Stress and its impact on the mental health of elite athletes – an analytical overview

Dissertation

zur Erlangung des Doktorgrades

der Wirtschafts- und Sozialwissenschaftlichen Fakultät

der Eberhard Karls Universität Tübingen

vorgelegt von

Barbara Nützel

Tübingen

Dezember, 2022

1. Betreuer:	Prof. Dr. Ansgar Thiel
2. Betreuer:	Prof. Dr. Stephan Zipfel

Tag der mündlichen Prüfung:	07.07.2023
Dekan:	Prof. Dr. Ansgar Thiel
1. Gutachter:	Prof. Dr. Ansgar Thiel
2. Gutachter:	Prof. Dr. Stephan Zipfel

Table of contents

"Take your time. A field that has had time to rest will produce a magnificent harvest."

Mahatma Ghandi

1 Introduction

Stress is a crucial topic in today's society. Negative effects on both physical and mental health have increasingly been proven as a direct consequence of stress in the working world, making complete human adaptation basically impossible (Hoppe, Bamberg & Kößler, 2020). However, stress is widely spread not only in the working environment, but also in elite sports, where it is recognized as an increasingly frequent aspect (Fletcher, Hanton & Mellalieu, 2006). Stress in itself is not a negative state, but if demanding situations are assessed as being negative or perceived as threat or danger, stress is triggered (Lazarus & Folkman, 1984). If stress is perceived strongly and negatively, physical, and mental consequences might ensue (Kaluza, 2018a).

Elite athletes[1] experience stress in their elite careers and are confronted to manifold stress-triggering factors. If these factors frequently reoccur, they increase the risk of situational stress becoming chronic stress with all the negative consequences. These may include depressive states, sleeping disorders, or increased susceptibility to injury (Kellmann, 2002).

1.1 Overall context pertaining to athletic activity, mental health, and stress

Numerous positive effects of athletic activity on both physical and psychological illnesses have been extensively documented in the past few years (Fuchs & Schlicht, 2012; White et al., 2017). If athletic activity is implemented as a type of stress-regulating strategy it is often associated with its antidepressant and anxiolytic effects (Edenfield & Blumenthal, 2011). Anxiety and depression are among the typical responses to stress. According to recent research, depressive disorders lead to worse health problems than diabetes or asthma (Moussavi et al., 2007). Furthermore, depressions are considered to be the second most frequent cause of disabilities and cardiovascular issues (Whiteford, Degenhardt, Rehm et al., 2013) and the most common type of mental health problems in the world by 2020 (WHO, 2010).

[1] **Gender-Disclaimer**

The generic masculine chosen in this paper refers equally to male, female, and other gender identities. For the sake of clarity, the use of masculine and feminine forms of speech is omitted. All gender identities are explicitly meant mutually, as far as the statements require this.

This prognosis is alarming considering the health-affecting impact, such as higher morbidity and mortality rates. The validity of positive and health-promoting effects of physical activity on depression and other mental disorders has often been proven for all age groups (Netz, Wu, Becker & Tenenbaum, 2005). These proven effects include, for example, an optimized endocrinological stress reaction or an increase of neuronal plasticity. For detailed and evidence-based statements on the topic of sport and mental health, please see the meta-analysis by Fuchs and Schlicht (2012).

Scientific focus has, however, shifted to the fact that athletic activity can also have a negative impact on health (Dijkstra, Pollock, Chakraverty et al., 2014), and might even lead to addiction (Hausenblas & Symonns Downs, 2002; Ziemainz, Stoll, Drescher, Erath, Schipfer & Zeuler, 2013) or eating disorders. This applies not only to the general population, but also to specific target groups (Hausenblas & Carron, 1999; Wheathley, Khan, Székely, Naughton & Petrózi, 2012).

Excellent health is as aforementioned the foundation of physical and mental performance. The health of the target group analyzed in this paper is permanently at risk, though. Elite athletes are not only confronted with the common stressors of life, but also with numerous sports-specific stressors (Mayer & Thiel, 2014).

In view of the above, the questions arise as to how stress influences the mental health of elite athletes, and which variables could be employed to promote mental health in elite sports.

Mental health is a global challenge. According to the IOC medial guidelines, protection of health must be of the highest priority (Mountjoy et al., 2008) for an athlete.

To date, sports medicine publications have been dominated by reports pertaining to injury and pain in elite sports (Thiel, Mayer & Digel, 2010, p. 9). Interdisciplinary studies from the areas of sports psychology, sports psychiatry, sports medicine, and sports sociology are represented only marginally, even though injury-related crises and stressors, the lack of coping strategies or a low self-esteem as risk factors for health impairments are discussed (Kleinert, 2006). The acceptance of risks or health-impairing practices to achieve athletic success has become a normal routine for elite athletes (Nixon, 1993; Pike & Maguire, 2003).

However, not only sports-related stressors trigger stress in elite athletes, but also their daily lives with its demands and events. An athletes' susceptibility to these stressors can be influenced by intra- and interindividual factors (e.g., age, gender, type of sport) and by genetic, metabolic, hormonal, or mental factors (Hanson, McCullagh & Tonymon, 1992; Borreson & Lambert, 2009; Johnson & Ivarsson, 2011). The discussion about the complex interaction of physiological, psychological, social,

and cultural factors in association with the mechanisms that may have a negative impact on a career in elite sports, has so far been rather controversial (Kellmann & Golenia, 2003).

Scientific sport psychology research studies within the context of mental health in elite sports can be considered rather rare in numbers, especially in comparison with sport medicine research.

Even though interconnections between stress, health, well-being, and athletic performance have been proven (Arnold & Fletcher, 2012b; Arnold, Fletcher & Daniels, 2016), influences such as continuous stress caused by competitions, or overtraining syndrome as a consequence of excessive training, or personality-related characteristics (e.g., perfectionism), have been scientifically discussed in a controversial manner for quite a while (Raedeke, 1997; Nixdorf et al., 2013; Kallus & Kellmann, 2000; Jowett, Hill, Hall & Curran, 2013).

To sum up the overall context of stress and mental health in elite sports: Nevertheless, the number of scientific studies on stress in elite sports has been increasing over the past few years (Arnold & Fletcher, 2012b), this topic still leaves a lot of room for research. Especially stressors affecting mental health negatively, epidemiological variables associated with stress and interrelationships among the biological, psychological, and sociocultural variables in an athletic context and factors promoting an athlete's mental health should be given more attention to in order to counteract any future health impairments (Gerber, Kalak, Lemola et. al, 2013; Hjendal, Vogel, Solem et al., 2011; Moesch et al., 2018).

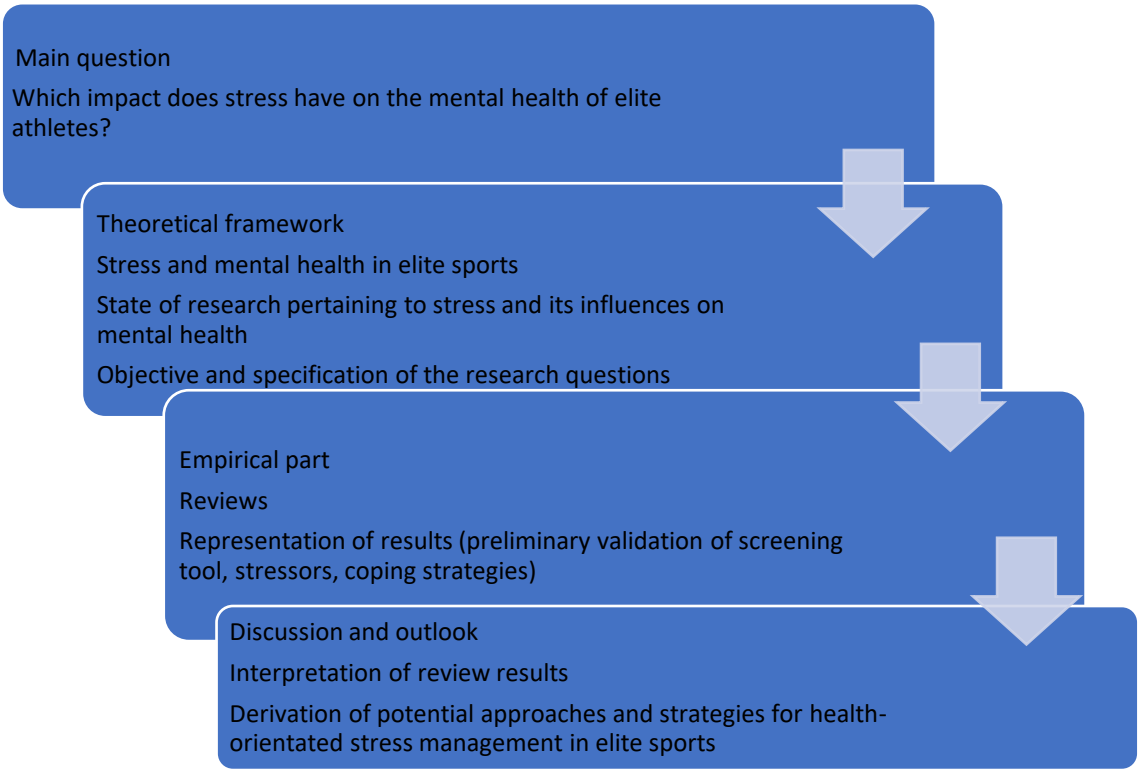

Figure 1 Conceptual research design „Stress and its impact on mental health of elite athletes "

1.2 Problem

From the very beginning of their athletic careers, elite athletes are trained to be "tough" without regard to their health in order to be successful (Bär & Markser, 2013).

To reach the top and competitive goals, elite athletes often cannot avoid situations that might be endangering their health (Hoyer & Kleinert, 2010). A career in elite sports means that elite athletes must take extreme health risks and at the same time protect their health to continuously deliver peak performances (Thiel et al., 2015).

"Mens sana in corpore sano"- a healthy mind in a healthy body – does this statement apply to elite athletes? Even though health is an absolute necessity for elite athletes to produce maximum performance, elite athletes act in favor of athletic success at the expense of their own health in a "culture of risk" (Thiel, 2014).

Health issues, such as pain or injuries, are trivialized or even ignored to fulfill athletic requirements. This phenomenon has long been discussed in sports science under the term "risk-pain-injury paradox" (Nixon, 1994). In this so-called culture of risk, potential health risks for elite athletes remain ignored, even though elite athletes are aware of the risk factors they are subject to. These include physical

strain, sleeping problems, or actual injuries (Nédélec et al., 2015; Soligard, Schwellnus, Alonso et al., 2016).

Thus, elite athletes often use up their last reserves and risk their health in both training and competition in order to reach their goals.

Especially young athletes do not care much about their health when it comes to training and competing. They go to the limit and beyond to force maximum athletic performances (Soligard et al., 2016). In addition to the elite athletes' general willingness to take on increasing training and competition intensities and volumes, they must adhere to tight schedules and satisfy the demands of associations, sponsors, organizations, media, and public expectations (Thiel, Mayer & Digel, 2010). However, not only sports-related stressors trigger stress in elite athletes, but also their daily lives with its manifold demands and events.

Considering this background, it is justified to analyze and identify in more detail not only stressors typical in elite sports, but also the corresponding coping processes need to be considered when analyzing the stress situation in elite sports (Thatcher & Day, 2008).

To date, however, an epidemiological or comprehensive approach to understanding the influence and interrelationship of these factors in elite athletes has not been sufficiently implemented (Bauman, 2016; Poucher, Tamminen, Kerr & Cairney, 2019). Therefore, this paper employs established models containing relevant scientific evidence from the fields of stress (Lazarus & Launier, 1981; Bamberg et al., 2012), risk factor typology (Kraemer et al., 1997), occupational health psychology (Rohmert, 1984; Demerouti et al., 2001; Bakker et al., 2008) and sports-associated research findings (Wiese & Weiss, 1987; Wiese-Bjornstal et al., 1995; Andersen & Williams, 1988) for further analyses.

All the above leads to the questions which individual impact is caused by stress, and how stress affects the mental health of elite athletes. The following paper will focus on answering those questions.

The first step will be an overview of the current state of research concerning stress and mental health in elite sports. Secondly, the impact of stress on the elite athletes' mental health will be analyzed. Furthermore, the corresponding coping strategies that are associated with stress handling of elite athletes will be scanned. Potential risk factors promoting the development and onset of mental disorders will be considered in the core of this paper as well.

1.3 Specification of the key questions and objective

As shown above mental health and stress in elite sports have been in scientific focus for a while. To date, however, neither a clear differentiation between sports-specific and non-sports-specific stressors, nor a discussion of health issues resulting from stress and the strategies elite athletes apply to manage stress has taken place.

Particularly the information pertaining to the described culture of risk in elite sports and regarding the fact that pain or injury-related restrictions tend to be ignored suggests that an exclusive orientation towards sports medicine diagnosis criteria does currently not fulfill the demand of the IOC to consider an athlete's health as a top priority (Mountjoy et al., 2008).

The primary objective of this paper is to obtain an overview of the current state of research regarding stress in relationship with mental health in elite sports.

Therefore, the following central research question resulting from the elite sports issues described above is to be analyzed in this paper:

Which impact does stress have on the mental health of elite athletes?

From this, the following preliminary questions can be derived for the reviews:

(a) *Which stressors (sport-specific and non-sport-specific) can be screened out from the literature in elite sport? Which effect do stressors have on elite athletes' mental health?* (Review 1)

b) *Which coping strategies influencing mental health can be found in elite sport? And how effective are they to handle stress?* (Review 2)

c) *Which potential risk factors promote the development and onset of mental disorders in elite sports?* (Review 3)

Based on the findings obtained, questions are to be derived for future analyses in the context of elite sports concerning the modes of action of various stressors (Review 1) and concerning the impact of coping strategies (Review 2) on the mental health of elite athletes. Review 3 covers risk factors promoting the development and onset of mental disorders in elite sports.

1.4 Structure

To answer the aforementioned questions in line with the current state of research, a topic-based theoretical framework needs to be constructed. Since both the stress in elite sports and the mental health of elite athletes are going to be discussed, a transdisciplinary merge of results from different scientific fields is to establish that theoretical basis.

The theoretical background of stress and the understanding of mental health in elite sports will be explained, e.g., by means of various approaches. In the context of stress, the transactional stress model (Lazarus, 1966; Lazarus & Launier, 1981), the job-demand-resources theory (Rohmert, 1984) and the conversation of resources theory (Hobfoll et al., 1990) will be applied.

Concerning mental health related topics, this paper will focus on Engel's biopsychosocial model (1980).

This all will be the basis for three systematic reviews providing details on stressors and their effect on elite athletes' mental health, health-associated forms of coping with stress in elite sports and potential risk factors leading to mental disorders in elite sports.

By means of comprehensive recording and representation of the results gathered in those reviews, recommendations to health-oriented stress management will be identified (see chapter 5).

2 Theoretical reflections on stress and mental health in elite sports

The analysis of thematic literature has shown that theory and practice differ when it comes to stress and the meaning of the term "mental health" in elite sports. It therefore seems logical to discuss the current scientific viewpoints on this topic first. The definition of the two constructs "stress" and "mental health" is the basis for determining the measures and strategies that promote health and the individual stress-management options elite athletes might have to maintain their health (Thiel, Mayer & Digel, 2010; Kaluza, 2018b).

To provide a clear overview of the terminology used in this paper, terms, and relevant concepts are defined and explained. In this regard the author included different theoretical backgrounds to help researchers and practitioners to refine their current state of knowledge.

2.1 Delimitation of the terms "elite sports" and "elite athlete"

Increasing attention is paid not only to the meaning of elite sports, but also to the protagonists, i.e., the athletes. This paper focuses on elite athletes and the impact of stress on their mental health. This topic is relevant because the current state of research pertaining to stress and its health-related consequences for elite athletes is still inconsistent and incomplete, even though some associated study results exist (Fletcher et al., 2006; Tamminen & Holt, 2010).

Before delving into the context of stress and its effects on the mental health of elite athletes, the terms "elite sports" and "elite athletes" need to be defined for a better overall understanding of the entire issue.

2.1.1 The meaning of elite sports

Both, at a national and international level elite sports is a supporting pillar of everyday culture.

For a while, elite sports have been undergoing changes, some of them are represented in the following by means of different principles established by Digel, 2001:

- The meaning behind elite sports needs to be defined because meaning is changeable over time and historically inconsistent, and
- elite sports have own ethic including rules and elite sports create own rules which are athletes subjected to.

Also, the perspectives of competition and success or failure need to be included to reach a different sign of view.

From a neutral point of view, an athlete's efforts and investments in his high-performance career always bears the risk of unilateral character development.

The system of winning or losing is in itself in order. It will become a risk to an athlete's character only when success or failure do not occur. One example of adverse character development is unilateral character development in athletes, caused - among other things - by the high degree of restrictions they are faced with.

Restrictions occur on a temporal and a psychosocial level because an athlete always develops at specific, not general levels. For example, an athlete does not have as many opportunities at the social level as comparable age groups to build friendships.

Those aspects are due to the conditions in elite sports. These conditions include strict training and competition schedules, an absolute focus on the goal, constant discipline, and a certain (mental) toughness.

Consequently, the obligation to permanently deliver athletic top performances leads to the development of personality traits in various forms. This can be seen as a justification for an athlete's public role and his character.

Athletes live their lives based on the performance principle. Their athletic performance is the central code that leaves no room for an individual development of meaning.

2.1.2 Key conditions in elite sports

To achieve a transparent representation of an elite athlete, the key conditions in elite sports at both the individual (i.e., for the athletes themselves) and the institutional level are summarized as follows:

- **Time** - continuous daily training over years with only little guarantee of success.
- **Sacrifice** - very few opportunities to engage in non-sports activities; elite sports mean complete physical, emotional, and mental commitment.
- **Mental toughness** - training up to the point of exhaustion is considered normal and natural; extreme physical exertion often results in enormous mental strain, too.

To ensure progress in elite sports, sophisticated planning is required, which includes an experienced coaching staff, cooperation between sports science, sports medicine and sports psychology, support from associations, and the availability of adequately equipped sports facilities and devices.

Also, talent scouting and promoting depend on the cooperation of schools, clubs, associations, and the performance centers.

At the national or community level, equipment and training facilities must be provided, the Federal Government needs to make financial means available for research, performance centers, and coaching staff, financial support of the athletes needs to be secured, e.g., from the German Sports Aid foundation.

The aforementioned aspects clearly show that elite sports must be considered as a socio-political topic (Digel, 2002).

Therefore, sport as a whole is not only a significant social and economic factor, but, with its meaning for mental and physical balance, it is also considered the most important leisure activity in our society.

From a cultural point of view, each individual must have the opportunity to develop in line with his athletic talent and thus have the chance to engage in elite sports.

Despite all the attention that elite sports draw, it is important to remember that elite sports are not elite sports. Intent and purpose of elite sports must be analyzed by discipline and not be generalized because sports in general have developed into a pluralistic system (Digel, 2002).

Increasing attention is paid not only to the meaning of elite sports, but also to the protagonists, i.e., the athletes. This paper focuses on elite athletes and the impact of stress on their mental health.

Swann, Moran & Pigott (2015) categorize "elite athletes" into different levels and recommend the definition of samples of elite athletes along a continuum of "eliteness" or "expertise". The definition is to be based on an athlete's highest standard of performance, the success at this level, and the amount of experience gained at that level. Taking into consideration these aspects, the following classification is proposed according to Swann et al. (2015):

- **Semi-elite athlete**: highest level of participation is below the highest possible standard in their sport
- **Competitive-elite athlete** competes at the highest level in his sport, but so far without any success at that level
- **Successful-elite athlete** competes at the highest level and has experienced (infrequent) success at that level
- **World-class elite athlete:** experiences sustained success at the highest level with repeated wins over a prolonged period of time

If stress and sports are scientifically treated, two different perspectives must be analyzed according to Gerber und Fuchs (2018). "Recreational sports" mainly covers the aspect of stress regulation through athletic activity, e.g., how daily stress can be handled better with the help of athletic activity and thus reduce or even prevent health impairments. Regarding the elite sports perspective, the focus lies on how elite athletes cope with various stressors, such as high training and competitive pressure and the mental strain to continuously have to perform at top level. The reasons for stress in elite sports are varied. A comprehensive overview of the multifactorial causal complex is provided by Beckmann und Ehrenspiel (2018). The authors point to the fact that both situational sports-specific and personal factors can be involved in stress development in elite sports, and that athletes can be affected by multiple stressors simultaneously. Regardless of the stressor, stress bears various health impairments and risks.

To increase awareness and for a better understanding of the context described in this paper, the author also refers to the typology of risk factors proposed by Kraemer et al., 1997 (see table 1).

According to Kraemer et al. (1997), a risk factor can be described as a measurable characteristic of each subject of a specified population.

Table 1 Excerpt of Typology of risk factors and methods of identification (modified by Jacobi et al., 2004; Kraemer et al., 1997)

Term	Definition	Study Design
Non-correlate [sic]	No significant association between factor and outcome (onset)	Cross-sectional and longitudinal studies
Correlate	Statistically significant association between factor and outcome	Cross-sectional, epidemiological, case-control, family, or family history studies
Risk factor	Significant statistical and clinical association between factor and outcome; precedence	Longitudinal studies

As, according to current findings (Moesch et al., 2018; Schinke et al., 2017), the etiologic background of mental disorders is complex and multifaceted in the world of elite sports, this paper will follow an integrative approach based on a bio-psychosocial model to analyze potential risk factors in elite sports (for more information, see Chapter 4, systematic review 3).

This approach seems to be justified in the athletic context because a factor can change its status during an elite athlete's life span and it has been scientifically proven multiple times that stress has negative effects on human health and performance (Gerber & Schilling, 2017; Siegrist 2017).

For example, the status may change depending on the time of assessment (such as during puberty or the transition phase from active professional career to retirement) or as a variable factor pertaining to the time of a certain event (such as before or after a competition) (Juliff et al., 2015; Stambulova et al., 2021).

Consequently, in elite sports the topic of stress should be understood as an interdisciplinary approach that does not predominantly focus on the fields of sports medicine or sports psychology. This approach should also be based on an (bio-psychosocial) understanding of illness, seeing stress as a complex interaction between various stressors.

2.2 Origin and development of stress processes

The term stress is often used to describe strain or requirements or excessive demands that are often accompanied by physical and/or mental symptoms (Reimann & Pohl, 2006, p. 217).

From a scientific viewpoint, stress is defined as a response to an external or internal stimulus (Semmer & Zapf, 2018). This stimulus disturbs homeostasis, which can be described as a stable, balanced state of the human organism. If the strain-regeneration ratio is balanced and the organism has sufficient time to recuperate with the help of adequate mechanisms, stress and its resulting responses do not threaten health in general. If, however, the organism is subjected to continuous strain, its adaptation resources are depleted, and the foundations are laid for pathogenetic stress responses (Kaluza, 2005).

That means, that stress develops when a human being deems a situation threatening, critical, and unavoidable.

Stress is influenced by both continuous and immediate conditions, such as confidence in one's own capacities, individual coping strategies, state of health, or gender. Since all humans are individuals, each human being is subject to different preconditions and feels and responds individually. The way humans perceive a task or situation depends on how they respond to mentally straining influences. Within the context of individual stress, the perception, thinking, and experiencing factors as well as stress intensity are important.

It is not necessary to avoid stress at all costs, but a balance between demands and coping options should be found (Richter, 2000).

Regarding elite sports, this context is characterized by elite athletes facing continuous, stressors with high impact on both their athletic performance and state of health. Not only the development of stress, but also its effects depend on different sports-specific, social, or personal factors (see fig. 2).

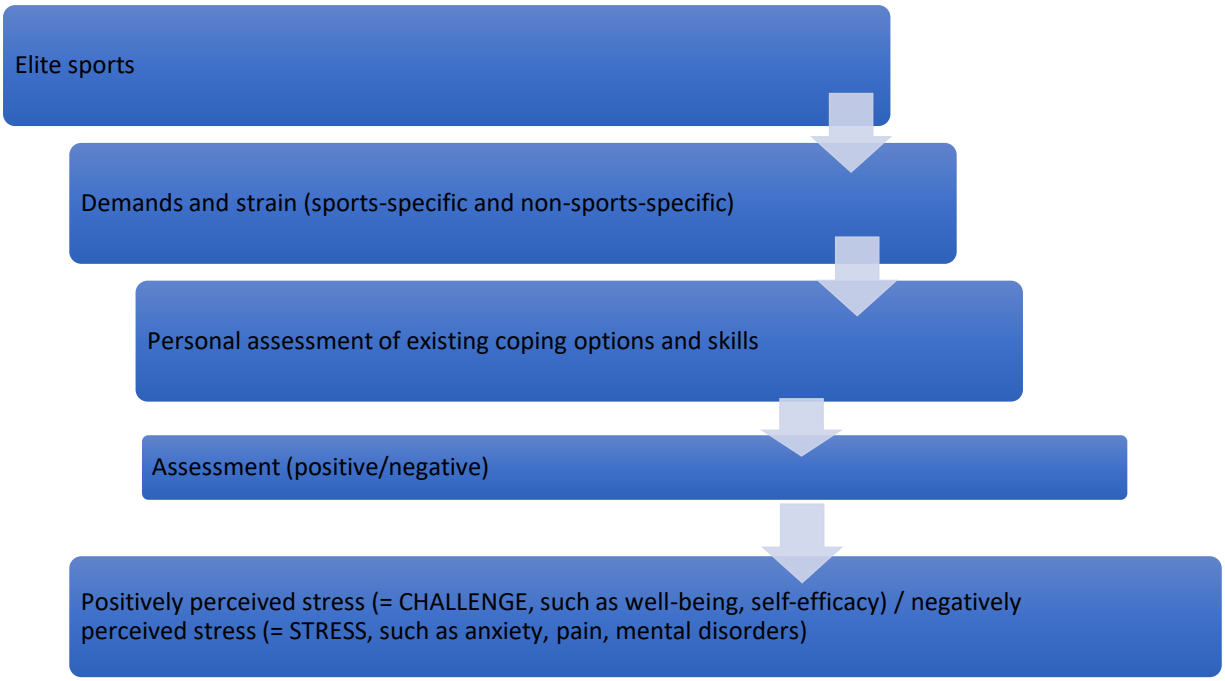

Figure 2 Strain-demands-stress relationship in elite sports (own representation)

Although it is undisputed that stress is one of the key health risk factors (Kaluza, 2018b), research on its impact on the mental health of elite athletes is still in its early stages. One reason for the sparse amount of scientific data on stress in elite sports is that only few studies were rigorously conducted and properly documented (Reardon & Factor, 2010; Hughes & Leavey, 2012).

According to the current state of research it is already known for quite some time that elite athletes are not immune to health-related issues, and that they are confronted with various stressors and risk factors that affect both their physical and mental health during or after their athletic careers (Reardon & Factor, 2010; Arnold & Fletcher, 2012b; Rice et al., 2016).

In terms of epidemiology, this requires the identification of health-impairing factors originating from stress instead of reasons for deficiencies and morbidity. Since the biomedical "what helps?" approach still dominates, the above method gains even more in importance (Lindstrom & Erikksson, 2006).

As elite athletes perform under immense external and internal pressure, much is at stake not only for them, but also for their coaches, promoters, associations, and the audience (Ehrenspiel et al., 2018).

The context of elite sports is characterized by athletes facing continuous, stress-triggering factors with high impact on both their athletic performance and state of health (see fig. 3).

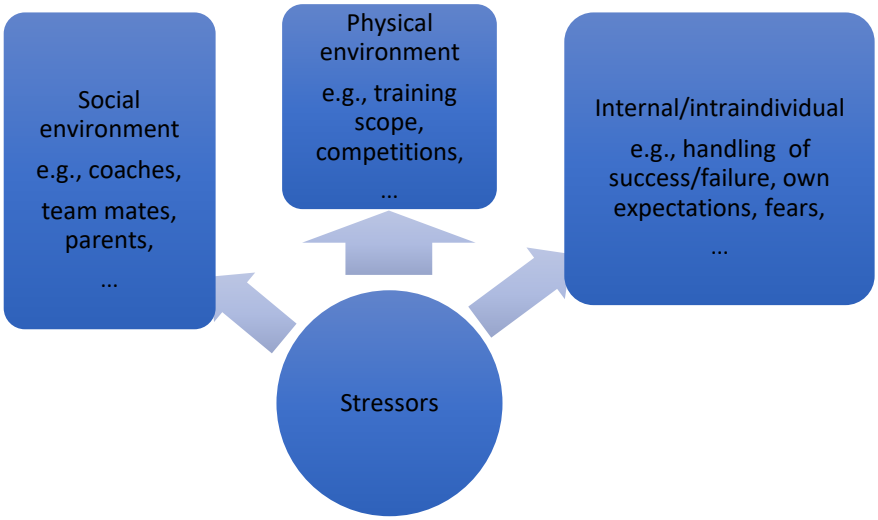

Figure 3 Interaction of various stressors in the context of elite sports (own representation, modified by Reif, Spieß & Stadler, 2018)

Figure 3 illustrates that stress as an individual response to strain can be triggered by different external, sports-specific, social, and internal or personal factors, all leading to a state of stress in the athletes affected.

Regarding the variety of stressors in an elite sports environment and how elite athletes perceive specific stress situations typical of elite sports and those resulting from daily life is analyzed in more detail in Chapter 4 (review 1).

To sufficiently understand stressors in elite sports, both stressors as an objective form of strain and stress as a subjectively perceived state need to be examined. Decisive for analyzing the stress process is the assessment of the stressor as to its relevance and threat, as well as the evaluation of individual coping options (see fig. 2).

For athletes, the subjective evaluation of their own coping resources as well as the strain-regeneration balance, (Kellmann et al., 2017) are particularly important. Identical stressors can be perceived differently by athletes and thus lead to varying stress consequences. For example, an athlete may see a competition as an impending failure or a challenge to prove his skills. Therefore, the individual assessment of a stressor, i.e., whether the athlete categorizes it as a threat or a challenge, and the associated perception and handling of coping options are essential.

Various studies have already shown interconnections between sports-specific stressors, their subjective assessment by the athletes, and the perceived stress (Nixdorf et al., 2013; Beckmann et al., 2016). Depending on how athletes assess and perceive their stressors, health impairments may occur. Primarily these health impairments manifest themselves in an increased susceptibility to infection or injury, or also depressive states (Kellmann, 2002; Nixdorf et al., 2013; Ivarsson et al., 2017).

Additionally, deeper-lying stress-associated problems due to a disturbed balance between stress and regeneration may result in mental disorders, such as eating disorders, depression, emotional exhaustion, or burnout (Raedke, 1997; Sungot-Borgen & Torstveit, 2010; Tabei & Fletcher, 2012; Gorczynski, Coyle & Gibson, 2017).

As mentioned in the previous section, it is at first important to analyze how an athlete perceives stress in general and which individual stress-triggering factors result, and how this stress is coped with.

Before having a closer look at typical stress situations elite athletes are confronted with, a few general models pertaining to stress research as well as models specific to elite sports are illustrated.

2.3 Theoretical concepts and models to explain the research questions

The reasons for the development of stress are varied and complex. Different stress models such as the stress-strain model (Rohmert & Rutenfranz, 1975, Rohmert, 1984), the transactional model of stress and coping (Lazarus & Folkman, 1984), and the theory of conservation of resources (COR) (Hobfoll et al., 1990) build the basis for explanation, as they are widely used within the sport psychology literature. There is empirical evidence regarding the relationship between (a) stress and strain, (b) coping and (c) mental health conditions of elite athletes (Rice et al, 2016; Schinke et al., 2017; Poucher et al., 2019).

Stress, strain, or stress reaction are terms that are located in the context of stress and are often also used synonymously (Richter & Hacker, 1998).

2.3.1 The stress-strain model

To avoid misunderstandings pertaining to these terms the stress-strain model from the 70s (Rohmert & Rutenfranz, 1975) is going to be explained in more detail (see fig. 4).

Chapter 6 discusses the stress-strain concept using the example of the job-demand-resources model as well as correlations in the context of elite sports with reference to stress and the associated effects on mental health. These findings will then be used to explore hypotheses and derive possible courses of action to cope with stress and to promote the mental health of elite athletes (Demerouti et al., 2001; Nielsen et al., 2017; Demerouti & Nachreiner, 2019).

Strain is defined as an objective criterion affecting humans from the outside with both internal and external consequences. Strain factors such as noise, time pressure, or heat all affect humans. The consequences of these strain factors are called stress. In addition to the duration and scope of the strain that an individual is subjected to, the level of the resulting stress also depends on individual

conditions, such as skills or the state of health (Schaper, 2019, p. 574). The strain factors affecting humans can lead to long- and short-term positive and/or negative stress consequences (Wegner, 2016, p. 345).

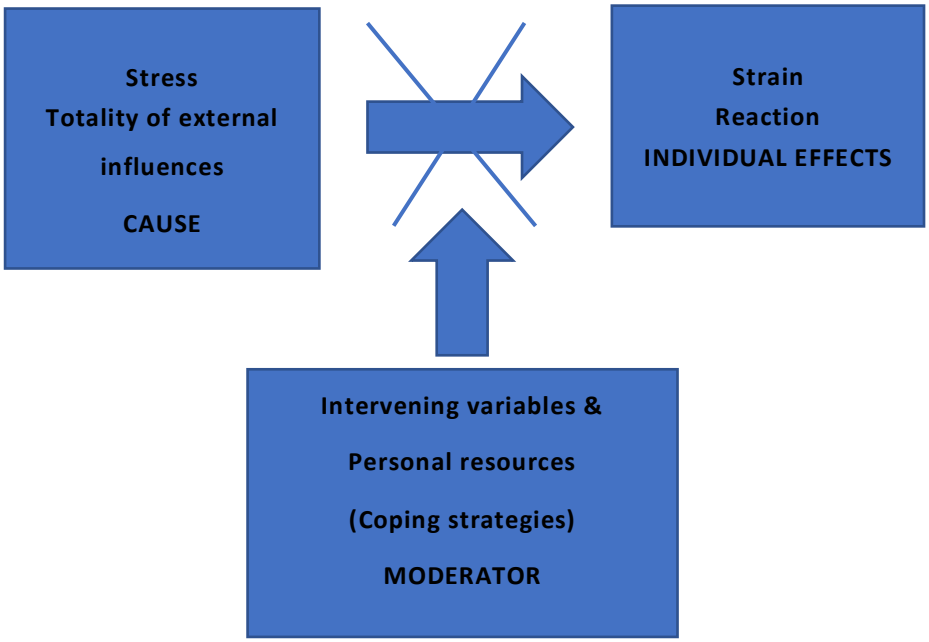

Figure 4 Stress-strain model (own representation, modified by Rohmert & Ruthenfranz, 1975)

If stress is explained according to the "live event approach" (Holmes & Rahe, 1967), stress is defined as a condition (= stressor) that affects a person from the outside and therefore requires a corresponding adjustment.

As stimulus-orientated models assume predominantly external stressors they are not sufficient to explain the individual state of health. The advantage of these models can be seen in the easier differentiation between causes and consequences.

2.3.2 The transactional stress perspective

The transactional stress perspective records interindividual differences in stress perception and associated responses and additionally includes subjective assessment processes pertaining to stressors (Lazarus & Folkman, 1984).

Stress in the sense of the transactional stress perspective is not a stimulus and response but an interaction between person and environment. Accordingly, stress is defined as a process, independent of the situation and variable through time (Folkman & Lazarus, 1985).

The key point in this approach is that stress can vary (dependent on the outcome of individual demands and resource assessment and on cognitive, emotional, physiological, and behavioral levels) (Lazarus, 1991; 1995). According to the authors, stress arises, when demands overwhelm an individual's coping capabilities. The transactional conceptualization of stress is thus reflected in the fact the individuum is actively involved in creating stress since its coping strategies are influenced by the appraisal process and have in turn a retroactive effect on the appraisal. That means, the subjective assessment of the relation between person and environment causes the emergence of a stress state (Lazarus, 1995).

The appraisal processes can be divided into two categories:

1. Primary appraisal refers to event evaluation (challenging, threatening…),
2. secondary appraisal includes resource evaluation (internal, such as abilities and external, such as social network)

These evaluation processes, which influence each other, are subdivided analytically rather than temporally. Then follows a process of reappraisal of the transaction which in turn can be the starting point of further appraisal.

Depending on the evaluation of the situation, coping takes on a decisive role and can be divided into of two functions:

1. Emotion-regulating coping primarily aiming at changing the subjective perception,
2. problem-solving coping primarily focusing on changing a stressful situation by direct action on the part of the person concerned.

According to Lazarus (1991; 1995) there are 4 strategies of coping in the transactional model:

1. Information seeking
2. Direct action
3. Suppression or postponement of certain actions
4. Intrapsychic coping mode

All strategies can act both as emotion-regulating and problem-solving.

In information seeking, the individual searches for information about the stressful event to be able to have a regulating effect on the transaction with the help of newly acquired knowledge. The second strategy, direct action, involves actions that aim to directly change the environment or even the

person. The third strategy focuses on suppression or postponement of certain actions. The intrapsychic coping mode, as the fourth coping strategy, focuses on cognitive processes with the goal of emotion regulation.

2.3.3 Conservation of Resources Theory (COR)

According to the Conservation of Resources Theory (COR) formulated by Hobfoll (1988; 1989), stress occurs when resources are either threatened, lost, or mis invested. Accordingly, in the person-environment relationship, the focus of stress conceptualization moves away from evaluations and toward resource loss or gain.

Compared to Lazarus and Folkman's (1984) outline of the stress theory, Hobfoll's focus of theory building shifts to the consideration of a person-environment interaction and its impact on the resources considered important by the individual. Following Hobfoll's theory (1988; 1989), stress results from environmental events that entail a potential or actual loss of resources. Parallels between Hoboll's theory and that of Lazarus and Folkman (1984) can be seen in that stress occurs by evaluating events either threatening or damaging resources. The basic assumption of the COR model is that an individual fundamentally seeks to protect, enhance, and cultivate his or her resources. Stress occurs whenever events take place that either imply an impending loss of resources, trigger a real loss, or result in a mis investment (Hobfoll, 1988; 1989). The loss of resources is considered to be particularly stressful, since coping capacities are lacking here, especially regarding future challenges, as well as mis investments due to insufficient possibilities to be able to increase individual coping strategies (Hobfoll & Buchwald, 2004). According to Hobfoll (1998) the loss of resources resulting from their objective value is the key element in the context of stress. Within the framework of COR theory, resources are viewed as objects, personality traits, circumstances, and energies that have value to the person or are viewed as a means to achieve them (Hobfoll, 1989). Resources can be classified into object resources (e.g., material things such as a house or car), condition resources (e.g., health or age), personal resources (characteristics that have a positive impact on an individual's resistance to stress, such as optimism or resilience), and energy resources (e.g., knowledge or time).

For an elite athlete, a competition can mean both a gain and a loss of individual resources. For example, the preparation for a competition can result in time-related losses in social contacts or in the athlete's private life. A gain for the athlete results, for example, from an increase in his sports-related competence. If the outcome of the competition is negative, this defeat is according to Hobfoll (1988), equivalent to a mis investment of resources and is experienced as correspondingly stressful. The resource change aspect of Hobfoll's (1998) theory is addressed by two basic principles:

1. the loss of resources weighs more heavily than the gain
   and
2. people invest resources to either gain new resources, compensate for losses, or even protect existing resources.

Success in competition means gain in resources for an athlete because it can result for example in better training opportunities.

From these two basic principles, it can be concluded that athletes with fewer resources are more susceptible to resource losses, whereas athletes with more resources are more resilient to loss and can use their resources more profitable.

In the context of the COR theory, resources are used for coping either to preserve resources, increase them or compensate for past losses. Coping thus serves to preserve, protect, or build up new resources.

All three theoretical concepts mentioned above are based on one assumption: *stress is associated with the adaption process of an individual to the environment and always occurs, if there's something wrong in this process* (Nitsch, 1981).

That's why in addition to the stress-strain concept both Hobfoll's theory and the transactional stress concept which represent an authoritative basis within sport psychological stress research, will be used in the further course to be able to explain and understand relevant aspects of the present work (see fig. 5).

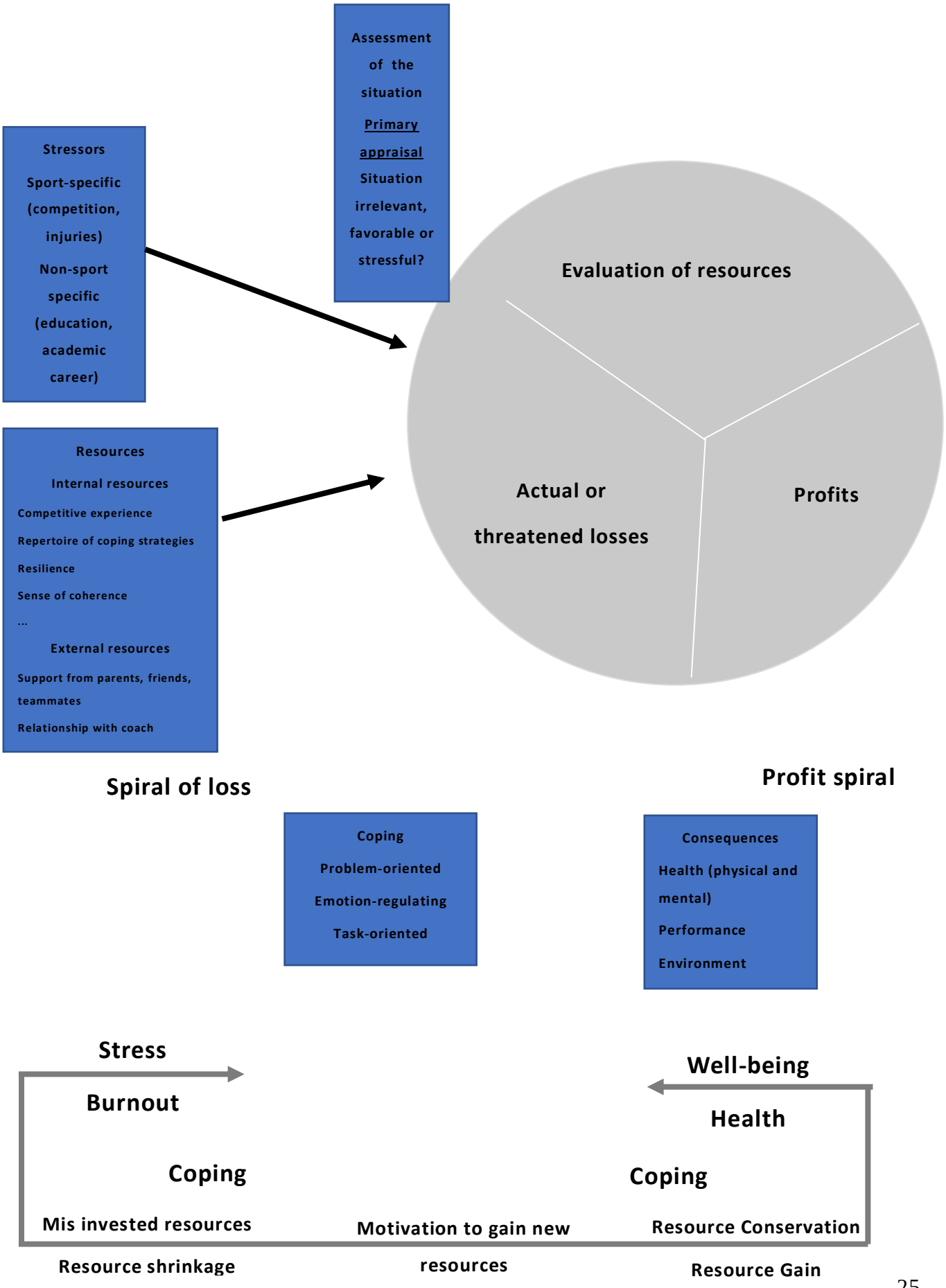

Figure 5 Transactional stress-resource conceptualization (own representation, modified by Lazarus & Folkman, 1984; Hobfoll, 1988; 1989; Hobfoll & Buchwald, 2004, p. 14)

2.4 Stress and mental health diagnostics

In this chapter measurement and diagnostic tools of stress and mental health are discussed in an overall context and with reference to an elite sport environment.

According to the DSM-V, it is essential to provide reliable guidelines for diagnoses that can inform about treatment and management (American Psychiatric Association (APA), 2013). Above all, standardized diagnostic measurements are considered to be essential for an assessment of evidence in a particular research context (Ressing, Blettner & Klug, 2009).

2.4.1 Overall context

To enhance diagnostic validity a critical consideration of alternate modes of measurement and ways of conceptualization of mental health are required. In the broader field of stress and mental health research this aspect will still take some time to become a topic of interest to researchers and practitioners. Another (conceptual) issue that is relevant for stress and mental health researchers is the theoretical similarity and overlap between constructs, such as burnout or depression (APA, 2013). The similarity in the symptomology of these two constructs means that general research on depression could inform future research in the field of sport psychology on burnout exploring the experiences of elite athletes.

The "Diagnostic and Statistical Manual of Mental Disorders" (DSM-V) is one of the internationally renowned and accepted classification and diagnosis guides in addition to ICD (International Statistical Classification of Diseases and Related Health Problems).

The ICD enables the systematic collection, analysis, interpretation, and comparison of mortality and morbidity data collected in different countries or areas and at different times. Since January 2022 a new code ICD-11 entered into force. Several mental health problems are subsumed under ICD-11 by now.

Compared with the previous version (ICD-10), incidents affecting health can be better collected. In addition, several mental health symptoms were included in ICD-11 that were not covered in ICD-10. For example, video and online game addiction (gaming disorder) as a symptom of increasingly mediatized and borderless lifestyles and burnout syndrome were included in the new ICD-11 in the course of the revision (WHO, 2010; 2019).

To increase diagnostic reliability, "mental disorders" are defined in a medical diagnosis system, such as the DSM-V, based on diagnostic criteria and according to differential-diagnostic guidelines.

Besides these diagnostic classification standards, standardized screening procedures are used in clinical-epidemiological research to objectively record mental disorders (Stieglitz & Baumann, 1994).

Since the focus of the present work is on stress and its impact on the mental health of elite athletes, it seems reasonable to mention stress-related diseases in the clinical context. Stress-dependent problems are currently coded in line with ICD-11 no. QE27 (problems with behavior related to mental health or wellbeing).

Mental health related factors influence the body and vice versa. Stress-related physical problems can only partially be diagnostically mapped in the conventional classification systems.

2.4.2 Measurement scales

The options to record stress are varied and usually depend on the system level (physical, behavioral, cognitive-emotional) that the stress is impacting. To assess different stress conditions, either interviews (written or oral), observations or questionnaires are employed (see table 2).

Table 2 Excerpt of selected questionnaires to determine stress level (own representation)

Diagnostic tool	**Editor/publication date**	**Content/objective**	**Number of items**
Perceived Stress Scale (PSS)	Cohen, Kamarck & Mermelstein, 1983	Perceived stress in the last 4 weeks	10
Trier Chronic Stress Inventory (TICS)	Schulz, Schlotz & Becker, 2004	chronic stress for the last 3 months	57
Stress Processing Questionnaire (SVF)	Erdmann & Jahnke, 2008	Coping/processing measures	20
Stress and coping inventory (SCI)	Satow, 2012	measurement of stress levels, stress symptoms and stress management strategies	54

Table 3 continued

Diagnostic tool	Editor/publication date	Content/objective	Number of items
Recovery Stress Questionnaire (RESTQ-Sport)	Kellmann & Kallus, 2001	Measure the frequency of current stress symptoms as well as the frequency of recovery activities	77
Athlete Psychological Strain Questionnaire (APSQ)	Rice, Parker, Mawren, Clifton, Harcourt, Lloyd, Kountouris, Smith, McGorry & Purcell, 2019	Brief screening tool for athlete mental health	10
WHO-5 Questionnaire	WHO, 1998	simple screening tool to assess feelings or moods over the past two weeks	5
Maslach Burnout Inventory (MBI)	Maslach & Jackson, 1981	Measuring instrument for the assessment of the burnout syndrome	22

To do justice to the complex occurrence of stress, it is necessary to capture stress in a multi-dimensional way. Therefore, both the subjective assessment of the athletes in terms of stress perception and objective biometric parameters, such as resting heart rate or cortisol level, should be included in the assessment (Kellmann, 2000).

2.4.3 Specific context

Due to the combination of intense physical demands as well as the influence of sport specific as well as everyday stressors, elite athletes face periods of increased vulnerability in terms of mental health and well-being (Hughes & Leavey, 2012).

For the above reasons, it seems even more necessary to provide both the athletes themselves and their support team with optimal support in terms of maintaining and enhancing (mental) health (Taylor, Chapman, Cronin, Newton & Gill, 2012). Recently published consensus statements (Henriksen et al., 2019; Reardon et al., 2019) recommend in relation to mental health of elite athletes, among other things, the development of athlete-specific diagnostic measurement procedures to be able to identify mental health symptoms at an early stage (Donohue et al., 2019). The problem of stress already represents an important field of application in sports psychology (Kohlmann & Eschenbeck, 2009). But there are still no uniform diagnostic sports-specific measurements for stress and mental health outcomes, especially in German speaking countries (Beckmann & Kellmann, 2008).

But there are diagnostic procedures to determine prevalence, which, consequently, complicates any comparison of research findings.

Despite the standardized diagnosis criteria established, there are still many issues to be criticized, especially in terms of the conceptualization of mental health impairments in the target group (Stein et al., 2010; Borsboom, 2017). One question that arises is: have stress-related impairments of the mental health been diagnosed, or rather a symptom? Even if the aspects of conceptualization and screening are focused upon in the broader field of stress and mental health research, they do not seem to have moved to the center of attention in sports-psychology research.

The approach to the topic of stress has so far focused predominantly on aspects regarding training and competition and allows virtually no conclusions to be drawn about demands from other areas of the lives of elite athletes. Chronic stress leads to health problems that can occur in performance losses and/or career problems (Becker, 2006; Richartz et al., 2009).

However, when it comes to elite athletes, it seems to be quite plausible and worthwhile to consider different types of measurement to underpin or strengthen diagnostic validity (see table 2). In general, the form of data collection concerning the research subject of "mental health" is rather challenging with elite athletes, particularly as the data collected to date stems mostly from cross-sectional analyses or self-evaluation report data, such as surveys, interviews, or clinical interviews (Gulliver et al., 2015). To rely primarily on cross-sectional data is problematic because only a part of the context examined at a given point in time is reflected. Due to the lack of longitudinal studies, it is impossible to derive a cause-effect relationship or draw conclusions concerning stress-associated changes in the mental health state of elite athletes. However, time-related research designs allow to establish a causality between the effect of sports- or non-sports-specific stressors, individual resources of the athletes affected, and their mental health. Concerning the self-evaluation report data, it is important to consider the aspects of stigmatization and mental toughness. Both can have an influence on the

willingness of athletes to allow an insight into their mental health state (Bird et al., 2018). Especially seeking help raises the fear of being seen as weak and leads to the athletes affected to "underreport", which in turn results in inaccurate statistical data (Lopez & Levy, 2013). Another deficit concerning self-evaluation report data is the phenomenon of "socially desirable answers". Depending on the context and issue at hand, the answer behavior of the person asked is exaggerated or toned down (Heppner, Wampold, Owen, Wang & Thompson, 2015). Overlapping symptoms often make mental health screening of elite athletes difficult, as well (APA, 2013).

Moreover, existing diagnostic instruments are often very time-consuming, such as the 77-question Recovery Stress Questionnaire (RESTQ-Sport) (Kellmann & Kallus, 2001), and their length makes regular screenings difficult. Non-representative samples and low response rates also complicate drawing firm conclusions regarding potential stress-related mental health impairments (Rice et al., 2016).

In the context of elite sports, the use of standardized diagnostic tools allows for more precise estimates of the prevalence of specific or mental disorders among elite athletes and thereby providing a more comprehensive understanding of various aspects of elite athletes' mental health (Haidich, 2010). The Athlete Psychological Strain Questionnaire (APSQ), for example, is an athlete specific mental health assessment tool that can help facilitate early detection of mental-ill health. Rice and colleagues developed a short scale from mental health research findings related to elite athletes. The APSQ, consisting of 10 items with focus on self-regulation, performance, and external coping, is included in a mental health screening procedure (Sports Mental Health Assessment Tool 1, SMHAT-1) developed by the International Olympic Committee (IOC) to better support the mental health of elite athletes and to stimulate ongoing international research (Rice et al., 2019).

Currently, researchers and clinicians still use different diagnostic tools to identify the prevalence of the same disorders. To reliably measure for example the impact of stress on mental health among elite athletes, the use of standardized diagnostic criteria and tools is therefore essential.

In future there's need for stress research to better understand an athlete's perception of stress and corresponding coping strategies. To prove causalities and the impact of stress on the mental health of elite athletes, etiological analyses are required, as well.

2.5 Stress management in elite sports

When working with elite athletes in terms of their conceptualization of mental health talking about stress is important to decrease perceptions of stress. As elite athletes may not feel comfortable seeking

help for a mental health problem or even a mental disorder (Bird et al., 2018), it is recommendable to continue collaborating with coaches and other staff members to encourage elite athletes to seek help when confronted with stress-related mental health problems. Additionally, elite athletes must be discouraged from competing in pain or playing through distress, whether physical or mental (Nixon, 1993; 1996; Moesch et al., 2018). Therefore, sport organizations must create a confidential environment for elite athletes to discuss their mental health issues. To foster an open discussion of mental health the impact of a myriad of stressors related to elite athletes' professional career on their mental health must be recognized. A sport environment where elite athletes feel comfortable to discuss their stress-related mental health problems and experiences openly, implies integrating stress management concepts to allow elite athletes enhancing coping skills and developing psychological resources such as resilience or self-compassion (Sarkar & Fletcher, 2014; Mosewich, Crocker, Kowalski & DeLongis, 2013).

2.5.1 Stress and coping

To understand the ways in which people can influence stress and mental health, the author will first take a closer look at the term "coping". The term "coping" comes from the English word "to cope with," which is synonymous in German with "bewältigen" or "zurechtkommen. According to Gerrig & Zimbardo (2008), coping describes a process of dealing with internal and/or external demands that people experience as limiting or that exceed their individual resources. Accordingly, coping involves strategies to ensure that threats or a loss of resources do not arise in the first place. Coping strategies are described as the actual response in relation to different stressors or contexts in which stress is experienced. In the literature (Klingenberg & Süß, 2020, p. 19), two different times of coping are differentiated:

1. reactive coping - coping strategy is applied while stress is felt or immediately afterwards,
2. proactive coping - preventive approach in which the affected person prepares for possible stressors to reduce or mitigate the resulting stress sensation.

The transactional stress concept (Lazarus & Launier, 1978) also includes the process of coping as well as individual components of stress management, distinguishing between problem-oriented and emotion-oriented coping. While problem-oriented coping aims to counteract stressors, emotion-oriented coping focuses on regulating the emotional state triggered by stressors. In this case, the feeling of stress is to be minimized or stress-triggering emotions are to be replaced by new emotions, such as positive rethinking or re-evaluating a situation (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

It is therefore conclusive that various systems of the human organism are involved in stress management, and that they all aim to quickly reestablish a balanced state in terms of homeostasis (Gerber, 2008).

Based on the transactional stress perspective (Lazarus & Folkman, 1984), which forms one of the theoretical foundations of this work (see chapter 2.3.2), the focus here is going to be on coping with stress in the context of elite sports (see fig. 5).

Lazarus and Folkman (1984) define coping as a constantly changing cognitive or behavioral effort focused on dealing with specific external or internal demands that severely tax or even exceed an individual's adaptive resources.

Stimuli or stressful situations can be challenging when the chances of coping are judged to be favourable. If, on the other hand, coping measures are not available to the individual, the individual feels threatened (Schlicht, 1989). Stress leads to a change in the individual (normal) state, and this can lead to a psychophysical imbalance (stress reaction). With the help of adequate coping strategies, this imbalance can be eliminated (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

In contrast to Lazarus, the aspect "appraisal" plays a subordinate role in Hobfoll's theory. Hobfoll (1988; 1989; 1998) places stress management and its motivations at the center of his considerations and assumes that every individual has certain resources and strives to maintain them. Stress arises according to Hobfoll if existing resources are threatened, lost or mis invested.

Hobfoll’s theory (1998) points out that the theoretical considerations on stress and coping available so far support a rather individualistic perspective and from this perspective control ability and action are propagated as particularly effective.

Also, the problem-oriented axis doesn’t represent a dimension but instead requires the distinction pro- versus anti-social. For example, in terms of avoidance: According to Lazarus and Folkman (1984), avoiding is a passive, emotion-centered strategy, whereas according to Hobfoll it’s a rather active strategy (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

Thus, Lazarus’ "classical" cognitive approach (1966; 1981) defines the process of coping as an equilibration process of an imbalanced psychophysical state.

Assessment of the situation

The core element of the transactional stress model (Lazarus & Launier, 1978) is the assessment of the situation by the affected person.

The elite athlete’s evaluations are decisive here, namely, on the one hand, whether an event is classified as a threat, danger, or challenge and, on the other hand, the extent to which one's own coping skills are consciously perceived and used. For example, an athlete may classify an upcoming competition as an impending defeat and react tense, nervous, and anxious in this regard. However, the competition could also be seen as a challenge or an opportunity to be able to call up one's own skills to the point. In the latter case, this could result in positive activation in the sense of competitive tension (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

Resource preservation

In contrast to Lazarus & Launier's stress coping model (1978), Hobfoll's model of resource maintenance (1998) views the change or maintenance of resources in the context of environment and social processes as essential for coping with stress (see fig. 5).

According to Hobfoll, stressors are defined as environmental events that either threaten resources or lead to loss in terms of object resources, condition resources, personal resources and/or energy resources.

Newer coping approaches, such as the multi-axial coping model (Hobfoll, Dunahoo & Ben-Porath, 1994) consider that stress and coping are also social phenomena, coping requires the use of resources and effective coping must be operationalized in its resource-protecting function (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

The decisive factor when considering these model concepts mentioned in chapter 2.2 is the evaluation of a situation as either stressful, threatening, or challenging.

However, there are large interindividual as well as intraindividual differences in the perception and regulation of stressors in elite sports function (Stoll & Ziemainz; Stoll & Ziemainz, 2003).

Likewise, certain situational circumstances can also lead to different perceptions of the sport-specific stress situation, e.g., in relation to the presence of certain people (parents, friends, coaches) during an important competition (Beckmann & Ehrenspiel, 2018). In the following, the options of stress regulation are explained in more detail.

2.5.2 Options of stress regulation

During stress development, both stress-reducing (1) and resource-strengthening (2) buffer effects are attributed to exercise behaviour.

A possible explanation for these adaptations is offered by the model of stress-regulating effects of physical activity (see Fig. 6) according to Fuchs and Klaperski (2018, p. 209).

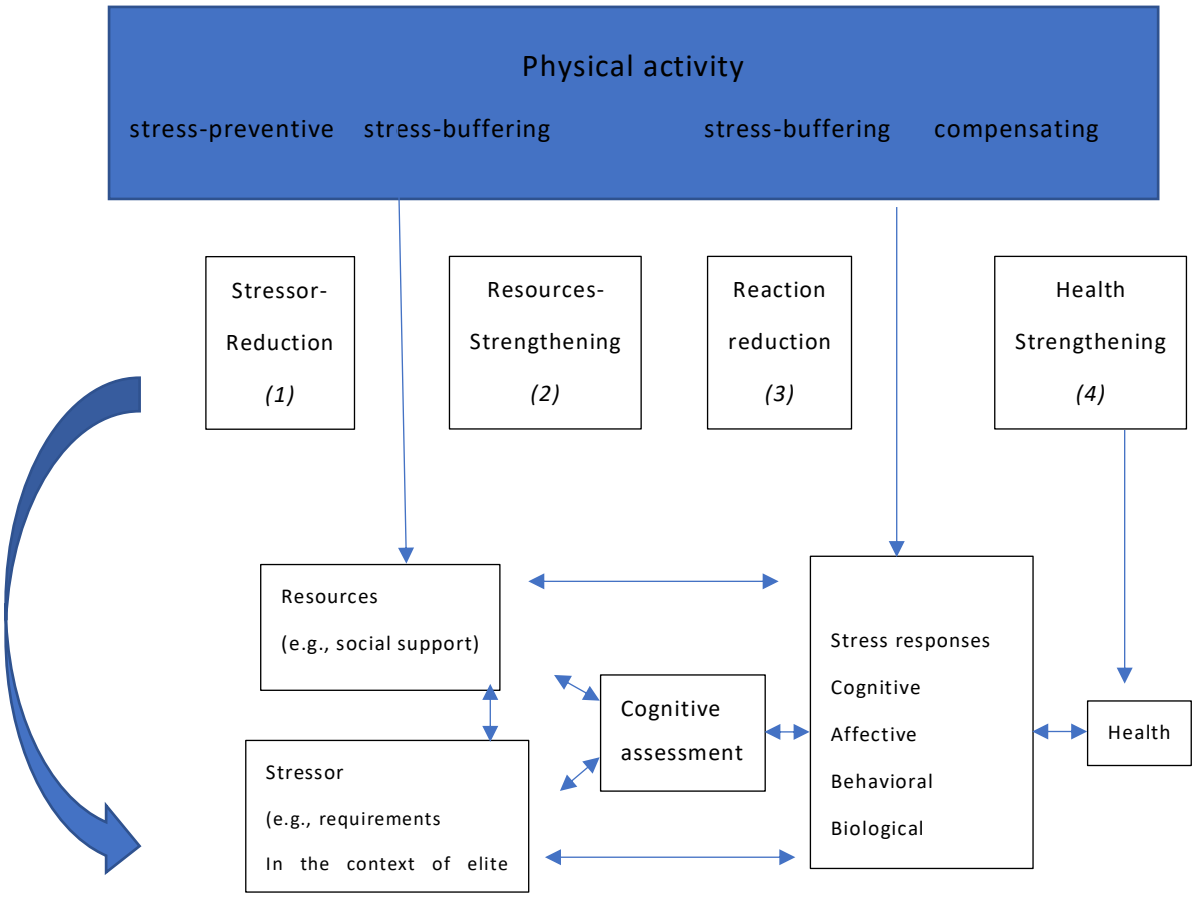

Figure 6 Effects of physical activity (own representation, modified by Fuchs & Klaperski, 2018)

Exercise-induced improved coping resources, such as in the form of social contacts, can lead to improved appraisals, thereby reducing the perception of stress. Furthermore, it is hypothesized that in the subsequent stage of stress coping, physical activity is responsible for the reduction of stress responses (3).

