scores in stress and low scores in recovery). This pattern was found for sport-related as well as general stress-recovery states. These data support previously found correlations between physical exhaustion and psychological mood changes (O'Connor et al., 1989), as well as the connection between overtraining syndrome and depression in athletes (L. E. Armstrong & Van Heest, 2002; Puffer & McShane, 1992).

1.2.3.4 Sport specifics

One of the most topical research questions is whether or not depression in elite athletes is subject to sport-specific circumstances (e.g. failure, injuries, pressure to perform, high training loads). Frank et al. (2013) and Wolanin, Gross, and Hong (2015) suggest depression in elite athletes is connected to such sport specific mechanisms and factors. The authors assume that risk factors unique to an athletic population (i.e., injury, involuntary career termination, performance expectations, and possibly overtraining) may increase the risk of depression in athletes compared with the general population.

Besides the factors unique to the context of elite sports, other previously mentioned variables may have a stronger effect for elite athletes. Stress and coping are discussed in the general population and have been shown to be

important factors in this regard. However, in the context of sport the value of these factors might increase even more, considering the various stressors for athletes. The relevance to sports is even more obvious in regards to the effects of overtraining and recovery. Therefore, the sport-specific implications and mechanisms of these factors have to be considered and investigated to best enhance the understanding of the mechanisms of depression in elite athletes.

However, few such sport-specific factors are known. For example, Hammond et al. (2013) showed generally increased levels of depressive symptoms among swimmers during competition. Moreover, the study found that performance failure accounted for an increase in the levels of depressive symptoms. Besides the importance of failure, injuries during the athletic career have been shown to predict depressive syndromes (Leddy, Lambert, & Ogles, 1994). Leddy et al. (1994) found injured athletes experienced depression not only within one week after an injury but also had significantly higher depression scores as much as two months post-injury. Appaneal, Levine, Perna, and Roh (2009) found similar results, with injured athletes having elevated depression scores from one week up to one month after injury when compared with healthy controls. Much evidence suggests that sport-related concussions can lead to changes in emotional state (Hutchison, Mainwaring, Comper, Richards, & Bisschop, 2009) and might be connected to depression (Kerr, Marshall, Harding, & Guskiewicz, 2012). But while there might be a significant connection between concussions and depression, evidence suggests that other sport injuries may have comparable or greater effects on mental health (Mainwaring, Hutchison, Bisschop, Comper, & Richards, 2010). In addition to the effects of acute injuries, the previously mentioned overtraining syndrome can also threaten mental and physical health and has been connected to depression in athletes (L. E. Armstrong & Van Heest, 2002; Puffer & McShane, 1992).

Recent findings also showed a sport-related effect, indicating that depressive symptoms vary by sport type. It has been repeatedly shown that athletes competing in individual sport disciplines were more prone to depressive symptoms than athletes competing in team sports (Nixdorf et al., 2013; Schaal

et al., 2011). In a German sample, Nixdorf et al. (2013) found higher levels of depressive symptoms in athletes competing in individual sports than in those competing in team sports. In a French sample, Schaal et al. (2011) found differences between sport disciplines: they indicate higher scores in aesthetic sports (24%) and fine motor skill sports (18%) than in team ball sports (8%). In North America, Wolanin et al. (2016) found that athletes competing in track and field had the highest rate of depression scores, while lacrosse players had significantly lower levels of depression. Although these authors do not explicitly address a differentiation into individual sports and team sports, their results further support the assumption that higher depression scores are found in disciplines with competitions based mainly on an individual performance. Which psychological variables mediate the relationship between depression and individual sport disciplines is yet unknown.

1.2.4 Critique of current research

Summing up the findings on associated factors for depression, there are potentially important factors discussed in recent research. However, most studies are conducted by gathering demographic factors (e.g. gender, injury, sport discipline) and staying on a more descriptive level. While this is a suitable way to conduct knowledge about associations, underlying connections or even explanations are not uncovered. Even if sport-specific associations are known, such as the effect of sport discipline, there is a lack of studies finding underlying psychological variables accounting for such effects.

This lack of knowledge of underlying connections and drivers of the development of depression in athletes also impacts applied sport psychology. Following a prevention approach, it is crucial for the sport psychologist to know both risks and protective factors in order to anticipate certain vulnerabilities and prevent depressive syndromes from developing (Frank et al., 2013). Therefore, the investigation of such sport-specific mechanisms seems essential in order to enable the promotion of athlete wellbeing and mental health.

2 Aim of the studies

Therefore, the aim of the first study was to further investigate previous findings on the correlation between stress and depression in athletes. As mentioned above, few articles provide information on specific triggers such as injuries (e.g. Appaneal et al., 2009) and overtraining (L. E. Armstrong & Van Heest, 2002; Meeusen et al., 2013). Researchers have started to reveal sources of chronic stress in elite athletes (Hanton et al., 2005) but so far have not analysed their connection to depression. Since there are strong correlations between chronic stress and depression in athletes (Nixdorf et al., 2013) a deeper understanding of the sources of this stress is needed. To summarise the above raised questions, there is a lack of knowledge on whether, and which, sport-related stressors have the potential to become relevant for depression in elite athletes. Therefore, the aim of study 1 is (1) to explore sport-relevant major stressors for elite athletes and (2) to identify possible connections between these stressors and depressive syndromes.

The aim of the second study is to further investigate a sport-specific finding of individual athletes' increased proneness to depressive symptomatology (Nixdorf et al., 2013; Schaal et al., 2011). As mentioned above, there are various sport-specific effects associated with depression in elite athletes (e.g. perceived failure, injury, overtraining and sport discipline). Therefore the goal is to identify underlying psychological variables accounting for this effect and explain if, and why, individual-sport athletes are more prone to depression than team-sport athletes.

3 Methodology

3.1 Study 1

Study 1 is cross sectional in nature and incorporates both qualitative and quantitative data. The qualitative data (open-ended questions) on chronic stressors were analysed by a conventional content analysis (Hsieh & Shannon, 2005). Conventional content analysis is commonly used with study designs that aim to describe a phenomenon, in this case the stressors of elite athletes. This type of design is appropriate when existing research literature on a phenomenon is limited. Because preconceived categories are avoided, categories and names for categories are allowed to flow from the data (Kondracki, Wellman, & Amundson, 2002). Thus new insights can emerge (Kondracki et al., 2002) in a process also described as inductive category development. As Hsieh and Shannon (2005) point out, the advantage of the conventional approach to content analysis is gaining direct information from study participants without imposing preconceived categories or theoretical perspectives. One challenge of this type of analysis is the failure to develop a complete understanding of the context, thus failing to identify key categories. This is described by Lincoln and Guba (1985) as credibility within the naturalistic paradigm of trustworthiness or internal validity within a paradigm of reliability and validity. In study 1 credibility was established through prolonged engagement, analyst triangulation (Denzin, 1978; Patton, 1999), the anonymity of an online assessment, precise questioning (only major stressors) and written data acquisition by the participants.

Directed content analysis was not used for analysing the data because no theoretical framework or theory existed or needed validation or extension. Existing categorizations of stressors (Hanton et al., 2005) in elite athletes seemed too narrow for the topic of depression or mental health in general. Summative content analysis was also not fitting since its goal (identifying and quantifying certain words or content in the athletes' major stressors, with the purpose of understanding the contextual use of words or content (Hsieh &

Shannon, 2005)) would not result in a thorough understanding of categories and groups of stressors.

Therefore in study 1, categories were developed in an inductive process with an open coding, grouping, categorization and abstraction into a conceptual model (Elo & Kyngäs, 2008) leading to 17 subcategories which were grouped into three main categories. Athletes were rated according to their stated main stressor as one of the three main categories, allowing an analysis with distinct factor levels to follow. Analyses of Variance (ANOVAs) were conducted to test possible connections between the categories of stressors with quantitative data of depression.

A total of 134 German elite athletes (M_{age} = 21.66; SD = 4.60) were included in the data analyses. Of originally 162 participating athletes 28 were excluded since they did not meet criteria for being an elite athlete. Further details on the participants, measures and procedure are stated in the original article.

3.2 Study 2

Study 2 is cross-sectional in nature. We used path modelling to test mediation between sport discipline (team or individual sport) and depressive symptoms. Bootstrapping was used to check for possible indirect effects and have more power and control over type I error rates (Hayes, 2009).

Attribution after failure, perfectionistic expectations and cohesion were assumed to potentially act as mediators and therefore explain why being an athlete in an individual sport discipline influenced the amount of depressive symptoms experienced. We conducted mediation, not moderation, analysis because in mediation analysis the mediator variable (e.g. attribution after failure) should explain the relationship between the two other variables (individual sport athletes and depressive symptoms). Baron and Kenny (1986) suggest that mediators explain how external events take on internal psychological significance. They define a mediator as a generative mechanism through which the focal independent variable is able to influence the

dependent variable. Mediators describe the psychological process that occurs to create the relationship, and as such are always dynamic properties of individuals (e.g., emotions, beliefs, behaviours, perceptions) (Hayes, 2013).

A simple mediation model was tested, expecting the total effect of *X* on *Y* to be the sum of the direct effect of *X* on *Y* and indirect effect of *X* on *Y* through *M*. In the present study *X* is dichotomous, with the two values of *X* differing by a single unit (individual sport athletes and team sport athletes), allowing *Y* to be interpreted as a group mean, and interpreting *c'* as the estimated difference between the two group means holding *M* constant.