At the level of palliative-regenerative stress management, exercise is thought to be able to reduce stress responses, as it can minimize both stress-induced cortisol release and the resulting states of tension. In this context, two regulatory effects come into play: In the mitigation effect (1) related to exercise, negative stress reactions are completely avoided, and adverse health effects are prevented. This mechanism can be observed, for example, in athletically active people, in whom the heart rate increases significantly more slowly in stressful situations. A compensatory mode of action is observed in the balancing mechanism (2). This means that stress reactions occur despite the compensatory mechanism but are balanced by exercise in such a way that they do not have an adverse effect on

health (Fuchs & Klaperski, 2018, p. 210). In summary, therefore, a health-promoting effect (4) of physical activity can be established due to the reduction of excess stress hormones.

In the context of elite sports, preventive and stress management approaches have so far been reduced to identifying external and internal stress triggering factors and formulating normative guidelines for injury prevention. The consideration of psychological and social conditions as well as corresponding factors pertaining to stress have so far only been little investigated to approximately do justice to the overall complexity (Poucher et al., 2019). Besides daily hassles and critical events, such as family conflicts or school difficulties, elite athletes are confronted with sport-specific stressors (e.g., injuries, poor performance, or defeat in competition). Coping with these stressors could optimize performance in competition and preserve physical and mental health. Failure in coping can lead to short-term stress and to longer-term negative consequences, such as burnout and a deterioration in subjective well-being, which in turn can lead to a decline in athletic performance (Hänsel et al., 2009) (see fig. 5).

As mental health of athletes is coming to focus of research, programs for long term stress management are increasingly developed in sports psychology. Stress management strategies are often subsumed under the term coping, which includes a variety of strategies and behaviours that can be used in a supportive manner when dealing with stressors and stressful situations (Poucher et al., 2019). Although there are individual differences in coping with stress, there are some basic principles, which will be discussed in more detail below. Starting points in stress management can be the assessment of the situation (1), the restoration of resources (2) or the (already existing) stress management skills (3). Based on the transactional stress coping model of Lazarus & Launier (1978) described in chapter 2.3.2, coping with stress is best achieved by developing a variety of coping strategies.

As previously stated, a variety of different stressors need to be managed, especially in elite sport, which is why the development of a flexibly applicable repertoire of coping skills is essential as part of a stress management program for elite athletes (Beckmann & Ehrenspiel, 2018).

In the foregoing, it has already been stated that the subjective perception of a stressful situation is decisive for the stress experienced individually. In the following, stress coping competencies will be discussed, which can be structured regarding a psychoeducational aspect, a behavioural aspect, and a social aspect.

According to Fletcher and Sakar (2012), the psychoeducational aspect is primarily about understanding causes of stress and learning coping strategies to develop how to deal with stressful situations as well as to promote individual resilience. For example, to change the perspective of an athlete who is in a stressful situation, work can be done on his assessment of that situation. In the behavioural aspect, the focus is on analysing and, if necessary, adapting coping strategies. Adaptive

strategies (e.g., self-care, positive self-instruction, or social support) or maladaptive strategies (e.g., self-pity, avoidance, or resignation) should first be identified to then develop an optimization of lifestyle or recovery-stress balance with the affected athlete. Personality factors, gender, and sport affiliation were also observed to influence stress management in athletes (Nixdorf et al., 2013). Due to the high individual variability regarding stress experience and recovery, elite athletes should undergo regular screenings to assess physical and psychological stress and recovery perceptions (Kellmann & Kallus, 2016; Kellmann et al., 2017).

Responses to social stressors also play an important role in the stress management process of elite athletes. Social support suggests a lower stress experience, especially in junior athletes (Beckmann, 2016). In the development and strengthening of stress competence, the focus should therefore not be exclusively on the athletes, but the entire support system such as parents, coaches, etc. should be involved.

2.5.3 Stress management approaches in elite sports

Basic stress management measures are also used in elite sports and include relaxation methods that can be used for long-term and short-term stress-management. In the care of elite athletes, the recording of stressors (see also chapter 2.3) has proven to be very helpful. For example, with the help of the Recovery Stress Questionnaire-Sport (Erholungs-Belastungs-Fragebogen-Sport, EBF-Sport) (Kellmann & Kallus, 2001), based on the athlete's self-assessment, the stress load related to the last three days or the perceived recovery in various areas can be recorded. Following the evaluation, it can then be considered in a joint discussion with the athlete which resources are basically available or need to be optimized or adapted in terms of stress management.

Mindfulness-based methods (Heinz et al., 2011), such as the Mindfulness-Acceptance-Commitment Approach (MAC) developed by Gardner and Moore (2007), have also recently gained an important role in stress prevention in elite sports. Mindfulness-based practices have three main effects:

1. development of a more serene (non-judging) approach to life,
2. mindfulness in dealing with stressors,
3. preservation of resources.

Stress management interventions that focus not only on the weaknesses of athletes and the skills they are lacking but instead integrate positive psychology perspectives such as enhancing positive coping skills, mindfulness and self-compassion have the potential to benefit a larger group of athletes and cover a broader range of topics underlining the strengths of athletes (Poucher et al., 2019).

In addition to the stress management approaches in elite sports just mentioned, the differentiation of acute and chronic sources of stress also appears to be important to further understanding and advance of risks to mental health and mental disorders for elite athletes (Keyes, 2002).

Short-term stress management techniques

So far, sports psychological intervention aimed at stabilizing performance in a competitive situation. The focus was on controlling stressful experiences and coping with fears arising during competition. Since coping resources are very individual, it is important to integrate both cognitive and physical-emotional components in the context of a short-term intervention for stress reduction or coping, following the Lazarus model, e.g., cognitive strategies can turn away from threats and turn to other goals (Beckmann, 1994).

The stress consequences resulting from anxiety and negative emotions are often based on habits of negative thinking. To change such negative thought processes, "if-then" strategies have been shown to be effective interventions (Adrianse et al., 2011), which aim to automate the implementation of an activity and thus make it less disruptive. A similar goal is pursued by establishing routines. Here, regular mental training aims to replace a dysfunctional old habit (e.g., rumination) with a functional new habit (Beckmann & Elbe, 2011).

Long-term stress management

In long-term stress management the focus is on relational and behavioral prevention. Relational prevention primarily aims to strengthen the social network, whereas behavioural prevention focuses on the development or expansion of individual skills. Another important element of behavioural prevention is recreation. For long-term stress management it is important to consider sports-related and non-sports-related causes. Here and in general, supportive social networks play a big role. As social support as well as the quality of social interaction are key determinants of stress and well-being (DeFreese & Smith, 2014), building positive relationships is especially recommended during the highly stressful transition phase from junior to senior levels to ease this transition for athletes and help them find or prioritize a balance between athletic and non-athletic demands. To achieve the best possible dovetailing of the demands of competitive sport and those imposed by school or university, it is therefore helpful to ensure a strong network (e.g., parents, coaches, friends, etc.) of social support for the athletes, especially during this transition phase.

2.6 Mental health in elite sports

The use of stress management programs (for a detailed overview see, Sallen, 2018) appears to be helpful not only against the background of enabling athletes in the respective phase of life to deal with stress in a self-responsible manner, but also to minimize the risk of stress-related impairments of elite athletes' mental health.

If health is analyzed from a biopsychosocial perspective, the physical, psychological, and social dimensions interact (Franke, 2012). This perspective is reflected in the WHO's definition of health.

According to the WHO (1948) "health" can be defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

Moreover, mental health is the ability and motivation to lead a socially active and autonomous life in terms one's own health, to cope with normal life, work productively, and contribute actively to society (WHO, 2001; 2005). This definition shows that mental health is a prerequisite for the realization of one's own potential and the implementation of one's role in society, profession, and family.

Elite sports have been influenced by the so-called "culture of risk" phenomenon: elite athletes exhibit a sport-specific risk behavior pertaining to their individual health in order to be able to continuously perform at the highest level. Absolving training or competitions while in pain (Thiel, Mayer & Digel, 2010), incomplete regeneration after injuries or illness (in terms of "sickness presenteeism") (Mayer & Thiel, 2018), and restrictive weight management (Sundgot-Borgen & Torstveit, 2010) are just a few examples illustrating sport-specific risk behaviors. Adolescent elite athletes are in a sensitive developmental phase and see themselves confronted by various physical, psychological, and social change processes (Feeley et al., 2016). They seem to be especially susceptible to negative health consequences due to their risky behavior. Considering the numerous requirements and stressors, remaining healthy represents an enormous challenge for elite athletes (Mayer & Thiel, 2014; Thiel et al., 2015), because they continuously need to both protect and risk their health at the same time.

Scientific research on mental health in elite sports is however, often based on a bio-medical perspective (Thiel et al., 2015) and primarily covers injuries and illness and not an effective preventive care (Hughes & Leavey, 2012).

This is one reason, why the current state of research concerning mental health in elite sports is not comprehensive (Reardon & Factor, 2010; Sebbens, Hassmén, Crisp & Wensley, 2016). Research focuses on health-related issues caused by injury or illness analyzed from a one-dimensional biomechanical or physiological perspective. Only few physicians, therapists, and coaches take the approach to analyze, diagnose, and treat an elite athlete's health based on a multi-dimension

perspective (Thiel et al., 2015). However, any utilization of results of a medical diagnosis in elite athletes (and their further treatment or therapy) depends on multiple factors. Thiel et al. (2015) emphasize the athletes' own perception of the diagnosis and their perceived negative effect of it on their performance. The strength of their feeling of being negatively affected in terms of participation or non-participation in competitions or training is a key parameter that needs to be considered. Despite the sparse epidemiological data basis, the results from the German Young Olympic Athletes' Lifestyle and Health Management Study (GOAL Study, Thiel et al., 2011) could lead to a better understanding of health-affecting factors with young athletes and to consequently promoting or counteracting these factors (Sabato, Walch & Caine, 2016).

Remaining healthy as well as understanding health-related behavior of elite athletes has therefore the highest priority in the context of elite sports (Schnell et al., 2014; Mayer & Thiel, 2014; Schinke et al., 2017).

Depending on the context, health is more than the simple absence of illness or illness prevention. The questions to be asked are: What is the relationship between the optimization of athletic performance and the individual biopsychosocial health of an athlete, and is biopsychosocial or mental integrity at all possible at the highest level of athletic performance (Thiel et al., 2010, p. 33)? Physical and mental health are a key precondition for performing at the highest athletic level, which means that promoting health and preventing stress seem to be extremely plausible in elite sports (Poucher et al, 2019).

Therefore, within the framework of prevention and health promotion, an early alert system programmed to detect potential stress signals needs to be established, and individual coping strategies need to be developed in cooperation with the athletes to keep injury and illness risks at bay (Thiel et al., 2010, p. 34). To determine the "how" concerning an athlete's options, first the construct of health will be contemplated.

Conceptualization of health in elite sports/perspectives on health preservation

If health is understood as the absence of illness, health is a state that is no longer given as soon as a medical diagnosis establishes an illness. In an athlete context, a medical diagnosis results in adhering to specific regeneration measures or the implementation of specific forms of training to prevent injury. International studies show that due to time restrictions a physician's relationship with an athlete is a lot less powerful than the one with a "regular" patient (Malcom, 2006). The reason for this is that athletic success and time constraints are often more important for treatments or the evaluation

of recovery processes than medical criteria. Often, physicians also face the problem of not having access to the health-relevant practices of the elite athletes they take care of.

It is therefore necessary to analyze how, and which factors might impact physical and mental health within the context of experiences, education, and social environment.

Particularly relevant in answering these questions is how one's own behavior might play a role in the context of the perception of health risks (Renner, 2003*).* For example, the aspects of potentially dangerous behaviors such as doping, use of pharmaceutics, medication, etc. need to be analyzed in terms of the athletes' risk perception. Since elite athletes have a high pain tolerance due to their training and competition situations, they will only cancel or stop a competition if they can no longer bear the pain. Their willingness to risk their health before major athletic events is higher, too (Thiel et al., 2010, p. 48*).* The subjective assessment of one's own state of health can differ significantly from the one medically defined. A particularly high conflict potential in terms of exertion control and competition participation exists in elite sports when no medical deviations from the norm are found and the athlete competes under pain in fear of losing support from the coach or the sponsoring partners.

In sports science, this behavior has been discussed as "risk-pain-injury paradox" (Nixon, 1994). The GOAL study, as the most comprehensive, interdisciplinary study on health and nutrition in Olympic junior sports, showed that the highest physical and mental exertion values were found in athletes who were subjected to high pressure both by themselves and external factors (Thiel et al., 2011). Those issues show that further optimization is required in the context of elite sports and health to limit the risks to the athletes' health to an ethically acceptable level.

In all, the following perspectives on health preservation in elite sports exist:

The first perspective: Health promotion (strengthen health by means of physical, mental, and social resources) (Antonowsky, 1987).

Sports science assumes that these resources must be deemed important for individual health promotion in elite sports, as well, though interrelationships between the resources have not been empirically proven much to date (Schaal et al., 2011). The implementation of relevant health-promoting measures (such as learning about coping strategies, balanced nutrition, etc.) in elite sports is of course up to the coaches and the athletes themselves.

The second perspective: Prevention of stress, injury, and illness. In contrast to the health-promotion perspective, the prevention perspective is about the avoidance of illness and to reduce or eliminate

existing stressors. In elite sports, the reduction or avoidance of stressors and mental strain aspects is important, as well (Hoyer & Kleinert, 2010; Wiese-Bjornstal, 2010).

Based on a typology of risk factors (see table 1), measures need to be taken to avoid psychosocial risk factors (Faltermaier, 2008).

Responsible for the implementation of preventive measures are athlete, coach, and medical staff. This applies particularly because the aspect of injury prevention is of utmost importance. The risk of injury can, for example, be minimized by adapting the training regime in terms of reducing exertion and strain, or by optimizing the exertion-regeneration ratio by means of suitable regeneration measures (such as relaxation techniques) (Soligard et al., 2016).

The third perspective: Maintaining or rehabilitating health. The point of reference clearly is illness. Optimized treatment and first aid in the event of illnesses and injuries are of paramount importance to establish and maintain health in the medium and long term. In elite sports, this perspective comprises a well-founded diagnosis, professional treatment and therapy, promotion of compliance on the athletes' side, and conveyance of adequate coping strategies (Thiel, Mayer & Digel, 2010).

The context explained above is now going to be examined in the form of three systematic reviews. They will focus on the different stressors, coping strategies and risk factors pertaining to the development of mental disorders in elite athletes. Moreover, this paper aims to gain insights on the impact of perceived stress on the mental health of elite athletes.

3 Methodological approaches

Three systematic reviews form the empirical part of this thesis (see chapter 4 and appendix A & B). Therefore, methodological aspects that need to be considered when preparing a systematic review are explained below. The structure of a systematic review, the mixed-method study design, and the quality assessment of the selected studies are discussed in detail.

3.1 Theoretical introduction

Review articles represent an important part of the professional literature, particularly in the fields of medicine and psychology. They summarize current subject-specific knowledge for the reader in a condensed form, thus providing the reader with a comprehensive overview of a particular topic. Similarly, reviews are used in the development of international guidelines for an assessment of

evidence in the context of a particular research context (Ressing, Blettner & Klug, 2009). Accordingly, a review is characterized by the summary of results with respect to different criteria. Broadly speaking, five types are distinguished:

- narrative reviews,
- systematic reviews,
- meta-analysis, pooled re- or new analysis,
- and prospectively planned meta-analysis.

In the following, the form of the systematic review will be specifically discussed, as it constitutes the core of the present work in terms of content. Characteristic for a systematic review is that the selection of the literature considered is determined based on predefined criteria. Among other things, the search strategy as well as the quality of the included literature in the methodological section are clearly and comprehensively described. Thus, the systematic review is based on objective and transparent evaluation criteria and thus represents a scientific review of data from published primary studies using a predefined methodology (Moher, Tetzlaff & Altman, 2009). In the remainder of this chapter, the main characteristics of a systematic review will be discussed in more detail. These include:

- conducting a systematic literature search in appropriate databases depending on a pre-formulated research question,
- a clear objective with a priori defined inclusion and exclusion criteria for study selection and analysis,
- a comprehensible and reproducible methodology,
- an ascertainment of risk of bias of the included studies,
- a systematic presentation of the results of the included studies with an appropriate summary.

The systematic literature search is the first necessary step to identify the best available evidence and should consider the following steps:

- the selection of suitable search sources based on the research question,
- the definition of a suitable search string or search vocabulary,
- the search in suitable databases,
- the review of the results and, if necessary, the adjustment of the search strategy,
- a renewed search,

- checking the relevance of the hits, and
- the documentation of the search.

In addition to the transparent presentation of the literature search, the formulation of a research guiding question, is a decisive criterion. The application of the PICO procedure (Patient, Intervention, Comparison, Outcome) should facilitate the literature search based on the research question. Defining the study type or the search period can also be helpful. Apart from the application of the PICO method, the preparation of a systematic flow protocol (Moher et al. 2009) is necessary. This includes, among other things, information about:

- the purpose of the systematic review,
- the description of the criteria for study selection
- the search strategy used,
- the study selection and extraction criteria,
- the description of the evaluation criteria.

The next step is to conduct a comprehensive literature search according to the criteria defined in the flow protocol and related to this, to select and evaluate the individual studies. The literature search must be documented in detail and transparently, and if studies are excluded, the reasons must be comprehensible to the reader. The checklist of the PRISMA - Statement (Moher et al. 2009) offers a good guideline to indicate the relevant parameters analogous to the PICO - scheme for each study included in the systematic review. Appropriate checklists also exist for the quality assessment of the study evidence to check the methodological quality and the risk of bias of the results in the included studies (Higgins & Altman, 2008).

To answer the research question underlying the systematic review, the evidence must be synthesized using a predetermined methodology. The GRADE (Grading of Recommendations, Assessment, Development and Evaluation) methodology is an internationally widely used method to assess the entire literature for an outcome parameter as opposed to other systems (Balshem, Schünemann & Guyatt, 2011). Within the GRADE - methodology, evidence is divided into four levels (high, medium, low, very low). Five factors can lead to downgrading or upgrading the quality of evidence in this context:

- study limitations,
- inconsistent presentation of results,
- imprecision due to a small sample,
- indirectness due to, for example, limited transferability,

- publication bias due to missing studies with non-significant results.

For each outcome parameter, a corresponding level of evidence must be determined. Depending on the publication-specific requirements, sections such as title, abstract, introduction and methodology are of central importance. Likewise, a results section, structured according to the research questions, as well as a discussion with reference to the evidence and a summary must be included. Finally, the authors must comment on the aspect of conflict of interest and, if applicable, provide information on financial support in the context of the preparation of the systematic review.

3.2 Mixed methods – Methodology and analysis

Since in the empirical part (chapter 4) of this thesis, among other things, mixed-methods study designs were examined, a brief outline of the mixed-method approach should be sketched for the reader at this point. In this approach, qualitative and quantitative research methods are combined and integrated within the same research project (Kuckarzt, 2014). Basically, at the core of mixed-methods research is the question of which methods support answering the research question, as the research question guiding the research determines the focus of the research project. It is also important to note that mixing quantitative and qualitative research strands can occur at any stage of the research process.

When analyzing the data of the quantitative or qualitative study strands, it is generally recommended to resort to the proven evaluation procedures (Kuckarzt, 2014). Following the separate analysis of quantitative and qualitative data, it is then necessary to combine and integrate both types of analysis and the respective results. The "mixing" represents the decisive gain of a mixed-method study, as here comparative observations of the inferences of both study strands take place. It is crucial at which point of the research project the "mixing" takes place. According to Creswell & Plano Clark (2011), four different situations can be distinguished in data and results integration:

1. **merging data:** findings are combined and contrasted here

2. **combining data and results:** one form of data collection is used to control the collection of the other type of data in the next step

3. **quantification and qualification:** one data type is transformed into the other data type to then exclusively apply either quantitative or qualitative evaluation strategies.

4. **embedding of data:** in a project that is primarily quantitative, for example, a qualitative survey takes place to include the perspective of those personally affected.

Similarly, differentiated by the four main types of mixed-method designs, the following integrative forms of presentation can be developed:

1. **Parallel design:** This design is primarily concerned with the question of the extent to which a quantitative and qualitative study lead to the same result, or in what form one study complements the other in the sense of complementarity.
2. **In-depth design:** The primary aim here is to answer to what extent the findings of the quantitative study can help to better understand or explain the results of the qualitative study.
3. **Generalization design:** The aspect of generalization is the focus here, i.e., in what way can the results of the qualitative study conducted first be generalized by the subsequent quantitative study.
4. **Embedded design:** This design is often used in health care and medical research; to gain a broader understanding of the findings of the quantitative study, a smaller qualitative study is inserted.

Integrative designs can link causal hypotheses and conjectures contained in the results of a quantitative study with qualitative themes, for example, to bring together significant measure effects with personal experiences of individuals.

Mixed-method research offers numerous advantages, especially in the field of sport psychology, such as the ability to reveal weaknesses or to show inferences, triangulations, and completeness (Horn, 2011).

Here, the integrative mixed-method research design just described above can be traced in two mixed-method investigations, among others:

McLoughlin et al. (2021) used a sequential, two-phase design in their study. Qualitative data were used here to help explain the quantitative results.

The results of this study suggest that total count and severity of lifetime stressor exposure significantly predicted greater depression and anxiety symptoms, and worse well-being in elite athletes. Thematic analysis revealed that cumulative lifetime stress exposure fostered poor mental health and well-being by promoting maladaptive coping strategies.

Davis et al. (2019) used an online survey with student-athletes regarding the perception of stress. To analyze the student-athletes' experiences of stress, additional semi-structured interviews were conducted with the athletes' coaches. The findings of both surveys were then gradually integrated through comparative and contrasting analyses with the aim of better understanding stress adaptations in the context of the dual career pathway of young alpine athletes. Davis et al. (2019) could observe that, athletes’ scores across the measures of the sport and life stress show they were

not experiencing particularly high levels of stress. As a source of stress, academic requirements scored highest; although athletes' reports indicate that stress related to demands at school were not frequently a cause for concern. Altogether, time management skills seem to be an important skill to teach student-athletes at an early stage in the dual career process to handle different sources of stress and how to protect their health.

3.3 Quality appraisal

As the critical appraisal of included studies is the core step of a systematic review, this is particularly challenging in mixed studies reviews due to the heterogeneity of study designs (Hong et al., 2018).

In principle, a quality appraisal should serve the purpose of excluding studies with low quality, to evaluate methodological quality of the included studies, to conduct sensitivity and subgroup analyses, and to nuance recommendations (Hong & Pluye, 2018a).

The Mixed Method Appraisal Tool (MMAT) by Pluye et al. (2009) was used in Review 1 and Review 3 to evaluate and synthesize the results, whereas in Review 2 the checklist Standard Quality Assessment Criteria for evaluating primary research papers from a variety of fields ("QualSyst") by Kmet, Lee & Cook (2004) was used. In the following, both tools are briefly explained.

Selected studies can have different designs and as there's no standard assessment system for different designs, QualSyst" with a scoring system for quantitative studies and a scoring system for qualitative studies offers, from the author's point of view, a possibility to evaluate the quality of studies potentially eligible for inclusion in review 2.

The scoring system for quantitative studies consists of 14 items, the scoring system for qualitative studies of 10 items, (see Table 4, 5, 6 & 7) depending on the extent to which a certain criterion was met ("yes" = 2, "partly" = 1, "no" = 0). If an item did not apply to a particular study design, it was marked as not applicable ("n/a") and excluded from the calculation of the total. The summary score of each study included in the review was calculated by adding the total score of all items (either 14 for quantitative designs or 10 for qualitative designs) and dividing by the total possible score. The decision to use "QualSyst" tool was based on the following advantages:

1. its ease of use and,
2. "QualSyst" is a systematic and reproducible means to simultaneously assess the quality of studies included in a review with different study designs.

According to Kmet et al. (2004), "QualSyst" ensures that the studies that are ultimately selected for a systematic review meet a minimum quality standard.

Table 4 Checklist for assessing the quality of quantitative studies

Criteria	**Yes (2)**	**Partial (1)**	**No (0)**	**N/A**
1. Question/objective sufficiently described?				
2. Study design evident and appropriate?				
3. Method of subject/comparison group selection or source of information/input variables described and appropriate?				
4. Subject (and comparison group if applicable) characteristics sufficiently described?				
5. If interventional and random allocation was possible, was it reported?				

Table 5 (continued): Checklist for assessing the quality of quantitative studies

Criteria	**Yes (2)**	**Partial (1)**	**No (0)**	**N/A**
6. If interventional and blinding of investigators was possible, was it reported?				
7. If interventional and blinding of subjects, was it reported?				
8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement/misclassification bias? Means of assessment reported?				
9. Sample size appropriate?				
10. Analytic methods described/justified and appropriate?				
11. Some estimate of variance is reported for the main results?				
12. Controlled for confounding?				
13. Results reported in sufficient detail?				
14. Conclusions supported by the results?				

MMAT is an assessment tool, the first version of which was developed by Pluye et al. in 2009, for use in mixed studies reviews.

Table 6 Checklist for assessing the quality of qualitative studies

Criteria	**Yes (2)**	**Partial (1)**	**No (0)**	**N/A**
1. Question/objective described?				
2. Study design evident and appropriate?				
3. Context for the study clear?				
4. Connection to a theoretical framework/wider body of knowledge?				
5. Sampling strategy described, relevant and justified?				
6. Data collection methods clearly described and systematic?				
7. Data analysis clearly described and systematic?				
8. Use of verification procedure(s) to establish credibility?				

Table 7 (continued): Checklist for assessing the quality of qualitative studies

Criteria	**Yes (2)**	**Partial (1)**	**No (0)**	**N/A**
9. Data collection methods clearly described and systematic?				
10. Data collection methods clearly described and systematic?				
11. Data analysis clearly described and systematic?				
12. Use of verification procedure(s) to establish credibility?				
13. Conclusions supported by the results?				
14. Reflexivity of the account?				

Reviews 1 and 3 used the second version of MMAT (Pluye et al., 2011). The MMAT checklist can be used to assess five different categories of study designs:

1. qualitative,
2. randomized controlled,
3. nonrandomized,
4. quantitative descriptive and,
5. mixed methods.

Three main steps need to be implemented in the application of MMAT:

1. Consideration of the two screening questions; the corresponding answer ("yes", "no" or "can't tell") then provides an indication of whether the work under consideration an empirical study is or not; if the latter, MMAT cannot be used,
2. Selection from five categories of study designs to then make an appropriate assessment,
3. Evaluation whether the criteria given for the study design selection are met ("Yes" meaning the criterion is met, "No" meaning the criterion is not met, " Can't tell" meaning there is not enough information in the paper to judge if the criterion is met or not).

As MMAT offers methodological quality criteria for different study designs in a condensed checklist, it is a helpful assessment tool. In addition, MMAT contains specific assessment criteria for mixed-method studies, which are often missing in other appraisal tools (Pluye, 2013). However, the focus on methodological quality criteria, can also be more difficult to interpret than purely content-based criteria, as this also involves an assessment of the results in terms of their trustworthiness (Hong & Pluye, 2018a).

4 Empirical findings

Evidence suggests that elite athletes are affected disproportionately by mental health issues. They are confronted with more than 640 stressors which can contribute to their physical and mental health (Arnold & Fletcher 2012b). These stressors can pertain to mental health impairments and manifest into a range of mental disorders (Rice et al., 2016; Montero, Stevens, Adams & Drummond, 2022).

If athletes are not able to cope with theses numerous stressors resulting from elite sport and to handle other challenges beyond their athletic career, these stressors can culminate into a mental health disorder (Gulliver et al., 2015; Purcell et al., 2019; Castaldelli-Maia et al., 2019).

So far, previous research has focused on issues such as stress, coping, mental health, and mental disorders independently among elite athletes. Current scope of literature is still narrow in terms of analyzing and assessing these issues in combination. This concerns not only athletic performance but also health and psychological well-being beyond sports.

The aim of the three systematic reviews below is to address this gap and to analyze the above-mentioned topics together.

While the first systematic review analyses current literature regarding stress and its impact on mental health in elite sports, the second review covers the topic of coping strategies for handling

stress and providing mental health in elite athletes. The third systematic review identifies potential risk factors for mental disorders in elite sport.

4.1 Stress and its impact on mental health in elite sport – a systematic review

4.1.1 Problem statement

The special situation of elite athletes is characterized by the fact that they are confronted with numerous stressors related to their sport participation. According to Wiese-Bjornstal (2010) these are physical challenges (e.g., risk exposure or high training load and high training intensity), psychological stress ("life event stress"), but also social and ethical stressors and stressors related to retirement from sport. These stressors can lead to misuse and strain of the target population's physical and mental health (Bruner et al., 2008).

Not only acute stress (caused by high stress levels in training or competition) has an impact on health. Also, transitional phases can lead to chronic stress and subsequently to mental-health related problems because of uncertainties and challenges in and out of sporting area (Ehrenspiel et al., 2018). Some researchers assume that elite athletes are more susceptible to stress-related negative health effects than the general population (Moesch et al., 2018**)**, especially during extremely stressful periods such as performance lows or injury breaks (Nixdorf, Frank & Beckmann, 2016). Studies say that stressors definitively have an impact on an athlete's mental health, but research on mental health in elite athletes is still comparatively in its infancy (Rice et al., 2016).

Additionally, elite athletes suffer from more problems (Bird, Chow, Meir & Freeman, 2018):

- Stigmatized in terms of mental toughness (social role) and therefore often find it difficult to seek help at the moment when a mental health problem arises,
- lack of knowledge around mental health,
- negative experiences in the past when seeking help (Gulliver, Griffiths & Christensen, 2012).

The recognition of the impact that stressors can have on an elite athlete's mental health, analyzing these stressors and the associated mental health outcomes seems to be the first step to raise awareness among researchers for this important topic.

This systematic review aims to answer the following questions:

Which stressors (sport-specific and non-sport-specific) can be derived from elite sport?

Which impact do stressors have on the mental health of elite athletes?

4.1.2 Findings

This systematic review aimed to analyze the current state of knowledge described in scientific literature concerning stress that promotes impairments of elite athletes' mental health. To obtain a clear understanding of this topic, a systematic electronic literature search based on the PRISMA-Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was conducted in Pubmed and PsychInfo, as well as in Google Scholar and via hand search. Literature search for this systematic review took place between February and June 2020 and resulted in a total of 252 hits. Both quantitative and qualitative studies were considered, all of them dealing with stress and potential stress-triggering factors associated with effects on the mental health of elite athletes.

Due to the heterogeneity across other study designs and outcome variables, it was impossible to conduct a meta-analysis.

After verifying the inclusion criteria and a methodological quality assessment, 35 studies were deemed suitable. 23 studies were drawn up based on a quantitative design, 10 on a qualitative design, and 2 were conceptualized as mixed-methods design studies.

The quality of the methodological approach of the included studies was evaluated according to the MMAT criteria proposed by Pluye et al. (2011). The quality appraisal for the studies fulfilling the inclusion criteria is presented in its complete version in **appendix B.** Almost all studies met the criteria requested in terms of methodology and were therefore assessed to be of good reporting quality. Some studies however were estimated to not correspond fully to all criteria proposed by Pluye et al. (2011). All the included studies used either clear quantitative and qualitative research questions (objectives), or a clear mixed method question (objective). The studies included also allowed addressing the research question or objective with the help of the data collected and respected the aspect of ethical review.

The included studies examined elite athletes from both sexes, a broad age range (from 14 to 51), individual (e.g., gymnastics, swimming, skiing) and team sports (e.g., soccer, rugby, football), and different nationalities.

Even though the analyzed study results point to superordinate stressor categories (sports-specific and non-sports-specific stressors), the results representation consciously forgoes such a categorization.

There are two reasons for that:

1. Variety of stress-triggering factors within and around the context of elite sports,
2. distinction between stress sources is not always plausible or possible.

It turned out, for example, that training- and competition-related stressors occur regardless of the type of sport performed, whereas organizational stressors are of a more varied nature and subject to

different influences, such as sociocultural, financial, or occupational factors (Fletcher & Hanton, 2003a; Fletcher et al., 2006; Fletcher & Scott, 2010).

Quantitative study design

23 quantitative studies were included in this review. Among them there were one single case study, one test battery, one multivariate analysis and five pre-post designs.

Training- and competition-specific stressors are part of a professional sporting career. One of these stressors is sport injuries, which are mostly accompanied by a decrease in athletic performance and psychological responses leading to mental health issues in elite athletes.

Injuries

Several studies identified injuries or changes in performance as primary outcome of sports-specific sources of stress (Andersen & Williams, 1999; Newcomer & Perna, 2003; Johnson & Ivarsson, 2011; Ivarsson et al., 2014; Laux, Krumm, Diers & Flor, 2015; Brink et al., 2010; von Rosen et al., 2017; Pensgaard et al., 2018).

The results of these studies showed that intense physical activity performed at elite level and the stressors associated with sport participation compromised the mental health and psychological well-being of elite athletes manifesting among others in symptoms of anxiety, overtraining, burnout, or injury.

Younger athletes seem to be particularly sensitive to injury-induced stimuli and thus are more susceptible to post-traumatic injury-related distress.

Their increased susceptibility to mental health symptoms can be explained amongst other things via exposure to sports-related stressors and the overlap in elite competition and the ages of primary onset of mental ill-health which also confers to a higher risk for mental health impairments in this population.

Results indicate an association between an increased injury risk and a higher vulnerability to mental health problems

Stress is seen as an important antecedent to sport injuries and can therefore play an important role in terms of mental health-related responses triggered by injuries, as these responses can lead to mental disorders such as depression or disordered eating.

In combination with training- and competition-induced stressors, other factors such as sleep disturbances sometimes induce changes of elite athletes' mental and hormonal parameters. The aforementioned factors could be summarized as non-functional overreaching or overtraining

syndrome. This can lead to impairments concerning the recovery-stress state and mental health challenges in the target population (Nicholls, Backhouse, Polman & McKenna, 2009; Brink et al., 2010; Faude et al., 2011; Laux, Krumm, Diers & Flor, 2015).

Perfectionism

Study findings showed that athletes who overtrain also exhibit a high degree of perfectionism and a higher level of compulsion to exercise. The key point of the findings suggests that perfectionism is a trigger factor for training-induced stress.

According to the study results (Madigan et al., 2017**)**, perfectionist concerns seem to be responsible for a negative relationship with training-induced stress. Athletes with many perfectionist concerns do not handle stress well and thus are more affected by the consequences of training distress.

Hence athletes who are setting perfectionistic standards are more likely to experience mental health symptoms, such as heightened levels of anxiety. In case of maladaptive perfectionism, athletes are even more at risk to compromise their mental health state, as this dimension of perfectionism is more associated with a low self-esteem and symptoms of anxiety and depression. Dysfunctional attitudes, negative coping strategies, and a high level of chronic stress were identified as stress-triggering factors resulting in burnout and depression in elite athletes.

Retirement/end of career/transitional phase

Study results suggest that athletes performing at top level face a higher risk of mental health problems because they are confronted with a huge array of "workplace" stressors (i.e., limited social support networks) together with enormous physical and competition stress (Gerber et al., 2018; Nixdorf et al., 2020). Additionally, a lack of processing sport-specific stress factors in combination with under-recovery may end up in mental ill-health.

Other stress related effects according to some of the studies analyzed **(**Perna & McDowell, 1995; Wippert & Wippert, 2008; Fessi et al., 2016; Blakelock, Chen & Prescott, 2016; Otter, Brink, Diercks & Lemmink, 2016) can put athletes at risk of experiencing severe mental health symptoms:

- traumatic life events
- age-related vulnerability
- personal factors

The results of these studies indicate that playing sport at highest level is associated with significant mental health symptoms such as elevated cortisol level, depressive or anxiety symptoms.

The effect of stress as a health influencing variable leading to an increased vulnerability to mental health symptoms was also seen in studies examining traumatic stress resulting from a career-ending event and an athlete's separation from social network (Wippert & Wippert, 2008**)**. The termination of career and transitioning out of sport can be a difficult period for elite athletes with an increased likelihood pertaining to the development and onset of mental health symptoms or disorders. Involuntary retirement from sport conditioned by an injury or illness in combination with a high level of athletic identity and a lack of retirement planning can be seen as sources of stress leading to post-career mental health impairments.

Findings underscored the importance of identifying which stressors are at play in deselected athletes and athletes whose careers ended with a negative termination experience to decrease the risk for mental health-related responses and corresponding effects on the mental health state of an athlete (Blakelock, Chen & Prescott, 2016).

Social environment

The "social perceptions" of the athletes seem to be particularly relevant in terms of their mental health. Results demonstrate that the sports-related social environment has a significant meaning for understanding the "outcomes" of health-related impairments in elite athletes (DeFreese & Smith, 2014).

Summarizing the results of the quantitative designs it can be said that negative life

event stress is a strong predictor for injury, that critical life events seem to affect the recovery-stress-state negatively and that deselection is seen as a major stressor in the target group, leading even to clinical levels of psychological distress.

Additionally, dysfunctional attitudes, negative coping strategies, and a high level of chronic stress were identified as stress-triggering factors resulting in burnout and depression in elite athletes.

Qualitative study design

Ten qualitative studies were included in this review.

Research findings suggest that not only competitive stress in elite sport, but also organizational stressors are important issues to consider in terms of mental health. Study results revealed some insights for stress and sport psychology research in the context of how stress affects mental health of elite athletes.

Competitive stress und organizational stress

Data analysis showed that many athletes mentioned situations, during which they were confronted with both competitive stressors (e.g., the pressure to qualify for an international competition) and organizational stressors (e.g., interpersonal conflicts with management).

Coping

That means that not only the various stressors experienced by athletes in their sporting and personal environment are reasons for an increased vulnerability to mental health problems, but also the resources athletes have available to cope with stress play an important role, which must be considered in the context of the impact of stress on mental health.

In line with the meta-model (Fletcher et al., 2006) the results of the included qualitative studies indicate that organisational stressors encountered by elite athletes can be associated with various outcomes (e.g., poor mental health, low well-being, or burnout) and that the on-going transactional stress process may affect elite athletes' vulnerability to any kind of stressor and in consequence influence their mental health status.

With regard of situation-specific stressors unsuitable coping strategies, insufficient support, and lack of competition experience were identified to be stress-triggering factors and are therefore to be considered risks, especially to mental health. If existing coping strategies are accessible, stress-related challenges can be handled because the stress-triggering factors are perceived as less threatening. Maladaptive coping by contrast may increase an athlete's susceptibility to mental health symptoms.

The analysis of the qualitative studies included in this systematic review revealed that competition and non-competition sources of stress need to be considered when analysing the effects of stress on an athlete's mental health.

Furthermore, the findings support the assertion that elite athletes experience more stressors associated with the sport organization than with competitive performance in terms of mental health challenges. Additionally, a considerable overlap in the years of elite competition and the age of primary onset for mental disorders may expose them to an increased mental health risk.

Mixed-method designs

Two studies (Tabei, Fletcher & Goodger, 2012; Davis et al., 2019) were of a mixed-method design and observed training- and competition-specific, non-sport-specific stressors as well as personal factors and critical life events.

The findings of the two mixed-method studies showed that not only various organizational stressors playing an important role regarding of how stress affects elite athletes' mental health, but also academic related stress factors are becoming an important variable to respect in the context of elite athletes' mental health status.

Training and competition load, training and competition environment, travel arrangements, nutritional issues, risk of injury, leadership style, lack of social support, career and performance development, inadequate communication channels and role overload appeared as major organizational stressors to be linked to athlete burnout. Furthermore, the transitional time between junior and senior phases was experienced as particularly stressful, because of the simultaneous demanding phases in school and job with many challenges both in athletic and non-athletic areas (Stambulova 2017).

4.1.3 Discussion

By focusing on the transactional stress model (Lazarus & Folkman, 1984), which states that stress reactions always result from the interaction, i.e., transaction or interaction between the organism (body and psyche) and the environment, various stressors that affected the performance and the (mental) health of elite athletes were identified within the framework of this systematic review. In this sense, this review adds to recent domain-related reviews on stress in elite sports (Flechter et al., 2006; Sarkar & Fletcher, 2014).

The analysis of 35 studies showed clearly that there are numerous stress-triggering factors that impact the stress experience and therefore athlete's health (Fletcher et al., 2012).

However, the question whether elite athletes suffer from increased risk for mental health due to elite sport-specific and non-sport-specific stressors cannot be answered conclusively by data from current literature.

In terms of training- and competition-specific stressors, it is almost impossible to separate causes from consequences as many of the variables identified as potential stressors may also be consequences, e.g., in case of injury and illness (von Rosen et al., 2017), overtraining (Silva III, 1990), or coping strategies (Kristiansen & Roberts, 2010), which can affect in both cases elite athletes' mental health.

In terms of situation-specific, dispositional, and personal stressors findings confirm that not only sex or personality, but also the relationship between coach and athlete represents evident predictors of stress, particularly in terms of the development of a burnout syndrome in elite athletes. However, not many details are known about the specific characteristics of the mutual influence between coach and

athlete. If a supportive atmosphere is not given on the part of the coach, or if the social support from family, friends, or team members is missing, these factors are stressors in a competitive context, which could consequently lead to mental health-related problems (Kristiansen & Roberts, 2010; DeFreese & Smith, 2014). If match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, particularly younger athletes are prone to sport-specific injuries and their consequences and to develop negative health- influencing symptoms due to their riskier behaviour (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007). To date, however, no conclusive and accurate study data has been gathered pertaining to individual sports-specific and general non-sports health-related behaviour (Thiel et al., 2011). Hence, destructive coping can mean the onset of mental disorders in the target population (Flett & Hewitt, 2006; Appleton et al., 2009).

Therefore, it needs to become possible to identify so-called risk athletes within the framework of optimum support. However, the significance of the existence of prospective health risks in the target population is still being ignored by the parties responsible despite reported injury tragedies (Reardon & Factor, 2010). Decreasing the stigma for mental health issues and normalising these issues seems to be essential in terms of treating mental health concerns.

Even though many reasons exist for the predisposition of elite athletes for mental health impairments, the current state of research presumes that scientific studies examining the epidemiology of variables associated with stress and mental health in elite sports are rare and often inaccurate (Reardon & Factor, 2010; Hughes & Leavey, 2012; Arnold, Fletcher & Daniels, 2016).

That means that it is necessary to develop an understanding of the mechanism and etiologies underlying mental health issues and to improve athlete-centered prevention and treatment programs (Nixdorf et al., 2020).

Stressors resulting from an organizational environment affect athletic performance and provoke implications in terms of mental health.

However, it should be taken into consideration that organizational stressors are not always associated with negative consequences. Sources of stress can rather be related to positive outcomes, such as commitment, pleasure, or satisfaction (Fletcher et al., 2006; 2012). Not only the fact that organizational stressors have the potential to be associated with either positive or negative health-related outcomes for top athletes (Fletcher et al., 2006) should be taken into consideration in future research designs, but also the interaction between stressors and coping styles which can protect athletes from negative or even pathogenic health-related effects of stressful events.

This aspect seems particularly worthy of investigation as coping styles applied under stress may help to explain which health-related outcomes may occur through inadequate or inappropriate use of coping strategies. According to Fletcher et al. (2006) the handling of coping styles may affect athletes' vulnerability to stress and influence the tone of health-related psychological responses.

4.1.4 Conclusion

Sports participation in general provides many benefits to individual health and well-being, but elite athletes are exposed to additional stress-triggering factors that may impact their mental health.

The current systematic review led to the following conclusions:

1. Stressors do not occur in isolation, but usually in combination,
2. stressors are situational and development-specific, and their effect is majorly influenced by the assessment of the coping strategies available,
3. stress-related outcomes (such as sports-related injuries) can also be considered stressors.

Excellent physical and mental health is essential to perform on the highest level in elite sport.

However, an elite athlete's mental health is permanently at risk because he's confronted with life and sport-related stressors, which are seen as potential risk factors for his mental health.

Staying healthy is a huge challenge in sense of coping successfully with the state of tension created by stressors.

To meet the needs of elite athletes in terms of their mental health, it is therefore recommended to conduct more interdisciplinary and more high-quality epidemiological intervention studies. Since the stress-triggering factors are very complex, it's necessary to initiate interdisciplinary research projects. These projects should also focus on the analysis of somatic and psychological factors that influence both the physical and mental health of elite athletes.

Thus, high-quality epidemiological intervention studies should do justice to the dynamics of stress in elite sports while considering an athlete's individual stress biography to develop customized and flexible strategies to cope with stress (see review article "*Coping strategies for handling stress and providing mental health in elite athletes*).

4.2 Coping strategies for handling stress and providing mental health in elite athletes – a systematic review

4.2.1 Problem Statement

Since elite athletes are not immune to stress and its health effects coping with stress is important (Holt, Hoar & Fraser, 2005). The increasing demands of elite sport, particularly at the international level, result in enormous pressure for athletes. In combination with high training loads and other stressors this is a serious threat to mental health (Rice et al, 2016).

Given the focus on physical performance in the world of elite sport, there is no room for weakness or lack of skills in dealing with stress.

The fear of social stigmatization can lead to the fact that mental health related problems experienced by athletes are concealed or covered up instead of seeking professional help (Teubel, Hoffmann, Bernert & Lau, 2010).

For this reason, it seems important to examine how elite athletes cope with stressors, as these stressors may cause psychological disruption, which may turn into decreased satisfaction, poor performance, mental health problems, and subsequently to withdrawal from sport (Stambulova & Ryba, 2014; Rice et al, 2016).

There is a need to balance training and recovery, and there is also a need to balance psychological demands and appropriate mental health support techniques and strategies, as mental health is a core component of any culture of excellence (Schinke, et al., 2017).

Given that less effective or maladaptive forms of coping can lead to mental health impairments (Kuettel & Larsen, 2020) among elite athletes and the combination of stressors unique to the athletic context plus the sensitive developmental phase (Gulliver et al., 2012) that athletes go through during their peak performance (Allen & Hopkins, 2015) is likely to amplify the athletes' increased vulnerability to the onset of mental disorders. Therefore, the purpose of the following review is to analyze ***which coping strategies help to manage stress and how effective they are.***

4.2.2 Findings

Literature search for this systematic review took place between August and October 2021.

There were initially 5.705 hits from 3 electronic databases (PubMed, PsychINFO, SPORTdiscus), manual search in various scientific journals and from a complementary search in Google Scholar. 33 research articles were chosen for this systematic review. 3 out of 33 research articles were deemed to

be of low quality and thus were excluded from the review. Thus, this systematic review was based on 30 studies that covered the research questions.

The author has used quantitative and qualitative study designs as well as a combination of both to examine coping strategies and the effectiveness of coping strategies applied to handle stress.

According to the inclusion criteria the studies of this systematic review reflected elite athletes according to Swan et al.'s (2015) definition. The comprehensive search yielded studies involving team sports, individual sports, or a combination of both. In all studies included, athletes were aged at least 12 or older.

Due to the heterogeneity of the studies included and due to the lack of randomized, controlled trials, a standardized risk-of-bias evaluation was not performed. As an alternative, the quality of the studies selected was evaluated based on the assessment tool "QualSyst" (Kmet, Lee & Cook, 2004).

The analyzed study results point to a broad spectrum of coping categories, elite athletes make use of to deal with stressful situations.

The results representation outlines a categorization of the most widely used higher-order coping dimensions based on their function and intension (Lazarus, 1966; Crocker, Kowalski & Graham, 1998), such as problem-orientated and emotion-regulative coping.

The application of the macro-level dimensions of coping seems to be suitable to provide an overall characterization of elite athletes' stress responses. However, these higher-order dimensions conceal the heterogeneity and complexity of the various coping responses and consider insufficiently the aspect of mental health.

As the extracted literature mainly focused on coping in elite sporting context the classification of coping was completed by the following aspects:

- type of sport
- gender
- dimensions of coping
- effectiveness of coping in terms of mental health

This approach was chosen to refer best to the review's research questions.

Coping and type of sports

Findings of Kerdijk, van der Kamp & Polman 's (2016) studies show that teammates play an important role in the experience and appraisal of stress and coping in team sports.

When others influenced by stress coping process situations were more likely to be appraised as a challenge and more adaptive problem- and emotion-focused strategies were used, whereas when a stressor was appraised as a threat a more maladaptive coping strategy or no coping at all was reported. The results of (Krokosz & Jochaimek, 2018) revealed that there is a significant relationship between coping with stress and perceptions of risk in extreme athletes. Findings showed that there are significant differences between men and women in their assessment of the frequency of using given strategies for coping with stress:

- Women were more likely than men to use strategies of searching for emotional support and instrumental support in threat situations,
- men reported using the strategy of relying on a sense of humor significantly more frequently than women did.

Deroche, Woodman, Stephan, Brewer & Le Scanff (2011) examined pain coping strategies of athletes from combat sports.

The results indicated that pain catastrophizing explained an incremental portion of the variance in the prediction of sport-related pain behavior, over and above the intensity of pain experienced during sport activity. The more athletes catastrophized their pain, the less they were inclined to play through the pain.

Coping and differences in gender

Regarding gender the analyzed studies revealed some differences. Dolenc (2015) observed that female athletes showed higher levels of anxiety and used more often emotion-focused coping strategies compared with male athletes.

Female athletes experienced more intense stress from their coaches than did male athletes. For approach behavioral and avoidance cognitive coping styles also significant gender differences could be revealed, but not for approach cognitive coping.

Athletes with an approach coping style were less likely to make the appraisals control-by-self and control-by-others than athletes with an avoidance coping style. Also, skill level affected athletes' coping style among both female and male athletes; according to the percentages, more elite male athletes had an approach coping style, and more non-elite male athletes had an avoidance coping style, and more elite female athletes had an avoidance coping style and more non-elite females had an approach coping style.

Coping dimensions applied in elite sports

Pensgaard & Ursin (1998) revealed that the coach is one of the most important sources of stress and that athletes who reported expectations or injury as stressful experiences were those employing the highest number of coping strategies, whereas athletes who reported the competition itself to be stressful employed the lowest number of coping strategies.

Study results regarding coping strategies in elite sports to handle stress showed that athletes adopted more often a task-oriented coping style to confront stressful sport-related situations (Bernacka, Sawicki, Mazurek-Kusiak. & Hawlena, 2016).

Regardless of gender the survey of (Szczypinska, Samelko & Guszkowska, 2021) showed that athletes most often applied the strategy of positive re-evaluation, acceptance, and planning.

Investigation of coping strategies in relation to athletes' illness revealed significantly different profiles of coping in resilient and non-resilient athletes. Those athletes, who remained healthy despite an elevated level of recent life stress generally favored problem-focused coping and seeking social support, whereas in the non-resilient group avoidance strategies were more dominant (Yi, Smith & Vitiliano, 2005).

Resilience is positively related with task-orientated coping and negatively with emotion-orientated (Secades et al., 2016).

Also**,** Litwick-Kaminska (2020**)** found out that during sport competitions athletes most often apply positive stress appraisals and made use of task-oriented coping, regardless of their perception of stress.

The findings revealed that avoidant coping was related to higher levels of athlete-burnout and higher levels of problem-focused coping were related to higher levels of self-oriented perfectionism.

Anshel & Anderson (2002) found out that the use of athletes' coping strategies is dependent of the situational context and of the stressor's intensity. The findings concerning coping style and coping strategies showed that athletes often used coping strategies that were commensurate with their coping style.

Effectiveness of coping in terms of mental health and handling stress

The results of Dolenc (2015) showed that problem-focused coping is associated with lower levels of anxiety and that emotion-focused coping is associated with higher levels of neuroticism. The obtained results indicated positive correlations between proactive coping and self-efficacy among elite athletes.

McLoughlin et al. (2021) investigated associations between different stressor types and athletes' mental health status. The results revealed that the total count and severity of chronic difficulties was a marginally stronger predictor of depression when compared with the total count and severity of acute life events.

Results of Cumming et al.'s study (2012) indicated that biological and psychological factors contribute in complex ways to influence the psychological well-being and mental health status of young female athletes. The balance between adaptive and maladaptive coping strategies predicted an outcome variable of clinical significance.

Coping strategies emerged as a predictor of variance of mental health in gymnastics but not in basketball. The results of the present study revealed that the adaptive scales were positively related to well-being and negatively to distress. The observation that coping style was most closely associated with mental health in gymnasts was novel and of particular interest.

Findings of Fogagca (2021) revealed that the intervention group had a significantly higher mean score on the Athletic Coping Skills Questionnaire than the control group at the end of the intervention period. Anxiety as the dependent variable showed that the intervention group had significantly lower levels of anxiety than the control group at the end of the intervention period.

Regarding psychological life quality, there are differences between athletes with lower or higher coping self-efficacy (CSE) under acute stress (Guo, Li, Qiaolong & Hon, 2019).

The study showed that low-CSE athletes lacked confidence and hence were more likely to not know what to do when facing stress.

Daumiller, Rinas & Breithecker (2021) examined the effects of elite athletes' achievement goals on their burnout levels and psychosomatic stress symptoms, and to what extent they can be explained by athletes' use of adaptive coping strategies.

In their study elite athletes reported rather strong mastery approach and performance goals, while at the same time moderate levels of burnout levels and psychosomatic stress symptoms, and relatively high levels of adaptive coping strategies. There were strong interindividual differences between the athletes,

Their results revealed that mastery approach goals were negatively associated with burnout levels but not with psychosomatic stress symptoms in terms of direct effects, and positively associated with use of coping strategies. In contrast, strong mastery avoidance goals were associated with increased burnout levels and with increased psychosomatic stress symptoms as well as with reduced use of coping strategies.

Kristiansen & Roberts (2010) examined how athletes cope with competitive and organizational stressors. The results showed that athletes needed to be prepared for the total competitive experience that includes both organizational and competitive stressors. Further findings revealed the importance of social support as a coping strategy and that informational and emotional support in combination with cognitive strategies were used most to cope effectively with competitive stress and to influence mental health positively. In addition, coach support was important to cope with both organizational and competitive stressors and it turned out that athletes tend to seek more likely support from people the feel close to.

4.2.3 Discussion

This systematic review attempts to outline the current knowledge of coping strategies for handling stress and providing mental health in elite athletes.

Overall, the findings of this review add to domain-related reviews (Rice et al., 2016; Kuettel & Larsen, 2020) suggesting, that elite athletes face various stressors during their sports career, that, if not well managed, put them at an increased risk of poor mental health. Despite growing interest in this topic, the factors that influence elite athletes' mental health in terms of effective coping remain unclear and therefore warrant further research.

The transactional model of stress and coping (Lazarus & Folkman, 1984) proposes that effective coping is an important variable to buffer the detrimental effects of stressors as results of coping theoretically influence the ability to deal with stressors in sport.

COR theory (Hobfoll, 2002) also advocates that someone with resources is less likely to encounter stressful circumstances that negatively affect psychological well-being and mental health

Hence, an elite athlete with coping skills such as high coping self-efficacy, highly pronounced resilience, sense of coherence or support from coaches, teammates, family members or friends can apply these resources in terms of coping with stressful situations towards growth and development instead of using these skills defensively to offset stressors.

However, limited attention has been given to the potential relationship of athletic coping skills with well-being and mental health and how coping and its effectiveness are associated with elite athletes' mental health, despite Smith et al.'s (1995) suggesting that these variables would be related to each other.

Findings of this review are consistent with the transactional model (Lazarus & Folkman, 1984), Hobfoll's theory of resources (1989; 1990) and show parallels to the biopsychosocial determinants

(Rice et al., 2020) (for more details see table 1 in review 2) influencing mental health in an elite sporting context.

Coping and type of sports

The findings of this review indicated that athletes' appraisal and the way they cope is influenced by the way teammates respond.

The identification of new coping dimensions at the team sports level represents an important step in the understanding of coping in team sports because it offers a new perspective of how teams cope dealing with stressors (Kerdijk, van der Kamp & Polman, 2016).

Regarding coping with pain, the analyses showed that the more athletes irrespective of the sport they play, ignore pain, the more they can maintain their sport involvement despite their pain (Deroche et al., 2011).

However, ignoring pain can increase pain tolerance and attenuate physiological arousal and intensify psychological distress (Cioffi, 1991). Thus, this coping strategy appears to lead athletes to divert from nociceptive input, allowing them to maintain their initial task involvement despite their pain.

The present review emphasized the contribution of pain coping in predicting athletes' inclination to play through their pain, whereas previous studies have shown how social networks can lead athletes to accept pain as a "part of the game" and can generate pressure on athletes to continue competing despite such pain (Nixon, 1993; Mayer & Thiel, 2018). To minimize athletes' willingness to compete hurt or ill implicates that coaches and other staff members in charge are the ones to regulate the intensity of the competition and to socialize athletes with respect to their risk-taking behavior (Nixon, 1996).

Coping and differences in gender

There may be various reasons for gender differences in coping behavior (Anshel et al., 2009; Dolenc, 2015) and that they are also consistent with previous sport psychology research showing that female athletes assess stressful situations as more negative compared to male athletes. Female athletes had stronger feelings of tension and worry with greater susceptibility to a variety of stressful events and seek for more social support.

That could implicate that gender differences may influence an athlete's selection of coping styles and strategies and, that females are more inclined to make use of an emotion-oriented coping style, whereas men use more often an active and approach-oriented coping style. In combination with the aspect of type of sports the findings show that for example female team sport athletes have a more

poorly developed task-oriented style of coping with stress. Compared with males, female athletes seem to be more prone to using an emotion-oriented style which has been related to females' higher emotional sensitivity especially with respect to interpersonal issues.

When analyzing the styles of coping with stress the influence of maladaptive strategies must be emphasized. The use of this kind of coping strategies may exert an unfavorable effect in terms of mental health, as stress can be seen as one of the most prevalent predictors for injury in team sports, notably in football.

Athletes with an approach coping style were more likely to appraise the stressful event as highly controllable, as opposed to competitors with an avoidance coping style. Following the appraisal framework of Lazarus and Folkman (1984**)** coping style is best predicted under conditions by determining the source of stress and the athlete's appraisal of the event.

Also, the significant findings between skill levels for the athletes' use of cognitive appraisal and coping style are consistent with results of former studies (Neil et al., 2011).

It is possible, that at a particular elite level of competition, athletes of both genders make cognitive appraisals and adopt coping styles that are similar and effective. The findings of this review coincide with the transactional model which recognizes the relationships between environmental demands, an individual's perceptions of these demands, and the individual's ability to handle the demands (Lazarus, 1999).

Coping dimensions applied in elite sports

In view of the coping dimensions applied in elite sports the findings of this review suggest that among the analyzed strategies of coping with stress, avoidance may be related to mental health impairments and absenteeism by contributing to psychological distress and emotional arousal, which may in turn suppress immunity.

As illness itself could serve as a socially accepted means of avoiding stressful situations, an avoidance strategy may temporarily be adaptive to cope with uncontrollable stressors.

According to Aspinwall and Taylor (1997) proactive coping involves providing the necessary resources and skills to prepare for confronting and anticipating stressors.

Also, resilience is one of the resources permitting athletes to protect their health (Sakar & Fletcher, 2014). Resilience takes on great importance to determine whether athletes will be able to go through stressful situations they are confronted with during their sports career.

The data obtained from the findings suggest that athletes with high resilience may have developed strategies that aid in mobilizing resources to permit facing up to the stressors of the context of elite sports in an active way.

According to the transactional stress theory (Lazarus, 2000) it can be assumed that being more flexible about choosing how to cope is associated with more adaptive outcomes.

It is apparent that highly skilled athletes use an array of coping techniques; there is no "best way" to cope under all conditions and that could explain why an athlete's use of coping strategies at least partially reflects his coping style.

Effectiveness of coping in terms of mental health and handling stress

The accumulation of stressors over life course in combination with sleep deprivation may limit the coping resources to deal with the demands of a stressful situation.

When coping resources are limited, individuals will typically appraise a stressful situation more as a threat. Repeated threat appraisals have been linked to deleterious health consequences (e.g., depression).

In addition, fear of failure also turned out to have a short-term impact on the athletes' psychological well-being, interpersonal behavior, sport performance, and schoolwork prompting athletes to employ both effective and ineffective coping strategies to deal with the effects of fear of failure. This finding seems to be important, as athletes who engage in ineffective coping skills to deal with their fears of failure may experience poor performance, negative emotions, a desire to withdraw from sport or to hold off from seeking help Sagar, Lavallee & Spray (2009).

Also, an increase in stressors during demanding periods of school and sporting competition in combination with chronic sleep deprivation may contribute to an increased intensity and frequency of perceived stress experienced by athletes.

Chronic sleep deprivation experienced by elite athletes may suggest that not only their recovery is impaired but also their mental health and well-being may be negatively affected.

Aside from differential schooling and sport-related demands there may undetermined athlete differences that influence the nature of coping responses. Differences in psychological maturity may explain why the tendency to employ adaptive versus maladaptive coping strategies was more closely associated with mental health in athletes.

Again, the findings are reflected in the research of Lazarus and Folkman (1984) and Hobfoll (2002). From their point of view individual resources that help to deal successfully with the demands imposed by a particular situational context (in our case the context of elite sports) determine the level and

intensity of distress experienced. That's why resources should be directed to detect early signs of mental health problems in this age group, as around 19 years of age, just after completing high school and moving from junior to senior competitions, seems to be a particularly vulnerable age for onset of mental health problems in elite athletes.

According to current literature coping self-efficacy seems to have a positive mental health effect on athletes' ability to cope with stress, supporting athletes to thus better cope with and eliminate interference caused by competitive stressors and eventually helping them to achieve their best performance and protect their mental health (Guo et al., 2019).

4.2.4 Conclusion

Coping in elite sporting settings is very complex and dynamic. This is the first systematic review that has analyzed coping strategies and their effectiveness to handle stress and to provide mental health in an elite sporting context.

Results highlight those coping strategies play an important role in understanding the handling of sport-specific and non-sport specific stressors in an athlete's professional career. There is evidence of coping being effective to buffer stress, but the interrelationships between stressor, appraisal of the stressor, application of a corresponding coping strategy, its effect especially in terms of mental health outcomes is still unclear because of lacking intervention-based study designs.

Therefore, understanding the mechanisms of the coping process and its complexity in the context of handling stress may assist in the development for future interventions. As mental health plays a key role in many functions that are necessary in a context of elite sporting, future studies may investigate strategies to cope effectively with the stressors elite athletes are confronted with, such as improving stress management techniques to avoid stress.

4.3 Potential risk factors for mental disorders in elite sport - a systematic review

4.3.1 Problem Statement

It is undisputed that sport promotes health, and that sport has been scientifically proven to be effective against various risk factors and diseases, such as obesity, high blood pressure or diabetes (Ströhle et al., 2007). Sport increases quality of life and life expectancy and has a protective and recovery-promoting effect on numerous mental illnesses (Ströhle et al., 2007; Brand & Schlicht, 2008). The benefits just mentioned apply to sporting activity that is carried out to a certain extent and within a

certain framework. In elite sports, on the other hand, athletes must take numerous risks, such as serious physical injuries, in terms of their health.

To advance to extraordinary levels of performance, elite athletes require not only distinct psychological competencies, but also excellent skills and talent in their sport (Gardner & Moore, 2006). For example, athletes must be able to withstand extreme strains in training and competition, among other things, and must also be able to recover quickly after these challenges.
Elite sport is characterized by a "culture of risk" in which athletes act permanently in two dimensions (Mayer, 2010; Thiel, Mayer & Digel, 2010):

1. Top performances are only possible with the willingness to go to the physical limit and,
2. sporting performance becomes the maxim in dealing with health in this culture of risk and physical and psychological problems are often ignored.

The assumption that elite athletes are characterized by exceptional physical and mental health compared to the general population has not yet been sufficiently proven scientifically. Rather, the question arises to what extent a sporting career in itself can be a risk factor for the development of mental disorders in athletes or whether elite sport is an expression or subjective form of coping with a mental disorder (Hoyer & Kleinert, 2010). With the help of a systematic review, the question of which potential risk factors promote the development of mental disorders in elite sport will be investigated. Based on the results obtained, a more differentiated approach to this topic can then take place and enable different scientific disciplines to be networked and to be promoted.

4.3.2 Findings

The main objective of this systematic review was the identification of risk factors that may be associated to mental disorders and therefore represent potential health risks in elite sports.

The study selection process ended with a total of 2,165 records. After analyzing titles, abstracts, and main texts, 1,508 studies were included based on the search criteria defined in advance. In the end, after sorting out duplicates and a manual search in the cross-references, 16 studies were selected for the final synthesis.
Due to the heterogeneity across other study designs and outcome variables, it was not possible to conduct a meta-analysis as part of this review.
The results of the study analysis point to the existence of health risk factors pertaining to mental disorders in elite sports. They are of a multifactorial nature, i.e., they occur in different categories.
The quality of the methodological approach of the included studies was evaluated according to the criteria proposed by Pluye et al. (2011).

3 of the studies met all criteria requested in terms of methodology and therefore were assessed to be of good reporting quality (Kristiansen & Roberts, 2010; Gulliver et al., 2012; Arthur-Cameselle, et al., 2017; Biggin, Burns & Uphill, 2017). The remaining studies (N= 13) were estimated to not correspond fully to all criteria proposed by Pluye et al. (2011).

The included studies examined elite athletes from both sexes, a broad age range (from 14 to 30+), individual (e.g., gymnastics, swimming) and team sports (e.g., soccer, hockey), and different nationalities.

Based on the current data, the occurrence of health risks in elite sports is seen in:

- female athletes
- adolescent athletes
- athletes who find themselves in a transitional stage between active athletic and professional career end phase.

The analysis of the studies included in this review confirmed that there is a theory-related differentiation of potential risk-factors that led to the following categorization.

Biological factors

In terms of biological factors both sexes represent "risk groups" in terms of the development of a pathological eating behavior, especially if a lean habitus is a competitive advantage.

Findings indicate that socio-ecological factors combined with genetic predisposition could mean a risk of mental disorders depending on sex and the type of sports. That means that numerous stress factors could be responsible for the susceptibility of elite athletes to subclinical symptoms of mental disorders (Krentz & Warschburger, 2013; Francisco et al., 2013).

Moreover, insufficient sleep and sleeping problems with different effects on performance and health have also been explored as one of the most frequent health risks in elite athletes in individual and team sports (Von Rosen et al., 2017).

Psychosocial factors

Among psychosocial factors stress is also an important variable for susceptibility to a performance pursuit of goals, showing that perfectionism is a predictor for burnout in young athletes.

In addition, there’s a hint that elite athletes are being subject to varied stressors and being confronted with associated consequences for both physical and mental health. In their study, major organizational stressors (such as training, competition load, competition environment, risk of injury, leadership style,

career, and development performance) were found to be associated to athlete burnout (Tabei et al., 2012).

Sociocultural factors

Regarding sociocultural factors (such as media attention) study findings report on concerns for elite athletes in terms of identification, development, and management of mental health issues.

According to the author's findings, athletes agreed that the general pressure that they are exposed to is the most important factor contributing to the development of mental disorders (Biggin et al., 2017). There is still a stigma inherent to the disclosure of mental health issues and to asking for help. Athletes rated stigma to be the greatest barrier to seek support.

Dual support from coaches and clinical psychologists seems to be the most appropriate source of help. Further agreement in athletes and coaches was identified concerning the role of coaches as "gatekeepers" to open the door to different sources of support. In addition, all participants agreed that more knowledge and education are required to increase the awareness and understanding of mental health risks in all parties.

Situational factors

Considering situational factors (such as early career end, defeat, or failure) female and younger athletes obviously represent "risk groups" just like those athletes who perform individual sports or have reached a point in their lives right before ending their career. The end of an athletic career is often associated with various challenges and stressors for the athletes, if athletes are forced to quit, for example, due to injuries or insufficient performance (Blakelock et al., 2016). Particularly, for younger athletes, inadequate coping strategies, insufficient support, and lack of experience in competitive situations represent a significant risk to their mental health (Kristiansen & Roberts, 2010).

Also, the relationship between athlete and coach (DeFreese & Smith, 2014) seems to be a health-influencing determinant. The crucial factor in this context is, whether the general atmosphere between athlete and coach is characterized by motivating and supportive components or destructive aspects.

Comparing the findings of DeFreese & Smith (2014) and Shanmugam & colleagues (2014), both point to the fact that the coach-athlete relationship is crucial in terms of either avoiding or fueling mental health-related problems in elite athletes. These findings also highlight the potential role of interpersonal difficulties in terms of the etiology of mental disorders, one of those being eating disorders.

Particularly in female athletes the individual perception of the body is considered a serious predictor for eating disorders (Francisco et al., 2013). Body image and parental influences were identified as the strongest predictors of low self-esteem and disordered eating in female elite athletes. This shows that these athletes are targets of additional pressure because they need to present a thin body image appropriate for the sport they perform. In addition, the results of Francisco et al. (2013) emphasize the idea that particularly aesthetic sports are associated with a higher risk for adolescent females to develop a pathological eating behavior.

According to the researchers, performance pressure in combination with a negative body image and body dissatisfaction also explain why an athlete's ability to train and compete can be compromised by injury or illness and therefore are considered to play a key role in terms of the onset of eating disorders.

4.3.3 Discussion

To the author's knowledge this systematic review is the first to analyze potential risk factors that promote the development and onset of mental disorders in elite sports in the structure mentioned in the review's theoretical framework (see fig. 2 in review 3).

In English-speaking regions research has been conducted on analyses of the prevalence of mental disorders or critical life phases in various populations for a while.

In German-speaking regions this research only recently took place (Hoyer & Kleinert, 2010). To date, only few epidemiological studies on mental disorders and stress symptoms (fear, depression, sleep problems, or substance abuse) exist in a pooled version in the target population (Gouttebarge et al., 2016; Bauman, 2016).

One observation of the studies analyzed is that there have been only few longitudinal evaluations that have been identified to be associated with mental disorders in elite athletes.

Regardless of sex, if persons are affected by any kind of mental disorder they usually suffer from additional negative health-influencing factors, such as depressive symptoms, anxious feelings, or substance addiction (Meng & D'Arcy, 2015). Currently, not much data exists on the correlation between mental disorders and the associated concomitants in elite athletes. As many of the variables identified as potential risk factors may also be consequences, e.g., in case of injury/illness (Wiese-Bjornstal, 2010; von Rosen et al., 2017) or coping strategies (Kristiansen & Roberts, 2010), it is almost impossible to separate causes from consequences.

Some of the associations observed are bidirectional, meaning that symptoms associated with a mental disorder may predict poorer psychosocial functioning in other areas of an elite athlete's life, as well,

such as starting a new relationship or having a fulfilled life after the professional athletic career (Schinke et al., 2017; Stambulova, 2017).

Current study findings indicate that various factors in the athletic context, such as injury, a high training load combined with inadequate recovery, or an upcoming end of career may increase an elite athlete's vulnerability to certain mental disorders (Gulliver et al., 2012; Stambulova, 2017).

As many of the studies analyzed tended to examine variables associated to mental disorders as separate or unconnected problems it is difficult to examine direct parallels or differences in the relevant risk factors in combination with bio-psychosocial processes involved in mental disorders (Moesch et al., 2018).

Moreover, variables such as age, sex, or type of sport (e.g., individual or team sport) have not been considered in a standardized manner (DeFreese & Smith 2014; Petito et al., 2016) and only two studies covered the aspect of using a control group (Francisco et al., 2013; Arthur-Cameselle et al., 2017).

As some of the included longitudinal studies tracked the target group only for a few weeks or months, this time span could be too short because some of the identified risk factors may have a greater impact not only in adolescence and early adulthood, but also in later adulthood (Thiel et al., 2015; Stambulova, 2017). This aspect seems to be highly important because symptoms detected during adolescence may not necessarily be predictive for developing a mental disorder in adulthood or vice versa.

Regarding career transition management, a clear differentiation between elite athletes still active as professional athletes and reflecting on retirement and those having already terminated elite sports career is required (Stambulova, 2017).

Elite athletes experience massive negative consequences due to a loss of athletic identity or even financial ruin, during the transition phase between their maximum athletic performance phase and withdrawal from elite sports. This is why and when they are even more vulnerable to other health-affecting life crises, primarily in the sense of depression or risky behavior, such as excessive alcohol intake (Reardon & Factor, 2010). Moreover, not only sex or personality, but also the relationship between coach and athlete represents evident predictors, particularly in terms of the development of a pathological eating behavior in elite athletes. However, not many details are known about the specific characteristics of the mutual influence between coach and athlete. If a supportive atmosphere is not given on the part of the coach, or if the social support from family, friends, or team members is missing, these facts are risk factors in a competitive context, which could consequently lead to health-related problems (Kristiansen & Roberts, 2010).

If match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, particularly younger athletes are more prone to sport-specific injuries and their consequences due to their riskier behavior and to develop negative health- influencing symptoms (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007). Hence, destructive coping can mean the onset of mental disorders in the target population and particularly in younger athletes (Flett & Hewitt, 2006; Appleton et al., 2009).
Therefore, it needs to become possible to identify so-called risk athletes within the framework of optimum support (Reardon & Factor, 2010).

4.3.4 Conclusion

Elite athletes' mental health challenges have gained awareness in recent years and therefore this topic calls for action. Regardless of age, elite athletes go to their individual limits, are continuously confronted with the most varied stress situations (Andersen & Williams, 1988), and therefore usually have an attitude towards their health that needs to be viewed as highly critical (Thiel et al., 2011). Because these challenges are multidimensional in nature, a comprehensive understanding of this topic's complexity is required.

Since the prevalence of mental health-related symptoms among elite athletes shows similar values as among the general population athletic activity itself does not cause mental disorders in the target group, even if carried out at a top performance level. It is necessary to examine the numerous factors in the personal, social, and athletic environment of an elite athlete as determinants for the development and onset of mental disorders.
According to Wiese-Bjornstal (2010) not only the physical challenges (e.g., risk exposure) and psychological stress ("life event stress") lead to misuse and strain of the target population's physical and mental health, but also social and ethical stressors.
The manifold theoretical knowledge about mental disorders in elite sports (Stillman, Ritvo & Glick, 2013) should elicit a more intense discussion of this subject matter and prompt active involvement of science.
Researchers and practitioners are requested to focus more on the identification of genetic, socio-ecological and gender-specific variables as well as protection factors. These function either as moderators or mediators to counteract further propagation of mental health-related symptoms and the associated consequences for elite athletes.

Looking at the complexity of the potential factors associated with mental disorders, it seems appropriate to initiate interdisciplinary research projects. These projects should aim at the analysis of somatic and other factors that influence both the physical and mental health of elite athletes.
It is therefore recommended to introduce targeted educational measures and provide intensive, comprehensive information to the athletes and their environment including society, physicians, and therapists concerning the potential danger that the performance of sports at an elite level pose to the physical and mental health of athletes (Claussen et al., 2015).

5 Discussion

The objective of the present work was to present an overview of stress and its impact on the mental health of elite athletes.
Development and publication of consensus statements and the launch of sport-specific screening tools to allow for early detection of mental health-related problems shows that the mental health of elite athletes has received greater attention in recent years (Reardon et al., 2019).
Even though elite athletes face over 600 stressors of various types and their effects on health, athletes are not able to talk openly about their stress-related issues and the consequences associated with them (Arnold & Fletcher, 2012). Elite athletes are not only exposed to their own often very high expectations, but also to harsh criticism from social media or their coaches. These forms of internal as well as external pressure can be psychologically very stressful and long-lasting. Consequently, these extreme psychological demands can end in impairments to the mental health of athletes, such as a mental disorder. Since mental health issues often accompany other health problems, it is reasonable to assume that there is a link between mental health issues and deleterious mental health outcomes, including psychological impairment and mental disorders. Of particular concern for elite athletes is the fact that high stress can impair athletic performance as well as well-being, becoming a burden on overall health (Silva et al., 2019; Asplund & Chang, 2020).
Scientific literature focusing on stress and its impact on the mental health of elite athletes reports key stress triggering factors such as critical life events, low or even lacking social support, injury, deselection, transition out of sport or maladaptive or lacking coping strategies for the development of mental health-related problems leading to mental disorders if not identified at an early stage (Rice et al., 2016; Reardon et al., 2019).

Knowledge and attitudes regarding mental health in elite sport remain low. Many coaches do not see the inclusion of mental health aspects in their work with athletes as their responsibility (Lebrun et al., 2020), which subsequently not only perpetuates a negative stigma but also leads, albeit unintentionally, to maladaptive coping mechanisms. Unhealthy coping strategies combined with fear of opening up lead athletes to not seek help. Even if athletes wanted to access support, they often do not know how or where to access it or avoid it for fear of potential consequences such as deselection or being removed from the team (Gulliver et al., 2015). However, preliminary research indicates a tendency in terms of increasing coaches' awareness of talking about mental health with their athletes (Murphy & Sullivan, 2021).
The findings are discussed as follows (a) critical reflection of the results of the conducted systematic reviews, (b) limitations of the literature analysis, (c) contribution to the theoretical framework and (d) implications for future research.

5.1 Overarching discussion of the results of the 3 systematic reviews

Within the framework of the literature analysis conducted for the three systematic reviews, questions regarding stressors (Review 1), coping strategies for coping with stress (Review 2), and risk factors leading to the development of mental disorders in elite athletes (Review 3) were examined.
All the studies reviewed in chapter 4 illustrate that the impact of stress on the mental health of elite athletes has only recently become the focus of academic research.
In the following, the results of the three literature analyses are discussed in relation to the main research question and implications for future research are derived based on different stress-strain theories using the JD-R model as an example.

5.1.1 Stress and mental health (Systematic review 1)

Which stressors (sport-specific and non-sport-specific) can be derived from elite sport? What influence do stressors have on the mental health of elite athletes?

Concerning mental health, evidence suggests that it is beneficial to elite athletes and that it has been negatively associated with stress, depression, or anxiety, and positively interrelated with psychological well-being, thriving or sleep quality (Gerber, Brand, Lang, Eliot, Holsboer-Trachsler et al., 2013).

According to the Medical and Scientific Commission of the International Olympic Committee (IOC), the protection of an athlete's health is even a primary goal (Mountjoy & Junge, 2013).
But elite sports are characterized by a health paradox: although athletes need to secure their health to continue performing at the highest levels, they continuously need to risk their health by not only performing at physical and psychological borders, but also – when necessary – practicing and competing under pain or injured (Thiel et al., 2015). The necessity to overstep limits repeatedly causes continuous stress and can result therefore in a physical and mental overload resulting in health-related problems and disorders (Schinke et al., 2017; Moesch et al., 2018).
Training and competition load, training and competition environment, travel arrangements, nutritional issues, risk of injury, leadership style, career and performance development, inadequate communication channels and role overload or critical life events appeared as major stressors to be linked to negative mental health outcomes, such as athlete burnout, depression or eating disorders (Tabei et al, 2012; Bratland-Sanda & Sundgot-Borgen, 2013). Additionally, the lack of social support from coach or related parties was identified as a stressor with consequential negative effects on the mental health of young athletes. The declaration that the coach matters to the athlete emphasizes the importance of supportive surroundings within a competitive setting (Kristiansen & Roberts, 2010; Gerber et al., 2013).
This observation corresponds to the transactional stress perspective of Lazarus & Folkman (1984), proclaiming that if existing coping strategies are accessible, stress-related challenges can be handled because the stress-triggering factors are perceived as less threatening.
Maladaptive coping by contrast may increase an athlete’s susceptibility to mental health symptoms. Therefore, young athletes are to be taught the handling of stress, as they have to carry a dual burden, fulfilling academic requirements and at the same time performing at top level in the athletic context.
In terms of mental ill-health research has to expand to reflect the interrelationship between stress and its effects on mental health within the dual career pathway of athletes. This request seems to be warranted against the background that peak performance age in elite sports in most disciplines coincides with a period in life with a peak in the onset of adult mental health disorders (Jones, 2013; Allen & Hopkins, 2015).
Furthermore, the transitional time between junior and senior phases is according to Anshel & Wells (2000) experienced as particularly stressful, because of the simultaneous demanding phases in school and job with many challenges both in athletic and non-athletic areas (Beckmann et al., 2006).

In line with the meta-model (Fletcher et al., 2006) findings of the first review indicate that particularly organisational stressors encountered by elite athletes can be associated with various outcomes (e.g., poor mental health, low well-being, or burnout) and that the on-going transactional stress process may affect elite athletes' vulnerability to any kind of stressor and in consequence influence their mental health status.
Hence, as to the researchers, it's judicious to explore the corresponding outcomes in terms of mental health to tailor preventative stress management interventions to reduce or even eliminate stressors encountered by elite athletes and to create facilitative environments that support the mental health of elite athletes.

5.1.2 Stress and coping (Systematic review 2)

Which coping strategies influencing mental health elite athletes use to manage stress?
How effective are these coping strategies for elite athletes to handle stress?
The high levels that elite athletes are required constantly to achieve best performance can result in psychosomatic stress symptoms, such as depression, anxiety or eating disorders (Rice et al., 2016). Such stress symptoms, stemming from physical as well as psychological factors, are especially detrimental to elite athletes, as they rely on their physical and mental health and functioning for performance success. An increasing body of evidence shows that elite athletes experience mental-health problems, that can be maladaptive if not treated at an early stage, as they can lead to compromised psychological and physiological functioning (Asplund & Chang, 2020).
In view of the coping dimensions applied in elite sports the findings of this review suggest that among the analyzed strategies of coping with stress, avoidance may be related to health and absenteeism by contributing to psychological distress and emotional arousal, which may in turn suppress immunity. In addition, there is evidence that avoidance could also relate to illness in terms of not taking care of oneself when one is ill (Szczypinska et al., 2021).
As illness itself could serve as a socially accepted means of avoiding stressful situations, an avoidance strategy may temporarily be adaptive to cope with uncontrollable stressors. One possible disadvantage could be that illness prevents the use of more problem- and emotion-focused strategies in terms of proactive coping. However, it can be expected that elite athletes in order to generate health and to successfully cope with the stressors they are confronted with problem-focused strategies are more likely used (Mayer & Thiel, 2014).

To prevent athletes from pain-trivializing or competing despite injuries, illness, or the pressure of elite sport the way of communication in sports networks and the role of the coach regarding establishing athlete-centered communication strategies seems to be more than mandatory (Roderick, 2006).

As social pressure is mainly generated by coaches or other team members, it can be presumed that also the perceived social support plays a decisive role regarding athletes' willingness to compete hurt or ill.

Coping strategies, such as talking to family members or friends, seeking help from a coach or mentor, or making effort to find some "time-out" also seem to be utilized by athletes in periods of increased demands in sport or school (Skein, Harrison & Clarke, 2019).

According to Fletcher & Sarkar (2012) athletes seem to be better protected from the pressures of elite sport when they were aware that social support was made available to them. This awareness suggests stress-reducing effects of social support as an important resource in dealing with stress. Situations, such as a competition, that are initially perceived as a threat or danger, can then, with the help of adequate support, rather be classified as a challenge (Freeman & Rees, 2009).

In addition to the knowledge about the positive effects of social support as a coping strategy, the results show that the aspects of psychological maturity and gender are also important in the context of coping with stress. Understanding differences in psychological maturity and gender may explain why the tendency to employ adaptive versus maladaptive coping strategies is more closely associated with mental health in athletes. Especially, if athletes are delayed in their psychological maturity, they may be less capable of using adaptive coping strategies to effectively deal stressors, including sport-specific demands, such as participating at competitions, training, and social life. Promoting mental health in sport culture requires therefore a more nuanced understanding of gender differences.

Whereas male athletes may suffer more silently with mental health-related problems, female athletes suffer for engaging in sport because female gender norms prescribe women to be sensitive, passive, and agreeable, restricting expressions of competitiveness or assertiveness common in sport. Stoic toughness masking distress behind a stoic exterior incorporated by male athletes seems to be more acceptable than emotional sensitivity, which may exacerbate mental health impairments conditioned by stress in females. This review's findings showed that, one possible explanation could be that men in comparison to women tried to preserve their image as brave and strong individuals (Krokosz & Jochaimek, 2018).

Findings are also consistent with previous sport psychology research showing that female athletes assess stressful situations as more negative compared to male athletes (Walton, Rice, Gao, Butterworth, Clements & Purcell, 2021). That could implicate that gender differences may influence an athlete's selection of coping styles and strategies and, that females are more inclined to make use of an emotion-oriented coping style, whereas men use more often active coping.
As for the essential aspects of coping in sports – cognitive appraisal and coping, it can be considered that different appraisals are coped with using different strategies.
Taken as a whole this review showed that the use of different strategies to cope with stress is of great importance to determine whether and how athletes will be able to go through stressful situations they are confronted during their sports career.
However, more research is required to confirm that the use of coping strategies might not only contribute to better sport performance but also improve elite athletes' mental health status (Fletcher & Sarkar, 2012).

5.1.3 Risk factors and mental disorders (Systematic review 3)

Which potential risk factors promote the development of mental disorders in elite athletes?
As elite athletes compete at the highest level, it has been assumed for a long time that they are immune to mental disorders. At first glance, it therefore seems to be contradictory to believe that elite athletes could be rather vulnerable to mental disorders. However, researchers have observed that these athletes do indeed experience mental health-related problems that are similar to those of non-athletes (Rice et al., 2016).
The combination of stressors unique to the athletic context plus the sensitive developmental phase (Gulliver et al., 2012) that athletes go through during their peak performance (Allen & Hopkins, 2015) is likely to amplify the athletes' increased vulnerability to the onset of mental disorders.
The results of this review point to the existence of health risk factors, being of a multifactorial nature, pertaining to mental disorders in elite sports.
Findings indicate that various factors in the athletic context, such as injury, a high training load combined with inadequate recovery, or an upcoming end of career may increase an elite athlete's vulnerability to certain mental disorders (Gulliver et al., 2012; Meeusen et al., 2013; Stambulova, 2017).

As many of the studies analyzed tended to examine variables associated to mental disorders as separate or unconnected problems it is difficult to examine direct parallels or differences in the relevant risk factors in combination with bio-psychosocial processes involved in mental disorders. This fact emphasizes the necessity to raise elite athletes' awareness of health risks, protect them early on, and make affected athletes aware of how to recognize, evaluate, and articulate potential risks to their health (Thiel et al., 2011).

Striking in the results was the fact that the coach-athlete relationship is crucial in terms of either avoiding or fueling mental health-related problems in elite athletes (DeFreese & Smith 2014; Shanmugam et al., 2014), which highlights the potential role of interpersonal difficulties in terms of the etiology of mental disorders, one of those being eating disorders.

With regard to potential risk factors promoting the development of eating disorders, particularly elite athletes of aesthetic sports seem to be targets of additional pressure because they need to present a thin body image appropriate for the sport they perform. Adolescent female athletes were more likely to develop a pathological eating behavior, as they were more susceptible to the influence of peers exhibiting disordered eating behavior, such as competitive dieting (Francisco et al., 2013).

The author's results are consistent with existing evidence that a negative body image in combination with body dissatisfaction plays a key role in terms of the onset of eating disorders (Sungot-Borgen & Torstveit, (2010); Haase, 2011; Arthur-Cameselle et al., 2017).

Not only gender or personality, but also the relationship between coach and athlete, leadership style and team atmosphere are considered potential predictors, particularly in terms of the development of a pathological eating behavior and burnout in (younger) elite athletes. However, not many details are known about the specific characteristics of the mutual influence between coach and athlete. Results are in line with findings from previous research (Davis & Jowett, 2014) confirming that if a supportive atmosphere is not given on the part of the coach, or if the social support from family, friends, or team members is missing, these facts are stressors in a competitive context, which could consequently lead to health-related problems.

It can be presumed that if match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, particularly younger athletes are more prone to develop negative health- influencing symptoms (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007). This presumption however needs further research into the relationship between match experience and repertoire of coping skills.

According to current research and in line with the author's findings, performance pressure combined with maladaptive or destructive coping strategies also explains why an athlete's ability to train and compete can be compromised by the development of negative health-influencing symptoms.
Moreover, currently, no conclusive and accurate study data has been gathered pertaining to individual sports-specific and general non-sports health-related risk factors increasing the target group's vulnerability to mental ill-health (Kuettel & Larsen, 2020). That means that due to the complexity of risk factors further longitudinal epidemiological studies are required to determine their effect on the mental health of elite athletes and to identify further potential health influencing variables.

5.2 Critical reflection of the work

All three systematic reviews follow similar methodological approaches, as detailed in chapter 4 as well as in the respective manuscripts (see **appendix A**). The limiting conditions of the respective approach have to be considered when interpreting the results. Furthermore, it must be noted that the results refer to the target group of active elite athletes and the transferability to other target groups, such as elite athletes who have ended their athletic career, should still be examined in follow-up studies. In the following, the limitations are discussed in an overarching manner.
The three systematic reviews presented in chapter 4 include only English language, peer-reviewed studies. The exclusion of non-English studies might lead to the omission of potential correlates that may be significant in terms of answering this work's research question about the impact of stress on elite athletes' mental health. Restricting the search to studies published in English language may not always be enough to influence systematic review findings (Morrison et al., 2012). Regarding the inclusion criteria "elite athlete" is not without problems, as the definition according to Swann et al., (2015) promotes the risk to exclude studies with collegiate or student-athletes and therefore to omit a crucial body of research on elite athletes' mental health. Secondly, the studies analysed in the three reviews are furthermore difficult to interpret due to the heterogeneous use of terminology and the missing clarity of definitions, for example, "stressors", "strains", "demands", "psychological factors", and "risk factors". Third, by not having included grey literature concerning stress in elite sports some important specific factors could have been missed which possibly affect elite athletes' mental health. Fourth, the use of a control group to validate outcomes was used in only a few studies:

Review 1: Newcomer & Perna, 2003; Wippert & Wippert, 2008; Fletcher, Hanton, Mellalieu & Neil, 2012,

Review 2: Gan, Anshel & Kim, 2009; Dolenc, 2015; Fogagca, 2021; Szczypinska, Samelko & Guszkowska, 2021,

Review 3: Francisco et al., 2013; Arthur-Cameselle et al., 2017.

What marks out all included studies is that they used either clear quantitative and qualitative research questions (objectives), or a clear mixed method question (objective) (Hammond et al., 2013; Tabei et al., 2012; Petito et al., 2016). The studies also allowed addressing the research question or objective with the help of the data collected.

The methodological quality criteria of precisely describing the process of participant recruitment were not consistently reported. From 84 studies most of them reported the use of validated screening instruments or questionnaires and clearly described outcomes. The aspect of ethical review was respected by all studies either by stating a participant rate or, if not available, by reporting a drop-out rate.

Due to the heterogeneity of the studies included, a standardized risk-of-bias evaluation was not performed.

Further limitations arise from the following aspects:

5.2.1 Sample characteristics

Although only studies that investigated the elite athlete population in relation to stress and mental health were included, the samples reviewed here were rather heterogeneous in terms of age, sporting level, type of sports and level of professionalization which made it rather difficult to compare findings across studies. Furthermore, the classification of elite athletes into different categories, such as members of the Olympic team, participating in competitions at an international or national level, or active at a professional level or university level (e.g., NCAA) (Swann et al., 2015), makes scientific comparison challenging. Studies often fail to describe their samples accordingly or athletes from different type of sports or different elite categories were included in the same sample (Kristiansen &Roberts, 2010; DeFreese & Smith, 2014; Wippert & Wippert, 2008).

In terms of gender, more male athletes or more team sport athletes were investigated in the studies analysed. Some authors emphasize that male professional athletes are at an increased risk of mental health-related problems due to their attitude of being mentally more though and their anxiety of disclosing their problems in case of seeking professional help (Gulliver et al., 2012; Biggin et al., 2017). Female athletes were found to be more prone to developing mental and behavioral disorders

(Krentz & Warschburger, 2013) and to exhibit higher levels of anxiety than their male participants (Dolenc, 2015).

The results revealed that biological and psychological factors contribute, often in complex ways, to influence mental health and the psychological well-being of elite athletes and that the tendency to use adaptive coping strategies is associated with a more positive health profile in adolescent (female) athletes (Cumming et al., 2012).

As the experience of stressors and coping appears to be a complex process, which is related to a multitude of variables some authors recommend taking into consideration gender, type of sport and coping skills of elite athletes and design interventions accordingly (Anshel, Sutasrso & Jubenville, 2009; Gan, Anshel & Kim, 2009; Krokosz & Jochaimek, 2018).

Elite athletes transport their uniqueness into training and competition, including their cultural background, that's why the training environment can become a mitigating factor for stress and its negative effects on an athlete's mental health status. Investigating cultural diversity could help protecting the mental health of the target group to provide suitable and appropriate support in the context of elite sport (Schinke et al., 2017; Moesch et al., 2018) (see table 5).

5.2.2 Study Design, scales and measurement instruments used

In terms of study design findings of the three reviews indicate that many of the empirical studies applied a study design from the category longitudinal design (Wippert & Wippert, 2008; Shanmugam et al., 2014; Blakelock, Chen & Prescott, 2016; Fogagca, 2021).

The time span of observation (only a few weeks or months) seems too short because some of the identified stressors, coping strategies and risk factors may have a greater impact not only in adolescence and early adulthood, but also in later adulthood (Johnson & Ivarsson, 2011; Madigan et al., 2017). This aspect seems to be highly important because stressors and risk factors detected during adolescence may not necessarily be predictive for developing mental health impairments in adulthood or vice versa.

Despite the predisposition of elite athletes for mental health-related problems, there is still minimal prospective research examining the epidemiology of variables associated to mental health-related problems in elite sports (Gulliver et al., 2012; Hammond et al., 2013; Biggin et al., 2017; Gerber et al., 2018; Nixdorf et al., 2020).

Of the total 84 included studies, 19 (approximately 23 percent) used a qualitative design (Thellwell et al., 2007; Krisitiansen & Roberts, 2010; Gulliver et al., 2012; Fletcher et al., 2012).

Qualitative studies such as interviews are characterized above all by the fact that they could help to reduce the phenomenon of social desirability, which often occurs when collecting data with the help

of questionnaires. The use of qualitative research designs will therefore enable a more detailed examination of similarities and differences among male and female athletes to foster the development of specially targeted educational and intervention programs in the context of coping with stress and optimizing mental health (Schnell et al., 2014).

In the studies of quantitative design self-reported screening instruments such as the RESTQ-Sport (Kellmann & Kallus, 2001), the GHQ-12 (Goldberg, 1972) or the EAT-26 (Garner & Garfinkel, 1979) were used to investigate the impact of stress on elite athletes' mental health. Because these screening tools originate from a clinical context and a non-peer sport context, they may not be appropriate for the target group of elite athletes.

A further problem is that researchers still use different and unrelated definitions to identify mental health-related problems and to measure the same concepts. That's why it is difficult to draw accurate comparisons across the studies analyzed in the three reviews.

Regarding the quality of quantitative studies included one could criticize that participants' self-selection may reduce the representativeness of the findings. According to Bird et al. (2018) especially stigma and mental toughness could influence an elite athlete's willingness to provide information about his own mental health status.

Fear of being seen as weak or even having to leave the team lead to underreporting of negative experiences related to one's mental health. Especially with regard to the use of self-report data, this attitude of the athletes concerned can lead to inaccuracies in the data evaluation. As long as the stigma of speaking out about possible mental health issues could be interpreted as a weakness, seeking help will be a barrier for elite athletes.

For those involved in monitoring and researching the mental health of elite athletes, decreasing this stigma may mean critically examining how mental health can be conceptualized and what alternative ways of capturing or measuring it exist.

As a result, athletes will feel more comfortable and open up more easily regarding possible mental health-related problems (Gulliver et al., 2012; Bird et al., 2018).

In addition, the use of different measurement and diagnostic tools was problematic leading to inconsistencies in terms of diagnoses and outcomes.

For example, variables such as age, gender, type of sport (e.g., individual or team sport) or effectiveness of applied coping strategies have not been considered in a standardized manner (Anshel & Anderson, 2002; Kristiansen & Roberts, 2010).

Not using standardized diagnostic criteria to allow for more reliable measurement of elite athlete perception of stress, mental health, and factors, such as the inconsistent application of measurement

and screening procedures, the theoretical approaches and research designs or the analysis of different samples (Johnson & Ivarsson, 2011; Faude et al., 2011) make precise statements on the topic difficult. Most of the measurement techniques or devices applied were not explicitly meant for the screening of stressful athletic situations, which might be since these devices have not been developed much yet except for the **Athlete Psychological Strain Questionnaire (APSQ)**. Rice and colleagues (2020**)** developed this brief screening tool to identify early signs of athlete-specific distress and potential mental health symptoms.

Due to the heterogeneity of study designs and scarce longitudinal data on athlete mental health the three reviews are not conducted as a meta-analysis. Currently, it is the lack of longitudinal research that may allow researchers to investigate in more detail the impact of numerous stressors, such as social support, maladaptive coping strategies or deficiencies in personal resources, on the mental health of elite athletes (Poucher et al., 2019).

5.2.3 Structure of the dimensions of stressors, coping strategies and risk factors

The author's attempt to structure mental health influencing factors, such as stressors, coping strategies or risk factors leading to mental health impairments into categories such as sport-specific or non-sport-specific was not without challenges as the causes of stress are multifactorial and interrelated, and it is therefore difficult to derive a clear cause-effect relationship in the context of stress and mental health. The selection of variables to be studied in the three reviews was based on the author's subjective understanding of stress-influencing factors, coping strategies, and risk factors, respectively, and the related background knowledge in the field of sport psychology and exercise science.

It is probable that more variables are associated with the impact of stress on mental health in the target population, which have not been systematically considered in the studies analyzed in this paper. These would, for example, include substance abuse (Tscholl et al., 2009; Heikinnen et al., 2011), sexual harassment (Mountjoy, Brackenridge, Arrington et al., 2016), cultural diversity and cultural migration of elite athletes and coaches (Schinke & McGannon, 2015) or training intensity (Lemyre, Roberts & Stray-Gunderson, 2007).

Additionally, some of the associations observed are bidirectional, meaning that symptoms associated with stress may predict poorer psychosocial functioning in other areas of an elite athlete's life, as well, such as starting a new relationship or having a fulfilled life after the professional athletic career (Schinke et al., 2017; Stambulova, 2017).

As many of the studies analyzed tended to examine variables associated to stress as separate or unconnected problems it is difficult to examine direct parallels or differences in the relevant

stressors, coping strategies and risk factors in combination with bio-psychosocial processes involved in mental health in an athletic context (Moesch et al., 2018).

5.2.4 Outcomes

In terms of outcomes findings of the three reviews indicate the following six as recurring with regard to elite athletes' mental health status:

Competitive and organizational stressors

Both competitive and organizational stressors turned to be salient features of elite athletes' sporting careers.

Indeed, stressors frequently occur not in isolation but in combination and elite athletes mostly encounter competitive stressors (e.g., the need to qualify for a major international competition) and simultaneously organizational stressors (such as interpersonal conflicts with management).

The findings support the assertion that elite athletes experience more stressors associated with the sport organization than with competitive performance (Hanton, et al., 2005; Thelwell, Weston & Greenlees, 2010).

Overtraining, athlete burnout and depression

Regarding the relationship between organizational stressors and dimensions of burnout specific organizational-related issues and risk factors could be identified with the incidence of burnout (Tabei et al., 2012). Findings clearly suggest that further systematic examination at the **youth, collegiate,** Olympic, and professional levels of competition is needed for **informational** and **educational** purposes on the topic of athletic training stress, elite athletes' mental health and corresponding (athlete) psychological outcomes over time (Silva III, 1990; DeFreese & Smith, 2014). Moreover, the reviews' findings showed that overtraining and athlete burnout are rather difficult to distinguish from depression as symptoms such as lack of motivation or concentration, mood swings or fatigue sometimes overlap with each other (Hammond et al., 2013; Madigan et al., 2017).

Social support

Factors related to negative social interactions seem to contribute to burnout across the competitive season (DeFreese & Smith, 2014), whereas a **good coach-athlete relationship** and **cognitive coping strategies** seem especially important for **younger athletes** to perform well and to stay mentally healthy (Kristiansen & Roberts, 2010).

Perfectionistic concerns

Perfectionistic concerns turned out to be a significant risk factor to an increased risk of injury and to have a negative impact on elite athletes' mental health status. In terms of longitudinal relationships only perfectionistic concerns predicted increases in training distress and were found to be related to athletes' mental-ill health (von Rosen et al, 2017; Madigan et al., 2017).

Disordered eating

Sport-related variables such as social pressure from sports environment, conflicts within the coach-athlete relationship, body image, desire to be leaner to improve sports performance, emotional distress from missed exercise sessions appeared as potential risk factors for disordered eating (Francisco et al., 2013). Elite athletes seem to be more at risk for disordered eating if they believe in enhancement of sports performance through weight regulation (Krentz & Warschburger, 2013; Shanmugam et al., 2014).

(Competitive) anxiety, and general emotional distress

In terms of (competitive) anxiety and emotional distress (Fletcher et al., 2012) it's important to recognize that above all, **younger athletes** do not just experience competitive anxiety in the hour preceding their event, but also because they worry about how their career is progressing in general and what significant others think of them. Other negative emotions included disappointment, distress, reproach, and resentment. These responses were often associated with a lack of control over some aspect of the organizational environment.

Findings showed that elite athletes experiencing relatively high levels of organizational stress seemed to be more susceptible to symptoms commonly associated with competitive anxiety.

That means, that also, in the context of elite sports it seems to be important to emphasize that stress should be considered from a transactional perspective (Lazarus, 1966, 1999; Lazarus & Launier, 1978) to provide an integrated framework for understanding and tackling the complexities of the stress process as a whole and to capture the relational meaning construed by an elite athlete in a competitive environment with specific stressors.

5.3 Contribution to the theoretical framework stress and the impact on mental health of elite athletes

Stress and mental health are two aspects that are meanwhile integral parts of the occupational context and that work concurrently. In elite sports, stress-related problems, and their impact on elite

athletes' mental health are often ignored or not diagnosed. Scientific evidence already suggests that elite athletes are disproportionately affected by mental health issues resulting from internal and external pressures from stress (Montero et al., 2022).

Elite athletes often identify sources of stress that go beyond those associated with the competitive event itself, such as constant public scrutiny, lack of feedback or difficulties balancing demands of the dual burden of school, university or job and a career as a professional (Cohn, 1990; Gould, Jackson, & Finch, 1993). These stressors from competition and non-competition sources result from the demanding nature of elite sports itself and can pertain to problems stemming from the interface of athletes' professionals and non-professionals lives, so-called relocation concerns (i.e., finding a suitable accommodation, adjusting to an independent living, or missing family and friends). Competitive experiences are however, only one aspect of elite sports. There is an athlete's life as a professional, such as long training hours, rehabilitation from injuries or contract negotiations which need to be considered as well when exploring stress and its impact on elite athletes' mental health status (Noblet & Gifford, 2002).

In light of the pressure to perform constantly at the highest level and the relatively short career-span of elite athletes, job insecurity was identified in recent research as a substantial stressor. Not only the time itself, but also the commitments being connected to an athlete's life as a professional limit the ability to pursue a non-sportive career.

That means that although there are various stressors experienced by all elite athletes, a comprehensive understanding of aspects contributing to job stress is essential to not overlook or misinterpret key sources of stress that are particularly damaging or negative to an athlete's mental health and performance (Sparks & Cooper, 1999).

Integration of stress-strain theories in elite sports using the JD-R model as an example

To examine the impact of stress on elite athletes' mental health status additional outcome measures such work engagement should be included in future longitudinal studies in terms of evaluation. In a further step, the development of athlete-specific models could assist to explore the impact of stress on mental health in the target group.

A first approach in this context could be the customized use of the Job-Demand-Resources model (JD-R-model) (Demerouti et al., 2001; Demerouti & Nachreiner, 2019) to examine how demands (in terms of stressors) and resources resulting from elite sport and non-sport-specific demands and resources affect the mental health of elite athletes both independently and in interaction.

The JD-R-model (Demerouti et al. 2000, 2001; Bakker & Demerouti 2007, 2014, 2017) combines research approaches of job-design theories (Rohmert & Rutenfranz, 1975) and stress theories (Selye 1956; Semmer et al., 1999) integrating both the motivational potential of work-related resources and concrete strain conditions in terms of stressors. To answer the overarching research question of this paper - which effects of stress arise regarding the mental health of elite athletes – the relationship between stress-related demands (in terms of stressors) and the resulting effects on the mental health of elite athletes, this model seems to be suitable to launch a pilot trial.

Previous research of the JD-R model not only confirmed relationships including subjective assessments of demands and resources but also examined objective condition-related measurements of demands and resources in relation to the work situation that are independent of the target individuals.

The relationships assumed in this model not only reflect tendencies of subjective representations of the work situation, but are also objectively detectable, independent of the individuals surveyed in each case.

Since studies on different populations, workplaces, and in different countries were able to confirm relationships between work-related demands and resources (Bakker & Demerouti, 2014, 2017), a high external validity as well as generalizability of the model can be assumed. The studies available so far suggest that, on the one hand, different aspects can be used to predict the (target) states of mental health-related problems and work engagement and, on the other hand, that condition-related rather than person-related prevention approaches are preferable for the prevention of mental health impairments.

With reference to the context of elite sports the participation of athletes in competitive sport, particularly at top levels, means dealing permanently with various pressures from a complex social and organizational environment. In many instances these organizations do not recognize or address sufficiently the (organizational) stressors elite athletes are confronted with (Fletcher et al., 2006). As there is still absence of (organizational) stress research in the athletic domain, the base of knowledge can be derived from research conducted in work-related settings. In line with the transactional stress conceptualization stress is seen as a relational meaning which a person construes from his or her relationship with the environment (Lazarus & Launier, 1978). Relational meaning of organizational stress combines personal characteristics of an individual and the environmental demands associated directly with the organization within which the individual is operating in an ongoing process of transaction. To explore this interplay that exists among stress-related constructs and to examine the multidirectional causality in the context of elite sport the combination of

Lazarus' transactional stress theory with models such as the JD-R- model from the occupational stress theory, offers a theoretical explanation of the relationships among stress, performance, resources, and health-related outcomes (Fletcher et al., 2006; Bakker & Demerouti, 2014; 2017). Demerouti et al. (2000, 2001) was able to show that burnout in particular is a consequence of high work demands and lack of work resources, and that lack of work engagement seems to be primarily a consequence of lack of work resources. These relationships have been demonstrated in both cross-sectional and longitudinal studies (Demerouti et al., 2009). Subsequent extensions of the JD-R model to include other indicators of health, such as sleep (Montero et al., 2022), resilience (Sarkar & Fletcher, 2014), or motivation (Lemyre et al., 2007) also appear relevant with respect to the target population under study (elite athletes). Moreover, in addition to work-related resources, personal resources and well-being seem to be interrelated and support successful adaptation to working conditions in the context of motivational processes (Xanthopoulou et al., 2009).

The assumption that work-related resources can moderate the influence of job demands in relation to the resulting stresses is consistent with the assumptions postulated in the Demand-Control Model (Karasek, 1998) and the Effort-Reward Imbalance Model (Siegrist, 1996), respectively.

Regarding elite sports environment, there is also a broad base of evidence-based knowledge concerning chronic stress perception and an imbalance between the demands of a career in competitive sport and the availability of coping resources (Sallen, Hirschmann & Herrmann, 2018). According to previous research findings, chronic stress as opposed to acute stress is associated with sustained adverse health effects (Fries & Kirschbaum, 2009). Whereas acute stress begins and ends abruptly, chronic stress is characterized by recurrent stressors with often negative or uncontrollable consequences or a lack of (adaptive) coping skills. Moreover, chronic stress perception may have its seeds in kind of default or failure of one's needs (e.g., not having success in an important competition or lack of appreciation or social support) (Hahn & Smith, 1999).

Another reason to take a closer look at the JD-R model in the research and practice of elite sports is mainly due to stress impairing the physical and mental health, well-being, and performance of elite athletes. Studies identified consequences of stress such as early dropouts from a professional sports career, prolonged impairments caused by injuries, mental disorders, and burnout induced by sport-specific and other sport-related stressors (Gustafsson, Sagar & Stenling, 2017). The findings stress research has generated in the field of elite sports warrant to develop and implement educational stress interventions based on a theoretical construct such as the JD-R model to prevent stress-related health and performance impairments of elite athletes (Breslin, Shannon, Haughey, Donnelly & Leavey, 2017; Schinke et al., 2017).

The JD-R model extends these research findings by the following statement: Depending on the activity and the characteristics typical for this activity, job-specific demands, and resources result. The so-called coping hypothesis (Bakker et al., 2007, 2010) also speaks in favor of testing the JD-R model in elite sport. It is assumed that work-related resources such as appreciation or a positive work climate have a particularly beneficial effect on the maintenance of work engagement, especially in situations characterized by high work demands. According to Bakker et al. (2010), the availability of resources such as support from colleagues or superiors, feedback on performance, or perspectives regarding career opportunities also seem to increase the enjoyment of task performance as well as affective commitment to the organization, especially in phases with very high demands (performance pressure and emotional demands). Accordingly, the availability of sufficient resources is of increased importance, especially in situations with high demands - these are found in the context of elite sport both in relation to the continuous delivery of top performance and in relation to the double burden caused by the competitive sporting career on the one hand and by completing a school or academic career on the other (Sallen, et al., 2018).

Staying healthy in elite sports is not only essential to perform on top level but also represents an enormous challenge for elite athletes. Elite athletes are confronted not only with common stressors of daily life, but also with numerous sport-specific stressors. Therefore, an important factor to cope with these stressors are one's resources. To promote effective coping, it is crucial to have resources available to meet the demands posed from an elite athlete's environment (Mayer & Thiel, 2014). For elite athletes resources are considered as a key component regarding staying healthy and withstanding strain in terms of emotional pressure engendered by stressors such as high training loads, management of injuries or expectations from sport organizations, coaches, family, or educational establishments. Against this background, it appears justified to assume that elite athletes with little resources will have difficulties staying healthy and being able to perform continuously on the highest level (Wendling, Kellison & Sagas, 2018). According to the conservation of resources (COR) theory, resources such as social support and certain personal characteristics (e.g., learned skills) are important as they enable people to be more resilient against stress and therefore can act as a safeguard to cope with different stressors (Hobfoll, 1989; 2002). As for the role of an individual's resources they are also considered in the JD-R model by viewing the individual as someone who can help shape or reshape his or her own (work) demands and resources.

One of the core ideas of this model is that an individual's state of health depends on the ability to handle external and internal demands with the means of external and internal resources. "External"

means any demands and resources that stem from the individual's environment or given structural factors, while “internal” includes any demands and resources that originate from within the individual, e.g., any kind of beliefs or personality features.

While external demands are demands, which are determined by an external system or person (e.g., the training load, academic demands, or expectations of the coach), internal demands are mostly based on individual (psychological) needs and internalized norms and values, such as perfectionism, needs satisfaction or individual expectations. Regarding resources, there are external structural resources, such as social support or financial stability, whereas internal resources include action beliefs, attitudes to life and personality traits (e.g., optimism or self-efficacy). However, it is worth mentioning that in the context of elite sports, there are some variables, which can be classified as either external or internal. This ambiguity is due to the fact, that it is not always possible to determine whether certain variables such as sleeping patterns are based on an elite athlete’s environment or internal processes (e.g., inner unrest or uptightness). Moreover, some variables constitute rather a reduced demand than a supportive resource (e.g., low stress perception outside of sport), whereas others turn out to be rather an adverse resource than an unfavorable demand such as lower willingness to make psycho-social sacrifices (Granz, Schnell, Mayer & Thiel, 2019).

The environment of elite athletes differs from that of nonathletes, not only because elite athletes have to complete high training volumes, but also, because they are exposed to permanent pressure to perform and succeed in training and competition or to deal with failure and defeats. Therefore, it is not surprising that elite athletes show higher stress levels than their nonathlete counterparts (Hoffmann, Sallen, Albert, & Richartz, 2012). For younger athletes, there is also the developmental phase with the transition into adolescence, which makes this target group particularly vulnerable to health impairments. In order to manage the tasks and demands resulting from elite sports, social support or the social environment is a key prerequisite. If athletes know they are in a "protected" and trustworthy environment, they can talk openly about possible health impairments (e.g., pain or mental problems) without having to expect negative consequences. Consequently, an intact social environment represents an important external resource for elite athletes with regard to the immense psychological and psychosocial stresses inherent in elite sport.

Athletes represent a risk group not only because of the extreme stresses associated with elite sport, but also because athletes are willing to give everything for their athletic success and make (health) sacrifices in order to continuously compete at the highest level (Mayer & Thiel, 2014; Schnell et al., 2014). However, the fact that (mental) health is an indispensable requirement in elite sports and the

basis for peak performance still seems to be given too little consideration by the athletes concerned and the corresponding coaching team.

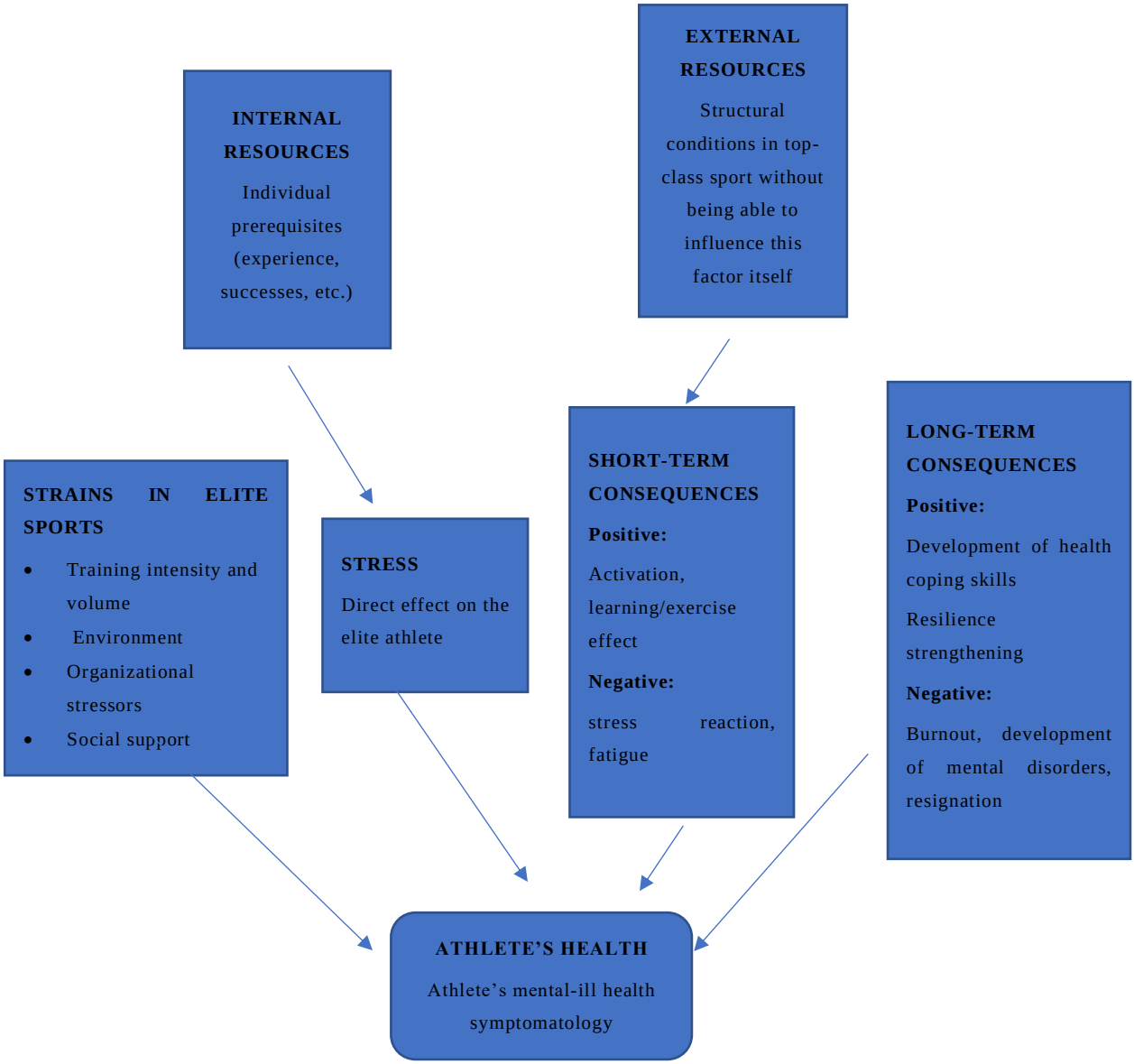

Figure 7 Relationship between stress, resources, strain, and individual health in the context of elite sports (author's own diagram)

The JD-R model, as an empirically already well-studied model, can certainly provide reliable predictions about health consequences due to stress and its interaction with resources. If subjective and objective survey methods for recording stress and the experience of stress are combined, conclusions can be drawn about the health of those affected and possible resources can be identified in addition to corresponding stress factors (Dunckel, 1999).

Within the JD-R model, demands and resources are viewed from two different process perspectives:

- Process of **health impairments**: poor work design and/or ongoing incorrect workloads lead to a decrease in physical and psychological resources of the affected persons.
- Process of **motivation**: adequate demands in combination with accessible work resources lead to high work engagement, enable further development and learning, and the achievement of appropriate work goals (Nebel-Töpfer et al., 2012).

Whether and to what extent these perspectives can also be applied to elite sports cannot be confirmed at this time.

The survey of resources and stress consequences makes sense by looking at the interplay of stress and resources and their physical and psychological consequences, as the idea of prevention can then be implemented in a more beneficial way. Furthermore, this approach also allows for a more differentiated derivation of behavioral and behavioral preventive measures (Demerouti & Nachreiner, 2019).

Despite the above mentioned advantages and even though the JD-R model has already been well studied empirically, one of its weaknesses, can be seen in terms of methodology.

The recording of working conditions is carried out by means of a person-oriented measurement, without its condition-related measurement quality having been sufficiently clarified regarding the criteria of objectivity, reliability, validity, sensitivity, and diagnostic, which is, however, indispensable for a condition-related interpretation of the research results. The clarification of the condition-related validity of the work demands and not only of the perceived or subjectively assessed ones as well as the clarification of the work resources and not only of the perceived ones should in the best case be done by a theoretical and an empirical longitudinal approach and in accordance with the specifications for the measurement of stress (DIN EN ISO 10075-3; 2004).

In the future the investigation of possible relationships between stress and mental health among elite athletes based on the JD-R model is recommended to gain a more profound insight of the complexity´ of stress and its health-related effects. Therefore, various hypotheses could be tested:

- **Hypothesis 1**: Different (work) demands, defined as physical (e.g., training), psychological (e.g., inner attitude, perfectionism), social (e.g., coach-athlete-relationship) and organizational (e.g., pressure from the federation, sponsor) require usually longer lasting physical and/or psychological strain and can therefore lead to the development of stress-related consequences for elite athletes' mental health. As the demands resulting from a career as an elite athlete are sometimes quite extreme and can exceed elite athletes' coping resources, not only an imbalance of their mental and emotional well-being, but also chronic stress or burnout turn out to be possible health impairments (Leiter & Maslach, 2000; Granz et al., 2019).

Especially for young athletes the involvement in elite sports seems to be demanding due to the double burden of academic and sport-specific requirements which can be added to the challenges of adolescence itself.

This combination of stressors unique to the sporting context and the age-sensitive developmental phase (Gulliver et al., 2012) that athletes go through during their elite sporting careers (Allen & Hopkins, 2015) are likely to exacerbate elite athletes' increased vulnerability to stress and its impact on mental health. According to Hanton, Fletcher & Coughlan (2005), it would be desirable for future research to consider the above-mentioned sources of stress to design more appropriate interventions to manage the wide range of demands placed upon elite athletes. That means that an understanding of the mechanisms and aetiologies underlying mental health issues in elite sports is necessary to develop and improve athlete-centred prevention and treatment programs (Nixdorf et al., 2020). Isoard-Gautheur, Guillet-Descas & Gustafsson, (2016), even suggested that high stress levels can foster an early dropout of elite sport. Psychological researchers and practitioners should feel called upon, in the context of stress and mental health in elite sport, to support elite athletes in the responsible management of their own health and the flexible and situational application of adequate coping strategies, thereby also identifying elite athletes being at risk of mental health-related problems and recognizing conditions making them susceptible for the development of mental disorders (Bauman, 2016; Rice et al., 2016). Necessary prerequisites for testing this hypothesis would be to use the model in cross-sectional and longitudinal studies and to conduct objective surveys of working conditions in the context of elite sport.

- **Hypothesis 2:** (Work) resources (e.g., opportunities for self-determination, participation in decision-making, feedback on performance, appreciation) and coping strategies (e.g., social support from teammates, parents, friends, communication opportunities) support the achievement of performance-related goals (1), reduce mental health-related problems (2), and stimulate personal growth and development (3).

Elite athletes are permanently challenged during their careers in terms of optimal performance. In addition to professional demands, they are confronted, for example, with an extremely high training workload, continuous pressure to perform, and a tightly scheduled competition calendar. So, it is not surprising that elite athletes have a significantly higher stress level than non-athletes (Hoffmann et al., 2012).

In order to be prepared for these challenges and demands, elite athletes need to build up resources, such as a well-functioning social support network. In this sense parents, coaches, and other staff members can have a positive influence, as the social climate of athletes contributes considerably to

an athlete's psycho-social development and formation of a positive self-concept (Tamminen, Holt & Crocker, 2012).

Following Hobfoll's theory of resources (Hobfoll & Buchwald, 2004), it therefore seems desirable to protect the mental health of elite athletes by building up or maintaining resources (Thiel et al., 2015). On top a lack of sufficient resources can make it more difficult to achieve performance-related goals and it can have a negative impact on the motivation to achieve these goals. Performance-related resources should therefore be understood as motivational incentives, since they are associated with increased motivation and commitment (Hackman & Oldham, 1980). Necessary prerequisites for testing this hypothesis would be to use the model in cross-sectional and longitudinal studies and to conduct objective surveys of working conditions in the context of elite sport.