Many approaches to statistical inference for the indirect effect have been proposed (MacKinnon, 2008; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). The *causal step approach* popularized by Baron and Kenny (1986) has been criticized on multiple grounds. Simulation studies have shown that among the methods for testing intervening variable effects, the causal step approach is among the lowest of power (MacKinnon et al., 2002). The main criticism of this approach is that it is not based on a quantification of the intervening effect (Hayes, 2009). Likewise the widely spread *Sobel test* (Sobel, 1982, 1986) assumes that the sampling distribution of the indirect effect is normal, when in fact this distribution tends to be asymmetric (skewed) with nonzero kurtosis (Bollen & Stine, 1990). Thus an alternative method, bootstrapping, was used in the present study analysis. In mediation analysis,"[…]bootstrapping is used to generate an empirically derived representation of the sampling distribution of the indirect effect, and this empirical representation is used for the construction of a confidence interval […]" (Hayes, 2013, p. 106). Unlike other approaches, no assumption is made about the shape of the sampling distribution and therefore it better respects the non-normality of the sampling distribution.

A total of N = 199 German junior elite athletes (M_{age} = 14.96; SD = 1.56) participated in the study and completed questionnaires on perfectionism, attribution, cohesion, and depressive symptoms. Originally, 295 junior elite athletes were recruited; of these 199 completed all questionnaires and therefore were included in study 2. Participants were part of a research project

which was reviewed, approved and financially supported by the German Federal Institute of Sport Science (*Bundesinstitut für Sportwissenschaft; BISp*) in order to investigate and help prevent depression and burnout in young elite athletes. Further details on the participants, measures and procedure are stated in the original article.

4 Publications

4.1 Article 1

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Title: An explorative study on major stressors and its connection to depression and chronic stress among German elite athletes

Journal: Advances in Physical Education, 2015, 5, 255-262
Doi: 10.4236/ape.2015.54030

Summary:

Due to a lack of knowledge on whether and which (sport-related) stressors have the potential to become relevant for depression in elite athletes, the present study addresses this matter by assessing qualitative and quantitative measures. Through this explorative approach, we gather new hypotheses and further assumptions regarding mechanisms for depression in elite athletes. The goal of the present study was to explore major stressors in elite athletes and its possible connection to depressive symptoms. Conventional content analysis of open ended questions concerning major stressors led to three main categories: Double Burden (DB), sport-specific demands (SSD) and conditions (C). Data analysis showed athletes with major stressors in the category SSD, representing psychological and physiological challenges in the context of sports, were found to have higher scores in depressive symptomatology than those in the other two groups.

The study and the article were mainly conducted, planned, executed, analysed and written by the first author. Substantial support from co-authors was appreciated.

The article was submitted in August 2015 and accepted in November 2015 by *Advances in Physical Education*. This is an international journal dedicated to the latest advancements in physical education, sport science and sport psychology. It is an open access, peer-reviewed journal.

Advances in Physical Education, 2015, 5, 255-262
Published Online November 2015 in SciRes. http://www.scirp.org/journal/ape
http://dx.doi.org/10.4236/ape.2015.54030

Scientific Research Publishing

An Explorative Study on Major Stressors and Its Connection to Depression and Chronic Stress among German Elite Athletes

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Received 12 August 2015; accepted 15 November 2015; published 18 November 2015

Abstract

Although research shows that chronic stress and specific stressful events (e.g. injury, failure) are associated with depressive symptoms in athletes, connections between chronic, major stressors and depressive symptoms are yet unknown. Therefore, the goal of the study was to gain new findings between major stressors and their relations to depressive symptoms and chronic stress. A total of 134 elite athletes provided data in an online survey. In addition to quantitative measurements (current depressive symptoms, and level of chronic stress), possible stressors were assessed qualitatively with an open ended question. By using content analysis to explore stressors, three different types of stressors were categorized: *Double burden*, *sport specific demands*, and *conditions*. Further statistical analysis found these stressors to be associated with dropout intentions, depression and chronic stress. Athletes, who reported sport specific demands (such as high training loads) as major stressors indicated higher levels of chronic stress and depressive symptoms than athletes without major stressors. Further research investigating sources of stress and its association to depressive syndromes in athletes could benefit from considering sport specific factors.

Keywords

Sources of Stress, Athlete, Depression

1. Introduction

Stress is a major determinant in the development of depression in the general population (Hammen, Kim, Eberhart, & Brennan, 2009; Lee, Jeong, Kwak, & Park, 2010; Monroe & Reid, 2009). Regarding the population of athletes in elite sports, stress is also discussed in relation to depressive syndromes according to Puffer &

How to cite this paper: Nixdorf, I., Frank, R., & Beckmann, J. (2015). An Explorative Study on Major Stressors and Its Connection to Depression and Chronic Stress among German Elite Athletes. *Advances in Physical Education, 5,* 255-262.
http://dx.doi.org/10.4236/ape.2015.54030

McShane (1992). Recent results (Nixdorf, Frank, Hautzinger, & Beckmann, 2013; Schaal et al., 2011) indicate that prevalence rates between 4% and 15% in elite athletes seem comparable to the general population in Europe (cf. Frank, Nixdorf, & Beckmann, 2013). Due to the profound prevalence rates, further knowledge on specific connections between depression and stress in athletes is needed.

Stress can be characterized as being either acute or chronic. "Participating in competitive sports often places the athlete under intense physical, psychological, and emotional demands" (Crocker & Graham, 1995: p. 325). And indeed, whether one takes into consideration the important tournaments and potential sporting injuries (acute stress) or the frequency of tournaments and training sessions (chronic stress), the life of an athlete can be regarded as "stressful". Nixdorf et al. (2013) found support for this assumption, indicating high associations between chronic stress and depressive syndromes, as well as between different coping strategies and depressive syndromes in elite athletes. But which are the main stressors, connected to experiences of chronic stress and depressive syndromes?

Sources of chronic stress can be located in the personal environment of an athlete as well as in the specific sport discipline that the athlete is competing in. Research on stressors in the context of sports shows that stressors can be found in the competitive surrounding as well as in the organization where an athlete is located in (Hanton, Fletcher, & Coughlan, 2005). Organizational stressors, representing the environmental demands associated primarily and directly with the organization in which an individual was operating in, were shown to be multiple facetted with dimensions such as interpersonal demands or stress due to roles within the sport organization (see Fletcher, Hanton, Mellalieu, & Neil, 2012). But besides stressors that are clearly related to the sport organization or the competitive nature of elite sports, athletes are also exposed to stressors such as job insecurity or difficulties balancing sport, study commitments (Noblet & Gifford, 2002) and the physical demand of training (Gould, Jackson, & Finch, 1993). Regarding the location of major stressors possibly connected to depressive syndromes in athletes, important stressors might be located within the sport organization, as well as within private challenges. Therefore, the contribution of specific factors in these domains needs further qualification.

Regarding which factors are associated with depressive symptoms, few articles provide information on specific triggers such as injuries (e.g. Appaneal, Levine, Perna, & Roh, 2009; Leddy, Lambert, & Ogles, 1994) and overtraining (Armstrong & VanHeest, 2002; Meeusen et al., 2013; O'Connor, Morgan, Raglin, Barksdale, & Kalin, 1989). The impact of chronic stress is mainly put in context with the overtraining syndrome (e.g. Kellmann, 2010; Lehmann, Gastmann, Keizer, & Steinacker, 1999). Athletes undergoing a strenuous training schedule can develop a significant decrease in performance associated with systemic symptoms or signs, which are also shown to be associated with other negative phenomena such as burnout (Lemyre, Roberts, & Stray-Gundersen, 2007). According to Angeli, Minetto, Dovio, & Paccotti (2004), this is a stress-related condition that consists of alteration of physiological functions and adaptation to performance, impairment of psychological processing, immunological dysfunction and biochemical abnormalities. The other sources of chronic stress which are relevant for depression in athletes are still unknown. There is little research regarding major stressors contributing to experiences of chronic stress in athletes (e.g., cohesion of teams/training partners, pressure from supportive surrounding etc.). In addition, measurement of psychological influences is mostly based on the ascertainment of questionnaires. Whereas a great benefit of standardized questionnaires is their reliability and validity, individual aspects are usually neglected and a broader range of sport-related information that could stimulate the generation of new hypothesis is missed.

Summarizing the above raised questions, there is a lack of knowledge on whether and which (sport related) stressors have the potential to become relevant for depression and possible dropout in elite athletes. Consequently, the present study focuses on this matter by giving the questioned athletes the opportunity to rise to speak and name major stressors. Therefore, aim of the study was (1) to explore sport-relevant major stressors for elite athletes and (2) identify possible connections between these stressors and depressive syndromes as well as with chronic stress. Through this explorative approach new hypothesis and further assumptions regarding mechanisms for chronic stress and depression in elite athletes should be gathered. Assessment of merely major stressors was operationalized by asking elite athletes to state stressors related to a possible dropout of competitive sports. The answers were explored in an open, bottom up approach leading to a categorization of major stressors. As existing categorizations of stressors (e.g. Hanton et al., 2005) in elite athletes might be too narrow for the topic of depression this open and explorative approach was used. In addition, athlete's depressive symptoms and levels of chronic stress were assessed in order to test possible connections to the categorized stressors.

2. Method

2.1. Participants

A total of 134 German elite athletes (M_{age} = 21.66; *SD* = 4.60; age range: 15 - 37) were included[1]. Of originally 162 participating athletes 28 athletes were excluded since they did not meet criteria for being an elite athlete. The decision about level of expertise was based on level of performance, age, hours of exercise per week, and number of competitions per season, with level of performance being the main criterion. Athletes in the national squad were automatically designated as elite athletes. Athletes in the first national league in handball, cycling, and volleyball and in the first and second national league in soccer were also designated as elite athletes. To ensure participant's adequate understanding and prevent inappropriate data, only complete cases (incomplete cases: *n* = 60) and cases meeting honesty criteria (nonplausible answers, response set, etc.: *n* = 8) were originally included. The final sample consisted of 56 female (M_{age} = 22.16; *SD* = 4.75; age range: 15 - 33) and 78 male (M_{age} = 21.29; *SD* = 4.48; age range: 16-37) elite athletes. Sports included athletics (*n* = 2), badminton (*n* = 3), beach volleyball (*n* = 3), canoeing (*n* = 19), cycling (*n* = 38), golf (*n* = 4), handball (*n* = 15), hockey (*n* = 2), ice hockey (*n* = 1), ice running (*n* = 5), modern pentathlon (*n* = 1), rugby (*n* = 12), snowboarding (*n* = 2), soccer (*n* = 20), swimming (*n* = 1), triathlon (*n* = 2), volleyball (*n* = 3), and wrestling (*n* = 1).

2.2. Measures

After receiving informed consent and demographic questions on gender, age and sport discipline, athletes were asked to state their main stressors, which could lead to a possible dropout in an open ended question format ("*Do you have major chronic stressor(s) in your life as an athlete, which could lead to a dropout*?"). Participants could indicate either "yes" or "no" in this dichotomous question format. In case of "no"-answers (*n* = 59), athletes were automatically treated as having no major stressor (NS). In case of "yes"-answers, athletes were asked to describe their major stressor. Therefore, athletes had the opportunity to state their stressors in short sentences or headwords. The "yes"-answers (*n* = 75) were used for qualitative analysis. For validation purpose, athletes were additionally asked to indicate the extent to which they had intentions of dropping out of competitive sports. Intentions were assessed using a 5-point rating scale (1 = *never intended to drop out* and 5 = *often intended to drop out*).

2.2.1. Depressive Symptoms

The incidence of depressive symptoms in athletes was assessed with the widely used German version of the Center for Epidemiologic Studies Depression Scale (CES-D) from the National Institute of Mental Health (Hautzinger, Bailer, Hofmeister, & Keller, 2011; Radloff, 1977). The CES-D is a short self-report scale designed to measure depressive symptomatology in the general population. The 20 items are assessed on a scale ranging from 0 to 3. The cutoff for a major depressive episode is a score of >22. The scale has been found to have very high internal consistency (α = 0.89), which was in the present study α = 0.90.

2.2.2. Chronic Stress

The Trier Inventory of Chronic Stress screening scale (Schulz, Schlotz, & Becker, 2004) was used to identify athletes with a high level of chronic stress. The 12-item questionnaire measures five aspects of chronic stress: work overload, worries, social stress, lack of social recognition, excessive demands. The answers are provided on a 5-point rating scale ranging from 0 - 4. Higher scores indicate a strong exposure to chronic stress. The scale was found to have a very high internal consistency (α = 0.91; Schulz et al., 2004). Reliability in the present study was also good with Cronbach's α = 0.88.

2.3. Procedure

After receiving informed consent, participants answered the online questionnaire containing these measures in predetermined order and therefore could not skip questions or go back to previous pages or questions. However, participants could quit the survey at any time. Before beginning the questionnaire, participants were provided

[1]Participants of the present study came from an online study in 2011 (Nixdorf et al., 2013). The goal of this study was to find prevalence rates and associations for depression in elite athletes. Within this online questionnaire the authors collected the present qualitative data on major stressors.

with information about the study, including the estimated duration of the survey (30 min). The participants first answered questions related to demographic information, followed by completion of the questions covering the mentioned topics. At the end of the survey, contact details of the authors were provided.

2.4. Data Analysis

The open ended question on main chronic stressors was analyzed by a conventional content analysis (Hsieh & Shannon, 2005). Therefore, categories were developed in an inductive process with an open coding, grouping and categorization and abstraction into a conceptual model (Elo & Kyngäs, 2008). Sampling unit consisted of all stressors the participating athletes provided. Athletes were treated as recording units. Stressors were treated as content unit. For open coding, all content units were extracted, sighted and carefully read. In the second step, all content units were re-read and analyzed regarding overlapping, respectively similar, stressors. For grouping, all stressors were clustered into 17 subcategories (level b). In the next step, these 17 subcategories were grouped inductively into three main categories (level a), which had to be thematically fitting. Main categories were developed in order to gather different locations of main stressors. These three main categories were developed out of the data and carefully defined in the following step. Next, all athletes were rated into one of the three main categories according their stated main stressor by two raters. Rating was referred to the recording units in contrast to content units and therefore provided for each participant a categorization into one main category allowing a following analysis with distinct factor levels. Participants without any stressors provided were categorized into the category *no stressor* (*NS*). The inter-rater reliability was good with Cohen's $\kappa = 0.86$. After the rating, stressors rated differently ($n = 7$) were discussed and categorized by both raters together.

Analyses of Variance (ANOVAs) were conducted for testing possible connections between the categories of stressors with chronic stress and depression. The stress-categories served as independent variables whereas depression, chronic stress and intentions of dropout served as dependent variables. As multiple ANOVAs were conducted, the problem of family wise error rate was accounted by setting alpha at $\alpha < 0.01$. Post-hoc analyses of significant group differences within the independent variable were performed by Tukey's honest significance test (Tukey's HSD). In addition, effect sizes were calculated for significant differences. Validity of main stressors was tested by its connection to intentions of dropout. As the single-item question lacks psychometric values and therefore did not meet criteria for parametrical testing, Kruskal-Wallis One-Way Analysis of Variance was conducted. Following group differences were performed by a Wilcoxon Rank Sum Test, using pairwise comparisons with Bonferroni correction for adjusting alpha.

3. Results

The analysis of the open ended question (**Table 1**) resulted in 17 subcategories (level b) and three main categories (level a): *Double burden* (*DB*), *sport specific demands* (*SSD*) (physiological and psychological) and *condi*

Table 1. Structure and overview over the heading categories and subcategories.

Categories, level a	Subcategories, level b
Double Burden (DB)	Education & Job Family & Friends (Free-) Time Self-Determination
Sport Specific Demands (SSD) - physiological	Bad performance Injury High training or competition load Fatigue
- psychological	Pressure to perform Mental stress Fear of failure Loss of joy Motivational difficulties
Conditions (C)	Lack of perspective Lack of sponsoring Lack of support from an organizational level Conflict within the team or with the trainer

tions (*C*). The category DB was found to describe subcategories (level b), which illustrated stressors due to conflicting interests and responsibilities besides being an athlete. Demands such as educating themselves in school or university, having an own family or keeping up with other hobbies along with their main sports were considered as stressors in this category. Examples for this category are "not enough time for my family", "clash of training and school" or "no time for hobbies and friends". The category SSD represents physiological and psychological stressors in the context of sports and is directly linked to being an athlete. Physiological stressors were related to heavy exercise loads, injuries or bad performance levels, which is illustrated by examples like "not in shape for multiple weeks" or "multiple injuries". In the psychological aspect of the category, major stressors concerning psychological difficulties relating to high pressure to perform well, mental stress, fear of failure or motivational difficulties were named (i.e. "the pressure to always succeed is too much"). The category C represents stressors related to disadvantageous or unfavorable structures within the sport. Stressors like finances or problems with sponsoring, lack of support in the team or conflicts and lack of appreciation would fall into this category. Examples are "lack of support from my teammates" or "financial insecurities due to insufficient sponsoring".

Results of the content analyses-ratings are displayed in **Table 2**, indicating equal distributions for the categories DB (n = 30) and SSD (n = 30) and fewer ratings in the category C (n = 15). In addition, the category NS was frequent with n = 59. Results for the three ANOVAs for analyzing possible connections between the three main categories with depressive symptoms, chronic stress and intentions of dropout are shown in **Table 2**. Results show significant main effects across the four categories for depression ($F(3, 130) = 3.95$; $p < 0.01$), chronic stress ($F(3, 130) = 9.60$; $p < 0.001$), and intentions of dropout ($\chi^2(3) = 74.19$; $p < 0.001$). Post-hoc analyses for intentions of dropout showed significant differences between the groups NS with DB, SSD and C (all $p < 0.001$). For depression, significant differences were found between the groups NS and SSD ($p < 0.01$). Effect size for mean differences was moderate to strong with Cohens $\delta = 0.78$. Regarding chronic stress, significant differences were found between the groups SSD and NS ($p < 0.001$; $\delta = 1.15$), as well as tendencies between the groups NS and C ($p = 0.016$), and NS and DB ($p = 0.049$). No differences were found between the three stressor categories with respect to chronic stress, depressive symptoms or intentions of dropout.