- **Hypothesis 3**: The JD-R model predicts inverse causal relationships (exhausted athletes initially exhaust themselves even more to remain efficient; committed athletes draw on their perceived or existing resources during demanding phases). According to Granz et al. (2019) there are different risk profiles for athlete burnout in adolescent athletes: results identified groups of different levels of stress (e.g., irregularities of sleep or dietary changes) and of athlete burnout symptomatology. High-risk characteristics included for example being involved in technical or weight-dependent sports, training under a specific coach leadership style, high levels of stress perception outside of sport, lack of sleep, low willingness to make psychological sacrifices and being female. A low-risk profile is characterized by fewer training hours, low social pressure, lower stress perception outside of sport, a high willingness to make psychological sacrifices and a high health satisfaction.
- **Hypothesis 4**: The development of stress-related consequences in relation to mental health is favored by poorly designed work requirements (= stressors) according to Selye (1956). Work demands do not have to cause negative effects per se, but they can become stressors with negative consequences if coping with the demands exceeds individual action competencies and adequate recovery is no longer possible (Meijman & Mulder, 1998). In order to decipher the consequences of stress and the corresponding aspects of demands arising from elite sports it seems to be vital to teach elite athletes adequate coping skills to prevent mental health related problems. With regard to this hypothesis, it should be examined whether poorly designed (work) tasks and execution conditions in the context of elite sports foster health impairments, such as burnout.

5.4 Implications for future research

To date, stress research in elite sport related to athletes' mental health is certainly still in its infancy. Study analysis of the three systematic reviews identified gaps in the following areas (for more details see table 5):

Younger athletes

If match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, particularly younger athletes are more prone to develop negative health- influencing symptoms due to their dual burden of career and their riskier behavior and to show negative health- influencing symptoms (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007). At present, however, no conclusive and accurate study data has been gathered pertaining to individual sports-specific and general non-sports health-related behavior (Thiel et al., 2011).

Younger athletes need to become aware of the potential risks to their health and their athletic performance so that as a result they decide to seek and take advantage of professional help (Arcelus, Mitchell, Wales et al., 2011).

Career transition management

There is need for a clear differentiation between elite athletes still active as professional athletes and reflecting on retirement and those having already terminated elite sports career (Stambulova 2017). Studies found that there are significant differences regarding the prevalence of depressive symptoms and levels of traumatic stress between athletes still competing in comparison to those being forced to end their career because of injury or dismissal, and those who had not reflected on career termination (Wippert & Wippert, 2008).

Elite athletes experience massive negative consequences due to a loss of athletic identity or even financial ruin, during the transition phase between their maximum athletic performance phase and withdrawal from elite sports. This is why and when they are even more vulnerable to other health-affecting life crises, primarily in the sense of depression or risky behaviour, such as excessive alcohol intake (Reardon & Factor, 2010). Pre-planning for career transition could help to identify mental-health related problems amongst current athletes (Montero et al., 2022).

As mental health plays a key role in many functions that are necessary in a context of elite sports, future studies may investigate strategies to cope effectively with the stressors elite athletes are confronted with, such as improving stress management techniques to avoid stress.

It seems indispensable to identify exactly the effects of stress-triggering factors on the mental health of elite athletes, and in a second step to develop corresponding protective measures and preventive strategies in cooperation with the athletes and their support staff.
Therefore, it is necessary to develop an understanding of socio-demographic differences to be able to better assess the relationships between body image and gender-specific behavior from a scientific point of view, and then conceptualize appropriate interventions (Rumbold et al., 2012).
Another crucial point (Arnold et al., 2016,) should be the identification of the extent to which personality-determining characteristics and resources, such as perfectionism, self-confidence, self-esteem, resilience, practicing individual or team sports, or factors such as social support and connections have an effect as stressors, potential risk factors or protectors regarding the mental health of elite athletes. The identification of these variables should enable all parties involved to provide targeted support for the specific health needs of elite athletes. According to Arnold, Fletcher & Daniels (2016) and Kuettel & Larsen (2020) coaches and practitioners should be provided with relevant knowledge and information to be able to create an environment that supports mental health and thereby help elite athletes to keep mentally and physically well and fit.
Additionally, further suggestions for future research such as promoting and enhancing mental health literacy, development of athlete specific screening tools, integration of environmental factors can be derived from tables 8, 9, 10 and 11.

Table 8 Future perspectives

Practical implications	**What is known**	**Knowledge Gaps**
As specific athlete-centric models of care are being developed and implemented (Moesch et al., 2018), the need for **athlete-specific**, targeted **screening tools** will grow; the use of such scales may enable an early identification of mental health symptoms and provision of support to improve mental health and well-being of elite athletes (Rice et al., 2020)	Within the scope of a **holistic lifespan** perspective (Stambulova & Wylleman, 2014; Wylleman, Reints & De Knop, 2013), the athlete is viewed as a whole person, his development in terms of a multidimensional context (e.g., athletic, academic, vocational, psychological, psychosocial) and his time spent in both athletic and non-athletic domains has to be recognized	More studies are needed providing information on race, ethnicity, disability, socioeconomic status, or sexuality to help understanding mental health symptoms and disorders and what factors to address to improve mental health, be they individual, cultural, or environmental factors (Castaldelli-Maia et al., 2019; Moreland, Cox & Yang, 2018; Reardon et al., 2019)

Table 9 Future perspectives (continued)

Practical implications	**What is known**	**Knowledge Gaps**
In order to deliver improved mental health outcomes, sport organizations and mental health services need to operate in a manner that moves towards "**cultural competence**"; **mental health literacy interventions** need to be delivered in a culturally competent manner (Betancourt, Green, Carrillo & Ananeh-Firempong, 2003); strategies aimed at enhancing mental health literacy amongst elite athletes need to be delivered in a manner that is context specific and culturally competent; additionally, mental health literacy interventions need to deliver information on mental health symptoms and disorders, provide strategies to promote mental health, challenge beliefs and attitudes about mental health symptoms and disorders and remove barriers to seek support for mental health (Kutcher, Wei & Coniglio, 2016)	**Epidemiological evidence** illustrates that mental health symptoms and disorders are prevalent and a concern for athletes, coaches, and sport organizations (Gouttebarge et al., 2019; Reardon et al., 2019); Factors such as **mental disorder stigma**, **poor knowledge** of **mental health symptoms** and **disorders**, **negative past experiences** with mental health services and **busy schedules** influence elite athletes seeking treatment and learning about mental health symptoms and disorders (Castaldelli-Maia et al., 2019); **Mental health literacy interventions** have been associated with improved knowledge of mental health symptoms and disorders, increased professional knowledge, reduced stigma, improved referral confidence, and improved intentions to seek support (Breslin, Shannon, Haughey, Donnelly & Leavey, 2017)	

Table 10 Future perspectives (continued)

Practical implications	What is known	Knowledge Gaps
Career assistance focusing on helping athletes with various career issues in and outside of sport consisting of career assistance interventions, new frameworks, strategies and instruments to monitor athletes' and support providers' competencies; the most recent development in career assistance is dealing with **re-conceptualization of mental health** from seeing it only as a resource to being both a resource and an outcome of the athlete career development; this shift contributed to a new understanding of **athlete career excellence** defined as an athlete's ability to sustain a healthy, successful and long-lasting career in sport and life	**Career development and transitions** of athletes according to the ISSP Position Stand revisited (Stambulova, Ryba & Henriksen, 2021): usually, after school graduation athletes select one of the **three pathways** termed "linear" (**focus on sport**), "convergent" (**prioritizing sport but maintain studies**) and "parallel" (**sport and studies are equally important**); with regard to competing demands athletes have to plan shifts in prioritizing and search for an optimal balance between social and private life (Brown et al., 2015)	

Table 11 Future perspectives (continued)

Practical implications	**What is known**	**Knowledge Gaps**
Inter- and intra-disciplinary collaborations in support teams (e.g., mental health and other experts) are postulated to optimize athletes' mental health and to facilitate athletes' striving for career excellence (Stambulova et al., 2021)	**Student-athletes** are confronted with **multiple demands** they must meet to successfully initiate and maintain a **dual career**; inability to **cope** with these demands leads to **elevated stress**, **compromised mental health**, **burnout, and dropout.** Key factors in **successful coping** are the athletes' **personal resources** (e.g., sense of coherence, (psychological resilience) and the conditions/support provided by sport organizations, coaches, family (Stambulova et al., 2021).	Regarding the **complexity** of athletes' **career development** and **transitions** many athletic populations and contexts are still unexplored; the following challenges are postulated: (1) paying attention to **crisis-transitions, risk and protective factors** in terms of athletes' **mental health, burnout and dropouts**, (2) studying athletes' **employability competencies** moving beyond athletic career, (3) creating **international networks** to collaborate on assisting athletes in **cultural transition**, (4) focusing on **athletes' environments** to support athletes when they move from one environment to the next; further **interactions** between different **sport psychology** discourses to deepen understanding of complexity and **interrelatedness between mental health, career, performance and personal development** of diverse athletic populations (Stambulova et al., 2021).

Following the results of the present work and in accordance with the current state of research, the following questions need to be answered:

1. What is the relationship between the optimization of athletic performance and the individual biopsychosocial health of an athlete?
2. Is biopsychosocial or mental integrity at all possible at the highest level of athletic performance (Thiel et al., 2010, p. 33) (see fig. 7)?
3. What is the role of influencing factors such as sports psychological support or socioeconomic or cultural background in the context of the impact of stress on the mental health of elite athletes?

6 Concluding remarks

When analyzing the effects of stress on athlete mental health, competition and non-competition sources of stress need to be considered to identify potential health impairments.

Investing in elite athletes' mental health is about more than preventing the development and onset of mental disorders; it is also about promoting mental health and psychological well-being.
As elite athletes seem to experience not only stressors unique to high performance sports, but also a considerable overlap in the years of elite competition and the age of primary onset for mental disorders may expose them to an increased mental health risk. There is an urgent need of exploration in terms any variables that could be potential risks for the development and onset of mental disorders, particularly as affected athletes may not show all symptoms required for a formal diagnosis of any mental disorder.
The reviews' findings showed that due to the complexity of stressors, coping strategies and risk factors further longitudinal epidemiological studies are required to determine their effect on the mental health of elite athletes to identify further potential health influencing variables.
When intense physical activity performed at top level is combined with a wide array of risk factors elite athletes are confronted with during their professional career, it is likely that they will experience periods of increased vulnerability to mental health-related problems or impeded wellbeing.
Therefore, an early identification of stress- or mental health-related problems is an effective means to enable early intervention for emerging mental-ill health, as elite athletes experience periods of increased vulnerability to mental health-related problems or impeded wellbeing during their professional career.

Currently, traditional sport psychology is mainly focused on optimizing performance in a presumably healthy population, although mental health problems in elite sport have received increased attention, revealing the need for a broader mental health continuum and for more attention to the potential relationship of stressors and coping skills with well-being and mental health.
An epidemiological or comprehensive approach to understand the influence and interrelationship of stressors compromising the mental health of elite athletes and factors leading to the development and onset of mental disorders in the target group has not yet been sufficiently implemented. This is important as intense physical activity performed at elite level is combined with a wide array of stressors and risk factors elite athletes are confronted with.
Supporting elite athletes to perform continually at the highest level means that the application of appropriate coping strategies conducive to the physical and mental health of the whole athlete is essential to bolster mental health and well-being in general.

7 References

Adriaanse, M.A., Gollwitzer, P.M., De Ridder, D.T.D, De Wit, J.B.F. & Kroese, F.M. (2011). Breaking habits with implementation intentions: A test of underlying processes. *Personality and Social Psychology Bulletin, 37*, 502-512.

Allen, S.V. & Hopkins, W.G. (2015). Age of peak performance of elite athletes: a systematic review. *Sports Med 45*(10), 1431-1441.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Andersen, M.B. & Williams, J.M. (1988). A model of stress and athletic injury: Prediction and prevention. *Journal of Sport & Exercise Psychology, 10,* 294-306.

Andersen, M. B. & Williams, J. M. (1999). Athletic injury, psychosocial factors, and perceptual changes during stress. *Journal of sports sciences*, *17*(9), 735-741.

Anshel, M. H., & Wells, B. (2000). Personal and situational variables that describe coping with acute stress in competitive sport. *The Journal of social psychology*, *140*(4), 434-450.

Anshel, M., & Anderson, D. (2002). Coping with acute stress in sport: Linking athletes' coping style, coping strategies, affect, and motor performance. *Anxiety, Stress & Coping*, *15*(2), 193-209.

Anshel, M. H., Sutarso, T., & Jubenville, C. (2009). Racial and gender differences on sources of acute stress and coping style among competitive athletes. *The journal of social psychology*, *149*(2), 159-178.

Antonovsky, A. (1987). *Unraveling the mystery of health.* How people manage stress and stay well. Jossey Bass: San Fransisco.

Appleton, P.R., Hall, H.K. & Hill. A.P. (2009). Relations between multidimensional perfectionism and burnout in junior-elite male athletes. *Psychology of Sport and Exercise, 10,* 457-465.

Arcelus, J., Mitchell, A. J., Wales, J., & Nielsen, S. (2011). Mortality rates in patients with anorexia nervosa and other eating disorders: a meta-analysis of 36 studies. *Archives of general psychiatry*, *68*(7), 724-731.

Arnold, R. & Fletcher, D. (2012b). A research synthesis and taxonomic classification of the organizational stressors encountered by sport performers. *J Sport Exerc Psychol 34* (3): 397-429.

Arnold, R., Fletcher, D. & Daniels, K. (2016). Demographic differences in sport performers' experiences of organizational stressors. *Scandinavian Journal Medicine & Science in Sports, 26,* 348-358.

Arthur-Cameselle, J., Sossin, K., & Quatromoni, P. (2017). A qualitative analysis of factors related to eating disorder onset in female collegiate athletes and non-athletes. *Eating Disorders*, *25*(3), 199-215.

Aspinwall, L. G., & Taylor, S. E. (1997). A stitch in time: self-regulation and proactive coping. *Psychological bulletin*, *121*(3), 417.

Asplund, C. & Chang, C. J. (2020). The role of sleep in psychological well-being in athletes. In *Mental health in the athlete* (pp. 277-290). Springer, Cham.

Bakker, A.B., Hakanen, J.J., Demerouti, E., Xanthopoulou, D. (2007) Job resources boost work engagement, particularly when job demands are high. *J Educ Psychol 99*:274–284.

Bakker, A.B., Van Veldhoven, M.J.P.M., Xanthopoulou, D. (2010) Beyond the demand-control model: thriving on high job demands and resources. *J Pers Psychol 9*:3–16.

Bakker, A. B., & Demerouti, E. (2014). Job demands–resources theory. *Wellbeing: A complete reference guide,* 1-28.

Bakker, A.B., Demerouti, E. (2017). Job demands-resources theory: taking stock and looking forward. J *Occup Health Psychol 22*:273–285.

Bakker, A. B., Schaufeli, W.B., Leiter, M.P & Taris, T.W. (2008). Work engagement: An emerging concept in occupational health psychology. *Work & Stress, 22*(3), 187-200.

Balshem, H. H.M., Schünemann, H.J. & Guyatt, H. (2011). GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol, 64,* 401-406.

Bär, K.J. & Markser, V.Z. (2013). Sport specificity of mental disorders: the issue of sport psychiatry. *Eur Arch Psychiatry Clin Neurosci, 263* (Suppl.2), 5205-5210.

Bamberg, E., Keller, M., Wohler, C. & Zeh, A. (Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrt, Hrsg.) (2012). *BGW-Stresskonzept. Das arbeitspsychologische Stressmodell* (2. Aufl.) Zugriff am 30.06.2020. Verfügbar unter https://bgw-online.de/ShareDocs/Downloads/DE/Medientypen/Wissenschaft-Forschung/BGW08-00-000_Stresskonzept_Das_arbeitspsychologische_Stressmodell_Download.pdf?__blob=publicationFile

Bauman, N.J. (2016). The stigma of mental health in athletes: are mental toughness and mental health seen as contradictory in elite sport?. *British Journal of Sports Medicine, 50,* 135-136, originally published online November 30, 2015.

Becker, M. (2006). Die Bedeutung von Persönlichkeitseigenschaften und chronischem Stress aufgrund eines Mangels an Bedürfnisbefriedigung für gesundheitliche Beeinträchtigungen von Lehrern. *Psychologie in Erziehung und Unterricht, 53, 81-96.*

Beckmann, J. (1994). Volitional correlates of action versus state orientation. In J. Kuhl & J. Beckmann (Hrsg.). *Volition and personality. Action versus state orientation* (S. 155-166). Göttingen: Hogrefe.

Beckmann, J. & Kellmann, M. (2008). Sportpsychologische Praxis: Von der Diagnostik zu Training und Intervention. In J. Beckmann & M. Kellmann (Hrsg.), *Anwendungen der Sportspsychologie. Band 2* (S. 1-12). Göttingen: Hogrefe.

Beckmann, J. & Elbe, A.M. (2011). *Praxis der Sportpsychologie in Wettkampf und Leistungssport.* Balingen: Spitta-Verlag.

Beckmann, D. (2016). Die Bedeutung eines systemischen Coachings in den sensiblen Phasen der Talententwicklung. In T. Wörz (Hrsg.), *Talentförderung. Sensible Phasen auf dem Weg zur Weltspitze* (S. 36-42). Lengerich: Pabst.

Beckmann, J., Zier, E. & Ehrenspiel, F. (2016). *Resilience of junior athletes.* München: Manuscript Technical University.

Beckmann, J. & Ehrlenspiel, F. (2018). Strategien der Stressregulation im Leistungssport. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport*. Heidelberg: Springer, S. 417-434.

Bernacka, R. E., Sawicki, B., Mazurek-Kusiak, A., & Hawlena, J. (2016). Conforming and nonconforming personality and stress coping styles in combat athletes. *Journal of human kinetics, 51*(1), 225-233.

Betancourt, J.R., Green, A.R., Carrillo, J.E. & Ananeh-Firempong, O. (2003). Defining cultural competence. A practical framework for addressing racial/ethnic disparities in health and health care. *Public Health Reports, 118*(4), 293-302.

Biggin, I. J., Burns, J. H., & Uphill, M. (2017). An investigation of athletes' and coaches' perceptions of mental ill-health in elite athletes. *Journal of Clinical Sport Psychology, 11*(2), 126-147.

Bird, M.D., Chow, G.M., Meir, G. & Freeman, J. (2018). Student-athlete and student non-athletes' stigma and attitudes toward seeking online and face-to-face counseling. *Journal of Clinical Sport Psychology, 12*(3), 347-364.

Blakelock, D. J., Chen, M. A., & Prescott, T. (2016). Psychological distress in elite adolescent soccer players following deselection. *Journal of Clinical Sport Psychology, 10*(1), 59-77.

Borresen, J. & Lambert, M.I. (2009). The Quantification of Training Load, the Training Response, and the Effect on Performance. *Sports Med 39*, 779-795.

Borsboom, D. (2017). A network theory of mental theory. *World Psychiatry, 16*(1), 5-13.

Brand, R. & Schlicht, W. (2008). Sportpsychologische Interventionen in Therapie und Rehabilitation. In J. Beckmann & M. Kellmann (Hrsg.), *Anwendungen der Sportpsychologie* (Enzyklopädie der Psychologie, Serie V, Sportpsychologie, Teil 2, S. 609-665). Göttingen: Hogrefe.

Bratland-Sanda, S., & Sundgot-Borgen, J. (2013). Eating disorders in athletes: overview of prevalence, risk factors and recommendations for prevention and treatment. *European journal of sport science, 13*(5), 499-508.

Breslin, G., Shannon, S., Haughey, T., Donnelly, P., & Leavey, G. (2017). A systematic review of interventions to increase awareness of mental health and well-being in athletes, coaches, and officials. *Systematic reviews, 6*(1), 1-15.

Brink, M. S., Visscher, C., Arends, S., Zwerver, J., Post, W. J., & Lemmink, K. A. (2010). Monitoring stress and recovery: new insights for the prevention of injuries and illnesses in elite youth soccer players. *British journal of sports medicine, 44*(11), 809-815.

Brown, D. J., Flechter, D., Henry, L., Borrie, A., Emmett, J., Buzza, A. & Wombwell, S. (2015). A British university case study of the transitional experience of student-athletes. *Psychology of Sport and Exercise, 21*, 78-90.

Bruner, M.W., Munroe-Chandler, K.J. & Spink, K.S. (2008). Entry into elite sport: A preliminary investigation into the transition experiences of rookie athletes. *Journal of Applied Sport Psychology, 20*(2), 236-252.

Castaldelli-Maia, J.M., Gallinaro, J.G., Falcao, R.S., Gouttebarge, V., Hitchcock, M.E., Hainline, R. et al. (2019). Mental health symptoms and disorders in elite athletes: a systematic review on cultural influences and barriers to athletes seeking treatment. *Br. J. Sports Med., 53*, 707-721.

Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological bulletin*, *109*(1), 25.

Claussen, M. C., Ewers, S. M., Schnyder, U., Frey, W. O., Schmied, C., & Milos, G. (2015). Psychische Probleme und Erkrankungen im Leistungssport. In *Swiss Medical Forum* (Vol. 15, No. 45, pp. 1044-1049). EMH Swiss Medical Publishers.

Cohn, P. (1990). An exploratory study on the sources of stress and athlete burnout in youth golf. *The Sport Psychologist, 4,* 95–106.

Cresswell, S. L., & Eklund, R. C. (2007). Athlete burnout: A longitudinal qualitative study. *The sport psychologist*, *21*(1), 1-20.

Creswell, J.W. & Plano Clark, V.L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage. (Chapter 7)

Crocker, P. R., Kowalski, K. C., & Graham, T. R. (1998). Measurement of coping strategies in sport. *Advances in sport and exercise psychology measurement*, 149-161.

Cumming, S. P., Smith, R. E., Grossbard, J. R., Smoll, F. L., & Malina, R. M. (2012). Body size, coping strategies, and mental health in adolescent female athletes. *International Journal of Sports Science & Coaching*, *7*(3), 515-526.

Daumiller, M., Rinas, R., & Breithecker, J. (2022). Elite athletes' achievement goals, burnout levels, psychosomatic stress symptoms, and coping strategies. *International Journal of Sport and Exercise Psychology*, *20*(2), 416-435.

Davis, L., & Jowett, S. (2014). Coach–athlete attachment and the quality of the coach–athlete relationship: Implications for athlete's well-being. *Journal of sports sciences*, *32*(15), 1454-1464.

Davis, P., Halvarsson, A., Lundström, W., & Lundqvist, C. (2019). Alpine ski coaches' and athletes' perceptions of factors influencing adaptation to stress in the classroom and on the slopes. *Frontiers in psychology*, *10*, 1641.

DeFreese, J.D. & Smith, A.L. (2014). Athlete Social Support, Negative Social Interactions, and Psychological Health Across a Competitive Sport Season. *Journal of Sport & Exercise Psychology*, *36,* 619-630.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2000). A model of burnout and life satisfaction amongst nurses. *Journal of advanced nursing*, *32*(2), 454-464.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied psychology*, *86*(3), 499.

Demerouti, E., Le Blanc, P., Bakker, A.B., Schaufeli, W.B. (2009) Absent or present: a three-wave study on presenteeism. *Career Dev Int 14*: 50–68.

Demerouti, E., & Nachreiner, F. (2019). Zum Arbeitsanforderungen-Arbeitsressourcen-Modell von Burnout und Arbeitsengagement–Stand der Forschung. *Zeitschrift für Arbeitswissenschaft*, *73*(2), 119-130.

Deroche, T., Woodman, T., Stephan, Y., Brewer, B. W., & Le Scanff, C. (2011). Athletes' inclination to play through pain: a coping perspective. *Anxiety, Stress & Coping*, *24*(5), 579-587.

Digel, H. (2001). Ist der Hochleistungssport verantwortbar? *Leistungssport* 1(02), 09-13.

Digel, H. (2002). Sport Sociology: A comparison of competitive sport systems. *New studies in athletics*, *17*(1), 37-50.

DIN EN ISO 10075-3:2004 Ergonomische Grundlagen bezüglich psychischer Arbeitsbelastung – Teil 3: *Grundsätze und Anforderungen an Verfahren zur Messung und Erfassung psychischer Arbeitsbelastung.* Beuth, Berlin.

Dijkstra, H.P., Pollock, N., Chakraverty, R., et al. (2014). Managing the health of the elite athlete: a new integrated performance health management and coaching model. *Br J Sports Med*, *48,* 523-531.

Dolenc, P. (2015). Anxiety, self-esteem and coping with stress in secondary school students in relation to involvement in organized sports. *Slovenian Journal of Public Health*, *54*(3), 222.

Dunckel, H. (Ed.). (1999). *Handbuch psychologischer Arbeitsanalyseverfahren* (Vol. 14). vdf Hochschulverlag AG.

Edenfield, T. & Blumenthal, J. (2011). Exercise and stress reduction. In R. Contrada & A. Baum (Eds.), *The handbook of stress science* (pp. 301-319). New York: Springer.

Ehrenspiel, F., Geukes, K. & Beckmann, J. (2018). Stress, Angst und Leistung im Leistungssport. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer, S. 391-416.

Engel, G. L. (1980). The clinical application of the bio-psychosocial model. *American journal of Psychiatry*, *137,* 535-544.

Faltermaier, T. (2008). Health psychology and health promotion: Salutogenetic and competence-oriented approaches in an educational context. *Zeitschrift für Gesundheitspsychologie*, *16*(3), 123-126.

Faude, O., Kellmann, M., Ammann, T., Schnittker, R., & Meyer, T. (2011). Seasonal changes in stress indicators in high level football. *International journal of sports medicine*, *32*(04), 259-265.

Fessi, M. S., Nouira, S., Dellal, A., Owen, A., Elloumi, M., & Moalla, W. (2016). Changes of the psychophysical state and feeling of wellness of professional soccer players during pre-season and in-season periods. *Research in Sports Medicine*, *24*(4), 375-386.

Fletcher, D. & Hanton, S. (2003a). *Research in organizational stress and British Olympic athletes: Conceptual, theoretical, and practical issues.* Symposium conducted at the meeting of the British Olympic Association Psychology Advisory and Steering Group. Milton, Keynes, Uk.

Fletcher, D., Hanton, S. & Mellalieu, S.D. (2006). An organizational stress review: conceptual and theoretical issues in competitive sport. In: Hanton, S., Mellalieu, S.D., eds. *Literature reviews in sport psychology.* Hauppauge, NY: Nova Science, 321-373.

Fletcher, D. & Scott, M. (2010). Psychological stress in sports coaches: a review of concepts, research, and practice. *J Sport Sci, 28*, 127-137.

Fletcher, D., Hanton, S., Mellalieu, S. D., & Neil, R. (2012). A conceptual framework of organizational stressors in sport performers. *Scandinavian journal of medicine & science in sports*, *22*(4), 545-557.

Fletcher, D. & Sarkar, M. (2012). A grounded theory of psychological resilience in Olympic champions. *Psychology of sport and exercise*, *13*(5), 669-678.

Fletcher, D., Hanton, S., & Wagstaff, C. R. (2012). Performers' responses to stressors encountered in sport organizations. *Journal of sports sciences*, *30*(4), 349-358.

Flett, G.L. & Hewitt, P.L. (2006). Positive versus negative perfectionism in psychopathology. *Behavior Modification, 30,* 472-495.

Fogaca, J. L. (2021). Combining mental health and performance interventions: Coping and social support for student-athletes. *Journal of Applied Sport Psychology*, *33*(1), 4-19.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: study of emotion and coping during three stages of a college examination. *Journal of personality and social psychology*, *48*(1), 150.

Francisco, R., Narciso, I. & Alarcão, M. (2013). Individual and relational risk factors for the development of eating disorders in adolescent aesthetic athletes and general adolescents. *Eat Weight Disord, 18,* 403-411.

Franke, A. (2012). *Modelle von Gesundheit und Krankheit* (3. überarbeitete Aufl.). Bern: Hans Huber.

Freeman, P., & Rees, T. (2009). How does perceived support lead to better performance? An examination of potential mechanisms. *Journal of Applied Sport Psychology*, *21*(4), 429-441.

Fries, E., & Kirschbaum, C. (2009). Chronischer Stress und stressbezogene Erkrankungen. *Stress-und Schmerzursachen verstehen. Gesundheitspsychologie und-soziologie in Prävention und Rehabilitation*, 113-126.

Fuchs, R. & Schlicht, W., (Hrsg.) (2012). *Seelische Gesundheit und sportliche Aktivität*. Hogrefe, Göttingen.

Fuchs, R. & Klaperski, S. (2018). *Stressregulation durch Sport und Bewegung.* In R. Fuchs & M. Gerber (Hrsg.), Handbuch Stressregulation und Sport. Heidelberg: Springer Verlag.

Gardner, F.L. & Moore, Z.E. (2006). *Clinical sport psychology.* Champaign: Human Kinetics.

Gardner, F.L. & Moore, Z.E. (2007). *The psychology of enhancing human performance: The mindfulness-acceptance-commitment (MAC) approach.* New York: Springer.

Garner, D. M., & Garfinkel, P. E. (1979). The Eating Attitudes Test: An index of the symptoms of anorexia nervosa. *Psychological medicine*, *9*(2), 273-279.

Gerber, M. (2008). Sportliche Aktivität und Stressreaktivität: Ein review. *Deutsche Zeitschrift für Sportmedizin*, *59*(7/8), 4-10.

Gerber, M., Brand, S., Feldmeth, A.K., Lang, C., Eliot, C., Holsboer-Trachsler, E. et al., (2013). Adolescents with high mental toughness adapt better to perceived stress: A longitudinal study with Swiss vocational students. *Personality and Individual Differences, 54*(7), 808-814.

Gerber, M., Kalak, N., Lemola, S., et al., (2013). Are adolescents with hig mental toughness levels more resilient against stress? *Stress and Health: journal of the International Society for the Investigation of Stress, 29*(2), 164-171.

Gerber, M. & Schilling, R. (2017). Stress als Risikofaktor für körperlicher und psychische Gesundheitsbeeinträchtigungen. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer.

Gerber, M. & Fuchs, R. (2018). Stressregulation und Sport: Ein Überblick zum Stand der Forschung. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer, S. 3-20.

Gerrig, R.J. & Zimbardo, P.G. (2008). *Psychologie, 18., aktualisierte Auflage.* München: Pearson.

Goldberg, D. P., & Hillier, V. F. (1979). A scaled version of the General Health Questionnaire. *Psychological medicine, 9*(1), 139-145.

Gorczynski, P.F., Coyle, M. & Gibson, K. (2017). Depressive symptoms in high-performance athletes and non-athletes: a comparative meta-analysis. *British Journal of Sports Medicine, 51,* 1348-1354.

Gould, D., Jackson, S., & Finch, L. (1993). Sources of stress in national champion figure skaters. *Journal of Sport & Exercise Psychology, 15,* 134–159.

Gouttebarge, V., Aoki, H., & Kerkhoffs, G. M. (2016). Prevalence and determinants of symptoms related to mental disorders in retired male professional footballers. *J Sports Med Phys Fitness*, *56*(5), 648-54.

Gouttbarge, V., Castaldelli-Maia, J. M., Gorczynski, P., Hainline, B., Hitchcock, M.E., Kerkhoffs, G. M. … Reardon, C. L. (2019). Occurrence of mental health symptoms and disorders in current and former elite athletes: A Systematic review and meta-analysis. *British Journal of Sports Medicine*, *53*(11), 700-706.

Granz, H. L., Schnell, A., Mayer, J., & Thiel, A. (2019). Risk profiles for athlete burnout in adolescent elite athletes: A classification analysis. *Psychology of Sport and Exercise*, *41*, 130-141.

Gulliver, A., Griffiths, K.M. & Christensen, H. (2012). Barriers and facilitators to mental health help-seeking for young elite athletes: A qualitative study. *BMC Psychiatry, 12*(1), 157-171.

Gulliver, A., Griffiths, K.M., Mackinnon, A., Batterham, P.J. & Stanimirovic, R. (2015). The mental health of Australian elite athletes. *J Sci Med Sport, 18*, 255-261.

Guo, T., Ni, Y., Li, Q. & Hong, H. (2019). The Power of Faith: The Influence of Athletes' Coping Self-Efficacy on the Cognitive Processing of Psychological Stress. *Frontiers in Psychology, 10,* 1565.

Gustafsson, H., Sagar, S. S., & Stenling, A. (2017). Fear of failure, psychological stress, and burnout among adolescent athletes competing in high level sport. *Scandinavian journal of medicine & science in sports, 27*(12), 2091-2102.

Haase, A. M. (2011). Weight perception in female athletes: associations with disordered eating correlates and behavior. *Eating behaviors, 12*(1), 64-67.

Hackman J.R. & Oldham, G.R. (1980) *Work redesign*. Addison–Wesley, Reading.

Haidich, A.B. (2010). Meta-analysis in medical research. *Hippokratia Quarterly Medical Journal, 14*, 29-37.

Hahn, S. E., & Smith, C. S. (1999). Daily hassles and chronic stressors: Conceptual and measurement issues. *Stress Medicine, 15*(2), 89-101.

Hammond, T., Gialloreto, C., Kubas, H. & Davis IV, H.H., (2013). The prevalence of failure-based depression among elite athletes. *Clinical Journal of Sport Medicine, 23*(4), *273-277.*

Hänsel, F., Tietjens, M. Senske, S., Baumgärtner, S.D. & Strauß, B. (2009/10). *Stress und Wettkampfleistung in Abhängigkeit von Selbstkomplexität.* BISP-Jahrbuch-Forschungförderung.

Hanson, S.J., McCullagh, P. & Tonymon, P. (1992). The relationship of personality characteristics, life stress and coping resources to athletic injury. *J Sport Exerc Psychol, 14*, 262-272.

Hanton, S., Fletcher, D., & Coughlan, G. (2005). Stress in elite sport performers: A comparative study of competitive and organizational stressors. *Journal of Sports Sciences, 23*, 1129–1141.

Hausenblas, H., A., Symons, Downs, D., (2002). Exercise dependance: a systematic review. *Psychol Sport Exerc, 3,* 89-123.

Heikkinen, A., Alaranta, A., Helenius, I., & Vasankari, T. (2011). Dietary supplementation habits and perceptions of supplement use among elite Finnish athletes. *International journal of sport nutrition and exercise metabolism, 21*(4), 271-279.

Heinz, K., Heidenreich, T., Wenhold, F. & Brand, R. (2011). Achtsamkeit und Akzeptanz. Grundlagen und Perspektiven eines neuartigen Ansatzes sportpsychologischen Trainings für den Leistungssport. *Zeitschrift für Sportpsychologie, 18*, 145-154.

Heppner, P.P., Wampold, B.E., Owen, J., Wang, K.T. & Thompson, M.N. (2015). *Research design counseling* (4th ed.). Belmont, CA: Brooks Cole.

Henriksen, K., Schinke, R., Moesch, K., McCann, S., Parham, W.D., Larsen, C.H. & Terry, P. (2019). Consensus statement on improving mental health of high-performance athletes. *International Journal of Sport and Exercise Psychology*.

Hjendal, O., Vogel, P.A., Solem, S., et al. (2011). The relationship between resilience and levels of anxiety, depression, and obsessive-compulsive symptoms in adolescents. *Clin Psychol Psychother, 18*, 314-321.

Higgins, J. P. T., & Altman, D. G. (2008). Assessing risk of bias in included studies.

Hobfoll, S.E. (1988). *The ecology of stress*. New-York: Hemisphere.

Hobfoll, S.E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist, 44*, 513-524.

Hobfoll, S. E., Freedy, J., Lane, C., & Geller, P. (1990). Conservation of social resources: Social support resource theory. *Journal of Social and Personal Relationships, 7*(4), 465-478.

Hobfoll, S.E., Dunahoo, C.L. & Ben-Porath, Y. (1994). Gender and Coping: The dual-axis model of coping. *American Journal of Community Psychology, 22*, 49-82.

Hobfoll, S.E. (1998). *Stress, culuture, and community*. New-York: Plenum.

Hobfoll, S. E. (2002). Social and psychological resources and adaption. *Review of General Psychology, 6*, 307-324.

Hobfoll, S.E. & Buchwald, P. (2004). Die Theorie der Ressourcenerhaltung und das multiaxiale Copingmodell – eine innovative Stressidee. In P. Buchwald, C. Schwarzer & S.E. Hobfoll (Hrsg.), *Stress gemeinsam bewältigen* (S. 11-26). Göttingen: Hogrefe.

Hoffmann, K., Sallen, J., Albert, K., & Richartz, A. (2012). Chronisches Belastungserleben von Spitzensportlern. Welche Rolle spielen soziodemografische und sportliche Rahmenbedingungen? In *Menschen in Bewegung-Sportpsychologie zwischen Tradition und Zukunft*. Czwalina Hamburg.

Holt, N.L., Hoar, S. & Fraser, S.N. (2005). How does coping change with development? A review of childhood and adolescence sport coping research. *European Journal of Sport Science, 5*(1), 25-39.

Holmes, T. H., & Rahe, R. H. (1967). The social readjustment rating scale. *Journal of psychosomatic research*, *11*(2), 213-218.

Horn, T. (2011). Multiple pathways to knowledge generation: qualitative and quantitative research approaches in sport and exercise psychology. *Qualitat. Res. Sport Exerc. Health 3*, 291-304.

Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M.P., Griffiths, F., Nicolau, B., O`Cathain, A., Rousseau, M.., Vedel I. & Pluye, P. (2018). *The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers*. Education for Information (Special Issue).

Hong, Q.N. & Pluye, P. (2018a). A conceptual frameworl for critical appraisal in systematic mixed studies. *Journal of Mixed Methods Research, Advance online publication,* https://doi.org/10.1177/1558689818770058.

Hoppe, A., Bamberg, E., & Kößler, F. J. (2020). Stress und Gesundheit in der interkulturellen Arbeitswelt. *Handbuch Stress und Kultur: Interkulturelle und kulturvergleichende Perspektiven*, 1-19.

Hoyer, J., Kleinert, J. (2010). Leistungssport und psychische Störungen. *Psychotherapeutenjournal, 3,* 252-260.

Hughes, L. & Leavey, G. (2012). Setting the bar: Athletes and vulnerability to mental illness. *The British Journal of Psychiatry 200*, 95-96.

Isoard-Gautheur, S., Trouilloud, D., Gustafsson, H., & Guillet-Descas, E. (2016). Associations between the perceived quality of the coach–athlete relationship and athlete burnout: An examination of the mediating role of achievement goals. *Psychology of Sport and Exercise*, *22*, 210-217.

Ivarsson, A., Johnson, U., Lindwall, M., Gustafsson, H., & Altemyr, M. (2014). Psychosocial stress as a predictor of injury in elite junior soccer: a latent growth curve analysis. *Journal of Science and Medicine in Sport*, *17*(4), 366-370.

Ivarsson, A., Johnson, U., Andersen, M.B., Tranaeus, U., Stenling, A., Lindwall, M. (2017). Psychosocial factors and sport injuries: meta-analyses for prediction and prevention. *Sports Medicine, 42,* 353-365.

Jacobi, F., Klose, M., & Wittchen, H. U. (2004). Psychische Störungen in der deutschen Allgemeinbevölkerung: Inanspruchnahme von Gesundheitsleistungen und Ausfalltage. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 47*(8), 736-744.

Johnson, U. & Ivarsson, A. (2011). Psychological predictors of sport injuries among junior soccer players. *Scand J Med Sci Sports, (21),* 1, 29-36.

Jones, G. R., & Jones, G. R. (2013). Organizational theory, design, and change.

Jowett, G.E., Hill, A.P., Hall, H. & Curran, T. (2013). Perfectionism and junior athlete burnout: The mediating role of autonomous and controlled motivation. *Sport, Exercise, and Performance Psychology, 2* (1), 48 - 61.

Juliff, L.E., Halson, S.L. & Pfeiffer, J.J. (2015). Understanding sleep disturbance in athletes prior to important competitions. *Journal of Science and Medicine in Sport, 18,* 13-18.

Kaluza, G. (2005). Stressbewältigungstraining. In *Verhaltenstherapiemanual* (pp. 383-390). Springer, Berlin, Heidelberg.

Kaluza, G. (2018a). *Gelassen und sicher im Stress. Das Stresskompetenz-Buch: Stress erkennen, verstehen, bewältigen.* (7. Auflage). Berlin: Springer.

Kaluza, G. (2018b). *Stressbewältigung. Trainingsmanual zur psychologischen Gesundheitsanalyse.* (4. Auflage). Berlin Heidelberg: Springer.

Kallus, K.W., Kellmann, M. (2000). *Burnout in athletes and coaches*, in Hanin Y (Hrsg.): Emotions in sport. Verlag Human Kinetics, Champaign, 209- 230.

Karasek, R.A. (1998) Demand/Control Model: A social, emotional, and physiological approach to stress risk and active behaviour development. In: Stellman JM (Hrsg.) *Encyclopaedia of occupational health and safety.* ILO, Geneva, S. 34.6–34.14.

Kellmann, M. (2000). Psychologische Methoden der Erholungs-Beanspruchungs-Diagnostik. *Deutsche Zeitschrift für Sportmedizin 51*(7&8), 253-258.

Kellmann, M. & Kallus, K.W. (2001). *Recovery-stress questionnaire for athletes: User manual* Vol.1. Champaign, IL.: Human Kinetics.

Kellmann, M. (2002). Underrecovery and overtraining: Different concepts-similar impact. *Enhancing recovery: Preventing underperformance in athletes*, 3-24.

Kellmann, M. & Golenia, M. (2003). Skalen zur Erfassung der aktuellen Befindlichkeit im Sport. *Deutsche Zeitschrift für Sportmedizin, 54*(11), 329-330.

Kellmann, M. & Kallus, K.W. (2016). The recovery-stress questionnaire for athletes. In: K.W. Kallus & M. Kellmann (Hrsg.), *The recovery-stress questionnaire: User manual* (S. 16-131). Frankfurt a. M.: Pearson.

Kellmann, M., Kölling, S. & Pelka, M. (2017). Erholung und Belastung im Leistungssport. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer.

Kerdijk, C., Van der Kamp, J., & Polman, R. (2016). The influence of the social environment context in stress and coping in sport. *Frontiers in psychology*, *7*, 875.

Keyes, C.L.M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior,43(2), 207.*

Kleinert, J. (2006). Psychologische Aspekte von Sportverletzungen. In M. Tietjens & B. Strauß (Hrsg.) *Handbuch der Sportpsychologie,* S. 279-286. Schorndorf: Hofmann.

Klingenberg, I. & Süß, S. (2020). *Coping und Resilienz – Individuelle Handlungen und persönliche Eigenschaften zur Stressbewältigung.* Accessed on: 19.02.2022. Available under:10_Klingenberg, Süß_Coping, Resilienz_Einführung.pdf

Kmet, L.M., Lee, R.C. & Cook, L. (2004). Standard quality assessment criteria for evaluating primary research papers from a variety of fields. *Alberta Heritage Foundation for Medical Research*,1-28.

Kraemer, H.C., Kazdin, A.E., Offord, D.R., Kessler, R.C., Jensen, P.S. & Kupfer, D.J. (1997). Coming to terms with the terme of risk. *Archives of General Psychiatry, 54,* 337-343.

Krentz, E. M., & Warschburger, P. (2013). A longitudinal investigation of sports-related risk factors for disordered eating in aesthetic sports. *Scandinavian Journal of Medicine & Science in Sports*, *23*(3), 303-310.

Kristiansen, E. & Roberts, G.C. (2010). Young elite athletes and social support: coping with competitive and organizational stress in „ Olympic“competition. *Scandinavian Journal of Medicine & Science in Sports*, *20,* 686-695.

Krokosz, D. & Jochimek, M. (2018). Coping strategies, perception of sport risk and satisfaction with life in men and women practicing extreme sports. *Balt J Health Phys Activ*, *10*(4), 238-245.

Kuckartz, U. (2014). *Mixed Methods. Methodologie, Forschungdesigns und Analyseverfahren.* Springer VS: Wiesbaden.

Kuettel, A. & Larsen, C.H. (2020). Risk and protective factors for mental health in elite athletes: a scoping review, *International Review of Sport and Exercise Psychology*, *13*(1), 231-265.

Kutcher, S., Wei, Y., Costa, S., Gusmio, R., Skokaukas, N. & Sourander, A. (2016). Enhancing mental health literacy in young people. *European Child & Adolescent Psychiatry, 25*(6), 567-569.

Laux, P., Krumm, B., Diers, M., & Flor, H. (2015). Recovery–stress balance and injury risk in professional football players: a prospective study. *Journal of sports sciences*, *33*(20), 2140-2148.

Lazarus, R.S. (1966). *Psychological Stress and the coping process*. New York Mac Graw Hill.

Lazarus, R. S., & Launier, R. (1978). Stress-related transactions between person and environment. In *Perspectives in interactional psychology* (pp. 287-327). Springer, Boston, MA.

Lazarus, R.S. & Launier, R. (1981). Stressbezogene Transaktionen zwischen Person und Umwelt. In J.R. Nitsch (Hrsg.). *Stress: Theorien, Untersuchungen, Maßnahmen*. Bern: Huber, S. 213-259.

Lazarus, R.S. & Folkman, S. (1984). *Stress appraisal and coping*. New York: Springer.

Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.

Lazarus, R. S. (1995). Emotions express a social relationship, but it is an individual mind that creates them. *Psychological Inquiry*, *6*(3), 253-265.

Lazarus, R. S. (1999). Hope: An emotion and a vital coping resource against despair. *Social research*, 653-678.

Lazarus, R. S. (2000). Toward better research on stress and coping.

Lebrun, f. Collins, D., MacNamara, A. & Rodgers, S. (2020). Supporting young elite athletes with mental health issues: coaches' experience and their perceived role. *Sport Psychol., 34*, 43-53.

Leiter, M. P., & Maslach, C. (2000). Burnout and health. *Handbook of health psychology*, 415-426.

Lemyre, P.-N., Roberts, G. C. & Stray-Gundersen, J. (2007). Motivation, overtraining, and burnout: Can self-determined motivation predict overtraining and burnout in elite athletes? *European Journal of Sport Science*, *7*(2), 115-126.

Lindstrom, B. & Erikksson, M. (2006) Contextualising salutogenesis and Antonovsky in public health development. *Health Promotion International* vol 212, No.3, pp. 238-244.

Litwic-Kaminska, K. (2020). Types of cognitive appraisal and undertaken coping strategies during sport competitions. *International Journal of Environmental Research and Public Health*, *17*(18), 6522.

Lopez, R.L. & Levy, J.J. (2013). Student athletes' perceived barriers to and preferences for seeking counseling. *Journal of College Counseling, 16,* 19-31.

Madigan, D.J., Stoeber, J., Forsdyke, D., Dayson, M. & Passfield, L. (2017). Perfectionism predicts injury in junior athletes: Preliminary evidence from a prospective study. *Journal of Sports Sciences*.

Malcom, N. L. (2006). "Shaking it off" and "toughing it out" socialization to pain and injury in girls' softball. *Journal of contemporary ethnography*, *35*(5), 495-525.

Mayer, J. (2010). *Verletzungsmanagement im Spitzensport: eine systemtheoretisch-konstruktivistische Analyse mit Fallstudien aus den Sportarten Leichtathletik und Handball.* Hamburg: Feldhaus Edition Czwalina.

Mayer, J. & Thiel, A. (2014). Health in Elite Sports from a Salutogenetic Perspective: Athletes' Sense of Coherence. *Plos One 9* (7), e102030

Mayer, J. & Thiel, A. (2018). Presenteeism in the elite sports workplace: The willingness to compete hurt among German elite handball and track and field athletes. *Sociology of Sport 53*(1), 49-69.

McLoughlin, E., Fletcher, D., Slavich, G. M., Arnold, R., & Moore, L. J. (2021). Cumulative lifetime stress exposure, depression, anxiety, and well-being in elite athletes: A mixed-method study. *Psychology of sport and exercise*, *52,* 101823.

Meijman, T.F. & Mulder, G. (1998). Psychological aspects of workload. In: Drenth P.J., Thierry, H., de Wolff, C.J. (Hrsg.) *Handbook of work and organisational psychology*, 2. Aufl. Erlbaum, Hove, S. 5–33.

Meeusen, R., Duclos, M., Foster, C. Fry, A., Gleeson, M., Nieman, D., Urhausen, A. (2013). Prevention, diagnosis, and treatment of the overtraining syndrome: Joint consensus statement of the European College of sport science (ECSS) and the American College of sports medicine (ACSM). *European Journal of Sport Science, 13*, 1-24.

Meng, X., & D'Arcy, C. (2015). Comorbidity between lifetime eating problems and mood and anxiety disorders: Results from the Canadian Community Health Survey of Mental Health and Well-being. *European Eating Disorders Review*, *23*(2), 156-162.

Moesch, K., Kenttä, G., Kleinert, J, Quignon-Fleuret, C., Cecil, S. & Bertollo, M. (2018). FEPSAC position statement: Mental health disorders in elite athletes and models of service provision. *Psychology of Sport and Exercise, 38*, 61-71.

Moher, D.L.A., Tetzlaff, J. & Altman, D.G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med,6*: e1000097.

Montero, A., Stevens, D., Adams, R. & Drummond, M. (2022). Sleep and Mental Health Issues in Current and Former Athletes: A Mini Review. *Frontiers in Psychology, 13*.

Moreland, J. J., Coxe, K. A. & Yang, J. (2018). Collegiate athletes' mental health services utilization: A systematic review of conceptualizations, facilitators, and barriers. *Journal of Sport and Health Science, 7*(1), 58-69.

Morrison, A., Polisena, J., Husereau, D., Moulton, K., Clark, M., Fiander, M., ... & Rabb, D. (2012). The effect of English-language restriction on systematic review-based meta-analyses: a systematic review of empirical studies. *International Journal of Technology Assessment in Health Care, 28*(2), 138-144.

Mosewich, A. D., Crocker, P.R.E, Kowalski, K.C. & DeLongis, A. (2013). Applying self-compassion in sport: An intervention with women athletes. *Journal of Sport and Exercise Psychology, 35,* 514-524.

Mountjoy, M., Armstrong, N., Bizzini, L., Blimkie, C., Evans, J., Gerrard, D., ... & Van Mechelen, W. (2008). IOC consensus statement:"training the elite child athlete". *British Journal of Sports Medicine*, *42*(3), 163-164.

Mountjoy, M., & Junge, A. (2013). The role of International Sport Federations in the protection of the athlete's health and promotion of sport for health of the general population. *British Journal of Sports Medicine, 47*(16), 1023-1027.

Mountjoy, M., Brackenridge, C., Arrington, M., Blauwet, C., Carska-Sheppard, A., Fasting, K., ... & Budgett, R. (2016). International Olympic Committee consensus statement: harassment and abuse (non-accidental violence) in sport. *British Journal of Sports Medicine, 50*(17), 1019-1029.

Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V. & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: results from the World Health Surveys. *Lancet, 370,* 851-858.

Murphy, J. & Sullivan, P. (2021). Factors associated with coach-athlete conversations about mental health in intercollegiate sport. *Int J Sports Sci. Coach, 16*, 509-518.

Nebel-Töpfer, C., Wolf, S., & Richter, P. (2012). Change-Prozesse im Unternehmen—eine Herausforderung für die Prävention. *Zeitschrift für Arbeitswissenschaft*, *66*(4), 277-290.

Nédélec, M., Halson, S., Abaidia, A.E., Ahmaidi, S. & Dupont, G. (2015). Stress, Sleep and Recovery in Elite Soccer: A Critical Review of the Literature. *Sports Med*, *45,*1387-1400.

Netz, Y., Wu, M. J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: a meta-analysis of intervention studies. *Psychology and aging*, *20*(2), 272.

Neil, R., Hanton, S., Mellalieu, S. D., & Fletcher, D. (2011). Competition stress and emotions in sport performers: The role of further appraisals. *Psychology of sport and exercise*, *12*(4), 460-470.

Newcomer, R. R., & Perna, F. M. (2003). Features of posttraumatic distress among adolescent athletes. *Journal of Athletic Training*, *38*(2), 163.

Nicholls, A. R., Backhouse, S. H., Polman, R. C. J., & McKenna, J. (2009). Stressors and affective states among professional rugby union players. *Scandinavian journal of medicine & science in sports*, *19*(1), 121-128.

Nielsen, K., Nielsen, M.B., Ogbonnaya, Ch., Känsälä, M., Saari, E. & Isaksson, K. (2017). Workplace resources to improve both employee well-being and performance. A systematic revies and meta-analysis. *Work & Stress*,*31*(2), 101-120.

Nitsch, J.R. (1981). Streßtheoretische Modellvorstellungen. In. J.R. Nitsch (Hrsg.). *Stress, Theorien, Untersuchungen, Maßnahmen* (S. 52-141). Bern: Huber

Nixdorf, I., Frank, R., Hautzinger, M. & Beckmann, J. (2013). Prevalence of Depressive Symptoms and Correlating Variables among German Elite Athletes. *Journal of Clinical Sport Psychology, 7,* 313-326.

Nixdorf, I., Frank, R. & Beckmann, J. (2016). Comparison of athletes‘proneness to depressive symptoms in individual and team sports: Research on psychological mediators in junior elite athletes. *Frontiers in Psychology, 7*, 1-8.

Nixdorf, R., Beckmann, J., & Nixdorf, I. (2020). Risikoeinschätzung für depressive Syndrome anhand eines Screenings psychologischer Variablen. *Zeitschrift für Sportpsychologie, 27*(3), 95-105.

Nixon II, H.L. (1993). Accepting the Risks of Pain and Injury in Sport: Mediated Cultural Influences on Playing Hurt. *Sociology of Sport Journal, 10,* 183-196.

Nixon, H.L. (1994). Coaches' View of Risk, Pain, and Injury in Sport. With Special Reference to Gender Differences. *Sociology of Sport Journal, 11,* 79-87.

Nixon, H. L. (1996). Explaining pain and injury attitudes and experiences in sport in terms of gender, race, and sports status factors. *Journal of Sport and Social Issues, 20*(1), 33-44.

Noblet, A.J. & Gifford, S.M. (2002). The sources of stress experienced by professional Australian footballers. *Journal of Applied Sport Psychology, 14,* 1-13.

Otter, R. T., Brink, M. S., Diercks, R. L., & Lemmink, K. A. (2016). A negative life event impairs psychosocial stress, recovery and running economy of runners. *International journal of sports medicine, 37*(03), 224-229.

Pensgaard, A. M., & Ursin, H. (1998). Stress, control, and coping in elite athletes. *Scandinavian journal of medicine & science in sports, 8*(3), 183-189.

Pensgaard, A. M., Ivarsson, A., Nilstad, A., Solstad, B. E., & Steffen, K. (2018). Psychosocial stress factors, including the relationship with the coach, and their influence on acute and overuse injury risk in elite female football players. *BMJ open sport & exercise medicine, 4*(1), e000317.

Perna, F. M., & McDowell, S. L. (1995). Role of psychological stress in cortisol recovery from exhaustive exercise among elite athletes. *International Journal of Behavioral Medicine, 2*(1), 13-26.

Petito, A., Altamura, M., Iuso, S., Padalino, F. A., Sessa, F., D'Andrea, G., ... & Bellomo, A. (2016). The relationship between personality traits, the 5HTT polymorphisms, and the occurrence of anxiety and depressive symptoms in elite athletes. *PLoS One, 11*(6), e0156601.

Pike, E. C. J. & Maguire, J. A. (2003). Injury in Women's Sport: Classifying Key of „Risk Encounters ". *Sociology of Sport Journal, 20,* 232-251.

Pluye, P., Gagnon, M.P., Griffiths, F., & Johnson-Lafleur, J. (2009). A scoring system for appraising mixed methods research and concomitantly appraising qualitative, quantitative, and mixed methods primary studies in mixed studies reviews. *International Journal of Nursing Studies, 46*(4), 529-546.

Pluye, P., Robert, E., Cargo, M., Bartlett, G., O' Cathain, A., Griffiths, F. et al., (2011). *Proposal: A Mixed Methods Appraisal Tool for systematic mixed studies reviews.* Retrieved September 10, 2022, from http://mixedmethodsappraisaltoolpublic.pbworks.com

Pluye, P. (2013). Critical appraisal tools for assessing the methodological quality of qualitative, quantitative, and mixed methods studies included in systematic mixed studies reviews. *Journal of Evaluation in Clinical Practice*, *19*(4), 722.

Poucher, Z.A., Tamminen, K.A., Kerr, G. & Cairney, J. (2019). A Commentary on Mental Health Research in Elite Sport. *Journal of Applied Sport Psychology.*

Purcell, R., Gwyther, K. & Rice, S.M. (2019). Mental health in elite athletes: increased awareness requires an early intervention framework to respond to athletes needs. *Sports Med Open* 5, 46.

Raedeke, T.D. (1997). Is athlete burnout more than just stress? A sport commitment perspective. *Journal of Sport & Exercise Psychology*, *19,* 396-417.

Reardon, C.L. & Factor, R.M. (2010). Sport psychiatry: a systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Med, 40,* 961-980.

Reardon, C.L., Hainline, B., Aron, C.M. et al. (2019). Mental health in elite athletes: International Olympic Committee consensus statement (2019). *Br J Sports Med, 53,* 667-699.

Reif, J.A.M., Spieß, E. & Stadler, P. (2018). Effektiver Umgang mit Stress. Gesundheitsmanagement im Beruf. In F.C. Brodbeck, E. Kirchler & R. Roschée (Hrsg.), *Die Wirtschaftspsychologie.* Berlin: Springer, S. 1-176.

Reimann, S. & Pohl, J. (2006). Stressbewältigung. In B. Renneberg & P. Hammelstein (Hrsg.), *Gesundheitspychologie*, 217-226. Heidelberg: Springer Medizin.

Renner, B. (2003). Hindsight bias after receiving self-relevant health risk information: A motivational perspective. *Memory*, *11*(4-5), 455-472.

Ressing, M., Blettner, M. & Klug, S.J. (2009). Systematic literature reviews and meta-analyses part 6 of a series on evaluation of scientific publications. *Deutsches Ärzteblatt international, 106*,456-463.

Rice, S., M., Purcell, R., De Silva, S. et al. (2016). The mental health of elite athletes: a narrative systematic review. *Sports Med, 46,* 1333-1353. Springer International Publishing.

Rice, S.M., Parker, A.G., Mawren, D., Clifton, P., Harcourt, P., Lloyd, M. et al. (2019). Preliminary psychometric validation of a brief screening tool for athlete mental health among male elite athletes: the athlete psychological strain questionnaire. *Int J Sport Exerc Psychol, 18*(6), 850-865.

Rice, S., Olive, L., Gouttebarge, V., Parker, A.G., Clifton, P., Harcourt, P., & Purcell, R. (2020). Mental health screening: severity and cut-off point sensitivity of the Athlete Psychological Strain Questionnaire in male and female elite athletes. *BMJ Open Sport & Exercise Medicine, 6*(1), e000712.

Richartz, A., Hoffmann, K. & Sallen, J. (2009). *Kinder im Leistungssport. Chronische Belastungen und protektive Ressourcen.* Schorndorf: Hofmann.

Richter, P. & Hacker, W. (1998). *Belastung und Beanspruchung: Stress, Ermüdung und Burnout im Arbeitsleben.* Kröning: Asanger Verlag.

Richter, G. (2000). Psychische Belastung und Beanspruchung-Stress, psychische Ermüdung, Monotonie, psychische Sättigung. *Schriftenwerke der Bundesanstalt für Arbeitsschutz und Arbeitsmedizin,* Fa 36. Bremerhaven: Wirtschaftsverlag NW.

Roderick, M. (2006). Adding insult to injury: Workplace injury in English professional football. *Sociology of Health & Illness, 28,* 76-97.

Rohmert, W. & Rutenfranz, J. (1975). *Arbeitswissenschaftliche Beurteilung der Belastung und Beanspruchung an unterschiedlichen industriellen Arbeitsplätzen.* Bonn: Bundesministerium für Arbeit und Sozialordnung.

Rohmert, W., (1984). Das Belastungs-Beanspruchungs- Konzept. *Z Arb Wiss 38, 193*-200.

Rumbold, J., Fletcher, D. & Daniels, K. (2012). A systematic review of stress management interventions with sport performers. *Sport, Exercise, and Performance Psychology, 1*(3), 173-193.

Sabato, T.M., Walch, T.J. & Caine, D.J. (2016). The elite young athlete: strategies to ensure physical and emotional health. *Journal of Sports Medicine, 7*, 99-113.

Sagar, S. S., Lavallee, D., & Spray, C. M. (2009). Coping with the effects of fear of failure: A preliminary investigation of young elite athletes. *Journal of Clinical Sport Psychology, 3*(1), 73-98.

Sallen, J., Hirschmann, F., & Herrmann, C. (2018). Evaluation and adaption of the Trier Inventory for Chronic Stress (TICS) for assessment in competitive sports. *Frontiers in psychology*, *9*, 308.

Sallen, J. (2018). Stress-Resistenz Trainings für Topathleten. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer, S. 505-535.

Sarkar, M. & Fletcher, D. (2014). Psychological resilience in sport performers: Review of stressors and protective factors. *Journal of Sports Science, 32*(15), 1419-1434.