4. Discussion

The present study was conducted to explore major stressors in elite athletes and its possible connection to depressive symptoms and chronic stress. Content analysis of open ended questions concerning major stressors led to three main categories: Double burden (DB) due to challenges of combining the career of an athlete with other duties, sport specific demands (SSD) such as heavy exercise loads, psychological pressure or failure, and conditions (C), which are referred to as stress through unfavorable structures within the team or organization. Further analyses revealed effects for chronic stress and depressive symptoms. Especially athletes with major stressors in the category SSD, representing psychological and physiological challenges in the context of sport, were found to have higher scores in depression and chronic stress. Firstly, the results of the content analysis and secondly, the found effects for chronic stress and depression will be discussed in the following.

Table 2. Results from content analysis rating for sample size, means and ANOVA for chronic stress, depression and intetions of dropout.

	Categories					ANOVA
	DB	SSD	C	NS	Overall	F/χ^2-value and degrees of freedom (df)
Sample Size n	n = 30	n = 30	n = 15	n = 59	N = 134	-
Chronic stress	M = 17.8	M = 22.8	M = 20.5	M = 12.4	M = 16.8	$F(3, 130) = 9.60^{**}$
Depression	M = 14.0	M = 16.9	M = 13.5	M = 10.3	M = 12.9	$F(3, 130) = 3.95^{*}$
Dropout intentions	M = 2.8	M = 2.7	M = 3.0	M = 1.4	M = 2.2	$\chi^2(3) = 74.19^{**}$

Note: Categories abbreviations DB = Double Burden, SSD = Sport Specific Demands, C = Conditions, NS = No Stressor. $^{**}p < 0.001$, $^{*}p < 0.01$.

4.1. Major Stressors in Elite Athletes

The process of abstraction throughout content analysis led to a further characterization of the three found categories. By describing the categories throughout location of the inherent stressors, SSD are located within the athlete (intra athletic). Stressors within this category are directly linked to possible physiological and psychological issues athletes have to deal with. In contrast, the category C is related to stressors located in the direct surrounding of athletes (e.g. in their teams, organization). Furthermore, the category DB represents stressors which result from the private life or through the conflict between the multiple roles of an athlete. Therefore, stressors in this category can be considered stressors with relation to the whole life of a person and are not merely bound to athletic or sports related aspects.

A categorization of stressors by Hanton et al. (2005) led to a differentiation between competitive and organizational stressors. The authors concluded that athletes experience and recall more demands related to competition. As the present results indicate few stressors in the category C and more in the category SSD one might draw equal conclusions. However, in this study athletes provided also several stressors regarding conflicts between sports and private life (DB) which are clearly not competition related. Other comparable classifications have their origin in research on dropout. Enoksen (2011) provides an overview about several causes of dropouts in the literature, including (1) training and performance factors; (2) education and work obligations; (3) motivational aspects; (4) social environment and (5) choice of other sport activities and interests. The author in particular underlines reasons due to injuries, performance stagnation, educational demands and lack of motivation as highly relevant factors (Enoksen, 2011). Similarities with the category DB especially appear regarding the second factor: education and work obligations. This is not surprising, as the major stressors in this study were linked to intentions of dropout. In addition, goal of the study was to link major stressors with chronic stress and depressive symptoms. Therefore, comparisons with other conceptual frameworks and categories are difficult and should be interpreted carefully.

4.2. Stressors, Chronic Stress and Depressive Symptoms

Regarding levels of chronic stress, effects were found for the category SSD along with tendencies for both other categories. This indicates that the stated stressors are associated with experiences of chronic stress among elite athletes. This effect validates the open ended question, as the study's goal was to explore main stressor with a chronic character. In detail, especially stressors within the athlete (psychological and physiological) are connected to higher levels of chronic stress. This effect was also seen for depressive symptoms. Here, the category SSD also accounted for the effect between major stressors and depressive symptoms with a moderate to strong effect size. Taken together, the present results indicate that mainly stressors linked to sport specific psychological and physiological demands of an athlete are related to negative experiences like chronic stress or depressive symptoms.

The present results clearly do not allow underestimating other, more sport distal stressors in an athlete's life. However, considering psychological aspects of the three categories might lead to testable assumptions for further research on this topic. One such possible psychological assumption in this regard lies in the different location of stressors within the three major categories. SSD, for example, represent stressors directly linked to athletes. Therefore, stressors within this category might have an impact on important aspects of an athlete's identity. Following this assumption, stressors within the category C might be relevant for athletes, too. However, as they are not directly involved, athletes have the opportunity to make other persons or circumstances accountable for the current stress. Concerning the category DB, one might expect an equally heavy impact on athletes, as aspects like education, relationship or family seem also highly important. However, having various aspects in one's life offers also the opportunity to have reinforcements by others. Therefore, difficulties in one aspect could be compensated throughout positive other aspects.

Other findings on specific events in an athlete's life such as injury (Appaneal et al., 2009) or failure (Hammond, Gialloreto, Kubas, & Davis, 2013) clearly indicate towards the importance of sport specific mechanisms for depression in athletes. However, not only single events but chronic stressors should be considered following the present results. Therefore, chronic stress and stressors seem to play an important role. Nevertheless, episodes like injuries, failure or overtraining might have an even longer and therefore chronic impact on an athlete's health than the event itself. To answer this question research would need to evaluate long-term effects of such

factors.

The found effects in the present study regarding the location of important stressors for athletes can be viewed from a practical perspective, too. Here, the specific aspects of sports in sport psychological counseling and psychotherapy can be taken into consideration. The results indicate that clearly sport related challenges (e.g. overwhelming demands of training, pressure to perform well) are connected to stress and depression. Unfortunately, little is known on clinical issues in elite athletes such as depression (Wolanin, Gross, & Hong, 2015) and therefore on sport specific mechanisms in development and therapy of psychological disorders. Thus, practitioners in the field of clinical sport psychology (sport psychologists and therapists) would benefit of a better understanding in this intersection.

4.3. Limitations

The present study is explorative in its nature and therefore does not test specific assumptions based on theories. Consequently, all results cannot be seen as empirical evidences and should rather be regarded as insight, which further research can base testable assumptions on. The found major stressor categories have to be interpreted with care, as they were developed inductively by qualitative research methods. Furthermore, findings are constrained by the research design. Sample characteristics such as size, nationality, or sport discipline can limit external validity of the present results. Furthermore, causal implications cannot be drawn by the explorative, cross-sectional design of the study. However, following research on chronic stress or depression in athletes could possibly benefit by considering sport related challenges and stressors and therefore conduct studies to test causal assumptions. In addition, this study focused merely on negative outcomes and therefore on possible negative influences (stressors). As discussed above, there also might be positive aspects related with the found stressful topics for elite athletes (e.g. reinforcement by family or school). Furthermore, other individual resources (e.g. support system, self-confidence) are possibly influencing experiences of stress and depression in a positive manner. Although not explored in the present study, such aspects might be valuable for further research.

5. Conclusion

The present study explored major stressors in elite athletes and found three main categories for sources of stress: double burden, sport specific demands and conditions. Major stressors seemed to be located in various, different aspects of an athlete's life. Thus, athletes may face different challenges during their careers and stress may origin from the daily training, the interaction with coaches and teammate, but also from conflicting interests regarding the career and private life. Further analysis showed connections between the stressors and experiences of chronic stress as well as with depressive syndromes in elite athletes. Especially stressors related to sport specific demands seemed accountable for this effect. Therefore, further knowledge on sport specific mechanisms regarding outcomes such as depression and stress is needed. Research on depression and other general psychological health issues could possibly benefit by taking such sport specific aspects (e.g. performance pressure, exercise loads, etc.) into greater consideration.

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4.2 Article 2

Authors: Insa Nixdorf, Raphael Frank, & Jürgen Beckmann

Title: Comparison of athletes' proneness to depressive symptoms in individual and team sports: Research on psychological mediators in junior elite athletes

Journal: Frontiers in Psychology, Movement Science and Sport Psychology, 2016, 7:893
Doi: 10.3389/fpsyg.2016.00893

Summary:

The present article is based on a sample of junior elite athletes and replicates the previously found differences in depressive symptoms between team- and individual sport athletes (Nixdorf et al., 2013; Schaal et al., 2011; Wolanin et al., 2016). Additionally, results support the assumptions of sport-specific mechanisms contributing to depressive symptoms among elite athletes. Attribution after failure was a significant mediator in the present study. Thus, attribution seems to play an important role in explaining the different vulnerability to depression in team and individual sports.

Participants of the present study were part of a research project which was reviewed, approved and financially supported by the BISp (funding reference number IIA1-071001/14-15). The goal of the study "Risk and protective factors for depressive syndromes and burnout in junior elite athletes" was to investigate and help prevent depression and burnout in young elite athletes.

The study and the article were mainly conducted, planned, executed, analysed and written by the first author. Substantial support from co-authors was appreciated.