Schaal, K., Tafflet, M., Nassif, H., Thibault, V., Pichard, C., Alcotte, M., ... & Toussaint, J.F. (2011). Psychological balance in high level athletes: gender-based differences and sport-specific patterns. *PLoS One, 6* (5), e19007.

Schaper, N. (2019). Wirkungen der Arbeit. In F.W. Nerdinger, G. Blickle &N. Schaper (Hrsg.), *Arbeits- und Organisationspsychologie*, 573-600. 4. Auflage. Berlin Heidelberg: Springer.

Schinke, R. J., & McGannon, K. R. (2015). Cultural sport psychology and intersecting identities: *An introduction in the special section*.

Schinke, R.J., Stambulova, N.B., Si, G. & Moore, Z. (2017). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology*, *16*(6), 1-18.

Schlicht, W. (1989). Belastung, Beanspruchung und Bewältigung. Erster Teil: Theoretische Grundlagen. *Sportpsychologie, 3*(2),10-17.

Schnell, A., Mayer, J., Diehl, K., Zipfel, St. & Thiel, A. (2014). Giving everything for athletic success! – Sport specific risk acceptance of elite adolescent athletes. *Psychology of Sports and Exercise, 15,* 165-172.

Sebbens, J., Hassmén, P., Crisp, D. & Wensley, K. (2016). Mental Health in Sport (MHS): Improving the Early Intervention Knowledge and Confidence of Elite Sport Staff. *Front. Psychol., 7*, 911.

Secades, X. G., Molinero, O., Salguero, A., Barquín, R. R., de la Vega, R., & Márquez, S. (2016). Relationship between resilience and coping strategies in competitive sport. *Perceptual and motor skills, 122*(1), 336-349.

Selye, H. (1956). *The stress of life.* New York: McGraw-Hill.

Semmer, N., Zapf, D., Dunckel, H. (1999) Instrument zur stressbezogenen Tätigkeitsanalyse (ISTA). In: Dunckel, H. (Hrsg.) *Handbuch psychologischer Arbeitsanalyseverfahren. Mensch, Technik, Organisation,* Bd. 14. vdf, Zürich, S. 179–20.

Semmer, N.K. & Zapf, D. (2018). Theorien der Stressentstehung und –bewältigung. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer, S. 23-50.

Shanmugam, V., Jowett, S. & Meyer, C. (2014). Interpersonal difficulties as a risk factor for athletes' eating psychopathology. *Scandinavian Journal of Medicine & Science in Sports, 24*,469-476.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of occupational health psychology*, *1*(1), 27.

Siegrist, J. (2017). Soziale Stressoren und stressbedingte Erkrankungen. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport.* Heidelberg: Springer.

Silva III, J. M. (1990). An analysis of the training stress syndrome in competitive athletics. *Journal of applied sport psychology*, *2*(1), 5-20.

Silva, A., Narciso, F.V., Rosa, J.P., Rodrigues, D.F., da Silva Cruz, A.Ä., Tufik, S. et al. (2019). Gender differences in sleep patterns and sleep complaints of elite athletes. *Sleep Sci., 12,* 242-248.

Skein, M., Harrison, T. & Clarke, D. (2019). Sleep characteristics, sources of perceived stress and coping strategies in adolescent athletes. *Journal of sleep research*, *28*(4), e12791.

Smith, R. E., Schutz, R. W., Smoll, F. L., & Ptacek, J. T. (1995). Development and validation of a multidimensional measure of sport-specific psychological skills: The Athletic Coping Skills Inventory-28. *Journal of sport and exercise psychology*, *17*(4), 379-398.

Soligard, T., Schwellnus, M. Alonso, J.M. et al. (2016). How much ist too much? (Part 1) International Olympic Commitee consensus statement on load in sport and risk of injury. *Br J Sports Med, 50,* 1030-1041.

Sparks, K., & Cooper, C. (1999). Occupational differences in the work-strain relationship: Towards the use of situation-specific models. *Journal of Occupational and Organizational Psychology*, *72,* 219–228.

Stambulova, N. B., & Ryba, T. V. (2014). A critical review of career research and assistance through the cultural lens: towards cultural praxis of athletes' careers. *International review of sport and exercise psychology*, *7*(1), 1-17.

Stambulova, N. B. & Wylleman, P. (2014). Athletes' career development and transitions. In A. Papaioannou & d. Hackfort (Eds.), *Routledge companion to sport and exercise psychology* (pp. 605-621). London, UK: Routledge.

Stambulova, N. B. (2017). Crisis-transitions in athletes: Current emphases on cognitive and contextual factors. *Current opinion in psychology*, *16*, 62-66.

Stambulova, N. B., Ryba, T. V. & Henriksen, K. (2021). Career development and transitions of athletes: the international Society of Sport Psychology Position Stand Revisited. *International Journal of Sport and Exercise Psychology*, *19*(4), 524-550.

Stein, D.J., Philips, K.A., Bolton, D., Fulford, K.W.M., Stadler, J.Z. & Kendler, K.S. (2010). What is a mental/psychiatric disorder? From DSM-IV to DSM-V. *Psychological Medicine 40*(11), 1759-1765.

Stieglitz, R.D. & Baumann, U. (1994). *Psychodiagnostik psychischer Störungen*. Enke, Stuttgart.

Stillman, M. A., Ritvo, E. C., & Glick, I. D. (2013). *11 Psychotherapeutic treatment of Athletes and their significant others.*

Stöhle, A., Höfler, M., Pfister, H., Müller, A.G., Hoyer, J., Wittchen, H.U. et al. (2007). Physical activity and prevalence and incidence of mental disorders in adolescents and young adults. *Psychological Medicine, 37,* 1657-1666.

Stoll, O., & Ziemainz, H. (2003). Stress and coping with stress in competitive sport. *Sportwissenschaft*, *33*(3), 280-290.

Stoll, O., & Ziemainz, H. Stress und Stressbewältigung im Sport–Theoretische Überlegungen zur Anwendung allgemeinpsychologischer Stresstheorien auf sportpsychologische Fragestellungen im Leistungssport.

Sungot-Borgen, J. & Torstveit, M.K. (2010). Aspects of disordered eating continuum in elite high-intensity sports. *Scandinavian Journal of Medicine & Science in Sports, 20* (Suppl. 2), 112-121.

Swann, Ch., Moran, A. & Piggott, D. (2015). Defining elite athletes: issues in the study of expert performance in sport psychology. *Psychology of Sport and Exercise, 16*, 3-14.

Szczypińska, M., Samełko, A. & Guszkowska, M. (2021). Strategies for coping with stress in athletes during the COVID-19 pandemic and their predictors. *Frontiers in Psychology*, 498.

Tabei, Y., Fletcher, D., & Goodger, K. (2012). The relationship between organizational stressors and athlete burnout in soccer players. *Journal of Clinical Sport Psychology*, *6*(2), 146-165.

Tamminen, K.A. & Holt, N.L. (2010). A meta-study of qualitative research examining stressor appraisals and coping among adolescents in sport. *Journal of Sport Science, 28,* 1563-1580.

Taylor, K., Chapman, D., Cronin, J., Newton, M.J. & Gill, N. (2012). Fatigue monitoring in high performance sport: A survey of current trends. *Journal of Australian Strength and Conditioning, 20*(1), 12-23.

Teubel, T., Hoffmann, A., Bernert, S., Lau, A. et al. (2010). Zum Umgang mit psychischen Erkrankungen im Leistungs- und Spitzensport – eine kritische Betrachung. *Leistungssport, 5*,24-28.

Thatcher, J., & Day, M. C. (2008). Re-appraising stress appraisals: The underlying properties of stress in sport. *Psychology of sport and exercise*, *9*(3), 318-335.

Thelwell, R., Weston, N. J., & Greenlees, I. (2010). Coping with stressors in elite sport: A coach perspective. *European journal of sport science*, *10*(4), 243-253.

Thiel, A., Mayer, J. & Digel, H. (2010). *Gesundheit im Spitzensport. Eine sozialwissenschaftliche Analyse.*[Health in Elite Sports. An Analysis from a Social Sciences Perspective]. Schorndorf: Hoffmann.

Thiel, A., Diehl, K., Giel, K.E., Schnell, A., Schubring, A., Mayer, J., Zipfel, S. & Schneider, S. (2011). *The German Young Olympic Athletes' Lifestyle and Health Management Study (GOAL Study): design of a mixed method study.*BMC Public Health11(1):410.

Thiel, A. (2014). Spitzensport und Gesundheit - eine Risikokultur im Fokus. *Dtsch Z Sportmed., 65,* 147-148.

Thiel, A., Schubring, A., Schneider, S., Zipfel, S. & Mayer, J. (2015). Health in Elite Sports – a „Bio-Psycho-Social"Perspective. *Dtsch Z Sportmed 66,* 241-247.

Tscholl, P., Feddermann, N., Junge, A., & Dvorak, J. (2009). The use and abuse of painkillers in international soccer: data from 6 FIFA tournaments for female and youth players. *The American journal of sports medicine*, *37*(2), 260-265.

Von Rosen, P., Frohm, A., Kottorp, A., Fridén, C. & Heijne, A. (2017). Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scandinavian journal of medicine & science in sports*, *27*(12), 2059-2069.

Walton, C. C., Rice, S., Gao, C. X., Butterworth, M., Clements, M., & Purcell, R. (2021). Gender differences in mental health symptoms and risk factors in Australian elite athletes. *BMJ open sport & exercise medicine*, *7*(1), e000984.

Wegner, B. (2016). Licht ins Dunkel-Analyse im BGM. In M.A. Pfannstiel & H. Mehlich (Hrsg.), *Betriebliches Gesundheitsmanagement. Konzepte, Maßnahmen, Evaluation*, 341-360. Wiesbaden: Springer.

Wendling, E., Kellison, T. B., & Sagas, M. (2018). A conceptual examination of college athletes' role conflict through the lens of conservation of resources theory. *Quest, 70*(1), 28-47.

Wheatley, S., Khan, S., Székely, A.D., Naughton, P.D., Petróczi, A. (2012). Expanding the female athlete triad concept to address a public health issue. *Performance Enhancement & Health, 1,* 10-27.

White, R.L., Babic, M.J., Parker, P.D., Lubans, D.R., Astell-Burt T. & London, C. (2017). Domain-Specific physical activity and mental health: A meta-analysis. *American Journal of Preventive Medicine, 52,* 653-666.

Whiteford, H.A., Degenhardt, I., Rehm, I. et al. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet, 382,* 1575-1586.

Wiese-Bjornstal, D. M., Smith, A. M., & LaMott, E. E. (1995). A model of psychologic response to athletic injury and rehabilitation. *Athletic training: sports health care perspectives*, *1*, 16-30.

Wiese-Bjornstal, D.M., (2010). Psychology and socio-culture affect injury risk, response, and recovery in high-intensity athletes: a consensus statement. *Scandinavian Journal of Medicine & Science in Sports, 20,* 103-111.

Wiese, D.M. & Weiss, M.S. (1987). Psychological rehabilitation and physical injury: Implications for the sports medicine team, *The Sport Psychologist, 1,* 318-330.

Wippert, P. M., & Wippert, J. (2008). Perceived stress and prevalence of traumatic stress symptoms following athletic career termination. *Journal of Clinical Sport Psychology*, *2*(1), 1-16.

Wolfenden, L. E., & Holt, N. L. (2005). Talent development in elite junior tennis: Perceptions of players, parents, and coaches. *Journal of applied sport psychology*, *17*(2), 108-126.

World Health Organization (WHO) (1948). *Constitution of the World Health Organization*. Geneva, Switzerland.

World Health Organization (WHO) (2001). The World Health Report: *Mental health: New Understanding, New Hope*. World Health Organization, Geneva, Switzerland.

World Health Organization (WHO) (2005). *Promoting Mental Health: Concepts, Emerging Evidence, Practice*. WHO in Collaboration with the Victorian Health Promotion Foundation and University of Melbourne. Geneva: WHO Press.

World Health Organization (WHO), (2010). *Depression*. Retrieved from: www.who/int./mental_health/management/depression/definiton/en/

World Health Organization. (2019). *ICD-11: International classification of diseases* (11th revision). Retrieved from https://icd.who.int/

Wylleman, P., Reints, A. & De Knop, P. (2013). A developmental and holistic perspective on athletic career development. In P. Sotiaradou & V. De Bosscher (Eds.), *Managing high performance sport* (pp. 159-182). New York, NY: Routledge.

Xanthopoulou, D., Bakker, A.B., Demerouti, E., Schaufeli, W.B. (2009) Reciprocal relationships between job resources, personal resources, and work engagement. *J Vocat Behav 74*:235–244

Yi, J. P., Smith, R. E., & Vitaliano, P. P. (2005). Stress-resilience, illness, and coping: a person-focused investigation of young women athletes. *Journal of behavioral medicine*, *28*(3), 257-265.

Ziemainz, H., Stoll, O., Drescher, A., Erath, R., Schnipfer, M., Zeuler, B., (2013). Die Gefährdung zur Sportsucht in Ausdauersportarten. *Dtsch Z Sportmed*, *64*, 57-64.

8 Indexes

9 List of abbreviations

APA	American Psychiatric Association
APSQ	Athlete Psychological Strain Questionnaire
COR	Conservation of Resources Theory
CSE	Coping Self Efficacy
EAT-26	Eating Attitudes Test
GHQ-12	General Health Questionnaire
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
ICD	International Statistic Classification of Diseases and Related Health Problems
IOC	International Olympic Committee
JD-R-Model	Job-Demand Resources Model
MAC	Mindfulness-Acceptance-Commitment Approach
PICO	Patient, Intervention, Comparison, Outcome
REST-Q	Recovery Stress Questionnaire Sport
SMHAT-1	Sports Mental Health Assessment Tool 1
WHO	World Health Organization

10 Appendix

Appendix A: Manuscripts of the 3 systematic reviews

Stress and its impact on mental health in elite sports – a systematic review

Abstract

Background
Elite athletes live in a "culture of risk": due to the effect of stress and stressors, athletes risk their mental health for their athletic career. This justifies the necessity of analyzing in a holistic and integrative manner the impact of stress and the potential stressors occurring in elite sports.
Objective
This systematic review analyzes the current state of knowledge described in scientific literature concerning the effect of stress and sports-specific and non-sports-specific stressors on elite athletes' mental health.
Methods
To obtain a clear understanding of the current state of knowledge, a systematic electronic literature search based on the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was conducted in Pubmed and PsychInfo, as well as in Google Scholar and via manual search. Both quantitative and qualitative studies published up to June 2020 were considered, all of them dealing with stress and potential stressors associated with effects on the mental health of elite athletes.
Results
After the screening process 34 studies were included. Three categories of stressors emerged from the findings: Training- and competition-specific and organizational stressors, dispositional, personal stressors and critical life events and situation-specific stressors. The main findings suggested that stress has an effect on elite athletes' mental health.
The consequences of stress and the challenges for the mental health of elite athletes become evident in health impairments such as burnout, depressive symptoms, changes in terms of the recovery-stress state, injuries, or sleep disturbances.
Conclusion
According to current scientific knowledge, evidence-based research on stress and its effects on mental health in the population under study is still scarce but shows nonetheless that elite athletes are not immune to health-impairing effects of stress.
Against the background of the complexity of the relationship between stress and mental health in elite sports, further research on stress and its effects on mental health is needed.
High-quality epidemiological intervention studies should consider the dynamics of stress in elite sports.

Keywords: elite athletes, stress, stressor, categories, mental health, effects

Author: Barbara Nuetzel, Eberhard Karls University Tuebingen, Tuebingen, Germany

1 Introduction

Stress is a crucial topic in today's society. Negative effects on mental health have increasingly been proven to be direct consequences of stress. This development is at least in part due to the major changes taking place in the working world, making complete human adaptation basically impossible (Hoppe, Bamberg & Kößler, 2020). However, stress is widely spread not only in the working environment, but also in elite sports, where it is recognized as an increasingly frequent aspect (Fletcher, Hanton & Mellalieu, 2006). Basically, stress is not a negative state, but if it is perceived negatively or seen as a threat or danger, physical and mental consequences might ensue (Lazarus & Folkman, 1984). If stress is perceived strongly and negatively, physical, and mental consequences might ensue (Kaluza, 2018).

Athletes are confronted with various sources of stress in their elite careers. If stressors stemming from these sources of stress reoccur frequently, they can increase the risk of situational stress becoming chronic stress with all the negative consequences. These may include depressive states, sleeping disorders, or increased susceptibility to injury (Kellmann, 2002a).

In addition to stress, the danger to mental health is another challenge (Kaluza, 2018).

However, looking at the IOC medical guidelines, the protection of health must be of the highest priority (Mountjoy et al., 2008) for an athlete. Within the context of elite sports, the term "health" is tantamount to maximum physical performance. To reach the top and competitive goals, elite athletes often cannot avoid situations that might be a danger to their mental health (Hoyer & Kleinert, 2010).

Despite their existence, health problems in elite sports are still mostly viewed from a biomedical perspective. A multi-disciplinary approach that analyzes stressors affecting elite athletes' health is still missing. No scientific evidence exists that might prove - in the sense of a cause-effect chain - the occurrence of epidemiological factors pertaining to the mental health of elite athletes (Hoyer & Kleinert, 2010). Stress and its specific effects on an elite athlete's mental health are also not known very well. In contrast to stress research at the workplace (Schmidt, Neubach & Heuer 2007), during which correlations were identified between work-related stressors and negative effects on mental health, no sports-psychological research of the stress process in elite sports has been conducted, e.g., focusing on stressor characteristics or situations perceived as stress by affected athletes (Arnold & Fletcher, 2012).

Schinke et al. (2017) and Stambulova (2017) see a possible explanation in the fact that elite athletes are confronted with numerous sports-specific stressors, among them injury-related pain, a tense relationship with coaches or team members, or the imminent end of their athletic career. The combination of stressors in elite sports and age makes athletes susceptible to health impairments (Gulliver, Griffiths & Christensen, 2012; Allen & Hopkins, 2015). Due to intense mental and physical demands within an elite athlete’s sports career, the peak age for impairment of mental health overlaps with the peak competitive years for elite athletes and in most disciplines peak performance age coincides with a peak in the onset of adult mental health impairments (Jones, 2013).

Stress and its effects exact a significant influence on the mental health of elite athletes in terms of their sensitization concerning health risks (Arnold & Fletcher, 2012; Arnold, Fletcher & Daniels, 2017).

However, not only sports-related stressors trigger stress in elite athletes, but also their daily lives with its demands and events.

To date, however, not much is known about the effect of these stressors on the mental health of elite athletes. A possible explanation for the lack of research could be the large number of qualitative studies. This type of research delivers targeted information on the persons interviewed, but it does not allow any conclusion pertaining to a causality between the variables analyzed, such as stress or health. Considering this background, the call for alternative types of data collection is justified in

order to be able to analyze and identify in more detail not only stressors typical in elite sports, but also aspects such as intensity, prevalence, or timing of stress occurrences.
The exact stress process as well as the influence of personal development (e.g., self-confidence) and situation-specific stressors (e.g., social support) on the individual stress management of elite athletes still pose questions for sports-psychology research, which cannot be answered based on the research conducted to date (Fletcher et al., 2006; Fletcher & Scott, 2010).
Focusing on identifying the relationship between stress, stressors, and related effects on mental health in elite sports populations, this systematic review intends to answer the following questions:

Which stressors (sports-specific and non-sports-specific) in elite sports can be derived from literature?
Which effect do stressors have on elite athletes' mental health?

To answer these questions, the current state of evidence is going to be analyzed concerning elite athletes' individual stressors within the context of mental health.

2 Theoretical backgrounds

The following section will try to clarify and explain the terms elite athlete, mental health, stress, stressors, and the integration of the term "stress" into the transactional stress model (Lazarus & Folkman, 1984). These terms are relevant to this systematic review.

2.1 Elite athlete

The variety and complexity of factors that may be a danger to mental health persist not only in the general populace, but also in specific groups of the population, such as elite athletes.
Swann, Moran & Pigott (2015) categorize "elite athletes" as semi-elite, competitive-elite, successful-elite, and World-class elite athletes.
These authors recommend the definition of samples of elite athletes along a continuum of "eliteness" or "expertise". The definition is to be based on an athlete's highest standard of performance, the success at that level, and the amount of experience gained at that level. Taking into consideration these aspects, the following classification is proposed according to Swann et al. (2015):

- Semi-elite athlete: highest level of participation is below the highest possible standard in their sport
- Competitive-elite athlete competes at the highest level in their sport, but so far without any success at that level
- Successful-elite athlete competes at the highest level and has experienced (infrequent) success at that level
- World-class elite athlete experiences sustained success at the highest level with repeated wins over a prolonged period of time

2.2 Mental health

Even though the term "health" has to date not been unambiguously defined (Franke, 2010), the WHO definition is used as the basis of discussion in this systematic review. Mental health is the ability and motivation to lead a socially active and autonomous life in terms of one's own health, to

cope with normal life, work productively, and contribute actively to society (WHO, 2001; 2005). This definition shows that mental health is a prerequisite for the realization of one's own potential and the implementation of one's role in society, profession, and family.
Remaining healthy as in maintaining or even optimizing both physical and mental health, as well as understanding the health-related behavior of elite athletes is therefore of the highest priority in the context of elite sports (Schnell et al., 2014; Mayer & Thiel, 2014; Schinke et al., 2017).

2.3 Stress and stressors

In general, stress develops if persons consider the coping strategies and resources available to them to be insufficient for performing their tasks (Richter, 2000). This personal, negative evaluation concerning coping strategies and skills lets them experience the stressful situation negatively. Consequently, stress-related short-, medium-term, and long-term health reactions ensue, starting with problems to focus all the way to critical health-related behavior and mental issues (Richter, 2000).
Stress in elite sports occurs before, during, and after competitions and needs to be understood as an individual response to strain triggered by both external stressors (such as pressure from the coach) and internal stressors (such as personal expectations, perfectionism) (Scanlan & Passer, 1979). Stress is neither seen as a pure event nor as a response, but as a process consisting of interdependent and interconnected variables (Gill, 1994). Each stimulus that causes a physiological or psychological reaction that exceeds in its kind, duration, and intensity that what is required for coping with the situation is considered a stressor (Franks, 1994).

2.4 The transactional stress model

The still most-defining model explaining the development of stress (see fig.1) is the transactional stress model (Lazarus & Folkman, 1984). It describes stressors as objective strain and stress as a subjectively experienced state of stress. Its key elements are the processes that result from the subjective evaluation of the stressor in terms of its threat and of one's own coping options. With regard to the evaluation processes in elite sports, factors originating in the environment and the individual personality are relevant, as well.

In the athletic context this means that identical stressors in two athletes with different personal preconditions can result in diverging effects and consequences in terms of performance and health. The individual cognitive and emotional constitution pertaining to a given requirement has a significant influence on whether and how intensively neuroendocrine stress responses are triggered (Kaluza, 2005).

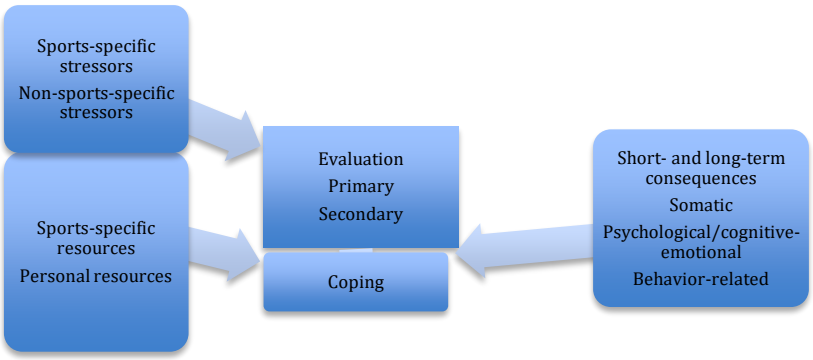

Figure 1: *Extension of the transactional stress model in the context of elite sports (author's own diagram based on Bamberg et al., 2012, p. 12)*

3 Methods

This systematic review is based on (PRISMA) guidelines (Moher et al., 2015; Moher, Liberati, Tetzlaff, Altman, & Prisma group, 2009) that serve the generation of systematic reviews and meta-analyses. It is important to note that the PRISMA guidelines were developed mainly for reporting on quantitative studies focusing on healthcare provision, such as study designs of randomized control experiments. The PRISMA explanation was, however, used as a guideline for this review, and relevant recommendations were implemented as much as possible in the sense of methodological strictness and quality.
This review analyzes studies containing quantitative, qualitative, and mixed data and results, i.e., it represents a systematic mixed study overview (Pluye & Hong, 2014).

3.1 Search strategy

The following process was applied to identify documents relevant to this overview: (1) Search in two electronic databases (PubMed, PsychInfo); (2) handsearch in various scientific journals; (3) complementary search in Google Scholar to ensure that no studies were overlooked. Table 1 shows the search terms used. They were comprehensive on purpose to ensure an overview of sports-specific and non-sports-specific stressors and their impact on the mental health of elite athletes. To minimize the risk of missing relevant studies the publishing date was not restricted. Literature search for this systematic review took place between February and June 2020.

Table 1: *Search terms for the literature search*

Database	**Search terms**
Pubmed, PsychInfo	["stress"] OR ["stress predictor"] OR ["stress predictors"] OR ["stress-related strain"] OR ["stress-related strains"] OR ["stress-related demand"] OR ["stress-related demands"] OR ["stress-related pressure"] OR ["stress-related pressures"] OR ["stress exposure"] OR ["stress-related tension"] OR ["stress-related tensions"] OR ["perception of stress"] OR ["sources of distress "] OR ["sources of negative stress"] OR ["psychological predictor of stress"] OR ["psychological predictors of stress"] AND ["mental health"] OR ["mental health effect"] OR ["mental health effects"] OR ["health effect"] OR ["mental health effects"] AND ["elite sports"] OR ["high performance sports"] OR ["high-level performance sports"] OR ["competitive sports"] OR ["high-level performance athlete"] OR ["high-level performance athletes"] OR ["elite athlete"] OR ["elite athletes"] OR ["competitive athlete"] OR ["competitive athletes"] OR ["high-intensity athlete"] OR ["high-intensity athletes"] OR ["professional athlete"] OR ["professional athletes"]
Google Scholar, manual search, cross-references	Initial search from reference list of key papers retrieved in original search
	Elite athlete distress, elite athlete stressors, elite athlete stress-related tension, elite athlete stress-related pressure, elite athlete perception of stress, elite athlete sources of stress

3.2 Inclusion and exclusion criteria

Inclusion criteria for each phase of the study selection were defined in advance. The following inclusion criteria were specified: (a) the studies were published in English; (b) the contributions were original articles; (c) the studies were available in full text; (d) the studies examined the effect of stressors on mental health; and (e) elite athletes were defined as either members of the Olympic team, participating in competitions at an international or national level, or active at a professional level or university level (e.g. NCAA) (Swann, Moran & Piggott, 2015).
Studies were excluded from this review if (a) they did not refer to elite athletes; (b) the test persons were below 12 years of age; (c) data on the study population or main findings and outcomes were missing; (d) only stressors were analyzed without considering their effects; (e) only the abstract was available; and (f) the studies were cross-sectional because they did not allow any deductions pertaining to stress effects preferably on mental health (lack of causality)/if the relationship between stressors and outcome was not analyzed.

3.3 Viewing and selecting articles

Selection of articles for this review consisted of three steps (see fig. 2). The author analyzed all matches based on title or abstract first. If the information contained therein did not suffice, the relevant full text was consulted, as well. In each phase, articles not complying with the inclusion criteria were excluded with the relevant explanations (please contact the initial author for specifics).

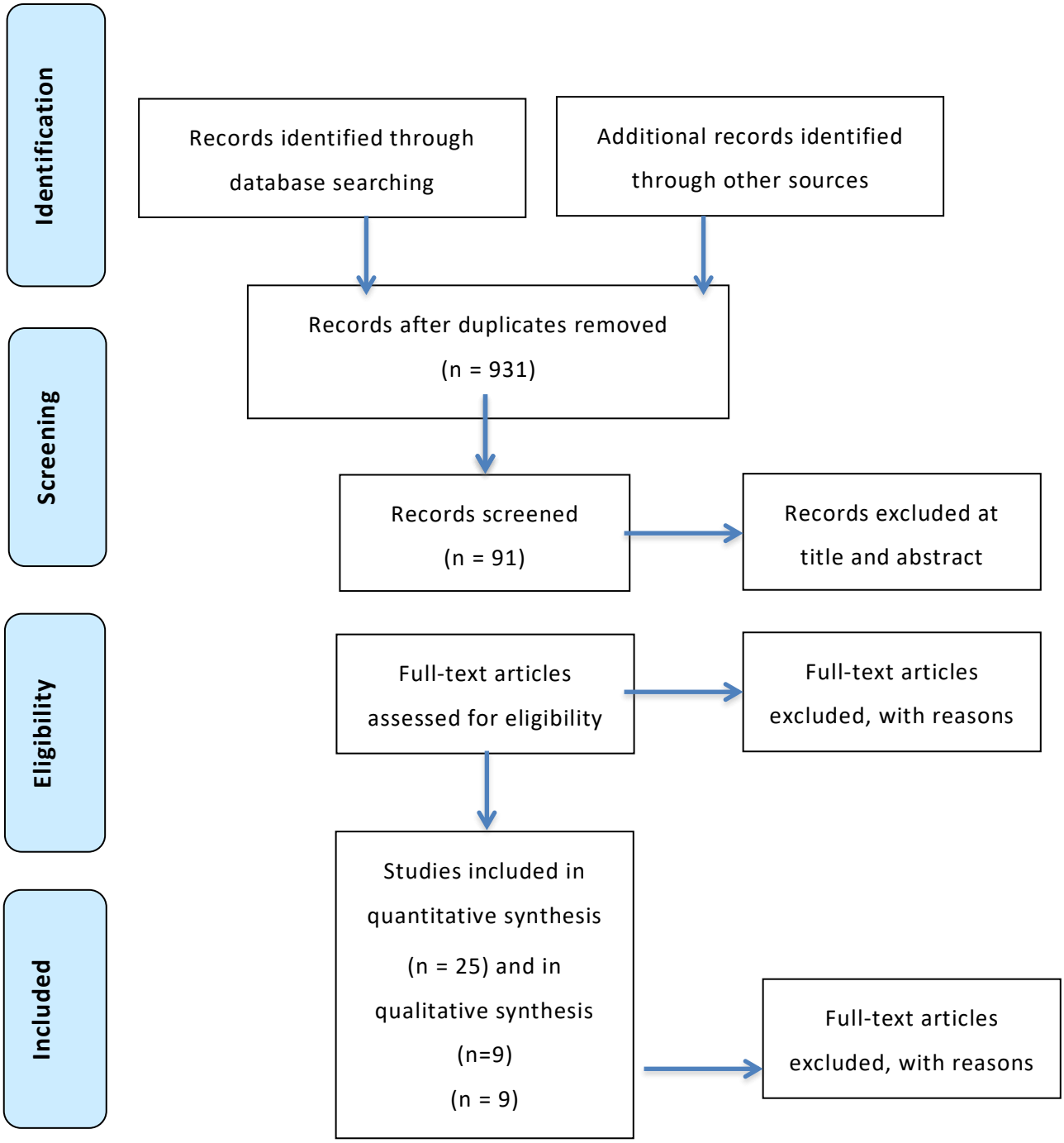

Figure 2: *Study selection flow chart*

3.4 Data extraction, synthesis of study results, and quality appraisal

The first step in data analysis is reading each study several times to become familiar with the research context, results, and conclusions.
Extracted data comprises information on the study's objective, participants, gender distribution, methodology, tools, and key results (see table 2 and 3).
In accordance with the PRISMA protocol, due to the heterogeneity of the study designs included, a "risk-of-bias" evaluation was performed based on the Mixed Method Appraisal Tools (MMAT;

Pluye et al., 2011, see table 4). MMAT has become an effective tool for systematic reviews in terms of quality assessment of studies within the context of sports psychology (Gröpel & Mesagno, 2017; Souto et al., 2015).
However, it is important to consider that MMAT is used exclusively for the assessment of methodological quality based on previously defined criteria. It does not make any deductions pertaining to the overall quality of a research piece.
A standardized risk-of-bias evaluation was not conducted because of the aforementioned heterogeneity and the omission of controlled, randomized trials. The decision in favor of MMAT is explained by its excellent "inter-rater reliability" (Pluye & Hong, 2014) and its value as a highly reliable quality assessment tool within the framework of mixed-methods research (Crowe & Sheppard, 2011).
Due to the heterogeneity across other study designs and outcome variables, it was impossible to conduct a meta-analysis as a part of this review.

4 Results

4.1 Literature identification

Research in the PsychINFO and Pubmed databases resulted in a total of 252 hits. Additional studies were identified by means of the Google Scholar search (n=86), handsearch in various specialist magazines (n=618), and a retrospective search (n=9). After inclusion criteria verification and a methodological quality assessment, 34 studies were deemed suitable. 23 studies were based on a quantitative design, 9 on a qualitative design, and 2 were conceptualized as mixed-methods design studies.

4.2 Quality appraisal

The quality of the methodological approach of the included studies was evaluated according to the MMAT criteria proposed by Pluye et al., 2011. The quality appraisal for the studies fulfilling the inclusion criteria is presented in its complete version in table 4 (additional files, appendix B).
Almost all studies met the criteria requested in terms of methodology and were therefore assessed to be of good reporting quality. Some studies however were estimated to not correspond fully to all of the criteria proposed by Pluye et al., 2011. All studies included used either clear quantitative and qualitative research questions (objectives), or a clear mixed-method question (objective) (Davis et al., 2019; Tabei, Fletcher & Goodger, 2012). The included studies also allowed addressing the research question or objective with the help of the data collected, and they respected the aspect of ethical review.
The methodological quality criteria of describing the process of participant recruitment and/or sampling strategy were not always reported precisely enough.
Applying the MMAT quality criteria indicated that quantitative studies reported their samples and sampling strategies with missing clarity, and the response rates were not always described in detail (Fessi et al., 2016; Nicholls, Jones, Polman & Borkoles, 2009; Andersen & Williams, 1999).
Only 3 studies used controls (Newcomer & Perna, 2003; Wippert & Wippert, 2008; Fletcher, Hanton, Mellalieu & Neil, 2012). The criteria of using random sampling to minimize selection bias, could not be answered satisfactorily by most of the studies.
Of the 34 studies included, sample sizes ranged from 1 to 429 participants, with studies using a qualitative or mixed method design including smaller samples of participants (Kristiansen & Roberts, 2010; Sohal, Gervis & Rhind, 2013; Tabei et al., 2012).
All 34 studies reported the use of validated screening instruments or questionnaires or standardized interview formats or interview-based approaches, and clearly described outcomes. Regarding the

aspect of measurements, almost all studies examined several stressors or sources of stress without considering the complex interrelationship in the context of psychological stress and mental health (Nicholls, Backhouse, Polman & McKenna, 2009; Blakelock et al., 2016; Ivarsson et al., 2014; Fessi et al., 2016).
As to the question of whether appropriate consideration was given to how findings relate to the context (e.g., the setting in which data were collected), all qualitative studies answered these questions satisfactorily (Kristiansen & Roberts, 2010; Silva III, 1990; Fletcher & Hanton, 2003; Sohal, Gervis & Rhind, 2013; Noblet & Gifford, 2002; Hanton, Fletcher & Coughlan, 2005; Weston, Thelwell, Bond & Hutchings, 2009; Fletcher, Hanton & Wagstaff, 2012; Fletcher, Hanton, Mellalieu & Neil, 2012; Evans, Wadey, Hanton & Mitchell, 2012).
It was noticed that very often the researchers' role during all stages of the study process (from formulating the research question to interpreting the findings) was not precisely articulated.
2 out of 8 prospective cohort studies (qualitative non-randomized design) explained the follow-up process (Gouttebarge et al., 2017; Gerber et al., 2018). Another 5 researchers (Ivarsson et al., 2014; Laux, Krumm, Diers & Flor, 2015; Otter, Brink, Diercks & Lemmink, 2016; Pensgaard et al., 2018) reported on outcome data or an acceptable response rate, and one study didn't give any information about this aspect (Brink et al., 2010). As for the question whether the participants in the groups being compared were comparable, or whether researchers considered the difference between these groups, no precise information was given by the researchers. This may be due to the data having been delimited to only one gender, a specific type of sport, or performance level (Sohal, Gervis & Rhind, 2013; DeFreese & Smith, 2014; Davis et al., 2019).
Table 2 describes the demographic characteristics and the main outcomes of the studies included. The included studies examined elite athletes of all genders, a broad age range (from 14 to 51), individual (e.g., gymnastics, swimming, skiing) and team sports (e.g., soccer, rugby, football), and different nationalities. Regarding the findings, only aspects that were relevant to the research question were reported (see also table 3 for additional information).

Table 2: *Overview of studies included (see appendix B)*

Table 3*: Additional information of study population (quantitative studies)*

No	Authors	N (male:female)	Age	Country	Sampling/grouping
1	Perna & McDowell (1995)	39 (17:22)	M=24,9, SD=3,0		Two groups (high and low life-event-stress)
2	Andersen & Williams (1999)	196 (79:117)	From 18 to 23 years	USA	No further details
3	Newcomer & Perna (2003)	283 (143:140); 24 (post-injury analysis)	M=16,7, SD=0,079		12 cases vs. 12 controls
4	Wippert & Wippert (2008)	19 (5:14); control group: 21 (12:9)	M=20, SD=3,63, control group: M=18, SD=2,1 (	Germany	19 cases vs. 21 controls
5	Nicholls, Backhouse, Polman & McKenna (2009)	16 (16:0)	M=19,3, SD=0,95	UK	No further details
6	Nicholls, Jones, Poleman & Borkoles (2009)	5 (5:0)	M=27,2, SD=5,7	England, Wales, Fiji	No further details
7	Brink et al. (2010)	53 (53:0)	From 15 to 18 years, M=16,5	The Netherlands	non-randomized
8	Paul, Khanna & Sandhu (2011)	100 (65:35)	M=21,22, SD=1,85	India	Three groups on the basis of the MAPPS Score (high risk, moderate risk and low risk group)
9	Johnson & Ivarsson (2011)	108 (85:23)	From 17 to 19	Sweden	Selection was made strategically in cooperation with Swedish Soccer Association
10	Faude et al. (2011)	15 (15:0)	M= 19,5, SD=3,0	Germany	No further details
11	Ivarsson et al. (2014)	101 (67:34)	M=16,7, SD=0,9	Sweden	Participation was voluntary, two groups (injured and non-injured players)
12	DeFreese & Smith (2014)	429 (41%:59%)	From 18 to 24 years	America	Convenience sample
13	Laux, Krumm, Diers & Flor (2015)	22 (22:0)	M=25,8, SD=5	Germany	non-randomized
14	Otter, Brink, Diercks & Lemmink (2016)	24 (11:15)	M=23, SD=4	The Netherlands	non-randomized
15	Fessi et al. (2016)	17 (17:0)	M=23,7, SD=3,2	Finland	No further details
16	Blakelock, Chen & Prescott (2016)	91 (91:0)	From 15 to 18 years, M=16,31, SD=1,10	England, Scotland	Convenience sample
17	Madigan et al., 2017	106 (90:16)	M=17,3, SD=0,8	UK	non-randomized
18	Von Rosen et al. (2017)	496 (54,4%:45,6%)	M=17	Sweden	non-randomized
19	Gouttebarge et al. (2017)	203 (36%:64%)	M=27, SD=7	the Netherlands	Self-selection, non-randomized
20	Pensgaard et al. (2018)	193 (0:193)	M=21,6, SD=4,2	Norway	non-randomized
21	Gerber et al. (2018)	257 (64%:36%)	M=16,82 years, SD=1,44	North-Western Switzerland	Self-selection, non-randomized
22	Strahler & Luft (2019)	1 (0:1)	25 years		No further details
23	Nixdorf, Beckmann & Nixdorf (2020)	194	M=15,08, SD=1,95	Germany	Two groups (completers and non-completers)

4.3 Main findings

34 studies were analyzed for this review: 23 quantitative studies, 9 qualitative designs, and 2 mixed-method designs.
In their analyses on stress, Arnold & Fletcher (2012) introduced a unique structure of "organizational" stressors that might occur within the context of elite sports. The taxonomy of 640 different stressors identified by the two authors is mostly based on four main dimensions: (1) leadership style and staff issues; (2) cultural and variables pertaining to the team/members; (3) environmental and logistics issues; (4) performance and personal issues.
The analyzed study results were subdivided according to stressor categories, which turned out to be relevant to the research question.
The results of the studies included in this review point to the existence of various stressors pertaining to outcomes, which result in mental health impairments in the target population.
Table 2 shows all included studies with their specific characteristics, key findings, and outcomes, table 3 represents additional information on the study population.

4.3.1 Training- and competition-specific and organizational stressors

Training- and competition-specific stressors are part of a professional career in sports. One of these stressors are injuries, which are mostly accompanied by a decrease in athletic performance as well as psychological responses leading to mental health issues in elite athletes. All these factors, as the analysis of the following study results shows, are inter-related and can affect mental health in the short and long term.

The pressure to permanently live and act on the boundary between overload and top performance can lead to an incongruity between stress and individual health protecting factors, such as resilience, which act as buffers against mental ill-health (Paul, Khanna & Sandhu, 2011).
It was confirmed (Silva III, 1990; Otter et al., 2016) that competitions seem to constitute a major stressor with higher salivary cortisol and salivary alpha-amylase levels. Strahler & Luft (2019) observed that chronic stress affected the athlete's mental health state in terms of elevated cortisol levels and changes in psychological wellbeing.
Several studies (Andersen & Williams, 1999; Newcomer & Perna, 2003; Johnson & Ivarsson, 2011; Ivarsson et al., 2014; Laux, Krumm, Diers & Flor, 2015; Brink et al., 2010; von Rosen et al., 2017; Pensgaard et al., 2018). showed that intense physical activity performed at elite level and the stressors associated with athletic participation compromised top athletes' mental health and psychological wellbeing, manifesting among others in symptoms of anxiety, overtraining, burnout, or injury.
Moreover, study results indicated that younger athletes are particularly sensitive to injury-induced stimuli and are thus more susceptible to post-traumatic injury-related distress (Newcomer & Perna, 2003).
In some of the studies included in the analysis, sleep quality and sleep disturbances caused by critical life events, were identified as possible reasons for an increased susceptibility to mental and physical health impairments (Perna & McDowell, 1995; Faude et al., 2011; Otter, Brink, Diercks & Lemmink, 2016; Brink et al., 2010; Gouttebarge et al., 2017).
Research findings of the studies analyzed suggest that not only competitive stress in elite sports, but also organizational stressors are important issues to consider when it comes to mental health.
Not only are the various stressors experienced by athletes in their athletic and personal environment reasons for an increased vulnerability to mental health problems, but also do the resources athletes have available to cope with stress play an important role. This must be considered within the context of the impact of stress on mental health (Hanton, Fletcher & Coughlan, 2005).

The findings of Fletcher et al. (2012) highlight that most of the stressors encountered by elite athletes are largely inherent aspects of sports participation, such as training and competition environment, exposure to hazards and risk of injury, cultural and political environment, and officials' and referees' decisions.
Another strong, emergent stressor turned out to be training facilities and equipment, as the majority of participants expressed a lack of adequate training facilities and playing surfaces. This issue was observed specifically pertaining to India and other developing nations (Sohal, Gervis & Rhind, 2013).

4.3.2 Dispositional and personal stressors, (negative or traumatic) life events

One of the key findings of the studies analyzed in this category is that perfectionism is a strong stressor for training-induced stress. According to the studies' results, perfectionist athletes are more susceptible to the negative consequences of the overtraining syndrome and to resulting mental health issues (Madigan et al., 2017). Results illustrated that strong perception of stress was associated with increasing mental health problems (Gerber et al., 2018; Nixdorf et al., 2020), such as symptoms of anxiety, depression, and burnout. Study results of Nixdorf et al. (2020) and Gerber et al. (2018) showed that athletes performing at top level face an increased risk of mental health problems because they are confronted with a huge array of "workplace" stressors (e.g., limited social support networks) in addition to enormous physical and competition stress.

Some of the studies analyzed mentioned traumatic life events, age-related vulnerability, and personal factors as stressors (Perna & McDowell, 1995; Wippert & Wippert, 2008; Fessi et al., 2016; Blakelock, Chen & Prescott, 2016; Otter, Brink, Diercks & Lemmink, 2016;). The results of these studies indicate that performing sports at the highest level is associated with significant physical and mental health symptoms, including elevated cortisol levels and depressive or anxiety symptoms.

4.3.3 Situation-specific stressors

Some of the studies included demonstrated that particularly the "social perceptions" of the athletes as well as the sports-related social environment are relevant in terms of their mental health (DeFreese & Smith, 2014).

Moreover, the data found in this context indicates that athlete burnout experiences were often associated with their general negative satisfaction with life and accordingly affected their mental wellbeing negatively.
Also, unsuitable coping strategies, insufficient support, and lack of competition experience were identified as stressors and are therefore to be considered mental health risks (Kristiansen & Roberts, 2010).
The lack of support from coaches, family, friends, and team members was found to be a package of stressors with all resultant negative effects on the mental health of elite athletes. These stressors were categorized as burnout predictors.
Results in this category showed that stressors can be quite varied and situational, and no matter where the stressors originate, they may impact the mental health state of elite athletes (Weston, Thelwell, Bond & Hutchings, 2009); Evans, Wadey, Hanton & Mitchell, 2012). More specifically, the findings support the role of organizational (e.g., environmental conditions), competitive (e.g., poor progress), and personal (e.g., financial or family issues) stressors influencing elite athletes.
Two studies were of a mixed-method design and observed training- and competition-specific, non-sports-specific stressors as well as personal factors and critical life events (Tabei, Fletcher & Goodger, 2012; Davis et al., 2019). The results emphasize that academic requirements were

identified as a stressor, although athletes' reports indicated that stress related to demands at school was not frequently a cause for concern in terms of mental issues (Davis et al., 2019).
The findings of Tabei et al. (2012) highlighted that training and competition load, training and competition environment, travel arrangements, nutritional issues, risk of injury, leadership style, lack of social support, career and performance development, inadequate communication channels, and role overload appeared as major organizational stressors to be linked to athlete burnout. Another clear and main finding that emerged from this study was that the experience of burnout is influenced by the psychosocial dynamics within sport organizations.

5 Discussion

This systematic review focused to give an overview of research on stress, stressors, and the mental health of elite athletes. By focusing on the transactional stress model (Lazarus & Folkman, 1984), which states that stress reactions always result from the interaction between the organism (body and psyche) and the environment, the author was able to identify various stressors that affect the mental health of elite athletes. Therefore, this review is an addition to recent domain-related reviews on stress in elite sports (Fletcher & Fletcher, 2005; Flechter, Hanton & Mellalieu, 2006; Sarkar & Fletcher, 2014; Rice et al., 2016).
Given the paucity of existing research in the field (Reardon & Factor, 2010; Schinke et al., 2017), the present review took a broad approach to analyze both stressors and their effects on mental health in elite sports. It identified the relatively poor overall quality of current study reporting and the lack of well-designed, intervention-based research in the area of stress and its effects on elite athletes' mental health.
Despite the limitations of current literature covering the topic of the effect of stress and stressors on elite athletes' mental health, a number of key observations and tentative conclusions can be drawn from the author's data synthesis.
A crucial point for future research projects (Sarkar & Fletcher, 2014; Madigan et al., 2017; von Rosen et al., 2017) should be the identification of the extent to which personality-determining characteristics, such as perfectionism, self-confidence, self-esteem, resilience, social support and connections, the financial situation and the sociocultural background have an effect as potential stressors regarding the mental health of elite athletes. The identification of these variables should enable all parties involved to provide targeted support for the specific health needs of elite athletes in dependence on the respective history of each stressor. Table 5 highlights the areas in which knowledge in the context of the topic discussed here already exists and where future research is recommended to close the pertinent knowledge gaps.

5.1 Summary of main findings

The consequences of stress and the challenges for the mental health of elite athletes become evident in health impairments such as (athlete) burnout (Gerber et al. 2018), depressive symptoms (Nixdorf et al., 2020), changes in terms of the recovery-stress state, injuries, or sleep disturbances (Faude et al., 2011; Ivarsson et al., 2014; Laux, Krumm, Diers & Flor, 2015).
According to Nixdorf et al. (2020) an understanding of the mechanisms and etiologies underlying health and in particular mental health issues in elite sports is necessary to develop and improve athlete-centered prevention and treatment programs.
It turned out that in particular training- and competition-related stressors occur regardless of the type of sport performed, whereas organizational stressors are of a more varied nature and subject to different influences, such as sociocultural, financial, or occupational factors (Fletcher & Hanton, 2003; Fletcher & Fletcher, 2005; Fletcher et al., 2006; Fletcher & Scott, 2010).

5.2 Training- and competition-specific and organizational stressors

Regarding training- and competition-specific stressors, it is almost impossible to separate causes from consequences as many of the variables identified as potential stressors may also be consequences, e.g., in case of injury and illness (von Rosen et al., 2017), overtraining (Silva III, 1990), or coping strategies (Kristiansen & Roberts, 2010), which can affect in both cases elite athletes' mental health.

The study findings analyzed in this review indicate that various factors in the athletic context, such as injury, high training load combined with inadequate recovery, sleep deprivation, or the upcoming end of career may increase an elite athlete's vulnerability to impairments of mental health (Andersen & Williams, 1999; Wippert & Wippert, 2008; Johnson & Ivarsson, 2011; Paul, Khanna & Sandhu, 2011; von Rosen et al., 2017). Studies investigating the impact of training- and competition-specific stressors showed that elite athletes often attributed health impairments – mainly injuries or illness - to the high demands typical of a top-performance context.
In elite-sports reality, athletes permanently go to their physical and mental limits in order to perform at the highest level and to be successful in important competitions. Nixon (1993) described this way of acting and living at the limits as "culture of risk", which is characterized by the notion that overcoming pain, injury, and serious distress is typical of a professional athletic career and successful elite athletes.
Current findings confirm an interrelationship between an increased training load and a decreasing sleep volume, and between an increased level of hassles and an increased injury risk (Ivarsson et al. 2014; von Rosen et al., 2017). Injury is a stressor that can trigger various mental health-related problems, such as depressive symptoms or anxiety. If these problems are persistent or even appear in an excessive manner, serious mental health issues (e.g., depression or eating disorders) can be provoked.
It is obvious that stressors resulting from an organizational environment particularly affect athletic performance and provoke psychological responses in terms of athletic mental health.
Since stressors usually occur in varied and situationally dependent circumstances (Fletcher et al., 2012), the individual "stress biographies" and associated assessments and coping styles of the athletes should be analyzed in more detail with regard to the mental health of athletes in the future. This aspect seems to be important because Fletcher et al. (2006) already suggested in their meta-model that stressors encountered by elite athletes and their way of coping with stressors can be linked to various outcomes, such as overtraining, low well-being, or burnout ending up in poor mental health (Fletcher, Hanton, & Wagstaff, 2012; Tabei et al., 2012). It should be taken into consideration, however, that organizational stressors are not always associated with negative consequences. Organizational stressors can also be related to positive outcomes, such as commitment, pleasure, or satisfaction (Fletcher et al., 2006; 2012). Therefore, it is recommended that sport research investigates this ambiguity, specifically in the context of athletic mental health and whether organizational stressors predict either negative or positive outcomes, to ascertain which stressor is related to which outcome.
Not only the fact that organizational stressors have the potential to be associated with either positive or negative health-related outcomes for elite athletes (Fletcher et al., 2006) should be taken into consideration in future research designs, but also the interaction between stressors and coping styles that can protect athletes from negative or even pathogenic health-related effects of stress. Previous sports psychology research already observed that elite athletes' coping styles are used according to the type and intensity of the stressor encountered (Anshel & Anderson, 2002). This aspect seems particularly worthy of investigation as coping styles applied under stress may help to explain which health-related outcomes may occur through inadequate or inappropriate use of coping strategies. According to Fletcher et al. (2006), the handling of coping styles may affect athletes' vulnerability to stress and influence the tone of health-related psychological responses.

5.3 Dispositional and personal stressors, (negative or traumatic) life events

The results of the study analyzing perfectionism and training-induced stress (Madigan et al., 2017) correspond to those of former studies, all of which showed that athletes who overtrain also exhibit a high degree of perfectionism and a higher level of compulsion to exercise.
Madigan et al. (2017) hold perfectionist tendencies responsible for training-induced stress. It has become clear that athletes with many perfectionist tendencies do not handle stress well and are thus more affected by the consequences of training stress. Athletes who are setting perfectionistic standards are therefore more likely to experience mental health symptoms, such as heightened levels of anxiety. It seems plausible that in case of maladaptive perfectionism, athletes are even more at risk to compromise their mental health state, as this dimension of perfectionism is associated with a low self-esteem and symptoms of anxiety and depression.
In terms of injury prevention, current research reports point to first indicators concerning the effects of perfectionism and other personality traits on the risk of injury among elite athletes (Madigan et al., 2017). According to Walker et al. (2007), the dose-response relationship between athletic activity and the probability of injuring oneself exposes elite athletes to a greater risk of injury than the population at large. This may be based on injury-related experiences that athletes are usually faced with. Each past injury constitutes a risk for new injuries. Therefore, it needs to become possible to identify so-called risk athletes within the framework of optimum support. However, the significance of the existence of prospective health risks in the target population is still being ignored by the parties responsible despite reported injury tragedies (Reardon & Factor, 2010). Decreasing the stigma of mental health issues and normalizing these issues as important seems to be essential in terms of treating mental health concerns. Interventions including measures to boost or improve health-protecting factors such as resilience or mental toughness are supposed to mitigate the effects of stress and to potentially reduce mental health symptoms such as depression or anxiety (Gerber et al., 2013). Encouragement by other athletes, family members or friends, a positive attitude and a good relationship with a health service provider could be further strategies to boost health-protecting factors. Moreover, the ability to perceive one's own feelings, express them verbally, and communicate openly and fairly with the supporting coaching staff could play another important role for the athletes to feel encouraged to seek help for mental health issues (Gulliver et al., 2012). That's why coaches and medical staff also play particularly important roles in terms of monitoring the psychosocial strain-regeneration state in combination with training load of the individual athletes.

5.4 Situation-specific stressors

DeFreese & Smith (2014) and Kristiansen & Roberts (2010) confirm that not only gender or personality, but also the relationship between coach and athlete represent evident predictors of stress, particularly in terms of the development of a burnout syndrome in elite athletes. However, not many details are known about the specific characteristics of the mutual influence between coach and athlete. If a supportive atmosphere is not given on the part of the coach, or if the social support from family, friends, or team members is missing, these factors are stressors in a competitive context, which could consequently lead to mental health-related problems (Kristiansen & Roberts, 2010).

According to DeFreese & Smith (2014) the failure to provide support when requested, giving inappropriate or inadequate advice, or tactless and insensitive behavior in the coach-athlete relationship are key predictors of burnout development in elite athletes.
Sagar, Lavallee & Spray (2009) even suggest that fear of failure combined with perfectionism could lead to maladaptive coping strategies, expressed in inappropriate reactions or harsh self-criticism. Destructive coping can mean the onset of mental disorders in the target population (Flett & Hewitt, 2006; Appleton et al., 2009).

If match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, developing negative, health-influencing symptoms due to elite athletes' riskier behavior seems to be possible (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007).
To date, however, no conclusive and accurate study data has been gathered pertaining to individual sports-specific and general non-sports health-related behavior (Thiel et al., 2011). Especially the willingness of athletes to take severe health risks by pushing their physical and mental capacities permanently to the limit in order to enhance their performance constitutes an enormous challenge for their mental health. When it comes down to analyzing stress and stressors in the population under study a multi-methodological longitudinal research design to unveil causal relations between the wide array of stressors and how these factors contribute to mental health impairments over time would be particularly of interest (Thiel et al., 2015).
The results of the two mixed-method studies (Tabei et al., 2012; Davis et al., 2019) emphasize that research must expand to reflect the interrelationship between stress and its effects on mental health within the dual career pathway of athletes. Against the background that peak performance age in elite sports (Allen & Hopkins, 2015) in most disciplines coincides with a period in life with a peak in the onset of adult mental health disorders (Jones, 2013) future empirical research should put more attention to this aspect. Furthermore, the transitional time between junior and senior phases is, according to Anshel & Wells (2000), experienced as particularly stressful. This is due to the simultaneous demanding phases in school and job with many challenges both in athletic and non-athletic areas (Beckmann et al., 2006).

5.5 Limitations

The main objective of this review was to perform a literature-based analysis of the effect of sports-specific and non-sports-specific stressors on the mental health of elite athletes.

34 studies (see table 2, 3, and 4) of different designs were scrutinized to identify the existence of potential stressors associated with mental health impairments in elite athletes.
Since the subject matter is rather intangible and hard to delimit, this review does have a few limitations.
A key problem lies in the methodological difficulty of clearly distinctive stressors.
The studies analyzed in this review are also difficult to interpret due to the heterogeneous use of terminology and the missing clarity of definitions, for example, "stressors", "strains", "demands", "psychological factors", and "risk factors".
Numerous factors, such as the inconsistent application of measurement and screening procedures, the theoretical approaches and research designs, or the analysis of different samples (Johnson & Ivarsson, 2011; Faude et al., 2011) make precise statements on the topic difficult. Most of the measurement techniques or devices applied were not explicitly meant for the screening of stressful athletic situations, which might be due to the fact that these devices have not been developed much yet.
Even though many reasons exist for the predisposition of elite athletes toward mental health impairments, the current state of research shows that scientific studies examining the epidemiology of variables associated with stress and mental health in elite sports are rare and often inaccurate (Reardon & Factor, 2010; Hughes & Leavey, 2012; Arnold, Fletcher & Daniels, 2017). The reasons for that may be seen in the difficulty in quantifying stress and mental health, and in the fact that research on the interrelationship between stress and mental health in elite sports is still in its beginnings.
Also, the lack of research in the field and well-designed, intervention-based research in the area of elite athletes' mental health added to the poor overall quality of study reporting on this topic.

Moreover, variables such as age, gender, the history of stressors, or type of sport (e.g., individual or team sports) have not been considered in a standardized manner (Hanton, Fletcher & Coughlan, 2005; Kristiansen & Roberts, 2010; DeFreese & Smith 2014), and only three studies covered the aspect of using a control group (Newcomer & Perna, 2003; Wippert & Wippert, 2008; Fletcher, Hanton, Mellalieu & Neil, 2012).
With regard to career transition management, a clear differentiation between elite athletes still being active as professional athletes and reflecting on retirement and those having already terminated their elite sports career is required (Stambulova 2017). Recent studies found that there are significant differences regarding the prevalence of depressive symptoms and levels of traumatic stress between athletes still competing, those being forced to end their career because of injury or dismissal, and those who had not reflected on career termination (Wippert & Wippert, 2008).
As a result of their career termination elite athletes experience massive negative consequences (e.g., a loss of athletic identity or even financial ruin). This is why and when they are even more vulnerable to other health-affecting life crises, primarily in the sense of depression or risky behavior, such as excessive alcohol intake (Reardon & Factor, 2010).
Another limitation could be the fact that some of the included longitudinal studies tracked the target group only for a few weeks or months. This time span is too short because some of the identified stressors may have a greater impact not only in adolescence and early adulthood, but also in later adulthood (Johnson & Ivarsson, 2011; Madigan et al., 2017). This aspect seems to be highly important because stressors detected during adolescence may not necessarily be predictive for developing mental health impairments in adulthood, or vice versa.
It is conceivable that more stressors are associated with serious problems concerning the mental health of elite athletes, which were not systematically considered in this review, such as the individual stress biographies of the population under study or epochal events like the COVID-19 pandemic.
Stress in elite sports including the associated complex and multifaceted processes should therefore attain more attention in future interdisciplinary research projects (Fletcher et al., 2012; Arnold, Fletcher & Daniels, 2017) to exactly identify the effects of stressors on the mental health of elite athletes, and in a second step to develop corresponding protective measures and preventive strategies in cooperation with the athletes and their support staff.

6 Conclusion

Elite athletes are subject to numerous stressors that may increase their vulnerability to mental health impairments.

The current systematic review led to the following conclusions:

1. Stressors do not occur in isolation, but usually in combination.
2. Stressors are situational and development-specific, and their effect is majorly influenced by the assessment of the coping strategies available.
3. Stress-related outcomes (such as sports-related injuries) can also be considered stressors.

Against the background of the complexity of the relationship between stress and mental health in elite sports, further research on stress and its effect on mental health is needed, especially since elite sports is subject to the principle of change, Fletcher et al. (2012). Furthermore, it is important for researchers, athletes, and coaches to be attuned to stress and its impact on athletic mental health to detect health-related issues early and to intervene in an appropriate manner.
The implementation of this type of research approach requires a cooperation of sports psychologists, sports physicians and therapists, trainer and support teams, and the athletes themselves. High-quality epidemiological intervention studies should do justice to the dynamics of

stress in elite sports while at the same time considering the athletes' individual stress biographies to develop customized, flexible strategies to cope with stress.

7 Future directions

In order to meet the needs of elite athletes in terms of their mental health, it is therefore recommended to conduct more interdisciplinary and more high-quality epidemiological intervention studies. Looking at the complexity of the above-mentioned stressors, it seems appropriate to initiate interdisciplinary research projects. These projects should also focus on the analysis of somatic and psychological factors that influence the mental health of elite athletes.

Table 5: *Future directions*

What is known	**Knowledge gaps**
Negative life event stress is a strong predictor for injury; injury has an impact on mental health issues **(**Andersen & Williams, 1998; Johnson & Ivarsson, 2011; Laux et al., 2015)	• Which stressor predicts which outcome; situational aspects (e.g., dimensions) of stressors should be taken into consideration (e.g., frequency, intensity, duration) since their exclusion has been identified as a shortcoming of previous stress in sport research (Arnold, Fletcher & Daniels, 2017), • a combined assessment of psychological stress and performance and mental health measures might be recommended for practical purposes (Faude et al., 2011), • the impact of organizational stressors on mental health or psychological well-being has been "under-researched"; it is recommended to extend research on the outcomes and consequences of organizational stressors (Sohal, Gervis & Rind, 2013)
Dysfunctional attitudes, negative coping strategies, and a high level of chronic stress were identified as stress-triggering factors resulting in burnout and depression in elite athletes (Nixdorf et al., 2020).	Stress is considered a risk factor in terms of mental health, but research analysing the specific effects of stress is scarce (Nixdorf et al., 2020)
Psychological life stress affects recovery after intense and exhausting training phases of competitive athletes, athletes might possibly become more susceptible to illness or injury (Perna & McDowell (1995)	Impact of various stressors and personality traits as mediators or protective factors regarding mental health impairments
Not only various organizational stressors playing an important role regarding the impact of stress on elite athletes' mental health, but also academic related stress factors are becoming an important variable to respect in the context of elite athletes' mental health (Tabei et al., 2012; Davis et al., 2019)	What is the role of contractual stressors concerning the mental health of elite athletes? (Reeves, Nicholls & McKenna, 2009)

Table 5: *Future directions (continued)*

What is known	Knowledge gaps
Career dissatisfaction is a significant predictor of signs of anxiety, depression, and distress among active and retired athletes (Stambulova, 2017)	
	The role of athletes' relationship with senior management has emerged as a widely reported stressor. This aspect has so far not been included in the taxonomic classification of Arnold & Fletcher (2012). It is dependent on a hierarchical organization of power and respect for seniority; therefore, it seems to be important to consider cultural contexts in future research on organizational stressors.
	The dual role perspective of stressors in other areas such as how perceived stress influences doping (Hodge et al., 2013), substance abuse (Grossbard et al., 2009), and eating disorders (Dockendorff et al., 2012)

Researchers should consider themselves invited to support elite athletes within the context of stress and mental health. They should make the athletes aware of the fact they need to handle their own health responsibly and to apply adequate coping strategies in a flexible and situationally appropriate manner. This would also counteract the still existing "mental health stigma" (Esfandiari, Broshek & Freeman, 2011; Bauman, 2016; Rice et al., 2016).

Author contributions

The author listed has made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

Additional files

Additional files to this review are added in appendix B.

Conflict of interest statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Correspondance: barbara.nuetzel@student.uni-tuebingen.de

References

Allen, S.V. & Hopkins, W.G. (2015). Age of peak performance of elite athletes: a systematic review. *Sports Med 45*(10), 1431-1441.

Andersen, M. B. & Williams, J. M. (1999) Athletic injury, psychosocial factors and perceptual changes during stress. *Journal of Sports Sciences, 17*(9), 735-741.

Anshel, M. H. & Anderson, D. I. (2002). Coping with acute stress in sport: Linking athletes' coping style, coping strategies, affect, and motor performance. *Anxiety, Stress, and Coping, 15,* 193-209.

Appleton, P.R., Hall, H.K., & Hill, A.P. (2009). Relations between multidimensional per- fectionism and burnout in junior-elite male athletes. *Psychology of Sport and Exercise, 10,* 457–465.

Arnold, R. & Fletcher, D. (2012). A research synthesis and taxonomic classification of the organizational stressors encountered by sport performers. *J Sport Exerc Psychol 34* (3): 397-429.

Arnold, R., Fletcher, D. & Daniels, K. (2017). Organizational stressors, coping, and outcomes in competitive sport, *Journal of Sports Sciences, 35*(7), 694-703.

Bamberg, E., Keller, M., Wohler, C. & Zeh, A. (Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrt, Hrsg.) (2012). *BGW-Stresskonzept. Das arbeitspsychologische Stressmodell* (2. Aufl.) Zugriff am 30.06.2020. Verfügbar unter https://bgw-online.de/ShareDocs/Downloads/DE/Medientypen/Wissenschaft-Forschung/BGW08-00-000_Stresskonzept_Das_arbeitspsychologische_Stressmodell_Download.pdf?__blob=publicationFile

Bauman, N.J. (2016). The stigma of mental health in athletes: are mental toughness and mental health seen as contradictory in elite sport?. *British Journal of Sports Medicine, 50,* 135-136.

Beckmann, J., elbe, A.-M., Szymanski, B., & Ehrlenspiel, F. (2006). *Chancen und Risiken vom Leben im Verbundsystem von Schule und Leistungssport – Psychologische, soziologische und Leistungsaspekte.* Köln: Sport und Buch Strauß.

Blakelock, D.J., Chen, M.A. & Prescott, T. (2016). Psychological Distress in Elite Adolescent Soccer Players Following Deselection. *Journal of Clinical Sport Psychology, 10,* 59-77.

Brink, M. S., Visscher, Ch., Arends, S., Zwerver, J., Post, W. J. & Lemmink, K. APM (2010). Monitoring Stress and Recovery: new insights for the prevention of injuries and illnesses in elite youth soccer players. *Br J Sports Med, 44,* 809-815.

Cresswell, S.L. & Eklund, R.C. (2007). Athlete burnout: a longitudinal qualitative investigation. *Sport Psychol, 21,* 1-20.

Crowe, M., & Sheppard, L. (2011). A review of critical appraisal tools show they lack rigor: Alternative tool structure is proposed. *Journal of Clinical Epidemiology, 64,* 79–89.

Davis P., Halvarsson, A., Lundström, W. & Lundqvist, C. (2019). Alpine Ski Coaches' and Athletes' Perceptions of Factors Influencing Adaptation to Stress in the Classroom and on the Slopes. *Front. Psychol. 10,*1641.

DeFreese, J. D. & Smith, A. L. (2014). Athlete Social Support, Negative Social Interactions, and Psychological Health Across a Competitive Sport Season. *Journal of Sport & Exercise Psychology, 36,* 619-630.

Dockendorff, S. A., Petrie, T. A., Greenleaf, C. A, Martin S. (2012). Intuitive eating scale: an examination among early adolescents. *Journal of Counseling Psychology 59*(4), 604–611.

Esfandiari A, Broshek DK, Freeman JR. Psychiatric and neuropsychological issues in sports medicine. *Clin Sports Med, 30*(3), 611–627.

Evans, L., Wadey, R. , Hanton , S. & Mitchell, I. (2012). Stressors experienced by injured athletes, *Journal of Sports Sciences, 30*(9), 917-927.

Faude, O., Kellmann, M., Ammann, T., Schnittker, R. & Meyer, T. (2011). Seasonal Changes in Stress Indicators in High Level Football. *Int J Sports Med, 32,* 259 – 265.

Fessi, M. S., Nouira, S., Dellal, A., Owen, A., Elloumi, M. & Moalla, W. (2016). Changes of the psychophysical state and feeling of wellness of professional soccer players during pre-season and in-season periods. *Research in Sports Medicine, 24*(4,) 375-386.

Fletcher, D. & Hanton, S. (2003). Sources of Organizational Stress in Elite Sport Performers. *The Sport Psychologist, 17,* 175-195.

Fletcher, D., & Fletcher, J. (2005). A meta-model of stress, emotions, and performance: Conceptual foundations, theoretical framework, and research directions. *Journal of Sports Sciences, 23,* 157–158.

Fletcher, D., Hanton, S., & Mellalieu, S. D. (2006). An organizational stress review: Conceptual and theoretical issues in competitive sport. In S. Hanton & S. D. Mellalieu (Eds.), Literature reviews in sport psychology (pp. 321–373). Hauppauge, NY: Nova Science.

Fletcher, D., Hanton, S. & Wagstaff, Ch. R. D. (2012). Performers' responses to stressors encountered in sport organisations. *Journal of Sports Sciences, 30*(4): 349–358.

Fletcher, D., & Scott, M. (2010). Psychological stress in sports coaches: A review of concepts, research, and practice. *Journal of Sports Sciences, 28,* 127–137.

Fletcher, D., Hanton, S., Mellalieu, S. D. & Neil, R. (2012). A conceptual framework of organizational stressors in sport performers. *Scand J Med Sci Sports, 22,* 545–557.

Flett, G. L., Hewitt, P. L., Blankstein; K. R. & Mosher, S. W. (1995). Perfectionism, Life Events, and Depressive Symptoms: A Test of a Diasthesis-Stress Model. *Current Psychology: Research & Reviews, 14*(2), 112-137.

Frank, R., Nixdorf, I., Beckmann, J., (2013). Depression among elite athletes: prevalence and psychological factors. *Deut Z Sportmed, 64,* 320–326.

Franke, A. (2010). *Modelle von Gesundheit und Krankheit (Programmbereich Gesundheit*, 2, überarb. und erw. Aufl.). Bern: Huber.

Franks, B.D. (1994). What is Stress? *QUEST, 46*, 1-7.

Gerber, M., Kalak, N., Lemola, S., Clough, P. J., Perry, J.L., Pühse, U., Elliot, C., Holsboer-Trachsler, E. & Brand, S. (2013). Are adolescents with high mental toughness levels more resilient against stress? *Stress Health*, *29*, 164–171.

Gerber, M., Best, S., Meerstetter, F., Walter, M., Ludyga, S., Brand, S., Bianchi, R., Madigan, D. J., Isoard-Gautheur, S. & Gustafsson, H. (2018). Effects of stress and mental toughness on burnout and depressive symptoms: A prospective study with young elite athletes. *Journal of Science and Medicine in Sport, 21*(12), 1200-1205.

Gill, D.L. (1994). A Sport and Exercise Psychology Perspective on Stress. *QUEST, 46*, 20-27.

Gouttebarge, V., Jonkers, R. , Moen,, M., Verhagen,, E., Wylleman, P. & Kerkhoffs, G. (2017). A prospective cohort study on symptoms of common mental disorders among Dutch elite athletes, *The Physician and Sportsmedicine, 45*(4), 426-432.

Gröpel, P., & Mesagno, C. (2017). Choking interventions in sports: A systematic review. *International Review of Sport and Exercise Psychology*.

Grossbard, J., Hummer, J., Labrie, E., Pederon, E., Neighbors, C. (2009). Is substance use a team sport? Attraction to team, perceived norms, and alcohol and marijuana use among male and female intercollegiate athletes. *Journal of Applied Sport Psychology 21*(3), 247–261.

Gulliver, A., Griffiths, K.M. & Christensen, H. (2012). Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study. *BMC Psychiatry*, *2*(1), 157.

Hanton, S., Fletcher, D. & Coughlan, G. (2005). Stress in elite sport performers: A comparative study of competitive and organizational stressors. *Journal of Sports Sciences*, *23*(10), 1129 – 1141.

Hodge, K., Hargreaves, E.A., Gerrard, D., Longsdale, C. (2013). Psychological mechanisms underlying doping attitudes in sport: motivation and moral disengagement. *Journal of Sport and Exercise Psychology, 35*(4), 419–432.

Hoppe, A., Bamberg, E. & Kößler, F.J. (2020). *Handbuch Stress und Kultur*. Berlin: Springer.

Hoyer, J. und Kleinert, J. (2010). Leistungssport und psychische Störungen. *Psychotherapeutenjournal, 3*, 252-260.

Hughes L, Leavey G. (2012). Setting the bar: athletes and vulnerability to mental illness. *Br J Psychiatry, 200*(2), 95–96.

Ivarsson, A., Johnson, U., Lindwall, M., Gustafsson, H. & Altemyr, M. (2014). Psychosocial stress as a predictor of injury in elite junior soccer: A latent growth curve analysis. *Journal of Science and Medicine in Sport,* 17, 366-370.

Jones, P.B. (2013). Adult mental health disorders and their age at onset. *The British Journal of Psychiatry, 202*, s5–s10.

Johnson, U. & Ivarsson, A. (2011). Psychological predictors of sport injuries among junior soccer players. *Scand J Med Sci Sports, 21*, 129–136.

Kaluza, G. (2005). Stressbewältigungstraining. In: Linden M., Hautzinger M. (eds.) *Verhaltenstherapiemanual*. Springer, Berlin, Heidelberg.

Kaluza, G. (2018). *Gelassen und sicher im Stress. Das Stresskompetenz-Buch; Stress erkennen, verstehen, bewältigen.* (7. Auflage). Berlin: Springer.

Kellmann, M. (2002a). Underrecovery and overtraining: Different conepts – Similar impact? In M. Kellmann (eds.), *Enhancing recovery: Preventing underperformance in athletes* (p. 3-24). Champaign: Human Kinetics.

Kellmann, M., Kölling, S., & Pelka, M. (2017). Erholung und Belastung im Leistungssport. In R. Fuchs & M. Gerber (Hrsg.), *Handbuch Stressregulation und Sport*. Heidelberg: Springer.

Kristiansen, E. & Roberts, G.C. (2010). Young elite athletes and social support: coping with competitive and organizational stress in „ Olympic“competition. *Scandinavian Journal of Medicine & Science in Sports, 20,* 686-695.

Laux, Ph., Krumm, B., Diers, M. & Flor, H. (2015). Recovery–stress balance and injury risk in professional football players: a prospective study, *Journal of Sports Sciences, 33*(20), 2140-2148.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

Madigan, D.J., Stoeber, J., & Passfield, L. (2017). Perfectionism and training distress in junior athletes: a longitudinal investigation, *Journal of Sports Sciences, 35*(5), 470-475.

Mayer, J. & Thiel, A. (2014). Health in elite sports from a salutogenetic perspective: Athletes' sense of coherence. *PLoSOne, 9*(7), e102030.

Mellalieu, S. D., Neil, R., Hanton, S., & Fletcher, D. (2009). Competition stress in sport performers: Stressors experienced in the competition environment. *Journal of Sports Sciences, 27*, 729–744.

Mountjoy, M., Armstrong, N., Bizzini, L., et al. (2008). The IOC Consensus Statement: "training the elite child athlete". *British Journal of Sports Medicine, 42*, 163-164.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine, 6* (7), e1000097.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... PRISMA-P Group (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews, 4* (1), 1–9.

Newcomer, R. R. & Perna, F. M. (2003). Features of Posttraumatic Distress Among Adolescent Athletes. *Journal of Athletic Training, 38*(2), 163–166.

Nicholls, A. R., Backhouse, S. H., Polman, R. C. J. & McKenna, J. (2009). Stressors and affective states among professional rugby union players. *Scand J Med Sci Sports, 19*, 121–128.

Nicholls, A. R., Jones, C. R., Polman, R. C. J. & Borkoles, E. (2009). Acute sport-related stressors, coping, and emotion among professional rugby union players during training and matches. *Scand J Med Sci Sports, 19*, 113–120.

Nixdorf, I., Frank, R., & Beckmann, J. (2016). Comparison of athletes' proneness to depressive symptoms in individual and team sports: Research on psychological mediators in junior elite athletes. *Frontiers in Psychology, 7*, 1–8.

Nixdorf, I., Beckmann, J. & Nixdorf, R. (2020). Psychological Predictors for Depression and Burnout Among German Junior Elite Athletes. *Front. Psychol*., *11*, 601.

Nixon, H. L, II (1993). Accepting the Risks of Pain and Injury in Sport: Mediated Cultural Influences on Playing Hurt. *Sociology of Sport Journal,10,* 183-196

Otter, R. T. A., Brink, M. S., Diercks, R. L., Lemmink, K. A. P. M. (2016). A Negative Life Event Impairs Psychosocial Stress, Recovery and Running Economy of Runners. *Int J Sports Med, 37*, 224–229.

Paul, M., Khanna, N. & Singh, S. J. (2011). Psychomotor Performance As An Indicator Of Training Distress Among Athletes. *Brazilian Journal of Biomotricity, 5*(3), 175-185.

Pensgaard, A. M., Ivarsson, A., Nilstad, A., et al. (2018). Psychosocial stress factors, including the relationship with the coach, and their influence on acute and overuse injury risk in elite female football players. *BMJ Open Sport & Exercise Medicine 4*:e000317.

Perna, F. M. & McDowell, S. L. (1995). Role of Psychological Stress in Cortisol Recovery From Exhaustive Exercise Among Elite Athletes *International Journal of Behavioral Medicine, 2*(1), 13-26.

Pluye, P., Robert, E., Cargo, M., Bartlett, G., O'Cathain, A., Griffiths, F., ... Rousseau, M. C. (2011). Proposal: *A mixed methods appraisal tool for systematic mixed studies reviews*. Retrieved from http://mixedmethodsappraisaltoolpublic.pbworks.com.

Pluye, P., & Hong, Q. N. (2014). Combining the power of stories and the power of numbers: Mixed methods research and mixed studies reviews. *Annual Review of Public Health, 35*, 29–45.

Reardon C. L., Factor, R. M. (2010). Sport psychiatry: a systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Med, 40*(11), 961–80.

Reeves, C. W., Nicholls, A. R. & McKenna, J. (2009). Stressors and Coping Strategies among Early and Middle Adolescent Premier League Academy Soccer Players: Differences According to Age. *Journal of Applied Sport Psychology, 21*(1), 31-48.

Rice, S.M., Purcell, R., De Silva, St., Mawren, D., McGorry, P.D. & Parker, A. G. (2016). The Mental Health of Elite Athletes: A Narrative Systematic Review. *Sports Med, 46*, 1333-1353.

Richter, G. (2000). Psychische Belastung und Beanspruchung – Stress, psychische Ermüdung, Monotonie, psychische Sättigung. *Schriftenreihe der Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Fa 36*. Bremerhaven: Wirtschaftsverlag NW.

Sagar, S.S., Lavallee, D. & Spray, C.M. (2009). Coping with the effects of fear of failure: A preliminary investigation of young elite athletes. *Journal of Clinical Sports Psychology, 3,* 1-27.

Sarkar, M. & Fletcher, D. (2014). Psychological resilience in sport performers: Review of stressors and protective factors. *Journal of Sports Science, 32*(15), 1419-1434.

Scanlan, T.K. & Passer, M.W. (1979). Sources of Competitive Stress in Young Female Athletes. *Journal of Sport Psychology, 1,* 151-159.

Schinke, R.J., Stambulova, N.B., Gangyan, S. & Moore, Z. (2017). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology.*

Schmidt, K-H., Neubach, B. & Heuer, H. (2007). Self-control demands, cognitive control deficits, and burnout. *Work & Stress, 21*(2), 142-154.

Schnell, A., Mayer, J., Diehl, K., Zipfel, St. & Thiel, A. (2014). Giving everything for athletic success! – Sports- specific risk acceptance of elite adolescent athletes. *Psychology of Sport and Exercise 15,* 165-172.

Silva III, J. M. (1990). An analysis of the training stress syndrome in competitive athletics, *Journal of Applied Sport Psychology, 2*(1), 5-20.

Sohal, D., Gervis, M. & Rhind, D. (2013). Exploration of organizational stressors in Indian elite female athletes. *International Journal of Sport Psychology, 44*(6), 565-585.

Souto, R. Q., Khanassov, V., Hong, Q. N., Bush, P. L., Vedel, I., & Pluye, P. (2015). Systematic mixed studies reviews: Updating results on the reliability and efficiency of the mixed methods appraisal tool. *International Journal of Nursing Studies, 52* (1), 500–501.

Stambulova, N.B (2017). Crisis-transitions in athletes: current emphases on cognitive and contextual factors. *Current Opinion in Psychology, 16,* 62-66.

Strahler, J. & Luft, C. (2019). "N-of-1"—Study: A concept of acute and chronic stress research using the example of ballroom dancing. *Scand J Med Sci Sports, 29,* 1040–1049.

Swann, C., Moran, A., & Piggott, D. (2015). Defining elite athletes: Issues in the study of expert performance in sport psychology. *Psychology of Sport and Exercise, 16,* 3–14.

Tabei, Y., Fletcher, D., & Goodger, K. (2012). The relationship between organizational stressors and athlete burnout in soccer players. *Journal of Clinical Sport Psychology, 6,* 146–165.

Thiel, A., Diehl, K., Schnell, A., Schubring, A.M., Mayer, J., Zipfel, S. & Schneider, S. (2011). The German Young Olympic Athletes' Lifestyle and Health Management Study (GOAL Study): design of a mixed-method study. *BMC Public Health, 11,* 410.

Thiel. A., Schubring, A., Schneider, S., Zipfel. S. & Mayer, J. (2015). Health in Elite Sports – a „Bio-Psycho-Social"Perspective. *Dtsch Z Sportmed, 66,* 241-247.

Von Rosen, P., Frohm, A., Kottorp, A. et al. (2017). Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scandinavian Journal of Medicine & Science in Sports, 27,* 2059–2069.

Walker, N., Thatcher, J. & Lavallee, D. (2007). Psychological responses to injury in competitive sport: a critical review. *J R Soc Promot Health, 127,* 174-180.

Weston, N. J. V., Thelwell, R. C., Bond, S. & Hutchings, N. V. (2009). Stress and Coping in Single-Handed Round-the-World Ocean Sailing. *Journal of Applied Sport Psychology, 21*(4), 460-474.

WHO – World Health Organization (Hrsg.) (2001). *The World Health Report (2001) – Mental Health: New Understanding, New Hope.* WHO, Geneva.

WHO - World Health Organization (2005). *Promoting Mental Health: Concepts, Emerging Evidence, Practice.* WHO in Collaboration With the Victorian Health Promotion Foundation and University of Melbourne. Geneva: WHO Press.

Wippert, P. & Wippert, J. (2008). Perceived Stress and Prevalence of Traumatic Stress Symptoms Following Athletic Career Termination. *Journal of Clinical Sport Psychology, 2,* 1-16.

Wolfenden, L.E. & Holt, N.L. (2005). Talent Development in Elite Junior Tennis: Perceptions of Players, Parents, and Coaches. *Journal of Applied Sport Psychology, 17,* 108-126.

Systematic review - Coping strategies for handling stress and providing mental health in elite athletes

Abstract

Background
The combination of stressors unique to the athletic context plus the sensitive developmental phase that elite athletes go through during their peak performance may increase the athletes' vulnerability to mental health decrements.
To emphasize the necessity to raise elite athletes' awareness of health risks, it seems to be essential to teach them coping skills to handle stress and to make affected athletes aware of how to recognize, evaluate, and articulate potential risks to their health.
Objective
This systematic review analyzes coping strategies used by elite athletes to deal with stress and the effect of these strategies on mental health to identify gaps that future research could prioritize.
Methods
The current review analyzes studies containing quantitative, qualitative, and mixed data and results, all of them focusing on coping strategies to deal with stress and the effect of coping strategies on elite athletes' mental health.
Literature search for this systematic review took place between August and October 2021 and included the use of 3 electronic databases: PubMed, PsychINFO, SPORTdiscus.
Results
There were initially 5.705 hits from 3 electronic databases, manual search in various scientific journals and from a complementary search in Google Scholar. After the screening process and quality appraisal 30 studies were included. The analyzed study results point to a broad spectrum of coping categories, elite athletes make use of to deal with stressful situations.
The results of this review underpin the necessity that especially college-students being confronted with a wide range of stressors, need to be taught mental skills to cope with these stressors. In addition, teaching coaches and teammates about social support seemed to decrease elite athletes' stress reactions, such as anxiety or depressive symptoms.
Conclusion
Coping in elite sporting settings is very complex and dynamic. Results highlight that coping strategies play an important role in understanding the handling of sport-specific and non-sport specific stressors in an athlete's professional career. There is evidence of coping being effective to buffer stress, but the interrelationships between stressor, appraisal of the stressor, application of a corresponding coping strategy, its effect especially in terms of mental health outcomes is still unclear because of lacking intervention-based study designs.

Keywords: elite athletes, coping strategies, stress, effects, mental health

Abstract: 355 words
Body text: words

Author: Barbara Nuetzel, Eberhard Karls University Tuebingen, Tuebingen, Germany

1 Introduction

For some time now, research on the impact of stress on mental health has also been an increasingly important issue in elite sport (Rice et al., 2016).

Elite athletes[1] are confronted with various stressors (Arnold & Fletcher, 2012), including competitive, organizational, and personal stressors, that have the potential to increase the risk of mental health related problems and mental illness (Rice et al., 2016).

The stressors elite athletes experience during their competitive years may be of different nature. That means that interdependencies between stress and mental health related problems in elite sport, can vary from athlete to athlete (Rice et al., 2016).

Previous approaches to stress or stress management clearly show that stress is one of the key health risk factors (Kaluza, 2018).

The combination of stressors unique to the athletic context plus the sensitive developmental phase (Gulliver et al., 2012) that elite athletes go through during their peak performance (Allen & Hopkins, 2015) may increase the athletes' vulnerability to mental health decrements.

Significant for the onset and development of mental health-related problems in elite athletes is the concept of psychological strain which is characterized by a combination of perceived stress and the difficulty to cope with stress. If coping resources are extended beyond an elite athlete's capacity, stress-related symptoms of psychological strain may rise (Arnold & Flechter, 2012).

To emphasize the necessity to raise elite athletes' awareness of health risks, it seems to be essential to teach them coping skills to handle stress and to make affected athletes aware of how to recognize, evaluate, and articulate potential risks to their health (Thiel et al., 2011).

Since elite athletes are continuously confronted with the most varied challenges, environments, and stressors (Arnold & Flechter, 2012), it is not only from a biopsychosocial perspective (Engel, 1977; 1981) to be desirable but also from the transactional stress perspective as well as from conservation of resources (COR) theory to develop flexible coping strategies against the potential negative impact of stressful life events (Lazarus & Folkman, 1984; Alvaro et al., 2010).

The "classical" cognitive psychological approach of Lazarus (1966) and Lazarus and Launier (1981) sees the process of coping with stress as an equilibration process of an imbalanced psychophysical state. The question of coping effectiveness, however, is different in elite sports than in the field of clinical psychology. In contrast to people in everyday life, elite athletes are inevitably confronted with critical situations in competition.

To date, scientific attention has not explicitly focused to analyze the possibly effect of coping strategies to handle stress regarding mental health within the context of elite sports (Kuettel & Larsen, 2020). Nicholls & Polman (2007) reviewed the literature on coping in sport spanning 16 years (1988-2004) to examine evidence for the types of coping strategies applied by elite athletes and coping effectiveness, whereas Sarkar & Fletcher (2014) focused on the interplay between stressors and protective factors and their influence on psychological resilience in elite athletes. However, it is this knowledge of factors affecting athletes' mental health that is of tremendous importance to research. This is where the current systematic review comes in to contribute to this scenario aiming to analyze coping strategies used by elite athletes to deal with stress and the effect of these strategies on the mental health of elite athletes to identify gaps that future research could prioritize. As such the purposes to this systematic review are twofold:

To give an overview of the coping strategies elite athletes use to cope with stress (1) and to investigate the effectiveness of these strategies for coping with stress (2).

[1] For improved readability, the masculine form of nouns will be used in this article, if applicable. All personal pronouns are meant to always refer to all genders.

2 Conceptual frameworks

To provide conceptual clarity and a clear overview of the terminology used in this paper, in the following section terms and concepts with relevance to this systematic review are defined and explained. In this regard the author included different theoretical backgrounds to help researchers and practitioners to refine their current state of knowledge.

2.1 Coping

As a top sporting career is associated with many demands and stressful situations, elite athletes have to cope with stress in very different ways.

Depending on whether appropriate coping skills or resources are available or not, science speaks of adaptive or maladaptive coping. That means that coping can lead on the one hand to a restoration of the performance-enhancing state and the solution of the requirement or task. On the other hand, coping can also fail. This intensifies the stress reaction; the equilibrium situation remains changed and a stress reaction occurs.

Through stress, there is a change in the individual (normal) state, and this can lead to a psychophysical imbalance (stress reaction). With the help of adequate coping strategies this imbalance can be eliminated. A key role in the development of stress responses is the effectiveness and appropriateness of coping efforts (Schlicht, 1989). Coping efforts may be directed at the following stress episodes: 1.) at the stressful stimulus and at the perception of the nature of the stimulus, or 2.) at the appraisal process.

In the context described here, coping is a rational process that is based on the result of a more detailed analysis of the situation (Schlicht, 1989).

The "classical" cognitive psychological approach of Lazarus (1966) and Lazarus and Launier (1981) sees the process of coping with stress as an equilibration process of an imbalanced psychophysical state. In the underlying theoretical frame of reference, effective coping is operationalized via the restoration of a psycho-physical equilibrium.

From the transactional approach coping can be defined as "constantly changing cognitive and behavioral efforts to manage specific external and/or internal stressors that are appraised as taxing or exceeding the resources of the person" (Lazarus & Folkman, 1984).

Regarding the relationship between stress appraisal and coping Lazarus & Folkman (1984) and Lazarus (1999) identified primary and secondary appraisal as crucial aspects. Primary appraisal deals with the perception of what is happening and whether it is relevant to a person’s beliefs, values, or situational intentions. Secondary appraisal describes the cognitive-evaluative process of the coping options available to the person and the way the person is going to cope with the situation especially in case of threat or loss (Lazarus, 1999). To deal with stressful experiences elite athletes dispose of a potentially broad spectrum of coping strategies.

According to transactional stress theory, two functions can be distinguished: problem-related coping and emotion-regulative coping (Lazarus, 1991).

In terms of problem-focused coping attempts are made to deal with environmental stressors (e.g., seeking information), whereas emotion-regulative coping strives to deal with one’s emotional responses to these stressors (e.g., seeking emotional support or relaxation).

To systematize these coping strategies, numerous attempts have been made to identify superordinate dimensions. For example, as described above, a distinction is made between problem-oriented and emotion-regulative coping. A further distinction lies in task-related, emotion-related, and avoidance coping.

The dynamic nature of the stress and coping process and the interrelationships between the stress process and the meanings elite athletes ascribe to these associations outline that research must give much more attention to athlete mental health to maintain mental and physical excellence (Taylor, Chapman, Cronin, Newton & Gill, 2012).

2.2 Stress, stressors, and strain

In current sport psychology literature stress is defined as an environmental stimulus, to which an athlete responds, that means stress comes up as a result of an interaction between the environment and the athlete (Fletcher, Hanton & Mellalieu & Neil, 2012). In the context of elite sports this definition implies a dynamic relationship between athlete and environment within the athlete is operating.

In addition, stress can also be described as a short-term and current state that arises from a current failure to cope with a significant challenge, (Kratzer, 1991).

Worth mentioning in this approach which goes in line with the transactional perspective of stress (Lazarus & Folkman, 1984) is that the athlete appraises an event and his available coping resources to handle this event. The athlete's appraisals are influenced as well by his personal characteristics as by the nature of the environmental demands (Fletcher et al., 2006). The appraisals of stressors and the athlete's possible choice of coping strategies will be affected by the ongoing dynamic of the stress process. According to Lazarus (1998; 1999) the following distinction between stressors and strains is adopted in this review:

Stressors are seen as environmental demands, which are encountered by an individual.

Strain is defined as an individual's negative psychological, physical and/or behavioral response.

Stress should therefore be used to describe the process between stressors, strains, appraisals, and coping responses of an individual (Lazarus, 1990). To put it simply, if an athlete does not believe to have coping strategies to handle the stressors encountered in the competition context this athlete will likely experience stress.

2.3 Mental health

Even though "health" has to date not been uniquely defined (Franke, 2010, p. 32), the WHO definition is used as the basis of discussion in this review.

According to the WHO (2006) mental health is defined as a state of complete physical, mental, and social well-being, and not merely the absence of disease. In line with this definition a positive state of mental health is characterized by a state of well-being in which an individual is able to lead a socially active and autonomous life in terms one's own health, to cope with normal life, work productively, and contribute actively and in a meaningful way to society (WHO, 2005).

This definition shows that mental health is a prerequisite for the realization of one's own potential and the implementation of one's role in society, profession, and family.

Considering the numerous requirements and stressors, remaining healthy as in maintaining or even optimizing both physical and mental health represents an enormous challenge for elite athletes (Mayer & Thiel, 2014; Schnell et al., 2014; Thiel et al., 2015), because they continuously need to both protect and risk their health at the same time.

2.4 Increase of mental health issues

Although there is an explosive growth in interest investigating mental health, mental health symptoms and mental disorders in elite athletes (Kuettel & Larsen, 2020; Reardon et al., 2019; Kuettel et al. 2021), the importance of psychological health among elite athletes was already introduced in the sport psychology literature in 1985 by Morgan, who suggested the Mental Health Model of sports performance.

Elite athletes are one sup-population with particular needs because of the broad spectrum of stressors and challenges associated with an elite sports career (Rice et al. 2021), but a focused approach to the management of mental health concerns is still warranted (Breslin et al., 2017). Scientists consider elite athletes to be a risk group particularly susceptible to (pre-) clinical symptoms, such as eating disorders (Giel.et al., 2016), or depressive moods (Gulliver et al., 2015).

Compared to the general populace elite athletes however do not seem to be as open to seeking professional help (Gulliver, Griffiths & Christensen, 2012).
Stigma in the athletic context in terms of health-related problems may lead elite athletes to avoid help seeking behaviors in fear of disclosure of weaknesses which are not compatible in a culture of elite sports (Bauman, 2016; Castaldelli-Maia et al., 2019).
According to Reardon & Factor (2010), the non-disclosure of mental-ill health problems in the sense of trivialization among athletes can be induced for example by the fear of exclusion from the team, from competitions, or even of losing their athletic existence or identity (Gulliver et al., 2012).
Stress-related problems and stress reactions following temporary setbacks or challenging sport-specific situations belong to elite athletes' daily life (Fletcher & Sarkar, 2012; Martindale, 2015).
To reduce stigma and to increase the understanding of mental health and the influence of stress on mental health among elite athletes, mental health literacy and awareness must become much more present in the culture of elite sports (Rice et al., 2016; Kuettel & Larsen, 2020).
Just the conceptualization of health, which is based on a mechanical perspective, i.e., the body is seen as a means to an end may be a further explanation for elite athletes non-disclosing their mental-ill health symptoms.
A body must be in perfect working condition in order to produce athletic top performances during an athletic career (Therberge, 2008). If the body is affected by injuries or other health-related issues, these need to be treated or "healed" in terms of the relevant sports-specific performance capability as quickly as possible (Thiel et al., 2015). Ideally, any long-term health management in elite sports is based on an analysis of health in terms of the interdependencies between the individual biography as well as the general context of each athlete, including family, hormonal, medical, and other personality- and development-specific aspects (Collins et al., 2012).
Unfortunately, the fact that elite athletes are immune to mental health concerns has been the prevailing view among most researchers for a long time (Bär & Markser, 2013; Bauman, 2016). As shown by recent research results, the current evidence base on elite athletes' mental health is dominated to an increasing extent to a holistic perspective (Schinke et al., 2017; Stambulova et al., 2020).

2.5 The role of biopsychosocial determinants in the context of coping, stress, and mental health
The hypothesis that elite athletes are exposed to a greater number of non-sport-specific and sport-specific stressors and are more vulnerable to mental health concerns than non-athletes is challenged in available research.
Although comparable levels of mental health-related symptoms are reported among elite athletes and non-athlete populations (Gulliver et al., 2015; Gouttebarge et al., 2019), the complexity and multidimensionality of mental health issues are not sufficiently considered in the current research (Uphill et al., 2016; Henrikson et al., 2010).
Research in the field of the general clinical psychological literature confirms that there exists a relationship between stress and mental health-related issues, which is highly complex because of various biopsychosocial factors such as genetic vulnerability, mental health literacy or coping repertoire meditating this relationship (Hammen, 2015).
These factors are commonly referred to Engel's biopsychosocial model (1980), which is increasingly applied to the athletic context (DeFreese, 2017; von Rosen, Frohm, Kottorp, Fridén & Heijne, 2017). Compared to the biomedical model of disease (Engel 1977), the biopsychosocial model comprises a variety of biological, psychological, and social determinants of an individual's mental health, which means that the biopsychosocial model is applied at the within person-level. Thus, the individual, body and surrounding environment are seen as essential aspects of the whole system with these biopsychosocial factors acting to facilitate, sustain or modify the course of mental health symptoms (Fava & Sonino, 2007).
Table 1 presents a range of biopsychosocial determinants relevant to elite athletes' mental health.

Table 1: *Biopsychosocial determinants influencing mental health in the context of elite sports (author's own table based on Rice et al., 2021)*

Biological	***Psychological***	***Social***
Sex	Personality	Cultural factors
Age	Behavior	Social media
Genetic predisposition	Coping repertoires	Support systems
Sleep	Perceived stress (e.g., selection pressure, competition schedule, critical life events)	Economic situation
Injury	Mental health literacy	Education

The significance of the biopsychosocial model can be seen in the clinical process of monitoring, screenings and supporting elite athletes in terms of appropriate health treatment. Moreover, this model highlights where medical practitioners and other persons in support should put their focus to avoid the onset or progress of mental health problems among elite athletes. As many of these biopsychosocial determinants are modifiable and customizable, it seems important according to the current state of research to create an environment where elite athletes feel safe to disclose possible symptoms of mental health-related problems. Such an approach may facilitate the initialization of appropriate treatment decisions (DeFreese, 2017) and help to avoid the likelihood of elite athletes developing chronic symptoms (Schinke et al., 2017). To sum up, paying attention to key biopsychosocial factors (see tab. 1) and fostering an environment where elite athletes are encouraged to adopt help-seeking behaviors regarding mental health related problems may be effective strategies to reduce the effects of stress on mental health (Walton, Baranoff, Gilbert & Kirby, 2020).

2.6 Resources and health (management) in an athletic context

Especially in terms of etiology, research has recognized the importance of psychological factors over time (Barry & Friedli, 2008). Therefore, a holistic approach to health including the mental aspect is recommended.

In the elite-sports reality, it is obvious that elite athletes differ from the general populace in their health-risking behaviors (Mayer & Thiel, 2014).

Therefore, the focus lies on resources and abilities pertaining to the "creation" of health in both the physical and mental context to utilize them in line with the requirements of the respective roles and environments.

With the beginning of the 1990s, a clear development in the sport psychological stress and coping theory data situation and discussion has begun. A closer look at the current theory discussion in psychological stress and coping research reveals the "Conservation of Resources-Theory" by Hobfoll (1989; 2002) in recent studies on stress problems. Like Lazarus' transactional model, this theory is based on a cognitive-psychological approach. Common to these theories is that they attempt to explain stress, coping, and action motivation from a "cognitive-transactional perspective."

According to conservation of resources theory (COR), (Hobfoll & Wells, 1998) stress stems from a combined effect of an individual’s subjective perception of an event as taxing or exceeding available resources and the objective environmental circumstances that either threaten or cause depletion of an individual’s resources. In COR theory resources are defined as objects (e.g. clothing), conditions (e.g. health), personal characteristics (e.g. personal skills and traits) or energy resources (e.g. knowledge) that are directly or indirectly valued for survival or that are used for achieving new resources.

The conservation of resources approach can therefore be applied to the "elite athletes" target group, especially when trying to find out which personal skills need to be promoted in order to develop and stabilize health, to cope with stress and to understand the general concept of health in the long term (Mayer & Thiel, 2014; Sabato, Walch & Caine, 2016).

Researching on the interplay of these mediating factors may help to explain with greater precision the relationship between stress exposure and mental health outcomes in elite sports (Schinke et al., 2017; Moesch et al., 2018; Rice et al., 2021).
Moreover, contemporary scholars within the field of sport psychology argue for developing extended systems of psychological support to assist elite athletes to maintain and to enlarge over time their mental health status during challenging career phases (Stambulova et al. 2020; Lundqvist 2021; Storm et al., 2021). From both a mental health and a physical performance perspective, the benefits of supporting elite athletes in a proactive way in terms of developing psychosocial resources, such as adequate coping skills, to have access to both during and after their professional sports careers are given. However, in most of the research conducted in Europe exactly these mediating factors mentioned before are less studied (Kuettel & Larsen, 2020).
To the author's knowledge no other review on the impact of stress, coping and mental health on elite athletes has been conducted so far. Based on this present lack of reviews and/or meta-analyses the necessity to systematically review the current state of research seems to be justified.
Due to the situation described above, this systematic review is

(1) to analyze which coping strategies influencing mental health elite athletes use to manage stress
(2) and how effective these coping strategies are for elite athletes to handle stress.

3 Methods

Methodologically, this systematic review is informed by the (PRISMA) guidelines (Moher et al., 2015; Moher, Liberati, Tetzlaff, Altman, & Prisma group, 2009) that serve the generation of systematic reviews and meta-analyses.
The PRISMA explanation was used as a guideline, and relevant recommendations were implemented in the study analysis as much as possible in the sense of methodological strictness and quality.
The current review analyzes studies containing quantitative, qualitative, and mixed data and results, i.e., it represents a systematic mixed study overview (Pluye & Hong, 2014).

3.1 Search strategy

Literature search for this systematic review took place between August and October 2021 and initially included the use of 3 electronic databases: PubMed, PsychINFO, SPORTdiscus. The rationale for using these databases relates to their prominent usage in other review articles (Rice et al., 2016; Kuettel & Larsen, 2020). Database searches included the following search strings (e.g., for PsychINFO): ((TITLE-ABS-KEY (sport*)) AND (TITLE-ABS-KEY (athlete*)) AND (TITLE-ABS-KEY (mental AND health)) AND (TITLE-ABS-KEY (coping strategies OR skills) AND (TITLE-ABS-KEY psych* AND problem OR stress).
The following process was applied to identify documents relevant to this systematic review: (1) Search in 3 electronic databases (PubMed, PsychINFO, SPORTdiscus); (2) manual search in various scientific journals; (3) complementary search in Google Scholar to ensure that no studies were overlooked. Table 2 and 3 show the development of search terms and the search terms used. To minimize the risk of missing relevant studies the publishing date was not restricted.

Table 2: *Development of search strings*

	Term 1	**Term 2**	**Term 3**	**Term 4**
General term	Mental health	Coping strategies	Elite athlete	Stress
Aspects of the general term	Well-being		Physical and mental performance	Imbalance between demands and resources
Additional aspects	Absence of illness Mental ill health	Risk factor compensation	Actively participating in competitive sports	various stressors and lack of resources leading to imbalance
Synonyms		Coping resources, Coping skills	Elite athlete, professional athlete, high-performance athlete	Pressure, tension

Table 3: *Search terms for the literature search*

Database	**Search terms** ["coping"] OR ["coping strategy"] OR ["coping strategies"] OR ["coping skill"] OR ["coping skills"] OR ["coping resource"] OR ["coping resources"] AND ["stress"] OR ["strain"] OR ["stressful demand"] OR ["strains"] OR ["stressful demands"] OR ["stress-related pressure"] AND ["mental health"] OR ["well-being"] OR ["flourishing"] OR ["mental health effect"] OR ["mental health effects"] AND ["elite sports"] OR ["high performance sports"] OR ["high-level performance sports"] OR ["competitive sports"] OR ["high-level performance athlete"] OR ["high-level performance athletes"] OR ["elite athlete"] OR ["elite athletes"] OR ["competitive athlete"] OR ["competitive athletes"] OR ["high-intensity athlete"] OR ["high-intensity athletes"] OR ["professional athlete"] OR ["professional athletes"]
Google Scholar, manual search, cross-references	Initial search from reference list of key papers retrieved in original search
	Elite athlete coping, elite athlete coping strategy, elite athlete coping skills, elite athlete well-being, elite athlete flourishing, elite athlete mental health, elite athlete stress buffer

3.2 Inclusion criteria

The author analysed all matches based on title or abstract. If the information contained therein did not suffice, the relevant full text was consulted, as well. All studies included had to meet the following criteria:

- Elite athletes were defined as either members of the Olympic squad, or as participants in competitions at the international and national levels, or as being active at a professional level (e. g. NCAA) (Swann, Moran & Piggott, 2015),
- the studies examined the effect of coping strategies on mental health,
- the contributions were original articles,
- the studies were available in full text
- and they were published in English.

Studies were excluded from this review if

- the test persons were under the age of 12,
- the test persons did not comply with the definition of an "elite athlete" as specified in the inclusion criteria,
- only the abstract was available, but not the full text,
- data was missing on the study population or main findings and outcomes
- and the studies were cross-sectional because they did not allow any deductions pertaining to the effect of coping strategies preferably on mental health (lack of causality)/if the relationship between coping strategies to manage stress and outcome was not analyzed.

This systematic review followed the PRISMA guidelines (Preferred Reporting Items Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (see figure 1 flow diagram).

A template was created for data extraction to specify the required information (study design, participants, test objective, gender distribution, tests/material used, main results, key effects) of the studies included.

3.3 Quality assessment

Due to the heterogeneity of the studies included and due to the lack of randomized, controlled trials, a standardized risk-of-bias evaluation was not performed. As an alternative, the quality of the studies selected was evaluated based on the assessment tool "QualSyst" (Kmet, Lee & Cook, 2004). This assessment tool includes 14 items (see table 5, additional files, appendix B). The scoring is based on how well a scoring was met (no=0, partial=1, yes=2); "NA" represents items that do not apply to the study design and are thus excluded from the calculation of the summary score. Each study's summary score was calculated by adding the total score and dividing it by the total possible score. The scores </= 55%, 55-75%, and >/= 75% indicate low, medium, and high quality, respectively. It is recommended to exclude any low-quality study from the systematic review.

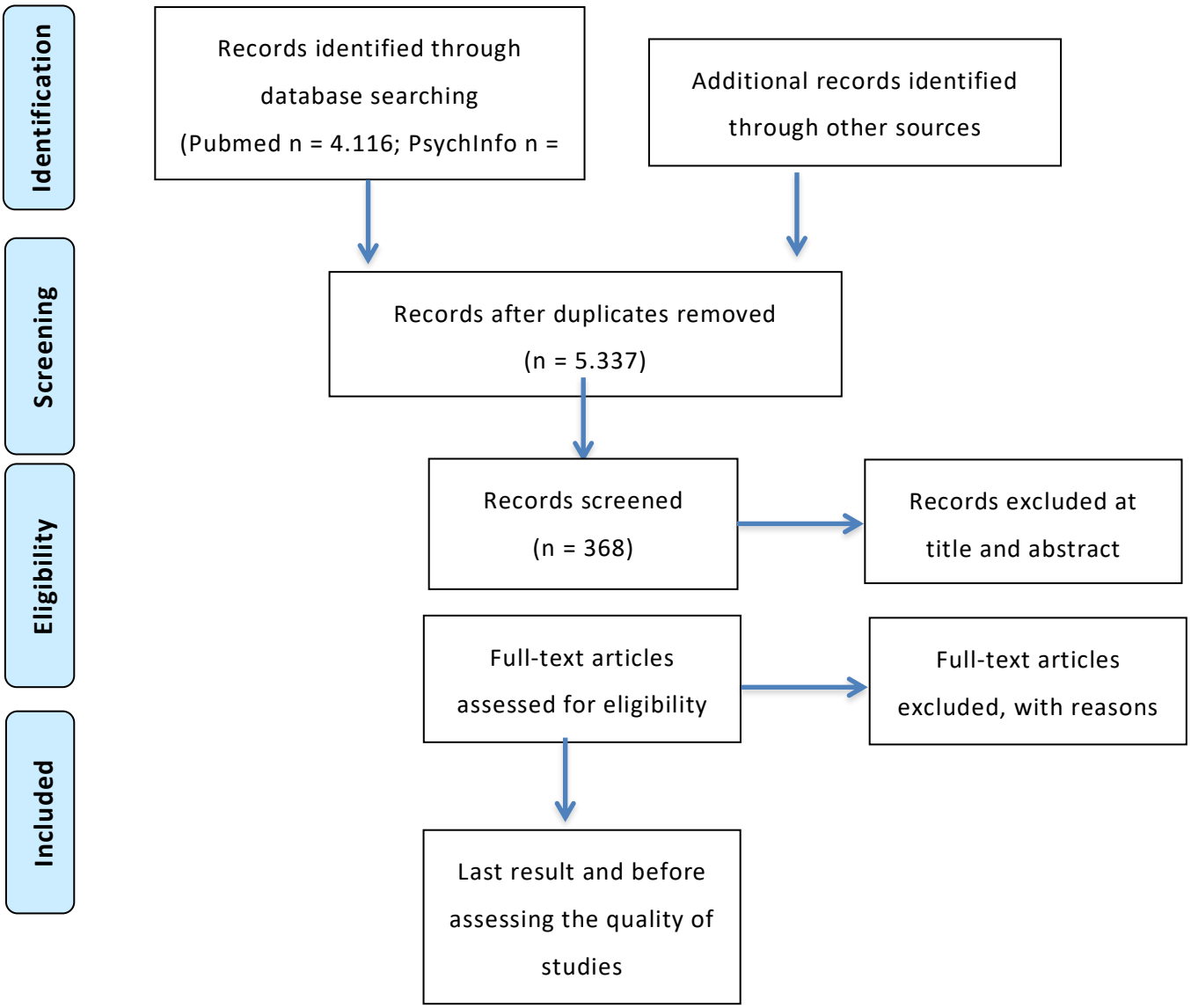

Figure 1: *study selection flow chart*

4 Results

4.1 Selection of literature

There were initially 5.705 hits from 3 electronic databases (PubMed, PsychINFO, SPORTdiscus), manual search in various scientific journals and from a complementary search in Google Scholar. All duplicates were removed, and after screening the title and abstract, the entire text was read. 33 research articles were chosen for this systematic review (see fig. 1). However, 3 out of 33 research articles were deemed to be of low quality and thus were excluded from this review. Thus, this systematic review was based on 30 studies that covered the research questions. Table 4 (for more details see additional files, appendix B) represents the details of the 30 studies included in this systematic review. The author has used quantitative and qualitative study designs as well as a combination of both to examine coping strategies and the effectiveness of the coping strategies applied to handle stress and to influence mental health.

Interestingly, the first study included was published in 1998 (Pensgaard & Ursin), which emphasizes a constant interest in coping in an elite sporting context. In addition, most studies have focused more on coping to handle stress rather than comprising the impact of coping on elite athletes' mental health (McLoughlin, Fletcher, Slavich, Arnold & Moore, 2021; Fogagca, 2021; Daumiller, Rinas & Breithecker, 2021).

The analyzed study results point to a broad spectrum of coping categories, elite athletes make use of to deal with stressful situations.

The results representation outlines a categorization of the most widely used higher-order coping dimensions based on their function and intension (Lazarus, 1966; Crocker, Kowalski & Graham, 1998), such as problem-orientated and emotion-regulative coping. Problem-orientated coping strategies are intended to change the stressful situation, whereas emotion-regulative coping deals with the emotional distress associated with the situation (Lazarus & Folkman, 1984). To describe the complexity and heterogeneity of coping within the context of elite sport and the effectiveness of coping strategies applied by elite athletes regarding their mental health, some higher-order coping dimensions were used to structure the study results. Avoidance coping comprises both behavioral and psychological efforts to get rid of a stressful situation (Krohne, 1993). Approach coping strategies involve the confrontation of the source of stress and the attempt to reduce it (e. g. taking direct action or planning) (Roth & Cohen, 1986). With the help of appraisal-focused coping the stressful situation is re-evaluated to reduce its intensity and importance (e. g. re-structuring) (Cox & Ferguson, 1991).

The application of the aforementioned macro-level dimensions of coping seems to be suitable to provide an overall characterization of elite athletes' stress responses. However, these higher-order dimensions conceal the heterogeneity and complexity of the various coping responses and consider insufficiently the aspect of mental health. As the extracted literature mainly focused on coping in elite sporting context the classification of coping was completed by the following aspects:

1. **type of sport**
2. **gender**
3. **dimensions of coping**
4. **effectiveness of coping in terms of mental health**

This approach was chosen to refer best to the review's objective/research questions.

4.2 Coping and type of sports

According to the inclusion criteria the studies of this systematic review reflected elite athletes according to Swan et al.'s (2015) definition. The comprehensive search yielded studies involving team sports, individual sports, or a combination of both. In all studies included, athletes were aged at least 12 or older.

Findings of Kerdijk, van der Kamp & Polman ‘s (2016) studies show that teammates play an important role in the experience and appraisal of stress and coping in team sports. In almost 50% of stressful encounters athletes reported that others influenced the way athletes appraised and coped with the situation, but teammates did not influence stress intensity levels.
When others influenced the stress and coping process situations were more likely to be appraised as a challenge and more adaptive problem- and emotion-focused strategies were used, whereas when a stressor was appraised as a threat a more maladaptive coping strategy or no coping at all was reported.
Problem-focused communal efforts aimed at managing and solving problems encountered by several teammates during the competitive event in a collective way, whereas relationship-focused coping included strategies using cognitive and behavioral efforts to manage and sustain relationships within the team during the stressful episode, such as motivational support (e.g. encouragement through verbal actions) and compensation (e.g. adapting the team play to relieve a teammate in difficulty and compensate for his or her weaknesses) (Leprince, D’Aripe-Longueville & Doron, 2018).
The results of (Krokosz & Jochaimek, 2018) revealed that there is a significant relationship between coping with stress and perceptions of risk in extreme athletes. Findings showed that there are significant differences between men and women in their assessment of the frequency of using given strategies for coping with stress. Women were more likely than men to use strategies of searching for emotional support and instrumental support in threat situations; men reported using the strategy of relying on a sense of humor significantly more frequently than women did. No statistically significant differences between men and women were observed in levels of satisfaction with life and in the assessment of risks associated with extreme sports.
Deroche, Woodman, Stephan, Brewer & Le Scanff (2011) examined pain coping strategies of athletes from combat sports.
The authors hypothesized that pain coping strategies including distraction from pain, praying, reinterpreting pain sensations, ignoring pain and pain catastrophizing would be related to athletes’ inclination to play through pain. The results indicated that pain catastrophizing explained an incremental portion of the variance in the prediction of sport-related pain behavior, over and above the intensity of pain experienced during sport activity. The more athletes catastrophized their pain, the less they were inclined to play through the pain.

4.3 Coping and differences in gender

Regarding gender the analyzed studies revealed some differences. Dolenc (2015) observed that female athletes showed higher levels of anxiety and used more often emotion-focused coping strategies compared with male athletes.
According to Anshel, Sutasrso & Jubenville (2009) female athletes experienced more intense stress from their coaches than did male athletes. For approach behavioral and avoidance cognitive coping styles also significant gender differences could be revealed, but not for approach cognitive coping.
Gan, Anshel & Kim (2009) focused on examining the extent to which sources of acute stress and cognitive appraisals predicted the coping style of competitive athletes in response to sport-related acute stress and to determine these predictions as a function of gender and skill level.
Discriminant analysis indicated that three sources of stress, verbal-abuse-by-others, coach-dissatisfaction, and environmental-sources, and two cognitive appraisals, control-by-self, and control-by-others, were significant predictors for athletes’ coping styles. Athletes with an approach coping style were less likely to make the appraisals control-by-self and control-by-others than athletes with an avoidance coping style. Also, skill level affected athletes’ coping style among both female and male athletes; according to the percentages, more elite male athletes had an approach coping style, and more non-elite male athletes had an avoidance coping style, and more elite female athletes had an avoidance coping style and more non-elite females had an approach coping style.

4.4 Coping dimensions applied in elite sports

Pensgaard & Ursin (1998) revealed that the coach was reported one of the most important sources of stress and that athletes who reported expectations or injury were those employing the highest number of coping strategies, whereas athletes who reported the competition itself to be stressful employed the lowest number of coping strategies.

Study results regarding coping strategies in elite sports to handle stress showed that athletes adopted more often a task-oriented coping style to confront stressful sport-related situations (Bernacka, Sawicki, Mazurek-Kusiak. & Hawlena, 2016).

Regardless of gender the survey of (Szczypinska, Samelko & Guszkowska, 2021)
showed that athletes most often applied the strategy of positive re-evaluation, acceptance, and planning. Athletes included in the Olympic preparations in comparison to their student colleagues showed a greater tendency to seek emotional and instrumental support, to engage in other activities and acceptance.

Investigation of coping strategies in relation to athletes' illness revealed significantly different profiles of coping in resilient and non-resilient athletes. Those athletes, who remained healthy despite an elevated level of recent life stress generally favored problem-focused coping and seeking social support, whereas in the non-resilient group avoidance strategies were more dominant (Yi, Smith & Vitiliano, 2005). Secades et al.'s (2016) results indicated that resilience correlated positively with task-oriented coping and negatively with emotion-oriented coping. Participants with lower resilience scored higher on emotion-oriented coping and distraction-oriented coping, whilst higher scores on resilience were observed on task-oriented coping.

Also, Litwick-Kaminska (2020) found out that during sport competitions athletes most often apply positive stress appraisals and made use of task-oriented coping, regardless of their perception of stress. Hill, Hall & Appelton (2010) examined whether different coping tendencies mediate the relationship between self-oriented and socially described dimensions of perfectionism and burnout in junior elite athletes. The findings revealed that avoidant coping was related to higher levels of athlete-burnout and higher levels of problem-focused coping were related to higher levels of self-oriented perfectionism. Dimensions of perfectionism explained 37% and 27% of variance in problem-focused coping and avoidant coping and, in turn, coping explained 58% of variance in athlete burnout.

Anshel & Anderson (2002) investigated the use of athletes' coping strategies is dependent of situational context and of the stressor's intensity. The findings concerning coping style and coping strategies showed that athletes often used coping strategies that were commensurate with their coping style. Additionally, the results of this study indicated that table tennis athletes used approach and avoidance coping strategies selectively as a function of personal and situational factors. The athletes' coping styles were significantly correlated with their use of coping strategies, with a higher correlation between avoidance coping style and strategy than between approach coping style and strategy. With respect to performance outcome, approach coping style was the best predictor of performance.

4.5 Effectiveness of coping in terms of mental health and handling stress

The results of Dolenc (2015) showed that problem-focused coping is associated with lower levels of anxiety and that emotion-focused copin**g** is associated with higher levels of neuroticism. The obtained results indicated positive correlations between proactive coping, moderate physical activity, and self-efficacy.

McLoughlin et al. (2021) investigated associations between different stressor types and athletes' mental health status. The results revealed that the total count and severity of chronic difficulties was a marginally stronger predictor of depression when compared with the total count and severity of acute life events. The aim of Skein et al.'s study (2019) was to examine the effect of periods with a

high number of commitments on sleep, stress and coping strategies compared with periods with relatively low commitments in both male and female athletes to find out potential detrimental implications on mental health, well-being, and academic performance.

Findings revealed that adolescent athletes are currently not attaining the National Sleep Foundation recommendations of 8-10 hrs. between the ages of 14 and 17 years. In addition, although not significantly different, female athletes retired to bed later than their male counterparts.

Results of Cumming et al.'s study (2012) indicated that biological and psychological factors contribute in complex ways to influence the psychological well-being and mental health status of young female athletes. Regarding the use of coping styles, the balance between adaptive and maladaptive coping styles predicted an outcome variable of clinical significance. The mental health scores of gymnasts and basketball players were more closely associated with the use of maladaptive coping strategies.

Coping strategies emerged as a predictor of variance of mental health in gymnastics but not in basketball. The results of the present study revealed that the adaptive scales were positively related to well-being and negatively to distress. The observation that coping style was most closely associated with mental health in comparatively short gymnasts was novel and of particular interest.

Findings of Fogagca (2021) revealed that the intervention group had a significantly higher mean score on the Athletic Coping Skills than the control group at the end of the intervention period. Anxiety as the dependent variable showed that the intervention group had significantly lower levels of anxiety than the control group at the end of the intervention period, whereas depression as the dependent variable showed that the difference between intervention and control group did not reach significance after controlling for their initial scores. Regarding psychological quality of life, the feedback collected from the intervention group indicated that athletes found the psychological skills easy to learn; they also reported that they frequently applied the skills they learned into their sports and lives.

The study of Guo, Li, Qiaolong & Hon (2019) examined differences between athletes with high and low coping self-efficacy (CSE) levels under acute psychological stress. The study showed that low-CSE athletes lacked confidence and hence were more likely to not know what to do when facing stress. High-CSE athletes were more alert to the error feedback compared with the low-CSE athletes and transmitted an early warning signal indicating the necessity of behavioral adjustment; high-CSE athletes could also recover quickly from frustration and disappointment and focused on positive information. By contrast, low-CSE athletes paid greater attention to negative information and the consequences of failure, not only causing them to lose confidence in their abilities but also affecting their subsequent coping behavior and possibly their mental health status.

Daumiller, Rinas & Breithecker (2021) examined the effects of elite athletes' achievement goals on their burnout levels and psychosomatic stress symptoms, and to what extent they can be explained by athletes' use of adaptive coping strategies. In their study elite athletes reported rather strong mastery approach and performance goals, while at the same time moderate levels of burnout levels and psychosomatic stress symptoms, and relatively high levels of adaptive coping strategies. There were strong interindividual differences between the athletes, which were particularly strong for mastery avoidance goals. Their results revealed that mastery approach goals were negatively associated with burnout levels but not with psychosomatic stress symptoms in terms of direct effects, and positively associated with use of coping strategies. In contrast, strong mastery avoidance goals were associated with increased burnout levels and with increased psychosomatic stress symptoms as well as with reduced use of coping strategies.