The article was submitted in March 2016 and accepted in June 2016 in the special section *Movement Science and Sport Psychology* in the journal *Frontiers in Psychology*. The article is part of the research topic *Mental health challenges in elite sport: balancing risk with reward.* This is an international

journal designed to advance research in foundational and applied aspects of psychological movement science. It is an open access, peer-reviewed journal.

frontiers in Psychology

ORIGINAL RESEARCH
published: 17 June 2016
doi: 10.3389/fpsyg.2016.00893

Comparison of Athletes' Proneness to Depressive Symptoms in Individual and Team Sports: Research on Psychological Mediators in Junior Elite Athletes

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Depression among elite athletes is a topic of increasing interest and public awareness. Currently, empirical data on elite athletes' depressive symptoms are rare. Recent results indicate sport-related mechanisms and effects on depression prevalence in elite athlete samples; specific factors associated with depression include overtraining, injury, and failure in competition. One such effect is that athletes competing in individual sports were found to be more prone to depressive symptoms than athletes competing in team sports. The present study examined this effect by testing three possible, psychological mediators based on theoretical and empirical assumptions: namely, cohesion in team or training groups; perception of perfectionistic expectations from others; and negative attribution after failure. In a cross-sectional study, 199 German junior elite athletes ($M_{age} = 14.96$; $SD = 1.56$) participated and completed questionnaires on perfectionism, cohesion, attribution after failure, and depressive symptoms. Mediation analysis using path analysis with bootstrapping was used for data analysis. As expected, athletes in individual sports showed higher scores in depression than athletes in team sports [$t(197) = 2.05$; $p < 0.05$; $d = 0.30$]. Furthermore, negative attribution after failure was associated with individual sports ($\beta = 0.27$; $p < 0.001$), as well as with the dependent variable depression ($\beta = 0.26$; $p < 0.01$). Mediation hypothesis was supported by a significant indirect effect ($\beta = 0.07$; $p < 0.05$). Negative attribution after failure mediated the relationship between individual sports and depression scores. Neither cohesion nor perfectionism met essential criteria to serve as mediators: cohesion was not elevated in either team or individual sports, and perfectionism was positively related to team sports. The results support the assumption of previous findings on sport-specific mechanisms (here the effect between individual and team sports) contributing to depressive symptoms among elite athletes. Additionally, attribution after failure seems to play an important role in this regard and could be considered in further research and practitioners in the field of sport psychology.

Keywords: depression, junior elite athletes, team sports, individual sports, attribution

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Edited by:
Tadhg Eoghan MacIntyre, University of Limerick, Ireland

Reviewed by:
Hugh John Gilmore, English Institute of Sport, UK
Katie Lynn Andrews, University of Limerick, Ireland

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Specialty section:
This article was submitted to Movement Science and Sport Psychology, a section of the journal Frontiers in Psychology

Received: *23 March 2016*
Accepted: *30 May 2016*
Published: *17 June 2016*

Citation:
Nixdorf I, Frank R and Beckmann J (2016) Comparison of Athletes' Proneness to Depressive Symptoms in Individual and Team Sports: Research on Psychological Mediators in Junior Elite Athletes. Front. Psychol. 7:893. doi: 10.3389/fpsyg.2016.00893

INTRODUCTION

Although depression among elite athletes seems to be a topic of interest, empirical data on prevalence rates and research on mechanisms in this regard are still rare. However, recent results on depression prevalence in elite athlete samples are noteworthy and range between 4% (Schaal et al., 2011), 24% (Wolanin et al., 2016), 27% (Gulliver et al., 2015), and in some cases even up to 68% in the last 36 months (Hammond et al., 2013). Obviously, there is variability in prevalence estimates, which might be due to different assessment methods (questionnaire vs. interview), different assessment times (period of heavy exercise, recovery, or championship), or samples (different sport disciplines, gender etc.). In fact, recent reviews on this matter (Frank et al., 2013; Wolanin et al., 2015) suggest depression in elite athletes to be connected to sport-specific mechanisms and factors, such as injuries, overtraining, or exceeding stress. Consequently, such factors should be taken into consideration while assessing depression in athletes.

However, few such sport-specific factors are known. For example, Hammond et al. (2013) showed largely increased levels of depressive symptoms among swimmers during competition. Moreover, the study found performance failure to account for an increase in the levels of depressive symptoms. Besides the importance of failure, research showed injuries during the athletic career as predictors for depressive syndromes (Leddy et al., 1994). Leddy et al. (1994) found injured athletes to experience depression not only within 1 week after an athletic injury but also to have significantly higher depression scores even 2 months *post*-injury. Appaneal et al. (2009) found similar results with elevated depression scores from 1 week up to 1 month after injury when compared with healthy controls. There has been a number of evidence suggesting that sport-related concussions can lead to changes in emotional state (Hutchison et al., 2009) and might be connected to depression (Kerr et al., 2012). But while there might be a significant connection between concussions and depression, there is evidence suggesting that other sport injuries may have comparable or greater effects on mental health (Mainwaring et al., 2010). Besides the effect of acute injuries, the overtraining syndrome can also threaten the mental and physical health of an athlete and has been connected to depression in athletes (Puffer and McShane, 1992; Armstrong and Van Heest, 2002).

Recent findings also showed a sport-related effect, indicating that depressive symptoms vary by sport type. It has been repeatedly shown that athletes competing in individual sports were more prone to depressive symptoms than athletes competing in team sports (Schaal et al., 2011; Nixdorf et al., 2013). In a German sample, Nixdorf et al. (2013) found higher scores in depressive symptoms for athletes competing in individual sports than those competing in team sports. In a French sample, Schaal et al. (2011) found differences between sport disciplines indicating higher scores in esthetic sports (24%) and fine motor skill sports (18%) in comparison to team ball sports (8%). In North America, Wolanin et al. (2016) found that athletes competing in track and field had the highest rate of depression scores, while lacrosse players had significantly lower levels of depression. Although these authors do not explicitly address a differentiation into individual sports and team sports, their results further support the assumption that higher depression scores are found in disciplines with competitions based mainly on an individual performance.

From a psychological perspective, there are some reasonable arguments for athletes in individual sports to be at a higher risk for depression. In this regard, attribution of failure and success might be one such psychological difference. Hanrahan and Cerin (2009) showed that athletes in individual and team sports differ in style of attribution. In detail, athletes competing in individual-sport disciplines showed attribution with higher levels in the dimension "internality". For positive events, individual-sport athletes showed attributions to be more internal, stable, and global. As the authors point out, it seems logical for individual-sport athletes to make more internal attributions as they do not have teammates which can be credited or blamed for results. For positive events, this style of attribution has potentially benefits in regard to performance or persistence (Hanrahan and Biddle, 2008). However, for negative events it can be a risk factor for depression and negative mood (Abramson et al., 1989). Internal attribution after negative events (failure) is associated with negative effect, such as guilt and shame (Tracy and Robins, 2004). Moreover, research on depression indicated that internal, stable, and global attribution after failure can lead to depression (e.g., Hull and Mendolia, 1991; Alloy et al., 2006). It is thus plausible that internal attribution can explain why athletes in individual sports might be at greater risk for depressive symptoms after failure.

Regarding cognition and attitudes, perfectionism is another plausible underlying mechanism. Perfectionism can be defined as a personal disposition characterized by striving for flawlessness and setting exceedingly high standards. Furthermore, it is accompanied by tendencies for overly critical evaluations of one's behavior (see Frost et al., 1990; Hewitt and Flett, 1991b; Flett and Hewitt, 2002). The concept of a multidimensional personality disposition (Enns and Cox, 2002) has different aspects, which can be regarded as maladaptive and adaptive (Stoeber and Otto, 2006). Maladaptive aspects have been demonstrated to be linked to depression (Hewitt and Flett, 1991a). In athletes, research also discusses maladaptive and adaptive aspects (Gotwals et al., 2012). On the maladaptive side, perfectionistic concerns have been repeatedly linked to burnout in athletes (Hill et al., 2008; e.g., Hill, 2013; Madigan et al., 2015). One aspect of perfectionistic concerns is perfectionistic expectations from others, e.g., coaches, teammates, and parents (Enns and Cox, 2002; Stoeber et al., 2004). Such perfectionistic expectations appear as one possible aspect to showcase the difference between individual and team sports. Most athletes reaching for an elite level will probably perceive pressure to perform well and therefore experience perfectionistic expectation from outside. But whereas in team sports, responsibilities can more likely be diffused, identifiability can be greater

in individual sports (Scanlan, 1984; Widmeyer et al., 1992). Data also show greater interest in athlete's performance in individual sports from a motivational perspective (van de Pol et al., 2015). These circumstances are discussed in regard to research indicating higher levels of social anxiety (Norton et al., 2000) and trait anxiety in individual athlete compared to team-sport athletes (Martin and Hall, 1997). Following this argumentation, while individual- and team-sport athletes both experience perfectionistic expectations these might be more intensified for individual sports. However, differences between perfectionism and sport disciplines have not been examined, neither its possible mediating role toward depressive symptoms in contrast between team and individual-sport athletes.