Kristiansen & Roberts (2010) examined as a second purpose of their investigation how the athletes cope with competitive and organizational stressors. The results showed that athletes needed to be prepared for the total competitive experience that includes both organizational and competitive stressors. Further findings revealed the importance of social support as a coping strategy and that informational and emotional support in combination with cognitive strategies were used most to

cope effectively with competitive stress and to influence mental health positively. In addition, coach support was important to cope with both organizational and competitive stressors and it turned out that athletes tend to seek more likely support from people the feel close to.

5 Discussion

This systematic review attempts to outline the current knowledge of coping strategies for handling stress and providing mental health in elite athletes.

Overall, the findings of this review add to domain-related reviews (Rice et al., 2016; Kuettel & Larsen, 2020) suggesting, that elite athletes face various stressors during their sports career, that, if not well managed, put them at an increased risk of poor mental health. Despite growing interest in this topic, the factors that influence elite athletes' mental health remain unclear and therefore warrant further research. The transactional model of stress and coping (Lazarus & Folkman, 1984) proposes that effective coping is an important variable to buffer the detrimental effects of stressors on mental health, as coping resources theoretically influence an athlete's ability to effectively deal with the challenges and stresses of sport participation. According to Hobfoll (2002) someone with resources is less likely to encounter stressful circumstances that negatively affect psychological well-being and mental health. Hence, an elite athlete with coping skills such as high coping self-efficacy, highly pronounced resilience, sense of coherence or support from coaches, teammates, family members or friends can apply these resources in terms of coping with stressful situations towards growth and development instead of using these skills defensively to offset stressors. The athlete makes use of his resources to solve problems inherent to stressful situations. The more resources are available the more likely these resources are used to fit upcoming demands in stressful contexts.

However, limited attention has been given to the potential relationship of athletic coping skills with well-being and mental health and how coping and its effectiveness are associated with elite athletes' mental health, despite Smith et al.'s (1995) suggesting that these variables would be related to each other.

The high levels that elite athletes are required constantly to achieve best performance can result in psychosomatic stress symptoms, such as depression, anxiety or eating disorders (Rice et al., 2016). Such stress symptoms, stemming from physical as well as psychological factors, are especially detrimental to elite athletes, as they rely on their physical and mental health and functioning for performance success. An increasing body of evidence shows that elite athletes experience mental-health problems, that can be maladaptive if not treated at an early stage, as they can lead to compromised psychological and physiological functioning (Asplund & Chang, 2020). Concerning the relationship between stress and resulting mental health problems, the different coping strategies elite athletes use to handle stress can be important (Lazarus, 2000; Nicholls & Polman, 2007). According to Lazarus (1991) coping strategies can be described as behaviors that help elite athletes to handle their problems, joys, and stresses of life.

Therefore, dealing effectively with stress and the actions one decides to take depend mainly on the characteristics of the stressor and largely determines the health costs of a stress transaction (Antonowsky, 1979).

This systematic review aimed to address this issue by analyzing both quantitative, qualitative, and mixed-method study designs examining elite athletes and the effectiveness of their coping strategies to handle stress and to protect their mental health.

The findings are also consistent with the transactional model (Lazarus, 1984; 1991) and show parallels to the biopsychosocial determinants (see table 1) influencing mental health in an elite sporting context (Rice et al., 2021). Worth mentioning are determinants on the psychological level (e.g., personality, perceived stress, coping repertoires) as well as on the social level (e.g., support systems) and the biological level (e.g., sleep, gender, age) as they were all focused on in the studies analyzed in this review.

5.1 Coping and type of sports

Teammates could influence with their verbal behavior the way athletes coped with a stressful encounter.

The findings of this review indicated that athletes' appraisal and the way they cope is influenced by the way teammates respond. Athletes positively valued the uncalled contribution of others and made use of more adaptive problem- or emotion-focused coping strategies. The social environment appeared to have influenced athletes employing more adaptive coping strategies (Kerdijk, van der Kamp & Polman, 2016).

The identification of new coping dimensions at the team sports level represents an important step in the understanding of communal coping in team sports because it offers a new perspective of how teams cope dealing with communal stressors. The identified communal coping strategies concretely describe the collective actions teammates use to cope. Relationship-focused coping strategies seem to be used to maintain and develop the relationship within the team, to obtain collective benefits during the game and to benefit the collective performance during the competitive encounter. Overall results revealed how communal coping operates specifically within sport teams in performance settings and provided unique insights into the processes and forms of communal coping in a sport context (Leprince, D'Aripe-Longueville, & Doron, 2018).

The findings of studies analyzed in terms of type of sport showed that in extreme sports concentrating on forming interpersonal relations through looking for instrumental and emotional support seems more natural to women (Krokosz & Jochaimek, 2018).

One possible explanation could be that women assess threats more realistically and do not feel the need to underestimate them to gain social approval. Men in contrast tried to preserve their image as brave and strong individuals. In the context of satisfaction with life the strategy of using self-blame, which was evident in the male group, it may be that athletes feel a sense of control and agency, which in turn translates into a sense of satisfaction with life.

In terms of coping with pain the analyses showed that the more athletes ignore pain, the more they can maintain their sport involvement despite their pain (Deroche et al., 2011).

The significant interaction between pain intensity and ignoring pain suggests that the relation between pain intensity and pain behavior changes as a function of athletes' tendency to ignore pain: the more athletes ignore pain, the less pain intensity will lead them to decrease their sport involvement. However, ignoring pain can increase pain tolerance and attenuate physiological arousal and intensify psychological distress (Cioffi, 1991). Thus, this coping strategy appears to lead athletes to divert from nociceptive input, allowing them to maintain their initial task involvement despite their pain.

Competing despite having health problems can cause irreversible physical damage and therefore may affect not only an athlete's professional career but also his long-term health. Studies investigating the phenomenon of playing hurt have shown that playing despite having health problems often is accompanied with disregarding medical guidelines or hiding pain from coaches and teammates (Thiel et al., 2010). As social pressure is mainly generated by coaches or other team members, it can be presumed that also the way of communication in sports networks plays a decisive role regarding athletes' willingness to compete hurt or ill. In this regard the role of the coach regarding establishing athlete-centered communication strategies to prevent athletes from pain-trivializing or competing despite injuries or illness seems to be more than mandatory (Roderick, 2006).

The present review emphasized the contribution of pain coping in predicting athletes' inclination to play through their pain, whereas previous studies have shown how social networks can lead athletes to accept pain as a "part of the game" and can generate pressure on athletes to continue competing despite such pain (Nixon, 1993; Mayer & Thiel, 2018).

5.2 Coping and differences in gender

The findings of the analyzed studies show that there may be various reasons for gender differences in coping behavior (Anshel et al., 2009; Dolenc, 2015).

Findings are also consistent with previous sport psychology research showing that female athletes assess stressful situations as more negative compared to male athletes. Female athletes had stronger feelings of tension and worry with greater susceptibility to a variety of stressful events and seek for more social support. One reason that males and females cope differently could be the emergence of differences in the socialization process because of gender role stereotypes and expectations from the social environment. That could implicate that gender differences may influence an athlete's selection of coping styles and strategies and, that females are more inclined to make use of an emotion-oriented coping style, whereas men use more often active coping.

In combination with the aspect of type of sports the findings show that for example female football players have more poorly developed task-oriented style of coping with stress. Compared with male players female players seem to be more prone to using an emotion-oriented style which has been related to females' higher emotional sensitivity especially with respect to interpersonal issues.

When analyzing the styles of coping with stress the influence of maladaptive strategies must be emphasized. The use of this kind of coping strategies may exert an unfavorable effect in terms of (mental) health, as stress can be seen as one of the most prevalent predictors for injury in team sports, notably in football. According to the literature the avoidance style of coping with stress is more predominant among athletes especially when avoidance is situationally beneficial to athletes and helps them to reduce the level of experiences of anxiety. A task-oriented style in contrast is associated with undertaking efforts to solve a problem or to change a situation by cognitive transformation. Therefore, it is naturally associated with a feeling of control over a particular situation.

Athletes with an approach coping style were more likely to appraise the stressful event as highly controllable, as opposed to competitors with an avoidance coping style. Following the appraisal framework of Lazarus and Folkman (1984) coping style is best predicted under conditions by determining the source of stress and the athlete's appraisal of the event. The athletes' coping styles were apparently influenced by their skill level. The findings implicate that the coping process in sport and the effective use of coping interventions are optimal when first determining an athlete's appraisal and coping style and the type of stressor the athlete is confronted with.

Also, the significant findings between skill levels for the athletes' use of cognitive appraisal and coping style are consistent with results of former studies (Neil et al., 2011). There is to some extent empirical evidence that less-skilled male and female athletes differ on various psychological characteristics. However, differences in psychological characteristics based on gender are less common among highly skilled athletes (Anshel et al., 2001). It is possible, that at a particular elite level of competition, athletes of both genders make cognitive appraisals and adopt coping styles that are similar and effective. The findings of this review coincide with the transactional model which recognizes the relationships between environmental demands, an individual's perceptions of these demands, and the individual's ability to handle the demands (Lazarus, 1999). The transactional model consists of determining the intensity of different acute stressors, the athlete's appraisal of the stressful situation and identifying the athlete's use of coping style in response to the perceived stressor.

5.3 Coping dimensions applied in elite sports

In view of the coping dimensions applied in elite sports the findings of this review suggest that among the analyzed strategies of coping with stress**,** avoidanc**e** may be related to health and absenteeism by contributing to psychological distress and emotional arousal, which may in turn suppress immunity. In addition, there is evidence that avoidance could also relate to illness in terms of not taking care of oneself when one is ill (Szczypinska, Samelko & Guszkowska, 2021).

As illness itself could serve as a socially accepted means of avoiding stressful situations, an avoidance strategy may temporarily be adaptive to cope with uncontrollable stressors. One possible disadvantage could be that illness prevents the use of more problem- and emotion-focused strategies in terms of proactive coping. Furthermore, the willingness to use active coping strategies can be predicted on the base of meaningfulness and sports activity. It can be expected that problem-focused strategies are more likely used by athletes or people with a strong sense of meaningfulness. According to Aspinwall and Taylor (1997) proactive coping involves providing the necessary resources and skills to prepare for confronting and anticipating stressors.
The data obtained from the findings suggest that athletes with high resilience may have developed strategies that aid in mobilizing resources to permit facing up to the stressors of the context of elite sports in an active way. Whilst emotion- and distraction strategies seem to draw away resources from the situation, task-oriented coping is seen as an orientation of self-regulation resources towards the specific task.
As resilience is one of the resources permitting athletes to protect their health (Sakar & Fletcher, 2014), resilience takes on great importance to determine whether athletes will be able to go through stressful situations they are confronted with during their sports career.
According to the findings it seems that high resilient qualities associate with coping strategies that might contribute more effectively to adapt to stressors and possible failures in elite sports (Secades et al., 2016). However, more research is required to confirm that enhanced resilience might not only contribute to better sport performance but also improve elite athletes' mental health status, as resilience is a relatively stable construct (Fletcher & Sarkar, 2012).
According to the transactional stress theory (Lazarus, 2000) it can be assumed that being more flexible about choosing how to cope is associated with more adaptive outcomes. Therefore, athletes' repertoire of coping skills should include a whole range of possibilities to be more flexible in various situations. As for the essential aspects of coping in sports – cognitive appraisal, coping strategies and emotions, and assuming a mediating role of emotions between appraisals and coping, it can be considered that different appraisals lead to different emotions and are coped with using different strategies. That's why athletes should also be taught specific strategies for increasing their self-awareness to be aware of negative threat appraisals as kind of alarm against potential problems. It is apparent that highly skilled athletes use an array of coping techniques; there is no "best way" to cope under all conditions.
This review's study analyses are in line with the findings of Lazarus & Folkman (1991) identifying that an athlete's coping style predicts a modest percentage of the variance in situational coping and performance outcome. The findings of this review lend increased support that an athlete's use of coping strategies at least partially reflects the coping style. The application of coping style and coping strategies seem to be a function of the type and the intensity of the stressors an athlete is confronted with or of the athlete's cognitive appraisal of the stressful event. Thus, the context in which coping is enacted appears to provide more powerful predictors of a person's use of coping strategies.

5.4 Effectiveness of coping in terms of mental health and handling stress

Findings of this review suggest that chronic stress may be a stronger predictor for depression than acute stress. The study results also highlighted that specific life domains and social-psychological characteristics might make athletes more susceptible to poor mental health and well-being.
The accumulation of stressors during childhood was found to render participants more susceptible to stress throughout adulthood. This finding suggests that the accumulation of stressors over life course may limit the coping resources to deal with the demands of a stressful situation.
When coping resources are limited, individuals will typically appraise a stressful situation more as a threat. Repeated threat appraisals have been linked to deleterious health consequences (e.g., depression). Athletes who experienced greater and more lifetime stressors demonstrated difficulty

in establishing and maintaining interpersonal relationships. According to extent literature a lack of interpersonal relationship can increase the cumulative effects of stress (McLoughlin et al., 2021). Fear of failure also turned out to have a short-term impact on the athletes' well-being, interpersonal behavior, sport performance, and schoolwork prompting athletes to employ both effective and ineffective coping strategies to deal with the effects of fear of failure. This finding seems to be important, as athletes who engage in ineffective coping skills to deal with their fears of failure may experience poor performance, negative emotions, and a desire to withdraw from sport Lavallee, Sagar & Spray, (2009). The analysis of the reviewed papers goes in line with Lazarus' (1999; 2000) findings that emotions will occur when a person appraises encounters with the environment as having either a positive or negative impact for well-being in terms of the person's goals. Fear will be provoked when an individual believes that failure is a threat to the achievement of goals.
Study results showed that an increase in scheduling demands during periods of school and sporting competition in combination with chronic sleep deprivation may contribute to an increased intensity and frequency of perceived stress experienced by athletes. As a result of increased stress during periods of increased demands in school and sport athletes appear to utilize a larger number of coping strategies, such as talking to family members or friends, seeking help from a coach or mentor, or making effort to find some "time-out" (Skein, Harrison & Clarke, 2019).
Chronic sleep deprivation experienced by elite athletes may suggest that not only their recovery is impaired but also their mental health and well-being may be negatively affected.
For athletes, poor sleep can result in impaired recovery, but also diminished athletic performance and increased injury risk are seen as health influencing factors. According to Asplund & Chang (2020), a bi-directional relationship has been observed, which means that sleep problems in athletes are positively correlated with depression or anxiety, while just mentioned psychiatric conditions can lead to sleep disturbances and therefore compromise sleep quality. Coming along that due to fear of negative evaluation, lack of mental health literacy and/or limited knowledge of where and how to seek help, elite athletes still fail to report sleep and mental health problems (Montero, Stevens, Adams & Drummond, 2022).
Aside from these barriers mentioned above and differential sport demands there may undetermined athlete differences that influence the nature of coping responses. Differences in psychological maturity may explain why the tendency to employ adaptive versus maladaptive coping strategies was more closely associated with mental health in athletes. Especially, if athletes are delayed in their psychological maturity, they may be less capable of using adaptive coping strategies to effectively deal stressors, including sport-specific demands, such as participating at competitions, training, and social life.
Again, the findings are reflected in the research of Lazarus and Folkman (1984). From their point of view individual resources that help to deal successfully with the demands imposed by of a particular situational context (in our case the context of elite sports) determine the level and intensity of distress experienced. That's why resources should be directed to detect early signs of mental health problems in this age group, as around 19 years of age, just after completing high school and moving from junior to senior competitions, seems to be a particularly vulnerable age for onset of mental health problems in elite athletes.
The results of this review underpin the necessity that especially college-students being confronted with a wide range of stressors, need to be taught mental skills to cope with these stressors. In addition, teaching coaches and teammates about social support seemed to decrease college-student athletes' stress reactions, such as anxiety or depressive symptoms. This finding is also in line with the transactional model of stress and coping (Lazarus & Folkman, 1984), which proposes that coping efforts and social support can decrease the effects of stressors on a person's mental health.
However, traditional sport psychology is mainly focused on optimizing performance in a presumably healthy population, although mental health problems in elite sport have received increased attention, revealing the need for a broader mental health continuum (Cumming et al.,

2012; Akesdotter et al., 2020) and for more attention to the potential relationship of athletic coping skills with well-being and mental health (Fogagca, 2021).
As coping self-efficacy has a positive mental health effect on athletes' ability to cope with stress, athletes can thus better cope with and eliminate interference caused by competitive stressors and eventually achieve their best performance and protect their mental health (Guo et al., 2019).

5.5 Practical implications and future directions

Understanding the mechanisms of the coping process and its complexity in the context of handling stress may assist in the development for future interventions. As mental health plays a key role in many functions that are necessary in a context of elite sporting, future studies may investigate strategies to cope effectively with the stressors elite athletes are confronted with, such as improving stress management techniques to avoid stress. Future approaches in sport psychology research may move beyond the identification of stressors and prevalence rates to point more vehemently to the complexity of mental-health problems in elite sports. The research directions displayed in Table 6, 7 & 8 could be adapted to an elite sporting context in future projects to investigate and improve understanding elite athletes' coping strategies regarding to cope with stress and mental health.

Table 6: *Practical implications & future directions for type of sports*

Practical implications	**What is known**	**Future directions**
• Athletes competing in **individual sports** or sports where athletes are expected to reach their performance peak at an early age, such as gymnastics, may benefit from learning to use adaptive coping strategies (like problem-focused coping, seeking social support, or cognitive restructuring (minimizing threat)) (Cumming., Smith, Grossbard, Smoll, & Malina, 2012) • In **team sports** coping effectiveness training programs combined with attention modification issues should be incorporated in the training of athletes to help them to better cope with and eliminate interference caused by competitive stressors and eventually achieve their best performance and protect their mental health (Guo, Li, Qiaolong & Hong, 2019)	• There are differences in terms of gender in **extreme sports** in the frequencies of using different coping strategies among extreme athletes (Krokosz & Jochaimek, 2018)	• As coping actions are influenced by **type of sport**, future research should also consider other sports with other requirements (e.g., exhibition, repetition) • Stress management programs should be developed to help **teams** to collectively solve problems, to strengthen the mental health status of the whole team and to strengthen relationships under stressful conditions (Leprince, D'Aripe-Longueville & Doron, 2018) • In the context of **team sport**s future research should take a closer look how the behavior of others influences the stress and coping process of team sport athletes (Kerdijk, van der Kamp & Polman, 2016) • To reduce athletes' vulnerability to emotional abuse and any mental health impairments, it is recommended to explore the coping process across a **broader range of sports and participants**

Table 7: *Practical implications & future directions for coping effectiveness in terms of mental health and handling stress*

Practical implications	What is known	Future directions
• Relationships between **protective or immune resource**s such as the sense of coherence and the **effectiveness of coping strategies** to deal with stress in an extreme situation such as the COVID-19 pandemic should be examined in a more detailed way in the context of developing coping interventions in the context of elite sports (Szczypinska, Samelko & Guszkowska, 2021) • Examining **fear of failure** in relation to individual variables (e.g., personality factors) and interpersonal factors (e.g., coach-athlete relationships), will enhance knowledge and help to contribute to young athletes' mental health, quality of life and their social development (Kristiansen & Robert, 2010) • By identifying the most efficient ways to cope in an athletic environment, an appraisal training may enhance performance and influence mental health and well-being (Nicholls, Levy, Carson, Thompson & Perry, 2018) • Assessing simultaneously the **use** and **effectiveness of coping strategies** to clearly disentangle the effects of the use versus effectiveness of a wide variety of coping strategies	• Because of increased stress during periods of increased demands in school and sport athletes appear to utilize a larger number of coping strategies (Skein, Harrison & Clarke, 2019) • the accumulation of stressors over life course may limit the coping resources to deal with the demands of a stressful situation; athletes who experienced greater and more **lifetime stressors** demonstrated difficulty in establishing and maintaining interpersonal relationships; a lack of interpersonal relationship can increase the cumulative effects of stress and pertain to mental health-related problems (McLoughlin, Fletcher, Slavich, Arnold & Moore, 2021) • Chronic sleep deprivation experienced by elite athletes suggest that not only their recovery is impaired but also their mental health and well-being may be negatively affected (Skein, Harrison & Clarke, 2019) • The coach-athlete relationship is a key factor for elite athletes' mental health (Daumiller, Rinas & Breithecker, 2021) • Coping self-efficacy has a positive mental health effect on athletes' ability to cope with stress (Guo, Li, Qiaolong & Hong, 2019) • The contribution of pain coping predicts athletes' inclination to play through their pain, to accept pain as a "part of the game" and to continue competing despite such pain (Deroche, Woodman, Stephan, Brewer & Le Scanff, 2011) • Coping plays a significant role in illness-resistance in the face of stress (Yi, Smith & Vitiliano, 2005) • Athletes who engage in ineffective coping skills to deal with their fears of failure experience poor performance, negative affect, and a desire to withdraw from sport	• Identifying the specific dimensions that underpin the association between **self-oriented perfectionism** and **problem-focused coping** is an interesting avenue for future research (Hill, Hall & Appelton, 2010) • More research is needed to determine the underlying factors and antecedents that predict an athlete's coping preferences following specific types of stressful events and then to target meaningful and effective interventions to improve **mental health** and **coping skills** (Gan, Anshel & Kim, 2009)

Table 8: *Practical implications & future directions for coping dimensions*

Practical implications	What is known	Future directions
• Training adolescent athletes to use **task-orientated coping** might help them to deal with competitive anxiety in sport • Elite athletes need to be better prepared to cope with a variety of stressors, secondly to cope with novel stressors and a **supportive coach-athlete relationship** is highly recommended especially if coaches want athletes continuing **long-term competitive participation** (Kristiansen & Robert, 2010)	• **Problem-focused coping** is associated with lower levels of anxiety and **emotion-focused coping** is associated with higher levels of neurocitism (Dolenc, 2015) • Males and females cope differently; females are more inclined to make use of an **emotion-oriented coping** style, whereas men use more often **active coping**; racial and gender differences influence an athlete's selection of coping styles and strategies (Anshel, Sutasrso & Jubenville, 2009) • According to the transactional stress theory (Lazarus, 2000) it can be assumed that being more flexible about choosing how to cope is associated with more **adaptive** outcomes	• Future sport psychology investigations should include examining links between an athlete's coping style and their actual application of coping strategies following various sources of acute stress as a function of sport type (e.g., individual and team), skill level, gender, age, and culture (Anshel & Anderson, 2002) • **Longitudinal designs** should investigate how elite athletes function over time in terms of their coping strategies and their psychosomatic stress symptoms; this seems to be especially relevant for young elite athletes dealing with chronic stress when facing a dual academic and sport career (Daumiller, Rinas & Breithecker, 2021)

5.6 Limitations

This systematic review shows a few noteworthy limitations. First, this systematic review includes only English language studies, which may limit the representation of the results. Second, this review is not a meta-analysis which was not possible to realize due to the heterogeneity of study designs. Third, the paucity of research in the field and the lack of well-designed, intervention-based research in elite athletes' coping to handle stress and to provide mental health contributes the poor overall quality of study reporting on this topic (Secades et al., 2016; Fogagca, 2021). Moreover, variables such as age, gender, type of sport (e.g., individual or team sport) or effectiveness of applied coping strategies have not been considered in a standardized manner (Anshel & Anderson, 2002; Kristiansen & Roberts, 2010).

Finally, the author's attempt to structure the dimensions of coping must be considered in a critical way. According to the cognitive-transactional stress theory, two functions can be distinguished: problem-related coping and emotional coping (Lazarus, 1991). However, the function is seen independently of the effect. According to Weber & Laux (1990) this dual function model should not be classified by functions, but rather by subjective intentions, i.e., by the very personal functionality of a behavior with respect to an individual's preferred goals. These personal intentions can be divided into four facets: the regulation of emotions, the solution of the underlying problem, the maintenance of self-worth, and the control of social interactions. Whether and when these four regulatory goals are met is then a question to be addressed independently. Content areas such as well-being, physical and mental health, or social behavior serve as one criterion for efficiency.

6 Conclusion

Coping in elite sporting settings is very complex and dynamic. This is the first systematic review that has analyzed coping strategies to handle stress and to provide mental health in an elite sporting context.

Results highlight that coping strategies play an important role in understanding the handling of sport-specific and non-sport specific stressors in an athlete's professional career. There is evidence of coping being effective to buffer stress, but the interrelationships between stressor, appraisal of the stressor, application of a corresponding coping strategy, its effect especially in terms of mental health outcomes is still unclear because of lacking intervention-based study designs. Future research is needed that assesses these relationships primarily as previous studies revealed that elite athletes

tend to ignore and trivialize health risks and act within a coherent culture of risk to perform successfully.

References

Allen, S.V. & Hopkins, W.G. (2015). Age of Peak Competitive Performance of Elite Athletes: A Systematic Review. *Sports Med* 45**,** 1431–1441.

Alvaro, C., Lyons, R. F., Warner, G., Hobfoll, S. E., Martens, P. J., Labonté, R. & Brown, E. R. (2010). Conservation of resources theory and research use in health systems. *Implementation science*, *5*(1), 1-20.

Anshel, M., & Anderson, D. (2002). Coping with acute stress in sport: Linking athletes' coping style, coping strategies, affect, and motor performance. *Anxiety, Stress & Coping*, *15*(2), 193-209.

Anshel, M. H., Raviv, S. & Jamieson, J. (2001). Cognitive appraisals and coping strategies following acute stress among skilled competitive male and female athletes. *Journal of sport behavior*, *24*(2).

Anshel, M. H., Sutarso, T. & Jubenville, C. (2009). Racial and gender differences on sources of acute stress and coping style among competitive athletes. *The journal of social psychology*, *149*(2), 159-178.

Antonovsky, A. (1979). Health, stress, and coping. *New perspectives on mental and physical well-*

Arnold, R. & Fletcher, D. (2012). A research synthesis and taxonomic classification of the organizational stressors encountered by sport performers. *J Sport Exerc Psychol, 34*, 397-429.

Åkesdotter, C., Kenttä, G., Eloranta, S. & Franck, J. (2020). The prevalence of mental health problems in elite athletes. *Journal of science and medicine in sport*, *23*(4), 329-335.

Asplund, C. & Chang, C. J. (2020). The role of sleep in psychological well-being in athletes. In *Mental health in the athlete* (pp. 277-290). Springer, Cham.

Aspinwall, L. G. & Taylor, S. E. (1997). A stitch in time: self-regulation and proactive coping. *Psychological bulletin*, *121*(3), 417.

Bär, K.J. & Markser, V. Z. (2013). Sport specificity of mental disorders: the issue of sport psychiatry. *Eur Arch Psychiatry Clin Neurosci 263*(Suppl. 2), S205-S210.

Barry, M. & Friedli, L. (2008). The influence of social, demographic, and physical factors on positive mental health in children, adults, and older people (State-of-Science Review: SR-B3). London: The Government Office for Science. *Foresight SR-B3 v1 stage, 1*.

Bauman, N.J. (2016). The stigma of mental health in athletes: are mental toughness and mental health seen as contradictory in elite sport? British Journal of Sports Medicine, 50, 135-136, originally published online November 30, 2015.

Bernacka, R. E., Sawicki, B., Mazurek-Kusiak, A. & Hawlena, J. (2016). Conforming and nonconforming personality and stress coping styles in combat athletes. *Journal of human kinetics*, *51*(1), 225-233.

Breslin, G., Shannon, S., Haughey, T., Donnelly, P. & Leavey, G. (2017). A systematic review of interventions to increase awareness of mental health and well-being in athletes, coaches and officials. *Systematic reviews*, *6*(1), 1-15.

Britton, D. M., Kavanagh, E. J., & Polman, R. C. (2019). A path analysis of adolescent athletes' perceived stress reactivity, competition appraisals, emotions, coping, and performance satisfaction. *Frontiers in Psychology*, *10*, 1151.

Castaldelli-Maia, J. M., e Gallinaro, J. G. D. M., Falcão, R. S., Gouttebarge, V., Hitchcock, M. E., Hainline, B., ... & Stull, T. (2019). Mental health symptoms and disorders in elite athletes: a systematic review on cultural influencers and barriers to athletes seeking treatment. *British Journal of Sports Medicine*, *53*(11), 707-721.

Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological bulletin*, *109*(1), 25.

Collins, D., Bailey, R.P., Ford, P.; MacNamara, A., Toms, M. & Pearce, G. (2012). Directions in participant development in sport and physical acitivity. *Sport Educ Soc, 17*, 225-244.

Cox, T. & Ferguson, E. (1991). *Individual differences, stress, and coping.*

Crocker, P. R. & Graham, T. R. (1995). Coping by competitive athletes with performance stress: Gender differences and relationships with affect. *The sport psychologist*, *9*(3), 325-338.

Crocker, P. R., Kowalski, K. C. & Graham, T. R. (1998). Measurement of coping strategies in sport. *Advances in sport and exercise psychology measurement*, 149-161.

Cumming, S. P., Smith, R. E., Grossbard, J. R., Smoll, F. L. & Malina, R. M. (2012). Body size, coping strategies, and mental health in adolescent female athletes. *International Journal of Sports Science & Coaching*, *7*(3), 515-526.

Daumiller, M., Rinas, R. & Breithecker, J. (2021). Elite athletes' achievement goals, burnout levels, psychosomatic stress symptoms, and coping strategies. *International Journal of Sport and Exercise Psychology*, 1-20.

DeFreese, J. D. (2017). Athlete mental health care within the biopsychosocial model. *Athletic Training & Sports Health Care*, *9*(6), 243-245.

Deroche, T., Woodman, T., Stephan, Y., Brewer, B. W. & Le Scanff, C. (2011). Athletes' inclination to play through pain: a coping perspective. *Anxiety, Stress & Coping*, *24*(5), 579-587.

Dolenc, P. (2015). Anxiety, self-esteem and coping with stress in secondary school students in relation to involvement in organized sports. *Slovenian Journal of Public Health*, *54*(3), 222-229.

Engel, G.L. (1977). The need for a new medical model. A challenge for biomedicine. *Science, 196*, 129-136.

Engel, G. L. (1981). The clinical application of the biopsychosocial model. *The Journal of Medicine and Philosophy: A Forum for Bioethics and Philosophy of Medicine*, *6*(2), 101-124.

Fava, G. A. & Sonino, N. (2007). The biopsychosocial model thirty years later. *Psychotherapy and psychosomatics*, *77*(1), 1.

Fletcher, D. & Sarkar, M. (2012). A grounded theory of psychological resilience in Olympic champions. *Psychology of sport and exercise*, *13*(5), 669-678.

Fogaca, J. L. (2021). Combining mental health and performance interventions: Coping and social support for student-athletes. *Journal of Applied Sport Psychology*, *33*(1), 4-19.

Franke, A. (2010). *Modelle von Gesundheit und Krankheit* (Programmbereich Gesundheit, 2, überarb. und erw. Aufl.). Bern: Huber.

Gan, Q., Anshel, M. H. & Kim, J. K. (2009). Sources and cognitive appraisals of acute stress as predictors of coping style among male and female Chinese athletes. *International Journal of Sport and Exercise Psychology*, *7*(1), 68-88.

Giel, K. E., Hermann-Werner, A., Mayer, J., Schneider, S., Thiel, A. & Zipfel, S. (2016). Eating Disorder Pathology in Elite Adolescent Athletes. Int J Eat Disord, *49*, 553-562.

Goyen, M. J., & Anshel, M. H. (1998). Sources of acute competitive stress and use of coping strategies as a function of age and gender. *Journal of Applied Developmental Psychology*, *19*(3), 469-486.

Gouttebarge, V., Castaldelli-Maia, J. M., Gorczynski, P., Hainline, B., Hitchcock, M. E., Kerkhoffs, G. M., ... & Reardon, C. L. (2019). Occurrence of mental health symptoms and disorders in current and former elite athletes: a systematic review and meta-analysis. *British journal of sports medicine*, *53*(11), 700-706.

Gulliver, A., Griffiths, K.M. & Christensen, H. (2012). Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study. BMC Psychiatry, *2*(1), 157.

Gulliver, A., Griffiths, K.M. & Mackinnon, A., Batterham, P.J. & Stanimirovic, R. (2015). The mental health of Australian elite athletes. J Sci Med Sport, *18*, 255-261.

Guo, T., Ni, Y., Li, Q. & Hong, H. (2019). The Power of Faith: The Influence of Athletes' Coping Self-Efficacy on the Cognitive Processing of Psychological Stress. *Frontiers in Psychology*, *10*, 1565.

Hammen, C. L. (2015). Stress and depression: old questions, new approaches. *Current Opinion in Psychology*, *4*, 80-85.

Henriksen, K., Stambulova, N. & Roessler, K. K. (2010). Holistic approach to athletic talent development environments: A successful sailing milieu. *Psychology of sport and exercise*, *11*(3), 212-222.

Hill, A. P., Hall, H. K. & Appleton, P. R. (2010). Perfectionism and athlete burnout in junior elite athletes: The mediating role of coping tendencies. *Anxiety, Stress, & Coping*, *23*(4), 415-430.

Hobfoll, S. E. (1989). Conservation of resources: a new attempt at conceptualizing stress. *American psychologist*, *44*(3), 513.

Hobfoll, S. E. & Wells, J. D. (1998). Conservation of resources, stress, and aging. In *Handbook of aging and mental health* (pp. 121-134). Springer, Boston, MA.

Hobfoll, S. E. (2002). Social and psychological resources and adaptation. *Review of general psychology*, *6*(4), 307-324.

Kaluza, G. (2018). *Gelassen und sicher im Stress.* Das Stresskompetenz-Buch: Stress erkennen, verstehen, bewältigen. (7. Auflage). Berlin: Springer.

Kerdijk, C., Van der Kamp, J. & Polman, R. (2016). The influence of the social environment context in stress and coping in sport. *Frontiers in psychology*, *7*, 875.

Kmet, L. M., Cook, L. S., & Lee, R. C. (2004). Standard quality assessment criteria for evaluating primary research papers from a variety of fields.

Kratzer, H. (1991). Psychische Belastung und Belastbarkeit im Sport. In P. Kunath & H. Schellenberger (Hrsg.), *Tätigkeitsorientierte Sportpsychologie - Eine Einführung für Sportstudenten und Praktiker* (S.235-264). Frankfurt/Main: Harri Deutsch.

Kristiansen, E. & Roberts, G. C. (2010). Young elite athletes and social support: Coping with competitive and organizational stress in "Olympic" competition. *Scandinavian Journal of Medicine & Science in Sports*, *20*(4), 686-695.

Krohne, H. W. (1993). Vigilance and cognitive avoidance as concepts in coping research.

Krokosz, D. & Jochimek, M. (2018). Coping strategies, perception of sport risk and satisfaction with life in men and women practicing extreme sports. *Balt J Health Phys Activ*, *10*(4), 238-245.

Kuettel, A. & Larsen, C.H. (2020). Risk and protective factors for mental health in elite athletes: a scoping review, *International Review of Sport, and Exercise Psychology*, *13*(1), 231-265.

Kuettel, A., Pedersen, A. K. & Larsen, C. H. (2021). To Flourish or Languish, that is the question: exploring the mental health profiles of Danish elite athletes. *Psychology of Sport and Exercise*, *52*, 101837.

Lavallee, D., Sagar, S. S., & Spray, C. M. (2009). Coping with the effects of fear of failure in young elite athletes. *Journal of Clinical Sport Psychology*, *3*(1), 73-98.

Lazarus, R. S. (1966). Psychological stress and the coping process.

Lazarus, R. S., & Launier, R. (1981). Stressbezogene Transaktion zwischen Person und Umwelt. In J.R. Nitsch & H. Allmer (Hrsg.), *Stress, Theorien, Untersuchungen, Maßnahmen*, 213–260. Bern: Huber.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

Lazarus, R. S. (1990). Theory-based stress measurement. *Psychological inquiry*, *1*(1), 3-13.

Lazarus, R. S. (1991). Progress on a cognitive-motivational-relational theory of emotion. *American psychologist*, *46*(8), 819.

Lazarus, R. S. & Folkman, S. (1991). 9. The Concept of Coping. In *Stress and coping: An anthology* (pp. 189-206). Columbia University Press.

Lazarus, R. S. (1998). The stress and coping paradigm. *Fifty years of the research and theory of RS Lazarus: An analysis of historical and perennial Issues*, 182-220.

Lazarus, R. S. (1999). Hope: An emotion and a vital coping resource against despair. *Social research*, 653-678.

Lazarus, R. S. (2000). How emotions influence performance in competitive sports. *The sport psychologist*.

Leprince, C., D'Arripe-Longueville, F. & Doron, J. (2018). Coping in teams: Exploring athletes' communal coping strategies to deal with shared stressors. *Frontiers in psychology*, 1908.

Litwic-Kaminska, K. (2020). Types of cognitive appraisal and undertaken coping strategies during sport competitions. *International Journal of Environmental Research and Public Health*, *17*(18), 6522.

Lundqvist, C., Macdougall, H., Noguchi, Y., Malherbe, A. & Abejean, F. (2021). When COVID-19 Struck the World and Elite Sports: Psychological Challenges and Support Provision in Five Countries during the First Phase of the Pandemic. *Journal of Sport Psychology in Action*, 1-13.

Martindale, A., Collins, D. & Richards, H. (2014). It's good to talk. Is elite sport good for you? *Sport Exerc Psychol Rev 10*, 68-76.

Mayer, J. & Thiel, A. (2014). Health in Elite Sports from a Salutogenetic Perspective: Athletes' Sense of Coherence. *PLoS ONE, 9*(7): e102030.

Mayer, J., Giel, K.E., Malcolm, D., Schneider, S., Diehl, K., Zipfel, S. & Thiel, A. (2018). Compete or rest? Willingness to compete hurt among adolescent elite athletes. *Psychology of Sport and Exercise 35*, 143-150.

Mayer, J., & Thiel, A. (2018). Presenteeism in the elite sports workplace: The willingness to compete hurt among German elite handball and track and field athletes. *International Review for the Sociology of Sport, 53*(1), 49-68.

McLoughlin, E., Fletcher, D., Slavich, G. M., Arnold, R. & Moore, L. J. (2021). Cumulative lifetime stress exposure, depression, anxiety, and well-being in elite athletes: A mixed-method study. *Psychology of sport and exercise*, *52*, 101823.

Moesch, K., Kenttä, G., Kleinert, J., Quignon-Fleuret, C., Cecil, S., & Bertollo, M. (2018). FEPSAC position statement: Mental health disorders in elite athletes and models of service provision. *Psychology of Sport and Exercise*, *38*, 61-71.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*, *4*(1), 1-9.

Montero, A., Stevens, D., Adams, R. & Drummond, M. (2022). Sleep and Mental Health Issues in Current and Former Athletes: A Mini Review. *Frontiers in Psychology, 13*.

Morgan, W. P. (1985). Selected psychological factors Limiting performance-A mental health model. *Limits of human performance.*, 70-80.

Neil, R., Hanton, S., Mellalieu, S. D., & Fletcher, D. (2011). Competition stress and emotions in sport performers: The role of further appraisals. *Psychology of sport and exercise*, *12*(4), 460-470.

Nicholls, A. R. & Polman, R. C. (2007). Coping in sport: A systematic review. *Journal of sports sciences*, *25*(1), 11-31.

Nicholls, A. R., Polman, R., Levy, A. R., Taylor, J. & Cobley, S. (2007). Stressors, coping, and coping effectiveness: Gender, type of sport, and skill differences. *Journal of sports sciences*, *25*(13), 1521-1530.

Nicholls, A. R., Levy, A. R., Carson, F., Thompson, M. A. & Perry, J. L. (2016). The applicability of self-regulation theories in sport: goal adjustment capacities, stress appraisals, coping, and well-being among athletes. *Psychology of Sport and Exercise*, *27*, 47-55.

Nixon, H. L. (1993). Accepting the risks of pain and injury in sport: Mediated cultural influences on playing hurt. *Sociology of sport journal*, *10*(2), 183-196.

Pensgaard, A. M. & Ursin, H. (1998). Stress, control, and coping in elite athletes. *Scandinavian journal of medicine & science in sports*, *8*(3), 183-189.

Pluye, P., & Hong, Q. N. (2014). Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews. *Annual review of public health*, *35*, 29-45.

Raedeke, T. D. & Smith, A. L. (2004). Coping resources and athlete burnout: An examination of stress mediated and moderation hypotheses. *Journal of sport and exercise psychology*, *26*(4), 525-541.

Reardon, C. L. & Factor, R. M. (2010). Sport psychiatry: a systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Med 40*, 961-980.

Reardon, C. L., Hainline, B., Aron, C. M., Baron, D., Baum, A. L., Bindra, A., ... & Engebretsen, L. (2019). Mental health in elite athletes: International Olympic Committee consensus statement (2019). *British journal of sports medicine*, *53*(11), 667-699.

Reeves, C. W., Nicholls, A. R. & McKenna, J. (2009). Stressors and coping strategies among early and middle adolescent premier league academy soccer players: Differences according to age. *Journal of Applied Sport Psychology*, *21*(1), 31-48.

Rice, S. M., Purcell, R., De Silva, St., Mawren D., McGorry, P.D. & Parker, A. G. (2016). The Mental Health of Elite Athletes: A Narrative Systematic Review, *Sports Med 46*, 1333-1353.

Rice, S. M., Treeby, M. S., Olive, L., Saw, A. E., Kountouris, A., Lloyd, M., ... & Purcell, R. (2021). Athlete experiences of shame and guilt: Initial psychometric properties of the Athletic Perceptions of Performance Scale within junior elite cricketers. *Frontiers in Psychology*, *12*.

Roth, S. & Cohen, L. J. (1986). Approach, avoidance, and coping with stress. *American psychologist*, *41*(7), 813.

Sabato, T. Walch, T. & Caine, D. (2016). *The elite young athlete: strategies to ensure physical and emotional health.*

Sarkar, M. & Fletcher, D. (2014). Psychological resilience in sport performers: a review of stressors and protective factors. *Journal of Sports Sciences*, *32* (15), 1419-1434.

Schinke, R. J., Stambulova, N.B., Si, G. & Moore, Z. (2017). International society of sport psychology position stand: Athletes' mental health, performance, and development. International *Journal of Sport and Exercise Psychology*.

Schlicht, W. (1989). Belastung, Beanspruchung und Bewältigung. Erster Teil: Theoretische Grundlagen. *Sportpsychologie, 3*(2),10-17.

Schnell, A., Mayer, J., Diehl, K., Zipfel, St. & Thiel, A. (2014). Giving everything for athletic success! – Sports- specific risk acceptance of elite adolescent athletes. *Psychology of Sport and Exercise 15*, 165-172.

Secades, X. G., Molinero, O., Salguero, A., Barquín, R. R., de la Vega, R. & Márquez, S. (2016). Relationship between resilience and coping strategies in competitive sport. *Perceptual and motor skills, 122*(1), 336-349.

Skein, M., Harrison, T. & Clarke, D. (2019). Sleep characteristics, sources of perceived stress and coping strategies in adolescent athletes. *Journal of sleep research, 28*(4), e12791.

Smith, R. E., Schutz, R. W., Smoll, F. L., & Ptacek, J. T. (1995). Development and validation of a multidimensional measure of sport-specific psychological skills: The Athletic Coping Skills Inventory-28. *Journal of sport and exercise psychology, 17*(4), 379-398.

Stambulova, N. B., Schinke, R. J., Lavallee, D. & Wylleman, P. (2020). The COVID-19 pandemic and Olympic/Paralympic athletes' developmental challenges and possibilities in times of a global crisis-transition. *International Journal of Sport and Exercise Psychology*, 1-10.

Szczypińska, M., Samełko, A. & Guszkowska, M. (2021). Strategies for coping with stress in athletes during the COVID-19 pandemic and their predictors. *Frontiers in Psychology*, 498.

Swann, C., Moran, A. & Piggott, D. (2015). Defining elite athletes: Issues in the study of expert performance in sport psychology. *Psychology of Sport and Exercise, 16*, 3-14.

Taylor, K., Chapman, D., Cronin, J., Newton, M. J. & Gill, N. (2012). Fatigue monitoring in high performance sport: a survey of current trends. *J Aust Strength Cond, 20*(1), 12-23.

Theberge, N. (2008). Just a normal bad part of what I do: elite athletes' accounts of the relationship between sport participation and health. *Sociology of Sport Journal, 25*, 206-222.

Thelwell, R. C., Weston, N. J. & Greenlees, I. A. (2007). Batting on a sticky wicket: Identifying sources of stress and associated coping strategies for professional cricket batsmen. *Psychology of Sport and Exercise, 8*(2), 219-232.

Thiel, A., Diehl, K., Giel, K. E., Schnell, A., Schubring, A. M., Mayer, J., Zipfel, S., & Schneider, S. (2011). The German young Olympic athletes' lifestyle and health management study (GOAL Study): Design of a mixed-method study. *BMC Public Health, 11*.

Thiel, A., Schubring, A., Schneider, S., Zipfel, S. & Mayer, J. (2015). Health in Elite Sports – a „Bio-Psycho-Social"Perspective. *Dtsch Z Sportmed 66*, 241-247.

Uphill, M., Sly, D. & Swain, J. (2016). From Mental Health to Mental Wealth in Athletes: Looking Back and Moving Forward. *Front. Psychol. 7*, 935.

von Rosen, P., Frohm, A., Kottorp, A., Fridén, C. & Heijne, A. (2017). Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scandinavian journal of medicine & science in sports*, *27*(12), 2059-2069.

Weber, H. & Laux, L. (1990). Bringing the person back into stress and coping measurement. *Psychological Inquiry*, *1*(1), 37-40.

World Health Organization [WHO] (2005). Promoting Mental Health: Concepts, Emerging Evidence, Practice. WHO in Collaboration with the Victorian Health Promotion Foundation and University of Melbourne. Geneva: WHO Press.

Weltgesundheitsorganisation. (2006). Psychische Gesundheit. Herausforderungen annehmen, Lösungen schaffen; Bericht über die europäische ministerielle WHO-Konferenz. [Konferenz über Psychische Gesundheit, 12. Bis 15. Januar 2005, Helsinki]. Kopenhagen.

Yi, J. P., Smith, R. E., & Vitaliano, P. P. (2005). Stress-resilience, illness, and coping: a person-focused investigation of young women athletes. *Journal of behavioral medicine*, *28*(3), 257-265.

Potential risk factors for mental disorders in elite sports - a systematic review

Abstract

Background

Elite athletes[2] live in a "culture of risk": due to the direct and indirect pressure they experience, they risk their health for their athletic career. This justifies the necessity to analyze in a holistic and integrative manner the potential health risks occurring in elite sports.

Objective

This systematic review analyzes the current state of knowledge of scientific literature concerning risk factors that promote the development and onset of mental disorders in elite sports.

Methods

To obtain a clear understanding of the current state of knowledge, a systematic electronic literature search based on the PRISMA-Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was conducted in Pubmed, PsychInfo, Bisp/Spolit, and SportDiscus, as well as Google Scholar. Additionally, relevant cross-references of the articles researched were included. Both quantitative and qualitative studies published between January 2000 and January 2018 were considered, all of them dealing with potential factors associated to mental disorders in elite sports.

Results

One key result of the study analysis conducted is that elite athletes see themselves confronted with all kinds of stressors and associated consequences for their physical and mental health. Individual stress experience and handling, however, vary from athlete to athlete. Socio-ecological factors combined with genetic predisposition may expose elite athletes to a higher risk of mental disorders.

Conclusion

According to current scientific knowledge, the prevalence of mental disorders in elite sports is comparable to that in the general population. Therefore, it is not athletic activity that is responsible for mental disorders in elite athletes. When it comes to the onset and development of mental disorders, it is rather the variables from the athletic, social, and personal environment of the athletes affected that need to be considered. At the same time, protective factors need to be identified with respect to potential consequences for the well-being and mental health of elite athletes.

Keywords: elite athletes, mental disorders, potential risk factors

[1] For improved readability, the masculine form of nouns will be used in this article, if applicable. All personal pronouns are meant to always refer to all genders.

1 Introduction

For quite some time, reports in Europe have been informing about mental disorders in elite sports, particularly in soccer and in connection with depression or even suicide Gouttebarge et al. (2017). Above all, the case of German national goalkeeper Robert Enke in November 2009 raised public awareness of the issue (Claussen et al., 2015).

As elite athletes compete at the highest level, it has been assumed for a long time that they are immune to mental disorders. At first glance, it therefore seems to be contradictory to believe that elite athletes could be rather vulnerable to mental disorders. However, researchers have observed that these athletes do indeed experience mental health-related problems that are similar to those of non-athletes (for a detailed review on this topic please refer to Rice et al., 2016).

According to Gulliver et al. (2015) athletes in Europe and Australia performing all kinds of sports exhibit symptoms of stress, depression, and mental disorders.

Schinke et al. (2017) and Stambulova (2017) identified a general health decline among elite athletes, which can be associated with various sport-specific stressors, such as injury, training load, relationship to coaches or peers, or transition from professional sports career to retirement. Athletes faced with this broad range of sport-specific stressors are potentially subject to an increased risk to their mental health Sarkar & Fletcher, 2014. The combination of stressors unique to the athletic context plus the sensitive developmental phase (Gulliver, Griffiths & Christensen, 2012) that athletes go through during their peak performance (Allen & Hopkins, 2015) is likely to amplify the athletes' increased vulnerability to the onset of mental disorders. This fact emphasizes the necessity to raise their awareness of health risks, protect them early on, and make affected athletes aware of how to recognize, evaluate, and articulate potential risks to their health (Thiel et al., 2011).

Already in 2012, Arnold & Fletcher developed a category scheme including several hundred stressors that can elicit the symptoms typical of mental disorders in elite athletes during or after their sports career. Increasing public attention and media interest in a successful performance are also factors that put athletes under enormous pressure to achieve and to satisfy those expectations Kristiansen, Halvari & Roberts (2012). In addition, elite athletes are continuously exposed to extreme exertion during training and competitions, and thus to a higher risk of injury than the general population von Rosen, Frohm, Kottorp et al. (2017).

Former study results have shown that a correlation exists between injuries in elite sports (regardless of the sports type) and mental disorders Gouttebarge, Frings-Dresen & Sluiter (2015). Serious or recurring injuries represent major physical and psychosocial stressors for affected athletes. These stressors can be taken into consideration as reasons for mental disorders during or after a sports career. For an elite athlete, being injured may mean - in the worst case and in addition to other negative consequences - an early end of his athletic career. According to Putukian (2016) an early, injury-induced career end can be considered another serious problem for the mental and psychosocial health of elite athletes. Therefore, according to Hoyer & Kleinert (2010), the question as to the extent to which or whether elite athletes are more susceptible to mental disorders than persons without an athletic background is definitely relevant.

In addition, it seems reasonable to examine in more detail and based on the current state of psychological research in elite sports any variables that could be potential risks for the development and onset of mental disorders, particularly as affected athletes may not show all symptoms required for a formal diagnosis of any mental disorder Bär & Markser (2013); Hoyer & Kleinert (2010); Gouttebarge, Backx, Aoki et al. (2015); Wolanin, Gross & Hong (2015).

2 Theoretical frameworks

For this systematic review, mental disorders are defined based on the diagnostic and statistical manual for mental disorders APA (2016). This manual describes health-related problems, such as

stress, anxiety, or burnout in more detail and categorizes them into various common mental disorders and the respective disorder conditions and their typical symptoms (see figure 1).
This paper intends to analyze the current state of knowledge in the context of potential health risk factors and the onset and development of mental disorders in elite sports.
For a better understanding the following terms are therefore explained in detail (see also figure 1): " mental disorder", "risk factor" and "elite athlete".

2.1 Mental disorder
According to the World Health Organization (WHO) (2019) mental, behavioral, and neurodevelopmental disorders are syndromes characterized by clinically significant disturbance in an individual's cognition, emotional regulation, or behavior that reflects a dysfunction in the psychological, biological, or developmental processes that underlie mental and behavioral functioning. These disturbances are usually associated with distress or impairment in personal, family, social, educational, occupational, or other important areas of functioning.
This definition underlines, that mental disorders comprise numerous factors, indicators, processes, and interactions, considering not only human behavior, but also the sociocultural and biological context. This is a phenomenon that can also be observed in the world of elite sports (Schinke et al., 2017).

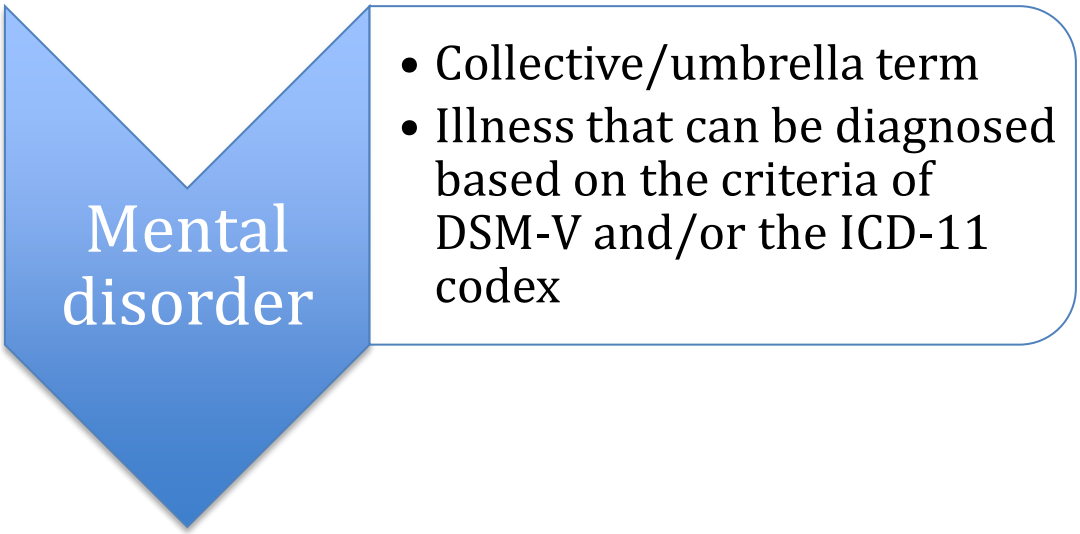

Figure 1: *Definition of "common mental disorder" (APA, 2016; WHO, 2019; Wittchen & Hoyer, 2011)*

The classification of mental disorders is based on the ICD-11 with exclusions regarding acute stress reactions and uncompleted bereavement. Stress-dependent problems for example, are coded at present in line with ICD-11 number QE27 (Problem with behaviors related to psychological health or wellbeing).
Except for eating disorders (Joy, Kussman & Nattiv, 2016), mental disorder conditions in elite sports have been analyzed only to a rather small extent since this topic is still stigmatized in elite sports (Bär & Markser, 2013), even though prevalence in that area is comparable to that in the general populace (DGPPN, 2013).
The results of the analyzed studies presented below will also be based on a bio-psychosocial understanding of illness, seeing mental disorders as a multifactorial complex between psychological, psychosocial, and biological aspects (see figure 2).

Regarding the development and onset of mental disorders in the world of elite sports, a variety of putative risk factors have been reported (Reardon & Factor, 2010; Hoyer & Kleinert, 2010).
It is, however, unclear whether these factors can be determined as symptoms preceding the onset of a disorder or as a consequence resulting from a disorder.

2.2 Risk factor

To increase awareness and for a better understanding of the context described in this paper the author will refer to the typology of risk factors proposed by Kraemer et al., 1997.
According to Kraemer et al. (1997), a risk factor can be described as a measurable characteristic of each subject of a specified population (see table 2 for more information).
This inconsistent use of risk factor terminology causes different perspectives of assessment. To date, a typology or classification of risk factors with regards to specific mental disorders does not exist Jacobi et al. (2004).
As, according to current findings (Moesch et al., 2018; Schinke et al., 2017), the etiologic background of mental disorders is complex and multifaceted in the world of elite sports, this review will follow an integrative approach based on a bio-psychosocial model to analyze potential risk factors in elite sports.
This approach seems to be justified in the athletic context because a factor can change its status during an elite athlete's life span. For example, the status may change depending on the time of assessment (such as during puberty or the transition phase from active professional career to retirement) or as a variable factor pertaining to the time of a certain event (such as before or after a competition) (Juliff et al., 2015; Stambulova et al., 2017).

Table 1: *Typology of risk factors and methods of identification (modified by Jacobi et al., 2004; Kraemer et al., 1997)*

Term	Definition	Study Design
Non-correlate [sic]	No significant association between factor and outcome (onset)	Cross-sectional and longitudinal studies
Correlate	Statistically significant association between factor and outcome	Cross-sectional, epidemiological, case-control, family, or family history studies
Risk factor	Significant statistical and clinical association between factor and outcome; precedence	Longitudinal studies
Fixed marker	Risk factor that cannot be changed or change spontaneously	Cross-sectional and longitudinal studies
Variable risk factor	Risk factor that can be changed or can change spontaneously	Longitudinal studies
Variable marker	Variable risk factor, manipulation does not change the risk of outcome	Randomized clinical trials (preventive or therapeutic intervention study)
Causal risk factor	Variable risk factor, manipulation changes the risk of outcome	Randomized clinical trials (preventive or therapeutic intervention study)

2.3 Elite athlete

The variety and complexity of factors that may be a danger to both physical and mental health persists not only in the general populace, but also in specific groups of population, such as elite athletes.
Swann, Moran & Pigott (2015) categorize "elite athletes" as semi-elite, competitive-elite, successful-elite, and World-class elite athletes.
These authors recommend the definition of samples of elite athletes along a continuum of "eliteness" or "expertise". The definition is to be based on an athlete's highest standard of

performance, his success at this level, and the amount of experience he has gained at that level. Taking into consideration these aspects, the following classification is proposed according to Swann et al. (2015):

- **Semi-elite athlete**: highest level of participation is below the highest possible standard in their sport
- **Competitive-elite athlete** competes at the highest level in his sport, but so far without any success at that level
- **Successful-elite athlete** competes at the highest level and has experienced (infrequent) success at that level
- **World-class elite athlete:** experiences sustained success at the highest level with repeated wins over a prolonged period of time

2.4 Categorization of potential risk factors

Since mental disorders do not exclusively root in organic, but also in psychological and social factors that affect the individual complaint and usually are very diverse in nature (Giel et al., 2016; Sundgot-Borgen et al., 2013; Nixdorf et al., 2016) they are divided into three overall categories in this review:

1. Factors determined by **predisposition**, including age, gender, and development-specific state (= **biological factors**). This category also comprises **psychosocial** (e.g., characteristics of personality, such as perfectionism, self-esteem, etc.) and **sociocultural** factors (family anamnesis, media attention, etc.).
2. **Situational** factors, including traumatic experiences, defeat or failure, early career end, etc.
3. **Sport-specific factors**. This category encompasses a high degree of peer pressure, sport types that require a lean habitus, lacking support from coach, family, and/or other athletes, an early (or too early) start of sport-specific training, general coach behavior, and the pressure that athletes feel when they subordinate themselves to rules and regulations.

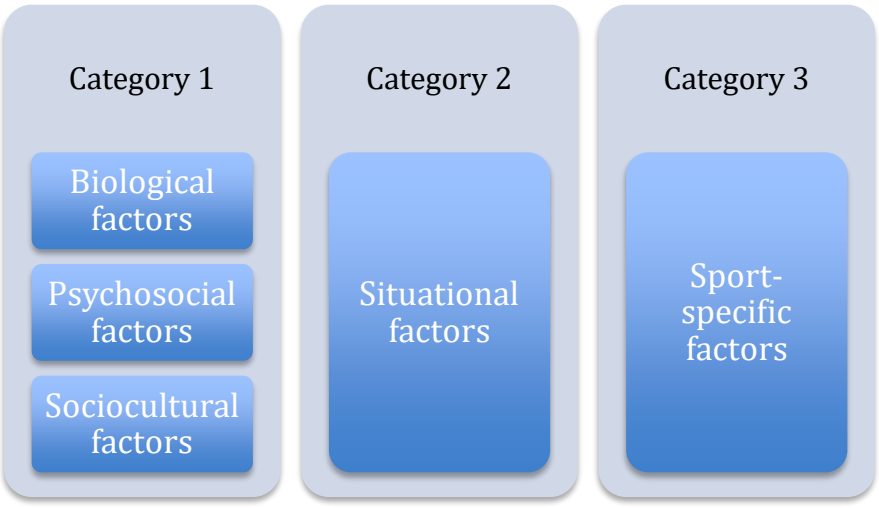

Figure 2: *Categorization of potential factors for the occurrence of mental disorders in elite sports (author's own diagram)*

According to Flechter & Hanton (2003a) research is confronted with a particular challenge because elite athletes are subject to numerous health risks both during and after their sports career. The examination of the relevant risk factors (relationships, competitive pressure, defeat, injuries, etc.)

points to a growing body of evidence that these factors could be responsible for mental disorders in the target population (Sagar et al., 2007; Sagar & Lavallee, 2010; Reardon & Factor, 2010) (see figure 3).
Consequently, in elite sports the topic of mental disorders should be understood as an interdisciplinary approach that does not predominantly focus on the fields of sports medicine or sports psychology. This approach should also be based on a bio-psychosocial understanding of illness, seeing mental disorders as a complex interaction between psychological, psychosocial, and biological factors.