Besides cognitive factors such as attribution or attitudes, social factors (cohesion or social support) are associated with depressive symptoms and its development (e.g., Alloy et al., 2006; Au et al., 2009). Therefore, low social support is connected with elevated depressive scores. The relevance of these social factors for depression in athletes has been demonstrated (Armstrong and Oomen-Early, 2009; Ohlert, 2012). Recent articles indicated that even in retired athletes low social support is connected to depression throughout and after the athlete's career (Gouttebarge et al., 2015). In regard to cohesion in teams and training groups of individual sports, differences can be assumed. The presence of shared goals and interdependent structures, e.g., can strengthen cohesion in teams (Evans and Eys, 2015). Feedback from coaches, experience of failure during important competition, surroundings, and support might be different depending on the sport discipline. Therefore, higher cohesion in teams can be expected and potentially mediate differences in depressive symptoms across sport disciplines.

In summary, it can be stated that there are plausible arguments for negative attribution after failure, perfectionistic expectations from outside and cohesion to be important variables for the association between depressive symptoms, team sports, and individual sports. More specifically, these variables could potentially mediate the observed differences regarding depressive symptoms among individual- and team-sport athletes. For testing these assumptions, we examined these variables in a cross-sectional study among German junior elite athletes. It was assumed (i) that even in junior elite athletes we would find differences regarding depressive symptoms between athletes in individual and team sports. Therefore, we expect higher depressive scores among individual-sport athletes. Furthermore, we hypothesized (ii) that negative attribution after failure, perfectionistic expectations from outside, and cohesion would mediate the association between individual sports and depression. No specific assumption was made about which variable was most likely to mediate this effect. As not all connections between possible mediators and type of sport have been established by previous research, this has been tested according to the stepwise approach from Baron and Kenny (1986). However, mediation was tested using path modeling with bootstrapping to check for possible indirect effects and have more power and control over type I error rates (Hayes, 2009).

MATERIALS AND METHODS

Participants

In a cross-sectional study, $N = 199$ German junior elite athletes ($M_{age} = 14.96$; $SD = 1.56$) participated and completed questionnaires on perfectionism, attribution, cohesion, and depressive symptoms. Originally, 295 junior elite athletes had participated, of which 199 completed all questionnaires and therefore were included in the present study. Participants were part of a scientific project which was reviewed, approved and financially supported by the German Federal Institute of Sport Science (*Bundesinstitut für Sportwissenschaft;* BISp) in order to investigate and help prevent depression and burnout in young elite athletes. Therefore, only junior athletes with high competition level (at least regional selection squad or members in professional junior development facilities) were included in the study. Participants came from different sport disciplines. Individual sports were: mountain bike ($n = 16$), badminton ($n = 9$), gymnastics ($n = 5$), swimming ($n = 10$), ice running ($n = 19$), and short track ($n = 12$). Team sports were: soccer ($n = 113$) and hockey ($n = 15$).

Measures

Depression

Depressive symptoms in junior athletes were assessed with the widely used German version of the Center for Epidemiologic Studies Depression Scale (CES-D) from the National Institute of Mental Health (Radloff, 1977; Hautzinger et al., 2011). The CES-D is a short, self-report scale designed to measure depressive symptomatology in the general population. It was also repeatedly used to assess depressive symptoms among elite athletes (Yang et al., 2007; e.g., Armstrong and Oomen-Early, 2009; Junge and Feddermann-Demont, 2016). The 20 items are assessed on a scale ranging from 0 to 3. The scale is constructed, reliable, and standardized for the age range 11–90 years. The scale has been found to have high internal consistency ($\alpha = 0.89$), which was in the present study $\alpha = 0.85$.

Cohesion

Cohesion in team and individual athletes was measured using the German version of the Group Environment Questionnaire (GEQ; Carron et al., 1985) by Ohlert (2012). The GEQ is a widely used questionnaire to assess cohesion by four factors, namely group integration (related to task), group integration (social), individual attraction to group (related to task), and individual attraction to group (social). The widely used GEQ was translated, adapted, and validated by ($N = 418$) German athletes (Ohlert, 2012). Adaption of the German version allowed assessment of cohesion in team and individual sports. Therefore, 18 items with a nine-point Likert scale (strongly agree to strongly disagree) were used. The scale was found to be internal consistent with Cronbach's alpha ranging between $\alpha = 0.74$ and $\alpha = 0.78$ for the four subscales. Overall, reliability was good in the present study with an internal consistency of $\alpha = 0.81$.

Perfectionism

Perception of perfectionistic expectations from outside was assessed using the subscale of the German Version of the Multidimensional Inventory of Perfectionism in Sport (MIPS; Stoeber et al., 2004). The MIPS was developed following existing questionnaires dominating research in the field of perfectionism (e.g., Frost Multidimensional Perfectionism Scale; FMPS; Frost et al., 1990; Multidimensional Perfectionism Scale; MPS; Hewitt and Flett, 1991b). The scale consists of nine subscales which can be regarded as either adaptive or maladaptive (Stoeber et al., 2004). The subscale used in the present study has eight items on a six-point Likert scale covering experiences of perfectionistic expectations from outside (from the coach) and is regarded as rather maladaptive (see Ashby and Rice, 2002; Enns and Cox, 2002). The scale was validated and tested regarding its reliability in two studies indicating good internal consistency (study 1: Cronbach's $\alpha = 0.94$; study 2: Cronbach's $\alpha = 0.86$). Reliability was good in the present study with Cronbach's $\alpha = 0.88$.

Attribution after Failure

Attribution after failure was assessed using the relevant dimensions, such as internality, stability, and globality after the last failure according to the Sport Attributional Style Scale (SASS; Hanrahan and Grove, 1990). Athletes had to rate their personal cause for failure and success on the following dimensions: internality, stability, globality, personal controllability, external controllability, and intentionality on separate seven-point bipolar scales. The SASS was shown to have adequate psychometric properties (Hanrahan and Grove, 1990). For analysis in the present study, the sum score for the three dimensions, such as internality, stability, and globality for the last failure was used.

Procedure

After review and approval of the BISp, written informed consent by athletes and parents of each participating athlete was provided. Data were assessed anonymously and pre-season in all sport disciplines with an online questionnaire battery. In case of interest or for further information on personal data, participants could use an individual code to access their individual data.

RESULTS

For replicating previous findings, athletes competing in team sports were compared with athletes in individual sports regarding depressive symptoms. A one-sided t-test revealed significant differences between the groups [$t(197) = 2.05$; $p < 0.05$; $d = 0.30$] with higher levels of depressive symptoms in athletes in individual sports ($M = 11.55$; $SD = 7.67$) than in team sports ($M = 9.47$; $SD = 6.80$).

Second, the hypothesized mediating variables negative attribution after failure, perfectionistic expectations from outside and cohesion were tested and results are shown in **Table 1**. Higher scores in individual sports are shown for the factor negative attribution after failure [$t(197) = 3.87$; $p < 0.001$]. Cohesion did not differ between team and individual sports and perfectionism differed contradictory to the hypothesis [$t(197) = -3.57$; $p < 0.001$].

Mediation analysis using path analysis with bootstrapping was used for data analysis. Therefore, the statistical program R using the package lavaan was employed. The categorical variable sport discipline (either team sports or individual sports) was included in the regression model as dummy coded variable (team = 0; individual = 1). As individual sports were coded with a higher value than team sports, the variable is called individual sports for easier interpretation of negative and positive pathways. For comparison between mediators, all scales were standardized and standardized path coefficients are reported. In addition, to illustrate associations between mediators and the dependent variable correlations between these variables were computed. In this regard, **Table 2** shows correlations between cohesion and depressive symptoms ($r = -0.41$; $p < 0.001$) as well as with negative attribution and depressive symptoms ($r = 0.28$; $p < 0.001$). Correlation between perfectionism and depressive symptoms was small ($r = 0.14$; $p = 0.045$). Also, inter-correlation between possible mediators was small (cohesion and negative attribution after failure; $r = 0.19$; $p = 0.008$) or absent (perfectionism and cohesion; perfectionism and negative attribution after failure).

Regarding the mediation analysis, the overall model for negative attribution after failure as mediator between individual and team sports and depression is shown in **Figure 1**. Negative attribution after failure was associated with individual sports ($\beta = 0.27$; $p < 0.001$), as well as with the dependent variable depression ($\beta = 0.26$; $p < 0.01$). Mediation hypothesis was supported by a significant indirect effect ($\beta = 0.07$; $p < 0.05$) which showed a possible range between $CI_{0.95} = 0.13, 0.02$ with a 95% confidence interval ($R^2_{med} = 0.07$). Therefore negative attribution after failure mediated the relationship between individual sports and depression scores.

Regarding the other possible mediators cohesion was significantly related to depression ($\beta = -0.40$; $p < 0.001$), as was perfectionism ($\beta = 0.19$; $p < 0.05$). However, as **Table 1** illustrates cohesion was not related to team sports and perfectionism was positively related to team sports, which was contradictory to the hypothesized mechanism in both regard. Thus, these variables did not meet essential criteria to serve as mediators (Baron and Kenny, 1986). Consequently, no analysis for mediating effects was performed.

DISCUSSION

The present study replicates the previously found difference in depressive symptoms between team- and individual-sport athletes (Schaal et al., 2011; Nixdorf et al., 2013; Wolanin et al., 2016), and results support the assumptions of previous findings on sport-specific mechanisms contributing to depressive symptoms among elite athletes. Athletes in individual sports showed higher scores in depressive symptoms than athletes in team sports, both in a non-clinical range in average. Along with other sport-specific mechanisms such as performance failure (Hammond et al., 2013) or

TABLE 1 | Comparison of athletes in team and individual sports regarding possible mediators.

	Individual sports	Team sports	*t*-Test
Perfectionism	$M = 13.79$; $SD = 8.33$	$M = 18.01$; $SD = 8.05$	$t(197) = -3.57$; $p < 0.001$
Cohesion	$M = 94.79$; $SD = 23.16$	$M = 97.75$; $SD = 17.07$	$^{*}t(197) = -0.94$; $p = 0.174$
Negative attribution after failure	$M = 12.55$; $SD = 3.03$	$M = 10.77$; $SD = 3.14$	$t(197) = 3.87$; $p < 0.001$

t-Tests were one sided as specific direction of difference was assumed. As perfectionism was distributed contradictory to hypothesis, two-tailored t-test was performed post hoc. As variances regarding the variable cohesion were not equal, Welch T-Test (*) was performed in this regard.

TABLE 2 | Pearson correlation between possible mediators and depressive symptoms.

	Cohesion	Negative attribution after failure	Perfectionism
Depressive symptoms	$r = -0.41$; $p < 0.001$	$r = 0.28$; $p < 0.001$	$r = 0.14$; $p = 0.045$
Cohesion	–	$r = -0.19$; $p = 0.008$	$r = 0.01$; $p = 0.906$
Negative attribution after failure	–	–	$r = 0.00$; $p = 0.958$

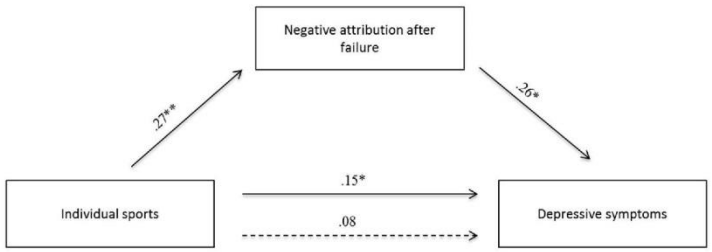

FIGURE 1 | Model of mediation path analysis with negative attribution after failure as mediator for the effect between sports and depressive symptoms (*$p < 0.05$; **$p < 0.001$).

injuries (Hutchison et al., 2009; Junge and Feddermann-Demont, 2016), the effects of individual vs. team sports should be taken into account when assessing clinical relevant prevalence in athletes to further explore the present sport-specific factors.

Whereas the previous studies referred to adult athletes, the present study was conducted with a relatively young athlete sample. Development of depression in the German general population is mostly evolving around adolescence and early adulthood (Jacobi et al., 2004). Therefore, the presence of this however small effect seems noteworthy and an increase in older samples seems likely. Furthermore, it indicates that possible underlying mechanisms for this effect are also sport inherent from an early stage.

Attribution after failure appears to be one such sport inherent factor that accounted for mediation in the present study. Thus, attribution seems to play an important role in explaining the different vulnerability to depression in team and individual sports. Since success and failure in individual sports are mostly based on the single athletes' performance an internal attributional style is more common in individual sports than in team sports (Hanrahan and Cerin, 2009). Future research should develop this assumption by going into greater detail regarding the level of interaction in different sports (assuming a continuum from single performance, through added, to coactive and finally interactive performance). Attribution after failure can be compared across sport disciplines such as swimming (single performance), relays (added performance), rowing (coactive performance), and volleyball (interactive performance).

Besides depressive symptoms, other outcomes such as motivational or emotional aspects could be affected by an internal attributional style in athletes. Following the framework of Tracy and Robins (2004) on self-conscious emotions, the internal attribution could lead to stronger experiences of emotions such as pride (positive event) and guilt or shame (negative events) in athletes in individual sports. Therefore, further investigations on possible outcomes contrasting individual- and team-sport athletes could support existing theories on attributional style and deliver useful information for practitioners in the field.

Comparable to research on athlete burnout (Hill et al., 2008; Madigan et al., 2015), the present study found a connection between one maladaptive aspect of perfectionism (perfectionistic expectations from outside) with depression. Applying knowledge from the research on perfectionism and burnout to depression could be useful in this regard. Perfectionism had a positive relationship with team sports, with athletes in team sports being more prone to perfectionism than athletes in individual sports. Thus, the assumed relationship that individual athletes would experience higher levels of perfectionistic expectations due to

their more obvious performance was clearly not supported. Recent research on burnout showed perfectionistic strivings to be connected to autonomous motivation and therefore prevent burnout (Jowett et al., 2013). Only perfectionism associated with controlled motivation should increase vulnerability to depression. However, Jowett et al. (2013) findings show once more that there is no unidimensional relationship between perfectionism and negative outcomes such as burnout or depression. Although in the present study a rather maladaptive aspect of perfectionism was used (Stoeber et al., 2004) this may also indicate that the construct as well as the assessment of perfectionism may be in need of further elaboration to clearly cover the different aspects associated with perfectionism.

Cohesion was associated with lower levels of depression in the present sample, leading to the assumption of cohesion being a protective factor for athletes. In line with previous findings (Armstrong and Oomen-Early, 2009; Gouttebarge et al., 2015), social factors might be important regarding depressive symptoms in athletes. However, no difference between individual- and team-sport athletes for cohesion was observed. This could be due to our sample. Also, it seems plausible that cohesion may not be the suitable factor to assess social connectedness and group dynamics. Evans et al. (2012) promote the investigation of group dynamics and social influence in individual sport by proposing a typology that distinguishes types of sport group environments according to levels of structural interdependence. Here, the individual athlete may still be exposed to similar cohesion effects as the team of athletes. Therefore, other variables such as coaching behavior and training environments could be important for the association between cohesion and depression.

As above mentioned, the present study assessed depressive symptoms in a relatively young sample. Goal of the study was to gather hints for underlying mechanisms with sport related connection in order to support prevention in this regard. Although differences in depressive symptoms were observed, results showed comparable means to the general population and most athletes were in a non-clinical range. Therefore, assumptions on the clinical relevance of this effect have to be further explored, using valid cut-off scores or clinical diagnosis by structured diagnostic interviews.

The present study is correlational in nature. Thus, causal implications cannot be drawn from the design. It is highly likely for the type of sport to be stable and can therefore be regarded as an early factor in a possible underlying sequence. However, no sequential order in regards to attribution or depression can be made. Thus results on mediator and outcome have no causal implication. Future research could investigate such causal mechanisms in prospective study designs. Nevertheless, practitioners could use these findings by considering attributional style and attribution after highly relevant events, especially in individual-sport disciplines and even in junior elite athletes in order to prevent negative reactions to failure such as depression.

AUTHOR CONTRIBUTIONS

IN, RF, and JB are a research group at the Chair of Sport psychology at the Technical University of Munich, Germany. The original research is part of the Ph.D.-Theses of IN and RF of which JB is the Ph.D. supervisor. Therefore, the conception and design of the work was a process done by all three authors in equal parts. The acquisition and analysis has been mainly lead by IN and RF. The interpretation of the data and the actual writing of the manuscript have been done by all three authors in equal parts. It is critically revised and approved to be published by IN, RF, and JB. All three authors agree to be accountable for all aspects of the work and ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

FUNDING

The present study was funded (grant number: IIA1-071001/14-15) by the German Federal Institute of Sport Science (*Bundesinstitut für Sportwissenschaft*; BISp) based on a decision of the German Bundestag. This work was supported by the German Research Foundation (DFG) and the Technical University of Munich (TUM) in the framework of the Open Access Publishing Program.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer KA and handling Editor declared their shared affiliation, and the handling Editor states that the process nevertheless met the standards of a fair and objective review.

5 Conclusion and general discussion

5.1 Summary of study 1 and 2

This thesis addressed whether or not sport-specific factors (vulnerabilities and stressors) affect depression in elite athletes. Both studies were guided by the theoretical assumptions of a vulnerability-stress model. Study 1 was conducted to explore major stressors in elite athletes and their possible connection to depressive symptoms and chronic stress. Content analysis of open ended questions concerning major stressors led to three main categories: *Double burden (DB)* due to challenges of combining the career of an athlete with other duties, *Sport-specific demands (SSD)* such as heavy exercise loads, psychological pressure or failure, and *Conditions (C)*, which are referred to as stress through unfavourable structures within the team or organization. Further analyses revealed effects for chronic stress and depressive symptoms. In particular, athletes with major stressors in the category SSD (psychological and physiological challenges in the context of sport) were found to have higher scores in depression and chronic stress.

Overall, it can be noted that athletes are able to distinguish their major stressors and thus differentiate the previously mentioned (abstract) chronic stress. Athletes with sport-specific stressors have significantly higher depression scores than athletes without major stressors. This leads to the need for the sport system to acknowledge and support these athletes to minimize these sport-specific stressors (e.g. long ways to commute to training facilities) whenever possible). We also emphasize the importance of recovery to counteract the impact of acute stress. As mentioned in the article's discussion, other findings on specific events in an athlete's life such as injury (Appaneal et al., 2009) or failure (Hammond et al., 2013) clearly indicate the importance of sport-specific mechanisms for depression in athletes. However, based on the current results, chronic stressors as well as single stressful events should be considered. Many of these are unique to the population of elite athletes.

Besides efforts of the sport system (e.g. by shortening commutes to training facilities or improving financial support) there are psychological factors which athletes can improve and therefore decrease the likelihood of experiencing depression.

Study 2 replicates the previously found difference in depressive symptoms between team and individual sport athletes (Nixdorf et al., 2013; Schaal et al., 2011; Wolanin et al., 2016), and supports the assumptions of previous findings of sport-specific mechanisms which contribute to depressive symptoms among elite athletes. Along with other sport-specific mechanisms such as performance failure (Hammond et al., 2013) or injuries (Hutchison et al., 2009; Junge & Feddermann-Demont, 2016), the effects of individual sports vs. team sports should be taken into account when assessing depression prevalence in athletes and further exploring the present sport-specific factors. Attribution after failure mediated the observed effect in study 2. Thus, attribution seems to play an important role in explaining the different vulnerability to depression in team and individual sports. Since success and failure in individual sports are mostly based on the single athletes' performance, an internal attributional style is more common in individual sports than in team sports (Hanrahan & Cerin, 2009).

As mentioned in the discussion of Nixdorf, Frank, and Beckmann (2016), future research should investigate these findings by going into greater detail about the level of interaction in different sports (assuming a continuum from single performance, through added, to coactive and finally interactive performance). Attribution after failure could be compared across sport disciplines such as swimming (single performance), relays (added performance), rowing (coactive performance) and volleyball (interactive performance). Internal attributional style in athletes could affect other outcomes such as motivational or emotional aspects in addition to depressive symptoms. Following the framework of Tracy and Robins (2004) on self-conscious emotions, internal attribution could lead to stronger experiences of emotions such as pride (positive event) and guilt or shame (negative events) in athletes in individual sports. Therefore, further

investigations on possible outcomes contrasting individual and team sport athletes could support existing theories on attributional style and deliver useful information for practitioners in the field.

Summarising the findings, we can see that specific circumstances (environment of elite sports, competitions etc.) impact depression scores and are specific for athletes; furthermore, certain psychological cognitive structures (attribution) are highly relevant in the field of elite sports. It appears that there are sport-specific factors regarding depression in elite athletes, which separate them from the general population; thus research into underlying mechanisms in athletes should be supported. The mere gathering of associations is not sufficient: rather, deepening the knowledge by finding underlying psychological mechanisms is needed in future research.

5.2 Research perspective

Most research on depression in elite athletes at this point in time is cross-sectional and correlational in nature. There is a strong need for a longitudinal assessment of depression (at least one sporting season) in order to verify the validity of a vulnerability-stress model in elite sports and to identify vulnerabilities that increase the risk of developing a depression. In its theoretical conception, depression is explained by a temporal, stress-related process model assuming its development due to unfortunate factors, whether personal (e.g., dysfunctional attitudes, perfectionism, negative coping strategies) or environmental (e.g., conflicts in teams), which coexist with severe stressors (chronic stress). A longitudinal assessment of vulnerabilities and stressors can help determine whether the structure of a process model (vulnerability-stress model) can be assumed with the assumption of temporal progression.

If vulnerabilities are known, prevention can become specific, effective and economical. Studies 1 and 2 of this thesis point to the validity of a vulnerability-stress model within the elite-sport context: they found that sport-specific stressors mediated a sport-specific finding in individual sport athletes, and were strongly correlated with depression, stress and cognitive processing (attributional style.) Since both studies are cross-sectional no assumption about a temporal link can be framed.

Since these studies found clear relevance for sport-specific factors (stressors and sport discipline), it might be useful to adapt the measurement of depression to the context of elite sports. There also might be a benefit to adapting the definition of depression to the population and specific symptoms of elite athletes, similar to the new definition of *athlete burnout* and sport-specific assessment (e.g. by the *Athlete Burnout Questionnaire, ABQ*) by Raedeke and Smith (2001).

In conclusion, further research is needed to establish how far the depressive syndrome is characterized by different symptoms in athletes compared to non-athletes, and to differentiate depression in athletes from burnout and overtraining. Findings of the prevalence of depression in elite athletes range from a low 4% (Schaal et al., 2011), 24% (Wolanin et al., 2016), and in some cases even up to 68% (Hammond et al., 2013): thus developing a definition and measurement accurately fitting the specific population would be meaningful, especially considering previously mentioned diagnostic challenges. With a validated and internationally standardized questionnaire with clear cut-off scores for athletes, prevalence rates could eventually be compared between studies. This would yield a robust diagnosis which clearly distinguished between negative feelings (e.g. due to an experience of failure or a scheduled intensive training episode) and depressive symptomatology.

In this line of thought, it is important to further investigate the sport specifics of clinical disorders, not only regarding depression. It is possible that certain circumstances of a sport discipline (e.g. weight categories, rating by judges) lead to different psychological issues, such as eating disorders or anxiety; in

this regard they would have different underlying psychological variables which accounted for the effect.

5.3 Challenges of future research on the topic

Further research on both vulnerabilities and stressors faces some critical challenges. Since depression and its vulnerabilities mostly evolve during adolescence and early adulthood (Jacobi, Wittchen, et al., 2004), and it is unknown at what age attributional style develops or consolidates, research on this matter would need to assess athletes at a very young age with multiple assessments throughout an athletic career. This would require a strong longitudinal study with a fairly large sample size, due to high dropout rates. Similarly, assuming that stressors change from junior (e.g. combining school and training schedules) to elite level (e.g. sponsoring, media presence) a study of stressors would need to cover a time frame of approximately 8 to 10 years to answer a developmental research question.

Unfortunately there still is a stigma surrounding mental disorders, especially in elite sports. Depression in particular, but mental health in general, has historically been used dichotomously to distinguish optimal from sub-optimal personal functioning (Schinke et al., 2017). Within this line of thought, those using the term would assume that an athlete either did or did not have a disease or disordered state (see Murphy, 2012). This approach led to misconceptions and negative connotations that have been a barrier for appropriate and necessary help-seeking behaviours and helped raise a stigma regarding help-seeking (Gulliver, Griffiths, & Christensen, 2012; Watson, 2005).

There are benefits for both a conservative cut-off score to ensure the existence of a depression, especially when assessing prevalence, and a lenient collection of depressive symptoms to provide a sensitive measure and prevent a diagnosis to occur. When assessing depression with a lenient, low cut-off score a linguistic distinction of *at risk* or *risk factors* can be helpful to avoid misconceptions. Building on this line of thought Schinke et al. (2017) advocate a continuum from active mental illness, to sub-syndromal illness, to

normal, to good mental health and to peak performance. This way of understanding mental health can potentially decrease stigma.

The field of Clinical Sport Psychology and depression in particular, is quickly evolving and has many pending research questions. It has much potential to unravel connections between depression and its correlating variables and their underlying psychological mechanisms.

5.4 Conclusion

The thesis confirms the existence of sport-specific mechanisms for depression in elite athletes. It finds support for the specific mode of action in the context of elite sports. First cross-sectional results support the adequacy of a vulnerability-stress model in this context; however the model has to be modified according to observed stressors and vulnerabilities (such as lack of recovery, attributional style, sport-specific demands, and so on). Research in a temporal, longitudinal study design is necessary to uncover mechanisms of the observed overall effects.

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7 Attachments

7.1 Reprint permission Advances in Physical Education

Nixdorf, Insa

Von: ape <ape@scirp.org>
Gesendet: Mittwoch, 19. April 2017 07:35
An: Nixdorf, Insa
Betreff: RE: Permission request

Kennzeichnung: Zur Nachverfolgung
Kennzeichnungsstatus: Gekennzeichnet

Dear Insa,

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From: Nixdorf, Insa <insa.nixdorf@tum.de>
Sent: Tuesday, April 18, 2017 21:07
To: ape
Subject: WG: Permission request

Dear Sir, dear Madam,

I am writing you today again to remind you of my email from March 29th asking for permission to use my published article (see below) as a reprint in my thesis/dissertation.
My University requires me to have a consent from the Publisher.

I am looking forward to hearing from you.
Best regards from Germany
Insa Nixdorf
--
Dipl.-Psych. Insa Nixdorf
Technical University of Munich
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7.2 Reprint permission Frontiers in Psychology

Nixdorf, Insa

Von:	Frontiers Science Production Office <science.production.office@frontiersin.org>
Gesendet:	Donnerstag, 30. März 2017 16:40
An:	Nixdorf, Insa
Betreff:	Re: Frontiers: Congratulations! Your article is published
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On Wed, Mar 29, 2017 at 2:47 PM, Nixdorf, Insa <insa.nixdorf@tum.de> wrote:
Dear Sir, dear Madam,

I am writing you today to ask for permission to use the below mentioned published article ("Comparison of athletes' proneness to depressive symptoms in individual and team sports: Research on psychological mediators in junior elite athletes") with the usual acknowledgements (author, title, publisher, journal name) as a reprint for my thesis/dissertation.

I am looking forward to hearing from you.
Best regards from Germany

Insa Nixdorf

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7.3 List of publications

Frank, R., Nixdorf, I., & Beckmann, J. (2018). Stress, under-recovery and health problems in athletes. In M. Kellmann & J. Beckmann (Eds.), *Recovery and performance.* Abingdon: Routledge.

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