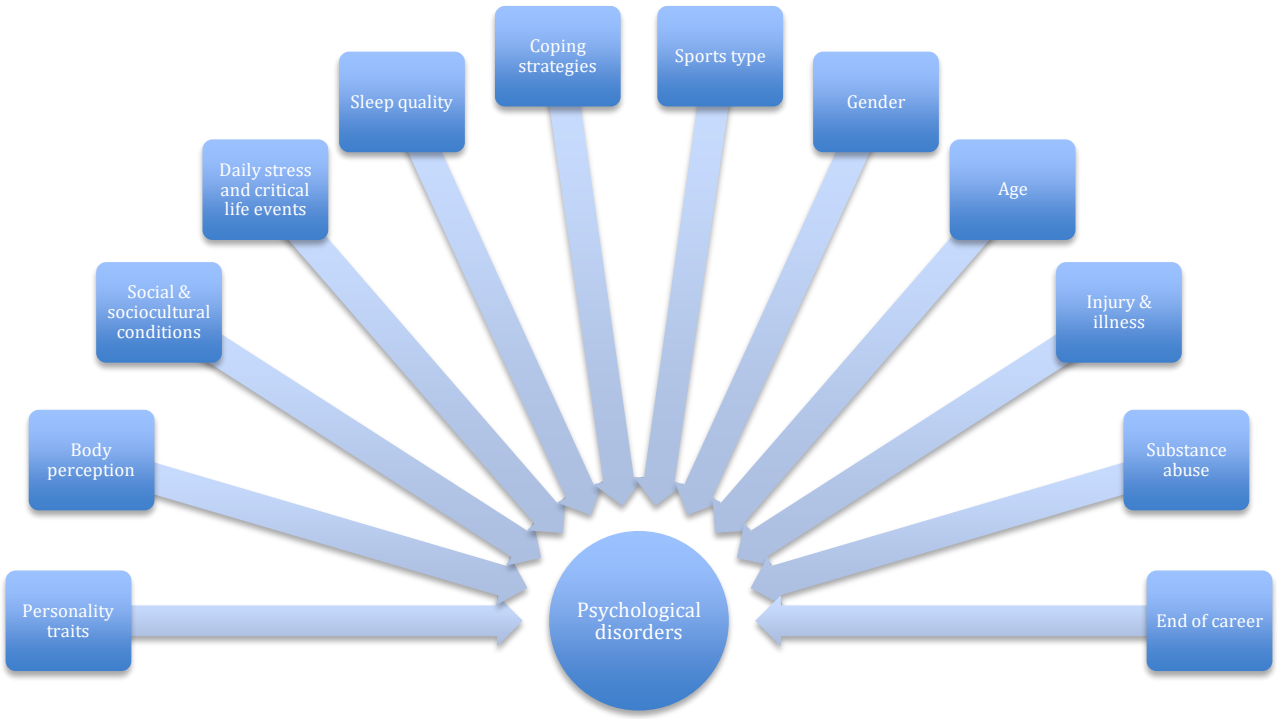

Figure 3: *Interrelationship between potential risk factors associated with mental disorders in elite sports (author's own diagram)*

To date however, an epidemiological or comprehensive approach to understanding the influence and interrelationship of these factors in terms of the development and onset of mental disorders in elite athletes has not been sufficiently implemented Bauman (2016). Therefore, already established models with relevant scientific evidence from the fields of stress (Kaluza, 2015b; Lazarus & Launier, 1981; Bamberg et al., 2012), risk factor typology (Kraemer et al., 1997) and sports-associated research findings (Wiese & Weiss, 1987; Wiese-Bjornstal et al., 1998; Andersen & Williams, 1988) should be employed for further analyses.
This review looks at potential factors that influence the development and onset of mental disorders in more detail and provides an overview of the data published from 2010 to 2018 to answer the following question:

> *Which potential risk factors promote the development and onset of mental disorders in elite sports?*

3 Methods

This review features an analysis of potential factors that may promote mental disorders in elite athletes. To provide the reader with a comprehensive overview of the current state of knowledge, this analysis includes studies published between 2010 and 2018. The search strategy covered both

quantitative and qualitative studies featuring structured and half-structured interviews, with a focus on factors pertaining to outcomes and the measurement of subclinical and/or clinical psychological symptoms. The study design draws upon longitudinal prospective, observational, exploratory, qualitative, and mixed method designs with or without the use of controls. The analysis of the studies searched is based on the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Moher, Liberati, Tetzlaff & Altman (2009).
Electronic literature search was conducted in the Pubmed, PsychInfo, SportDiscus and Bisp/Spolit databases. It was supplemented by searches in Google scholar applying the snowball system, as well as by cross-references in the studies found to be relevant. The search strategy was based on the following search terms:
["mental disorder"] OR ["mental illness"] OR ["mental health disorder"] OR ["mental health problem"] OR ["mental disorders"] OR ["mental health disorders"] OR ["mental health problems"] OR ["mental illnesses"]
AND
["elite athlete"] OR ["elite sports"] OR ["high performance sports"] OR ["high-level performance sports"] OR ["high-level performance athlete"] ["elite athletes"] OR ["high-level performance athletes"].

3.1 Screening process
The following study characteristics were extracted regarding data extraction and management:

- Participants: age (in years, mean, standard deviation) or age range, gender, sample size (total, athletes, controls), nationality (if this data was available), sports type (see table 3)
- Methods: author(s), year of publication, purpose, study design
- Outcomes: Description of outcomes and their methods of assessment
- Results: Description of main findings results

The studies analyzed were selected based on the following inclusion criteria:

(a) The keywords used were to occur either in the title, in the abstract and/or in the main text.
(b) Peer-reviewed manuscripts or specialist articles in English or German were included; meta-analyses, reviews, dissertations, and essays were excluded.
(c) The time of publication had to be between 2010 and 2018. This limitation of the publication period is justified by the fact that scientific reviews by Mann, Grana, Indelicato, O'Neill & George (2007) and by Reardon & Factor (2010) already covered mental health-related problems in elite sports.
(d) The studies had to focus on elite athletes older than 10 and competing at least in the national team of the athlete's home country and/or as part of a national selection squad.

Table 2 provides an overview of the demographic and sport-specific characteristics of the samples extracted from the studies included in this review.

Table 2: *Demographic and sport-specific characteristics of study samples*

Team sports							
Author	**Age in years (Mean, SD)**	**Gender**	**Nationality**	**Total sample size**	**Sample size athletes**	**Sample size controls**	**Sports type**
1 Tabei et al., 2012	20.25 (1.20); 20.89 (0.89)	Males only	English, Japanese	98/9	98/9	0	Soccer
2 Gouttebarge et al., 2016b	25 (4.0)	Males only	Gaelic	204	204	0	Hurling, football
3 Blakelock, Chen & Prescott, 2016	16.31 (1.10)	Males only	English, Scottish	91	91	0	Soccer
4 Petito et al., 2016	23.36 (8.48)	Males only	Italian	133	133	0	Soccer, basketball, hockey
Individual sports							
Author	**Age in years (Mean, SD)**	**Gender**	**Nationality**	**Total sample size**	**Sample size athletes**	**Sample size controls**	**Sports type**
5 Francisco et al., 2013	15.3 (2.1)	272 male, 453 female	Portuguese	725	245	480	Gymnastics, dance
6 Hammond et al., 2013	20.5	28 male, 22 female	Canadian	50	50	0	Swimming
7 Krentz & Warschburger, 2013	14.0 (2.3)	27 male, 38 female	German	65	65	0	Gymnastics, ice figure skating, diving, ballet, roller-skate figure skating, rhythmic gymnastics
8 DeFreese & Smith, 2014	19.7 (2.3)	41% male, 59% female	American	429	429	0	Swimming, diving, track and field
Team & Individual sports							
Author	**Age in years (Mean, SD)**	**Gender**	**Nationality**	**Total sample size**	**Sample size athletes**	**Sample size controls**	**Sports type**
9 Kristiansen & Roberts, 2010	16.6 (0.77)	8 male, 21 female	Norwegian	29	29	0	Handball, track and field, swimming, judo
10 Gulliver, Griffiths & Christensen, 2012	19.3	9 male, 6 female	Australian	15	15	0	Various (not named to protect identity of participants)

Table 2: *Demographic and sport-specific characteristics of study samples (continued)*

Author	Age in years (Mean, SD)	Gender	Nationality	Total sample size	Sample size athletes	Sample size controls	Sports type
11 Shanmugam, Jowett & Meyer, 2014	21.22 (4.02)	36 male, 86 female	British	122	122	0	Swimming, cycling, judo, rugby, football, hockey
12 Madigan et al., 2017(2)	17.3 (0.8)	125 male, 16 female	UK	141	141	0	Soccer, rugby, basketball, athletics and other sports
13 Madigan et al., 2017(1)	17.1 (0.6)	65 male, 15 female	UK	80	80	0	Soccer, basketball, athletics, rugby, cricket, swimming
14 Von Rosen et al., 2017	17	54.4% male, 45.6% female	Swedish	496	496	0	Athletics, cross-country skiing, orienteering, ski-orienteering, handball, downhill skiing, freestyle skiing, water skiing, canoe, rowing, wrestling, bowling, triathlon, golf, cycling, American football
15 Arthur-Cameselle, Sossin & Quatromoni, 2017	20.5; 19.80	Females only	American	29	12	17	Track and field, cross-country, basketball, crew, soccer, tennis
16 Biggin, Burns & Uphill, 2017	31.8 (athletes); 43.1 (coaches)	9 male, 10 female (athletes); 12 male, 4 female (coaches)	UK, GB	19 (athletes); 16 (coaches)	19/16	0	Athletics, basketball, cycling, lacrosse, running, target shooting, touch rugby, triathlon, other

3.2 Methodological appraisal

Due to the absence of randomized controlled trials in the context analyzed for this review, the author deemed the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins, 2011) to be inappropriate. Instead, the author chose to use the Mixed Methods Appraisal Tool (MMAT, Version 2011) to appraise and describe the methodological quality of all studies included in this paper. This appraisal tool is based on established guidance for the evaluation of qualitative, quantitative, and mixed method studies (Pluye et al., 2011).
The included studies' risk of bias was assessed according to the following criteria:

- references to research questions,
- appropriate findings in relation to the context and to the researchers' influence,
- clear descriptions of randomization and allocation concealment or blinding,
- reference to outcome data and drop-out.

Essentially, the outlined quality appraisal criteria were applied for descriptive purposes and to highlight variations between the studies.
16 studies fulfilling the inclusion criteria described above were selected for analysis (see table 4 and figure 4). The conclusions of this review are based on the findings of the studies analyzed. Implications for research include directions for future research and outline uncertainties and limitations pertaining to this domain of research.

4 Results

The main objective of this systematic review was the identification of risk factors (see table 2 and figure 3) that may be associated to mental disorders and therefore represent potential health risks in elite sports.
With reference to the categorization of factors introduced in figure 2 which may have negative effects on the target group's health, the factors identified during study analysis are presented below.
The study selection process ended with a total of 2,165 records. After analyzing titles, abstracts, and main texts, 1,508 studies were included based on the search criteria defined in advance. In the end, after sorting out duplicates and a manual search in the cross-references, 16 studies were selected for the final synthesis (see fig. 4 showing the study selection process). 9 quantitative studies, 4 qualitative studies and 3 mixed method studies were included in this review. The study designs varied amongst others between longitudinal (N=8), and other designs (N=8). Due to the heterogeneity across other study designs and outcome variables, it was not possible to conduct a meta-analysis as part of this review.
The results of the study analysis point to the existence of health risk factors pertaining to mental disorders in elite sports. They are of a multifactorial nature, i.e., they occur in different categories (see fig. 2).

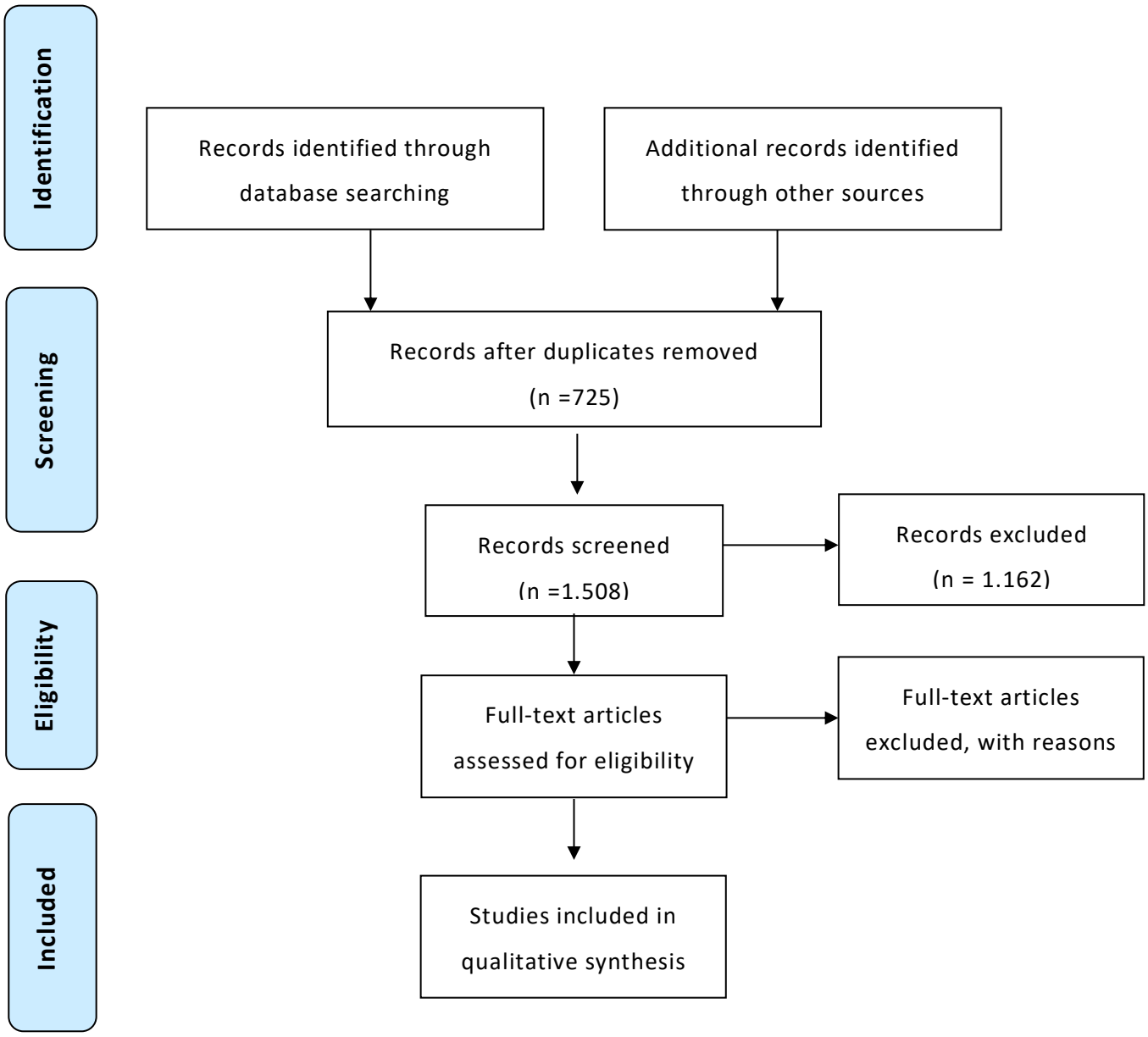

Figure 4: *Flowchart showing the study selection process*

4.1 Quality appraisal

The quality of the methodological approach of the included studies was evaluated according to the criteria proposed by Pluye et al., 2011. The quality appraisal for the studies fulfilling the inclusion criteria is presented in its complete version in the appendix. 3 of the studies met all criteria requested in terms of methodology and therefore were assessed to be of good reporting quality (Kristiansen & Roberts, 2010; Gulliver et al., 2012; Arthur-Cameselle, et al., 2017; Biggin et al., 2017). The remaining studies (N= 13) were estimated to not correspond fully to all criteria proposed by Pluye et al., 2011. All the included studies used either clear quantitative and qualitative research questions (objectives), or a clear mixed method question (objective) (Hammond et al., 2013; Tabei et al., 2012; Petito et al., 2016). The studies included also allowed addressing the research question or objective with the help of the data collected. The methodological quality criteria of describing the process of participant recruitment were not reported precisely enough by most of the studies of type

quantitative non-randomized. From 16 studies all of them reported the use of validated screening instruments or questionnaires and clearly described outcomes. Regarding the aspect of measurements, the included studies examined single factors or variables without considering the complex interrelationship in the context of mental disorders (Blakelock et al., 2016; Krentz & Warschburger, 2013; Shanmugam et al., 2014). As for the question whether the participants in the groups being compared are comparable, or whether researchers control for the difference between these groups, very few of the quantitative studies could answer these questions sufficiently. This may either due to the fact of small sample sizes, or data delimited to only one gender, a specific type of sport or performance level (Gulliver et al., 2012). The aspect of ethical review was respected by all studies either by stating a participant rate or, if not available, by reporting a drop-out rate. Very few studies used random sampling (N= 1) (Gouttebarge et al., 2016b), and only one study used controls (Arthur-Cameselle et al., 2017).

Table 3 describes the characteristics and the main outcomes of the studies included. For the purpose of analysis, the studies were grouped according to the aforementioned categorization of potential risk factors and based on ICD 11coding. The included studies examined elite athletes from both genders, a broad age range (from 14 to 30+), individual (e.g., gymnastics, swimming) and team sports (e.g., soccer, hockey), and different nationalities (see table 2 for demographic and sport-specific characteristics).

Table 3: *Description of the included quantitative and qualitative studies on influences and risk factors regarding the development and onset of mental disorders in elite athletes*

No	Author	Age in years (mean, SD)	Participants	Sports type	Purpose and design	Outcome	Measures, instruments	Results
1	Madigan et al., 2017(1)	17.1 (0.6)	15 female, 65 male	Team and individual sports	Prospective longitudinal study design	Perfectionistic strivings, perfectionistic concerns, injury	SMPS, MIPS	Perfectionistic concerns as a significant positive predictor to an increased risk of injury
2	Tabei Fletcher & Goodger, 2012	20.25 (1.20), 20.89 (0.89)	98 phase 1, 9 phase 2	Soccer	Quantitative and qualitative mixed method study	Relationship between organizational stressors and dimensions of burnout	ABQ	Specific organizational-related issues identified with the incidence of burnout
3	Madigan et al., 2017(2)	17.3 (0.8)	16 females, 125 males	Different types of sport (e.g., soccer, rugby, basketball, athletics and other sports)	Two-wave design; investigation of relationships between perfectionism and training distress	Perfectionistic strivings, perfectionistic concerns, training distress	SMPS, MIPS, TDS	Perfectionism as a significant predictor; in terms of longitudinal relationships only perfectionistic concerns predicted increases in training distress
4	Kristiansen & Roberts, 2010	16.6 (0.77)	21 female, 8 male	Team and individual sports (handball, track and field, swimming and judo)	Qualitative (semi-structured interviews), exploratory study design	Experience of competitive and organizational stress; coping with stressors		Cognitive coping strategies and a good coach-athlete relationship important in order to perform well
5	DeFreese & Smith, 2014	19.7 (2.3)	n=429	Swimming, diving, track and field	Longitudinal design	Social support and negative social interactions; perceived sport stress	The Social Support Questionnaire (short form); Positive and Negative Social Exchanges; items from research on affect, aging and happiness (Mroczek & Kolarz, 1998); The Life Orientation Test; The Sport Motivation Scale; PSS, ABQ, five-item Satisfaction with Life Scale	Social support and negative social interactions contribute to burnout and well-being across the competitive season
6	Gouttebarge et al, 2016	25 (4.0)	n=204, males only	Hurling, football	Longitudinal observational prospective cohort study	Symptoms of common mental disorders; potential stressors	4DSQ, GHQ-12, PROMIS (short form), AUDIT-C	Prevalence ranged from 23% for adverse alcohol use to 48% for anxiety/depression; severe musculoskeletal injury, surgery, recent life events and career dissatisfaction led to an increased risk for common mental disorders

Table 3: *Description of the included quantitative and qualitative studies on influences and risk factors regarding the development and onset of mental disorders in elite athletes (continued)*

No	Author	Age in years (mean, SD)	Participants	Sports type	Purpose and design	Outcome	Measures, instruments	Results
7	Blakelock, Chen & Prescott, 2016	16.31 (1.10)	91 Elite middle adolescent soccer players, males only	Soccer	Longitudinal design, two group cohort design	Clinical levels of psychological distress	GHQ-12	Deselected players experienced higher levels of psychological distress than retained players at post-selection time points
8	Von Rosen et al., 2017	15-19 (17)	n=496, 45,6%female, 54,4% male	16 different sports	Prospective cohort study Part of the KASIP project (Karolinska Athlete Screening Injury Project)	Risk for injury in adolescent elite athletes	OSTRC, Overuse Injury Questionnaire, PSS, SNFA, CBSE	Increase in training load, training intensity, and at the same time a decreasing sleep volume resulted in a higher risk for injury; injury occurrence confirmed as a result of multiple risk factors in complex ways
9	Francisco et al., 2013	15,3 (2.1)	453 female, 272 male	Competitive gymnasts; professional dance students	Exploratory study design	Potential risk/protective factors for the development of eating disorders (ED); levels of DE; relationship between risk/protective factors and disordered eating	McKnight Risk Factor Survey-IV; Contour Drawing Rating Scale; Eating Disorder Examination-Questionnaire	Social pressure as the strongest predictor of disordered eating in non-athletes and controls; body image as strongest predictor of disordered eating in elite athletes
10	Petito et al., 2016	23.36 (8.48)	n=133	Team sports (soccer, basketball, hockey)	Quantitative and qualitative study design, structured interviews	Relationship between personality traits, presence of polymorphism in the 5HHT promoter region (SLC 6A4), anxiety and depressive symptoms	NEO-FFI, POMS, IPPS-48, The Clinical Interview for DSM-IV Disorders; polymerase chain reaction to identify genotypes at the 5HTTLPR polymorphism	Associations between the 5-HTTLPR *s/s* genotype and anxiety, depression symptomatology in elite athletes; neuroticism played a significant role in the etiology of anxiety and depressive symptoms
11	Krentz & Warschburger, 2013	11-18 (14.0; 2.3)	38 females, 27 males	Individual sports (gymnastics, ice figure skating, diving, ballet, roller-skate figure skating, rhythmic gymnastics)	1-year longitudinal study with two assessment points	Potential risk factors for disordered eating focusing on sports-related variables (social pressure from sports environment, desire to be leaner to improve sports performance, emotional distress from missed exercise sessions	EAT-26, Obligatory Exercise Questionnaire, subscale OEQ-EE, CDRS, The Athlete-Scale Drive for Thinness and Performance (first four items); German Questionnaire on Appearance-Related Social Pressure (subscale)	Athletes are more at risk for disordered eating if they believe in enhancement of sports performance through weight regulation
12	Shanmugam, Jowett & Meyer, 2014	17-36 (21.22; 4.02)	86 females, 36 males	62% individual sports (swimming, cycling, judo), 38% team sports (rugby, football, hockey	Longitudinal study design	Predictive Role of interpersonal difficulties on eating psychopathology	EDEQ, S-SQRI, ECR	Conflict within the coach-athlete relationship as potential risk factor for eating disorders

Table 3: *Description of the included quantitative and qualitative studies on influences and risk factors regarding the development and onset of mental disorders in elite athletes (continued)*

No	Author	Age in years (mean, SD)	Participants	Sports type	Purpose and design	Outcome	Measures, instruments	Results
13	Gulliver, Griffiths & Christensen, 2012	16-23 (19.3)	6 females, 9 males	Australian Olympic & developmental elite athletes; team-based & individual sport	Qualitative study	Perceived barriers and facilitators to help-seeking for common mental health problems of depression, anxiety, and general emotional distress	Focus group methodology	Stigma, lack of mental health literacy and negative past experiences as the most important perceived barriers to seeking help for young athletes; facilitators to help-seeking were encouragement from others, having an established relationship with a provider, pleasant previous interactions with providers, positive attitudes of others
14	Arthur-Cameselle, Sossin & Quatromoni, 2017	18-24 (20.5 =athlete sample; 19.80 non-athlete sample)	12 collegiate student-athletes; 17 college student non-athletes, females only	team-based & individual sport	Qualitative study	Factors related to eating disorder onset	Semi-structured interviews	Sport-specific factors (performance pressure, team weigh-ins and injury) most commonly reported triggers for athletes; low self-worth, peer issues and comorbid mental disorders common in both groups
15	Biggin, Burns & Uphill, 2017	31.8 (athletes); 43.1 (coaches	10 females, 9 male, 4 female, 12 male (coaches)	team-based & individual sport (athletics, basketball, cycling, lacrosse, running, target shooting, touch rugby, triathlon, other	Qualitative study	Perceptions of mental health problems amongst athletes and coaches	Three round Delphi method (anonymous questionnaires; online methodology)	Different opinions of mental ill health amongst athletes and coaches; pressure as most significant factor; anxiety and obsessional compulsive tendencies particularly prevalent
16	Hammond et al., 2013	20.5	22 females, 28 males	Elite Swimmers, competing for positions on Canadian Olympic and World Championship teams	Quantitative and qualitative study design, semi-structured interviews	Prevalence of failure-based depression; symptoms of depression	BDI-II, DSM-IV-TR criteria as base for semi-structured interviews	Prevalence of depression doubled among the elite top 25% of athletes assessed; performance failure was significantly associated with depression

Based on the current data, the occurrence of health risks in elite sports is seen in:

- female athletes
- adolescent athletes
- athletes who find themselves in a transitional stage between active athletic and professional career end phase.

The analysis of the studies included in this review confirmed the aforementioned theory-related differentiation of potential risk factors (see table 2 and figure 2) and led to the categorization to which the author will refer to below.

4.2 Biological factors (such as age or gender)

Both genders represent "risk groups" in terms of the development of a pathological eating behavior, especially if a lean habitus is a competitive advantage.

Findings indicate that socio-ecological factors combined with genetic predisposition could mean a risk of mental disorders depending on gender and the type of sports. While male athletes are mainly affected by injury-related stressors female athletes are more impacted by stressors in the areas of communication and team atmosphere.

That means that numerous stress factors could be responsible for the susceptibility of elite athletes to subclinical symptoms of mental disorders (Krentz & Warschburger, 2013; Francisco et al., 2013).

Insufficient sleep and sleeping problems with different effects on performance and health have also been explored as one of the most frequent health risks in elite athletes in individual and team sports.

However, in comparison to prior study findings, inconsistencies exist in statements on socio-demographic variables (age, gender), individual sleeping habits, or situational stress factors, all of which are considered potential risk factors for sleep disorders and the development of mental health related problems in the target population (Von Rosen et al., 2017).

4.3 Psychosocial factors (such as personality traits)

The analysis of corresponding literature also confirmed that stress is an important variable for susceptibility to a perfectionist pursuit of goals, showing that perfectionism is a predictor for burnout in young athletes. Findings are comparable to current studies suggesting that a socially prescribed perfectionism may psychologically impede the athletic development and performance of young elite athletes (Madigan et al., 2017).

In addition, sports-psychological research results (Tabei et al., 2012) increasingly point to elite athletes being subject to varied stressors and confronted with the associated consequences for both their physical and mental health. In their study, major organizational stressors (such as training, competition load, competition environment, risk of injury, leadership style, career, and development performance) were found to be associated to athlete burnout.

However, how athletes experience stress and how they cope with stressors varies from athlete to athlete. According to Tabei et al. (2012) this is due to the fact that individual character traits of athletes, such as self-confidence or their social environment can either reduce or increase stress and therefore influence their susceptibility or resilience in terms of stress-triggering stimuli.

4.4 Sociocultural factors (such as media attention)
Biggin, Burns & Uphill (2017) report on concerns for both elite athletes and coaches in terms of identification, development, and management of mental health issues in elite athletes. According to their findings, both groups agreed that the general pressure that athletes are exposed to is the most important factor contributing to the development of mental disorders. Athletes were reported to perceive this issue as more serious than coaches, which Biggin and colleagues attribute to the fact that coaches were not aware of the situation's serious nature. All participants agreed concerning the topic of the still existing stigma inherent to the disclosure of mental health issues and to asking for help. They all rated stigma to be the greatest barrier for elite athletes to seek support. This is an observation that is consistent to prior findings by Gulliver et al. (2012). Athletes and coaches stated that dual support from sport and clinical psychologists is the most appropriate source of help. Further agreement in both groups was identified concerning the role of coaches as "gatekeepers" to open the door to different sources of support. In addition, all participants agreed that more knowledge and education are required to increase the awareness and understanding of mental health risks in all parties.

4.5 Situational factors (such as early career end, defeat, or failure)
Female and younger athletes obviously represent "risk groups" just like those athletes who perform individual sports or have reached a point in their lives right before ending their career. The end of an athletic career is often associated with various challenges and stressors for the athletes, in particular if athletes are forced to quit, for example, due to injuries or insufficient performance.
Other stressors include adjustment and integration into a new sociocultural environment, for example, caused by having to relocate. If there are no adequate coping strategies in place to handle this kind of stressors, the mental health of the athletes is at risk. Under these circumstances an increased occurrence of depressive symptoms is often observed in athletes, especially in combination with an unsuccessful career end (Blakelock, Chen & Prescott, 2016). For younger athletes, inadequate coping strategies, insufficient support, and lack of experience in competitive situations represent a significant risk to their mental health (Kristiansen & Roberts, 2010).

4.6 Sports-specific factors (e.g., social support, sports type)
Another health influencing factor with an impact on the development and onset of mental disorders in elite athletes is the relationship between athlete and coach DeFreese & Smith (2014). According to DeFreese & Smith (2014), the refusal of support if explicitly requested by an athlete, inappropriate advice, and a low degree of empathy are considered health risks for athletes, in particular if the competitive stress is strong. The crucial factor in this context is, whether the general atmosphere between athlete and coach is characterized by motivating and supportive components or destructive aspects.
Shanmugam, Jowett & Meyer (2014), demonstrated with their study that interpersonal difficulties play a predictive role in the eating psychopathology of their sample. Their findings indicate that a conflict in the coach-athlete relationship is a potential risk factor for eating disorders in elite athletes. A longitudinal design was applied, and the results showed significant differences in the athletes' perception of the experienced conflict, and the received support over a 6-month period. Comparing the findings of DeFreese & Smith (2014) and Shanmugam & colleagues (2014), both point to the fact that the coach-athlete relationship is

crucial in terms of either avoiding or fueling mental health-related problems in elite athletes. These findings also highlight the potential role of interpersonal difficulties in terms of the etiology of mental disorders, one of those being eating disorders.

4.7 Outcomes

Eating disorders

Eating disorders are an example of the processing of mental problems and serve as a compensator to cope with the pressure to succeed.

Particularly in female athletes the individual perception of the body is considered a serious predictor for eating disorders (Francisco et al., 2013).

Francisco et al. (2013) compared three groups (female and male athletes, non-athletes, and controls) in terms of potential risk and protective factors pertaining to the development of eating disorders, levels of disordered eating behavior, and the relationship between risk and protective factors and disordered eating behavior. Their findings show noticeable differences in all 3 groups, and these differences are particularly prevalent among females. Social pressure turned out to be the strongest predictor of disordered eating in non-athletes and controls, whereas body image and parental influences were identified as the strongest predictors of low self-esteem and disordered eating in elite athletes. This shows that these athletes are targets of additional pressure because they need to present a thin body image appropriate for the sport they perform. In addition, the results of Francisco et al. (2013) emphasize the idea that particularly aesthetic sports are associated with a higher risk for adolescent females to develop a pathological eating behavior.

Arthur-Cameselle, Sossin & Quatromoni (2017) identified pressure in terms of achieving an ideal body as another trigger factor for adopting unhealthy habits in the athletic context. Female athletes were more likely to be negatively influenced by peers exhibiting disordered eating behavior and ended up in competitive dieting. Although athletes did not specifically identify media coverage as a source of pressure (e.g., images of skinny persons or books about anorexia), they considered the athletic environment as most related to the onset of eating disorders. The study by Arthur-Cameselle et al. (2017) is the first study exploring the initial experiences of female athletes with clinical-level eating disorders, and to also include a non-athlete comparison group.

Particularly noteworthy in this study are the observations regarding psychiatric comorbidity and poor body image, which was mentioned by over 80% of both athletes and non-athletes. Findings of Arthur-Cameselle et al. (2017) identified a negative body image in combination with body dissatisfaction to play a key role in terms of the onset of eating disorders. Performance pressure was reported to be the second-most common variable for athletes (67%). This mostly reflects the athletes' own competitive goals, though, rather than comments from coaches or teammates. According to the researchers, performance pressure also explains why an athlete's ability to train and compete can be compromised by injury or illness.

Depressive disorders

2 studies (Hammond et al., 2013; Gouttebarge et al., 2016b) analyzed the interrelationship between stress and the occurrence of depressive symptoms in elite athletes. The results identified an interrelationship between stress, sports-specific stress factors, and the increased occurrence of depressive symptoms. The most stressors include insecurity concerning the future, worry about not fulfilling high standards and expectations, and the fear of not getting enough sleep.

According to the ICD-11 categorization, 2 of sixteen studies analyzed can be grouped into the category of affective disorders as they all have depressive symptoms or depression as outcomes, see table 5.

Table 4: *Outcomes affective disorders (elite athletes)*

Author	Females	Males	Both genders	Symptomatology
Gouttebarge et al., 2016b		48% (professional football and hurling players)		Symptoms of anxiety and depression
Hammond et al., 2013			25% (elite swimmers)	Symptoms of depression associated with performance failure

Generalized anxiety disorder

In several studies (Gulliver et al., 2012; Gouttebarge et al., 2016b) the samples showed symptoms of fear and/or failure.

Concerning the "gender" and "signs of distress" variable: considerably more female athletes were affected by signs of distress than their male colleagues, which corroborates earlier examinations (Gulliver et al., 2012). Regardless of "gender", "career dissatisfaction" was identified as another significant predictor of indications of fear, depression, and distress in the target population. In addition, injured athletes showed increasing symptoms of a generalized anxiety disorder.

Burnout

As burnout is a phenomenon also occurring in sports and has been the focus of "media, sports organizations, and researchers", Smith (1986), the terminology is briefly explained here. Burnout is a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions: 1) feelings of energy depletion or exhaustion; 2) increased mental distance from one's job, or feelings of negativism or cynicism related to one's job; and 3) a sense of ineffectiveness and lack of accomplishment. Burn-out refers specifically to phenomena in the occupational context and should not be applied to describe experiences in other areas of life (WHO, 2019).

Raedke & Smith (2001) describe burnout as an "experiential syndrome" characterized by emotional and physical exhaustion, lower accomplishment levels, and athletic devaluation. Various studies found connections between perfectionism, stressors, varied demands (Tabei et al., 2012), risk of injury (Madigan et al., 2017), and burnout. These results indicate that perfectionist characteristics in the target population may bring forward the development of burnout.

Table 5: *Key points*

Key points
Varying stress experiences among elite athletes result in varying strategies to cope with the stressors
Stress resilience influenced by individual character traits with either stress-reducing or stress-enforcing consequences
Gender as one of the most significant influencing factors in terms of perception and handling of stressors as well as the development and onset of mental disorders
Socio-ecological factors in combination with predisposition variables depending on the sports performed, gender, and age representing serious predictors
Individual body perception increases the risk of eating disorders
Athlete-coach relationship, coaching and leadership style, team atmosphere are considered predictors particularly for burnout and particularly in younger athletes
Career end in general or an early or injury-induced career end are further factors being possibly associated to mental disorders; coping with a changed life situation depends on the strategy applied
Sleeping problems/disturbances also lead to negative health effects

5 Discussion

To the author's knowledge this systematic review is the first to analyze potential risk factors that promote the development and onset of mental disorders in elite sports in the aforementioned structure. However, after the analysis of 16 studies, an explicit answer to the author's research question has not yet been found.

While in English-speaking regions research has been conducted for a while on analyses of the prevalence of mental disorders or critical life phases in various athlete populations, the German-speaking regions have seen publication of comparable studies only recently (Hoyer & Kleinert, 2010). To date, only few epidemiological studies on mental disorders and stress symptoms (fear, depression, sleeping disorders, or substance abuse) exist in a pooled version in the target population (Gouttebarge et al., 2016b; Bauman, 2016).

5.1 Risk factors and outcomes

One of the major limitations of the studies analyzed is that there have been only few longitudinal evaluations that have been identified to be associated with mental disorders in elite athletes.

Even though many reasons exist for the predisposition of elite athletes for mental health-related problems, the current state of research presumes that scientific studies examining epidemiology of variables associated to mental disorders in elite sports are rare and often inaccurate (Gulliver et al., 2012; Hammond et al., 2013; Biggin, Burns & Uphill, 2017). Regardless of gender, if persons are affected by any kind of mental disorder they usually suffer from additional negative health-influencing factors, such as depressive symptoms, anxious feelings, or substance addiction (Meng & D'Arcy, 2015). Currently, not much data exists on the correlation between mental disorders and the associated concomitants. For detailed insights please refer to the study by Shanmugam, Jowett & Meyer, 2014.

As many of the variables identified as potential risk factors may also be consequences as illustrated in table 2, e.g., in case of injury/illness (Wiese-Bjornstal, 2010; von Rosen et al., 2017) or coping strategies (Kristiansen & Roberts, 2010), it is almost impossible to separate causes from consequences.

Some of the associations observed are bidirectional, meaning that symptoms associated with a mental disorder may predict poorer psychosocial functioning in other areas of an elite athlete's

life, as well, such as starting a new relationship or having a fulfilled life after the professional athletic career (Schinke et al., 2017; Stambulova, 2017).
So far, most studies have investigated mental disorders in the target population with a focus on specific disorders, such as depression (Hammond et al., 2013) or eating disorders (Arthur-Cameselle, Sossin & Quatromoni, 2017). Current study findings indicate that various factors in the athletic context, such as injury, a high training load combined with inadequate recovery, or an upcoming end of career may increase an elite athlete's vulnerability to certain mental disorders (for more details see Meeusen et al., 2013; Gulliver et al., 2012; Stambulova, 2017).
As many of the studies analyzed tended to examine variables associated to mental disorders as separate or unconnected problems it is difficult to examine direct parallels or differences in the relevant risk factors in combination with bio-psychosocial processes involved in mental disorders. To date, there has been only limited empirical research that has investigated the interrelationships among the biological, psychological, and sociocultural variables in an athletic context (Moesch et al., 2018).
Moreover, variables such as age, gender, or type of sport (e.g., individual or team sport) have not been considered in a standardized manner (DeFreese & Smith 2014; Petito et al., 2016) and only two studies covered the aspect of using a control group (Francisco et al., 2013; Arthur-Cameselle et al., 2017).
Another limitation could be the fact that some of the included longitudinal studies tracked the target group only for a few weeks or months. This time span is too short because some of the identified risk factors may have a greater impact not only in adolescence and early adulthood, but also in later adulthood (Thiel et al., 2015; Stambulova, 2017). This aspect seems to be highly important because symptoms detected during adolescence may not necessarily be predictive for developing a mental disorder in adulthood or vice versa.
With regard to career transition management, a clear differentiation between elite athletes still active as professional athletes and reflecting on retirement and those having already terminated elite sports career is required (Stambulova, 2017). Recent studies found that there are significant differences regarding the prevalence of depressive symptoms and levels of traumatic stress between athletes still competing in comparison and those being forced to end their career because of injury or dismissal, and those who had not reflected on career termination (Gouttebarge et al, 2016b; von Rosen et al., 2017).
Elite athletes experience massive negative consequences due to a loss of athletic identity or even financial ruin, in particular during the transition phase between their maximum athletic performance phase and withdrawal from elite sports. This is why and when they are even more vulnerable to other health-affecting life crises, primarily in the sense of depression or risky behavior, such as excessive alcohol intake (Reardon & Factor, 2010).
The consequences of stress and the challenges for both physical and mental health of elite athletes become evident in symptoms such as pathological eating behavior (Werner et al., 2013), depressive symptoms (Gorczynski et al., 2017) or sleep disturbances (Juliff et al., 2015).
As sleep is a key component for athletic performance and recovery, interconnected to motor functions, precision, and quick and targeted decisions (Underwood, 2010) a lack of sleep, in particular before a competition, leads to reduced response times and cognitive performance (Halson, 2013).
Studies by Silva et al. (2012) and Sargent et al. (2014) came up with similar results, i.e., that sleeping problems negatively affect athletes and their performance.

In addition, the role of variables such as "gender" and "social pressure for thinness" as mediators for comorbidities (such as depression or anxiety) that function as predictors for eating disorders is still unclear (Sundgot-Borgen & Torstveit, 2010; Reardon & Factor, 2010). Shanmugam, Jowett & Meyer (2014) confirm that not only gender or personality, but also the relationship between coach and athlete represents evident predictors, particularly in terms of the development of a pathological eating behavior in elite athletes. However, not many details are known about the specific characteristics of the mutual influence between coach and athlete. If a supportive atmosphere is not given on the part of the coach, or if the social support from family, friends, or team members is missing, these facts are stressors in a competitive context, which could consequently lead to health-related problems (Kristiansen & Roberts, 2010). According to DeFreese & Smith (2014) the failure to provide support when requested, giving inappropriate or inadequate advice, or tactless and insensitive behavior in the coach-athlete relationship are key predictors for burnout development in elite athletes. According to Sagar et al. (2009), fear of failure combined with perfectionism even leads to maladaptive coping strategies, expressed in inappropriate reactions or harsh self-criticism. Destructive coping can mean the onset of mental disorders in the target population (Flett & Hewitt, 2006; Appleton et al., 2009).

If match experience and a corresponding repertoire of coping strategies concerning the various stressors and challenges in an elite sports career are missing, particularly younger athletes are more prone to sport-specific injuries and their consequences due to their riskier behavior and to develop negative health- influencing symptoms (Wolfenden & Holt, 2005; Cresswell & Eklund, 2007). At present, however, no conclusive and accurate study data has been gathered pertaining to individual sports-specific and general non-sports health-related behavior (Thiel et al., 2011).

In terms of injury prevention, current research reports point to first indicators concerning the effects of perfectionism and other personality traits on the risk of injury among elite athletes (Ivarsson et al., 2017). According to Walker et al. (2007) the dose-response relationship between athletic activity and the probability of injuring oneself exposes elite athletes to a greater risk of injury than the population at large. This may be based on injury-related experiences that athletes are usually faced with. Each past injury constitutes a risk for new injuries. Therefore, it needs to become possible to identify so-called risk athletes within the framework of optimum support. However, the significance of the existence of prospective health risks in the target population is still being ignored by the parties responsible despite reported injury tragedies (Reardon & Factor, 2010).

5.2 Limitations

Due to the complexity of mental disorders in the athletic context, the author's analysis cannot claim to be representative for all types of potential risk factors that are associated to mental disorders. The main objective of this review was to provide an overview of the variables that promote the development and onset of mental disorders in elite sports and can therefore be considered as potential risk factors. 16 studies (see table 4) of different designs were scrutinized to identify the existence of potential risk factors associated to mental disorders in elite athletes.

Nevertheless, since the subject matter is rather intangible and hard to delimit and the results to date are ambiguous and imprecise, this review does have a few limitations.

The studies analyzed in this review are difficult to interpret due to the heterogeneous use of terminology, for example, "common mental health disorder" or "mental health disorder".

Numerous factors, such as the inconsistent application of measurement and screening procedures or the analysis of different samples make precise statements on the topic difficult. It is probable that more risk factors are associated with mental disorders in the target population, which have not been systematically considered in the analyzed studies. These would, for example, include substance abuse (Tscholl et al., 2009; Heikinnen et al., 2011), sexual harassment (Mountjoy, Brackenridge, Arrington et al., 2016), cultural diversity and cultural migration of athletes and coaches (Schinke & McGannon, 2015) or training intensity (Lemyre, Roberts & Stray-Gunderson, 2007). These factors should be integrated in future research projects to observe their influence on the development and onset of mental disorders in elite sports.

The potential risk factors (see fig. 3) discussed in this review appear to be associated to serious problems concerning the development and onset of mental disorders in elite sports and should therefore attain much more attention in future research projects.

To sum up, it is not yet possible to confirm the assumption that potential risk factors are associated to the development and onset of mental disorders analyzed in this review. This would require further interdisciplinary research of a potential connection between physical and mental symptoms of mental disorders in the target population.

5.3 Future directions

Based on the author's understanding of the onset of mental disorders among elite athletes, more quantitative and qualitative data is needed. Particularly qualitative interviews would help to reduce the phenomenon of social desirability, which often occurs when collecting data with the help of questionnaires. The use of qualitative research designs will therefore enable a more detailed examination of similarities and differences among male and female athletes. Researchers should develop specially targeted educational and intervention programs to be able to address risk factors that may lead to mental disorders (Schnell et al., 2014).

Hoyer & Kleinert (2010) recommend that the protection mechanism of athletic activity be critically scrutinized, particularly in terms of the mental health of elite athletes. They also demand that playing down the significance of negative health- influencing symptoms (Schwenk, 2000; Reardon & Factor, 2010) needs to stop to enable a clear and selective differentiation of positive and negative health factors in elite sports. Elite athletes themselves need to become aware of the potential risks to their health and their athletic performance so that as a result they decide to seek and take advantage of professional help (Arcelus, Mitchell, Wales et al., 2011).

Therefore, it is necessary to develop an understanding of socio-demographic differences to be able to better assess the relationships between body image and gender-specific behavior from a scientific point of view, and then conceptualize appropriate interventions (Rumbold et al., 2012).

According to Stambulova (2017) particular emphasis must be placed on support options for a "healthy" career end, for example, in the form of career transition management.

Another crucial point (Arnold et al., 2016,) should be the identification of the extent to which personality-determining characteristics, such as perfectionism, self-confidence, self-esteem, resilience, practicing individual or team sports, or factors such as social support and connections have an effect as potential risk factors or protectors regarding the health of elite athletes. The identification of these variables should enable all parties involved to provide targeted support for the specific health needs of elite athletes in dependence on the respective disorder. Table 6 highlights the areas in which knowledge in the context of the topic discussed

here already exists and where future research is recommended to close the pertinent knowledge gaps.

Table 6: *Future directions*

What is known	Knowledge gaps
	Use of terminology and diagnostic screenings in a sport-specific context
Prevalence of signs of anxiety, depression, and psychological distress comparable to general population	Interrelationship of socio-demographic and gender-specific behavior in terms of the onset and development of mental disorders among the target population
Prevalence among females more frequent, also among female athletes of leanness and aesthetic sports	Dimension of "subclinical" eating pathologies, such as "anorexia athletica" or "adipositas athletica" with respect to health risks (i.e., "Female Athlete Triad") among male athletes
High prevalence of eating disorders and signs of anxiety and depression among target population	Impact of various stressors and personality traits as mediators or protective factors regarding the onset and development of mental disorders
More often, female athletes show signs of distress	Impact of injury, illness, gastrointestinal troubles, and other physical issues associated with mental disorders
Career dissatisfaction as significant predictor for signs of anxiety, depression, and distress among active and retired athletes	Impact of match experience regarding signs of anxiety and depression in particular in adolescent athletes
Alcohol among athletes still most consumed substance; different drinking habits regarding type of sports; early end of career due to injury is seen as a higher risk for alcohol abuse; in particular adolescent athletes are exposed to a higher risk due to their "risky lifestyle"	Prevalence of different categories of mental disorders with respect to age, gender, sports type, performance level, and culture

6 Conclusion

Elite athletes' mental health challenges have gained awareness in recent years and therefore this topic calls for action. Regardless of age, they go to their individual limits, are continuously confronted with the most varied stress situations Andersen & Williams (1988), and therefore usually have an attitude towards their health that needs to be viewed as highly critical (Thiel et al., 2011). Due to the fact that these challenges are multidimensional in nature, a comprehensive understanding of this topic's complexity is required. It involves not only the athletes affected by mental health issues, but also service providers and other stakeholders (e.g., sport ministries or members of national sport federations) who need to set up an optimal support system.

Although initial scientific approaches focusing on mental aspects in elite sports have been around for some time (Mann et al., 2007; Grossbard, Smith & Smol et al., 2009; Bär & Markser, 2013) this paper cannot answer the question which potential risk factors promote the development and onset of mental disorders in elite sports.

Since the prevalence of mental health-related symptoms among elite athletes shows similar values as among the general population athletic activity itself does not cause mental disorders in the target group, even if carried out at a top performance level. Therefore, it is necessary to

examine the numerous factors in the personal, social, and athletic environment of an elite athlete as determinants for the development and onset of mental disorders.
In the past, study results already showed that an integral scientific analysis is important regarding factors such as the permanent confrontation with expectations from society or media, or the continuous pressure to participate in training and competitions even if exhaustion, pain, or even injuries manifest themselves.
According to Wiese-Bjornstal (2010) not only the physical challenges (e.g., risk exposure) and psychological stress ("life event stress") lead to misuse and strain of the target population's physical and mental health, but also social and ethical stressors. Ultimately, this could result in the retreat of an affected athlete from elite sports or in the adoption of risky behavior, such as substance abuse (Lisha & Sussman, 2010).
The manifold theoretical knowledge about mental disorders in elite sports (Stillman, Ritvo & Glick, 2013) should elicit a more intense discussion of this subject matter and prompt active involvement of science.
Moreover, as Bauman (2016) so aptly expresses, it is important to close the gap between "hardware" and "software". He appealed to researchers and practitioners to focus more on the identification of socio-ecological and gender-specific variables and protection factors. These function either as moderators or mediators to counteract further propagation of mental health-related symptoms and the associated consequences for elite athletes. According to current research, mental disorders in an athletic context occur across all genders, ages, sport types, and cultures. Looking at the complexity of the potential factors associated with mental disorders, it seems appropriate to initiate interdisciplinary research projects. These projects should focus on the analysis of somatic and other factors that influence both the physical and mental health of elite athletes. In addition, future research should investigate the nature and frequency of comorbid factors and their potential impact on the target group's performance and its health status. The implementation of this type of research approach requires an interdisciplinary cooperation of sports psychologists, sports physicians and therapists, the coach and support teams, and the athletes themselves. It is therefore recommended to introduce targeted educational measures and provide intensive, comprehensive information to the athletes and their environment including society, physicians, and therapists concerning the potential danger that the performance of sports at an elite level pose to the physical and mental health of athletes (Claussen et al. 2015).

As a subsequent step, further research-leading questions can be derived, for example:

1. Is it possible to identify an interrelationship between various potential risk factors depending on the sports type performed, age, gender, or culture?

2. Which correlations exist between the individual health risk factors promoting the development or onset of mental disorders in elite athletes?

References

Allen, S.V. & Hopkins, W.G. (2015). Age of peak performance of elite athletes: a systematic review. *Sports Med 45*(10), 1431-1441.

American Psychiatric Association APA (2016). *DSM-V Update (August 2015). From: 03rd Feb.,2018; available:* https://dsm.psychiatryonline.org.

Andersen, M. B. & Williams, J. M. (1988). A model of stress and athletic injury: Prediction and prevention. *Journal of Sport & Exercise Psychology, 10,* 294-306.

Appleton, P.R., Hall, H.K. & Hill. A.P. (2009). Relations between multidimensional perfectionism and burnout in junior-elite male athletes. *Psychology of Sport and Exercise, 10,* 457-465.

Arcelus, J., Mitchell, A.J., Wales, J. & Nielsen, S. (2011). Mortality Rates in Patients with Anorexia Nervosa and Other Eating Disorders. *Arch Gen Psychiatry*, *68* (7), 724-731.
tono, A. (1997). *Salutogenese: Zur Entmystifizierung der Ge*tv-Verlag.

Arnold, R. & Fletcher, D. (2012). A research synthesis and taxonomic classification of the organizational stressors encountered by sport performers. *J Sport Exerc Psychol 34* (3): 397-429.

Arnold, R., Fletcher, D. & Daniels, K. (2016). Demographic differences in sport performers' experiences of organizational stressors. *Scandinavian Journal Medicine & Science in Sports, 26,* 348-358.

Arthur-Cameselle, J., Sossin, K. & Quatromoni, P. (2017). A qualitative analysis of factors related to eating disorder onset in female collegiate athletes and non-athletes. *Eating Disorders, 25* (3), 199-215.

Bär, K.J. & Markser, V.Z. (2013). Sport specificity of mental disorders: the issue of sport psychiatry. *Eur Arch Psychiatry Clin Neurosci, 263*(Suppl.2), 5205-5210.

Bamberg, E., Keller, M. Wohlert, C. & Zeh, A. (Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrt, Hrsg.). (2012). *BGW-Stresskonzept. Das arbeitspsychologische Stressmodell* (2. Aufl.) Zugriff am 03.10.2017. Verfügbar unter https://www.bgw-online.de/SharedDocs/Downloads/DE/Medientypen/Wissenschaft-Forschung/BGW08-00-000_Stresskonzept_Das_arbeitspsychologische_Stressmodell_Download.pdf?_blob=publicationFile

Bauman, N.J. (2016). The stigma of mental health in athletes: are mental toughness and mental health seen as contradictory in elite sport? *British Journal of Sports Medicine, 50,* 135-136, originally published online November 30, 2015.

Biggin, I. J. R., Burns, J. & Uphill, M.A. (2017). An investigation of athletes' and coaches' perceptions of mental ill-health in elite athletes. *Journal of Clinical Sport Psychology, 11*(2), 126-147.

Blakelock, D.J., Chen, M.A. & Prescott, T. (2016). Psychological Distress in Elite Adolescent Soccer Players Following Deselection. *Journal of Clinical Sport Psychology, 10,* 59-77.

Claussen, M. Ch., Ewers, S. M., Schnyder, U., Frey, W., Schmied, Ch. & Milos, G. (2015). Psychische Probleme und Erkrankungen im Leistungssport. *Swiss Medical Formum-Schweizerisches Medizin-Forum, 15*(45), 1044-1049.

Cresswell, S.L. & Eklund, R.C. (2007). Athlete burnout: a longitudinal qualitative investigation. *Sport Psychol, 21,* 1-20.

DeFreese, J.D. & Smith, A.L. (2014). Athlete Social Support, Negative Social Interactions, and Psychological Health Across a Competitive Sport Season. *Journal of Sport & Exercise Psychology, 36,* 619-630.

Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde (DGPPN) (Hrsg.). (2013). *Psychische Erkrankungen bei Leistungssportlern*. Referat "Sportpsychiatrie und –psychotherapie", Positionspapier.

Fletcher, D. & Hanton, S. (2003a). *Research in organizational stress and British Olympic athletes: Conceptual, theoretical, and practical issues.* Symposium conducted at the meeting of the British Olympic Association Psychology Advisory and Steering Group. Milton, Keynes, Uk.

Flett, G.L. & Hewitt, P.L. (2006). Positive versus negative perfectionism in psychopathology. *Behaviour Modification, 30,* 472-495.

Francisco, R., Narciso, I. & Alarcão, M. (2013). Individual and relational risk factors for the development of eating disorders in adloescent aesthetic athletes and general adolescents. *Eat Weight Disord, 18,* 403-411.

Giel, K. E., Hermann-Werner, A., Mayer, J., Diehl, K., Schneider, S., Thiel, A., ... & GOAL Study Group. (2016). Eating disorder pathology in elite adolescent athletes. *International Journal of Eating Disorders*, *49*(6), 553-562.

Gorczynski, P.F., Coyle, M. & Gibson, K. (2017). Depressive symptoms in high-performance athletes and non-athletes: a comparative meta-analysis. *British Journal of Sports Medicine, 51,* 1348-1354.

Gouttebarge, V., Frings-Dresen, M.H. & Sluiter, J.K. (2015). Mental anf psychosocial health among current and former professional footballers. *Occup Med, 65,* 190-196.

Gouttebarge, V. Backx, F.J.G., Aoki, H. et al. (2015). Symptoms of common mental disorders in professional football (soccer) across five European countries. *J Sports Sci Med 14* (4): 811-818.

Gouttebarge, V., Kerkhoffs, G. & Lambert, M. (2016b). Prevalence and determinants of symptoms of common mental disorders in retired professional Rugby Union Players. *European Journal of Sport Science, 16,* 595-602.

Gouttebarge, V. Jonkers, R. Moen, M., Verhagen, E., Wylleman, P. & Kerkhoffs, G. (2017). The prevalence and risk indicators of symptoms of common mental disorders among current and former Dutch elite athletes. *Journal of Sports Science, 35,* 2148-2156.

Grossbard, J.R., Smith, R.E., Smoll, F.L. & Cumming, S.P. (2009). Competitive anxiety in young athletes: Differnatiating somatic anxiety, worry, and concentration disruption. *Anxiety, Stress & Coping, 22*(2), 153-166.

Gulliver, A., Griffiths, K.M., Mackinnon A., Batterham, P.J. & Stanimirovic, R. (2015). The mental health of Australian elite athletes. *Journal of Science and Medicine in Sport 18* (3): 255-261.

Gulliver, A., Griffiths, K.M. & Christensen, H. (2012). Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study. *BMC Psychiatry 12*, 157.

Halson, S.L. (2013). Sleep and the elite athlete. *Sports Sci, 26*(113), 1-4.

Hammond, T., Gialloreto, C., Kubas, H. et al., (2013). The prevalence of failure-based depression among elite athletes. *Clin J Sport Med 23* (4): 273-277.

Heikkinen, A., Aralanta, A., Helenius, I., Vasankari, T. (2011). Dietary Supplementation Habits and Perceptions of Supplement Use Among Elite Finnish Athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 21,* 271-279.

Higgins, J.P.T (2011). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 (updated March 2011). The Cochrane Collaboration, 2011. https://www.cochrane-handbook.org

Hoyer, J. und Kleinert, J. (2010). Leistungssport und psychische Störungen. *Psychotherapeutenjournal, 3,* 252-260.

Ivarsson, A., Johnson, U., Andersen, M.B., Tranaeus, U., Stenling, A., Lindwall, M. (2017). Psychosocial factors and sport injuries: meta-analyses for prediction and prevention. *Sports Medicine, 42,* 353-365.

Jacobi, C., Hayward, Ch., de Zwaan, M., Kraemer, H.C. & Agras, W. St. (2004). Coming to terms with risk factors for eating disorders: application of risk terminology and suggestions for a general taxonomy. *Psychological Bulletin, 130*(1), 19-65.

Joy, E., Kussman, A. & Nattiv, A. (2016). 2016 update on eating disorders in athletes: A comprehensive narrative review with a focus on clinical assessment and management *British Journal of Sports Medicine, 50,* 154-162.

Juliff, L.E., Halson, S.L. & Pfeiffer, J.J. (2015). Understanding sleep disturbance in athletes prior to important competitions. *Journal of Science and Medicine in Sport, 18,* 13-18.

Kaluza, G. (2015b). *Stressbewältigung. Trainingsmanual zur psychologischen Gesundheitsförderung* (3. Aufl.). Heidelberg: Springer.

Kraemer, H.C., Kazdin, A.E., Offord, D.R., Kessler, R.C., Jensen, P.S. & Kupfer, D.J. (1997). Coming to terms with the terme of risk. *Archives of General Psychiatry, 54,* 337-343.

Krentz, E. M., & Warschburger, P. (2013). A longitudinal investigation of sports-related risk factors for disordered eating in aesthetic sports. *Scandinavian Journal of Medicine & Science in Sports, 23*(3), 303-310.

Kristiansen, E. & Roberts, G.C. (2010). Young elite athletes and social support: coping with competitive and organizational stress in „ Olympic"competition. *Scandinavian Journal of Medicine & Science in Sports, 20,* 686-695.

Kristiansen, E., Halvari, H. & Roberts, G.C. (2012). Organizational and media stress among professional football players: testing an achievement goal theory model. *Scandinavian Journal of Medicine & Science in Sports 22* (4): 569-579.

Lazarus, R. S. & Launier, R. (1981). Stressbezogene Transaktionen zwischen Person und Umwelt. In J.R. Nitsch (Hrsg.). *Stress: Theorien, Untersuchungen, Maßnahmen*, S. 213-259. Bern: Huber.

Lemyre, P.N., Roberts, G.C. & Stray-Gunderson, J. (2007). Motivation, overtraining, and burnout: Can self-determined motivation predict overtraining and burnout in elite athletes? *European Journal of Sport Science, 7*(2), 115-126.

Lisha, N.E. & Sussman, S. (2010). Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: a review. *Addict Behav, 35,* 399-407.

Madigan, D.J., Stoeber, J., Forsdyke, D., Dayson, M. & Passfield, L. (2017). Perfectionism predicts injury in junior athletes: Preliminary evidence from a prospective study. *Journal of Sports Sciences*.

Madigan, D.J., Stoeber, J. & Passfield, L. (2017). Perfectionism and training distress in junior athletes: a longitudinal investigation. *Journal of Sports Sciences, 35*(5), 470-475.

Mann, B.J., Grana, W.A. Indelicato, P.A., O'Neill, D.F. & George, S.Z. (2007). A Survey of Sports Medicine Physicians Regarding Psychological Issues in Patient-Athletes. *The American Journal of Sports Medicine, 35*(12).

Meng, X., & D'Arcy, C. (2015). Comorbidity between lifetime eating problems and mood and anxiety disorders: Results from the Canadian Community Health Survey of Mental Health and Well-being. *European Eating Disorders Review, 23*(2), 156-162.

Meeusen, R., Duclos, M., Foster, C. Fry, A., Gleeson, M., Nieman, D., Urhausen, A. (2013). Prevention, diagnosis, and treatment of the overtraining syndrome: Joint consensus statement of the European College of sport science (ECSS) and the American College of sports medicine (ACSM). *European Journal of Sport Science, 13*, 1-24.

Moesch, K., Kenttä, G., Kleinert, J., Quignon-Fleuret, C., Cecil, S. & Bertollo, M. (2018). FEPSAC position statement: Mental health disorders in elite athletes and models of service provision. *Psychology of Sports & Exercise, 38*, 61-71.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med., 6*: e1000097.

Mountjoy, M., Brackenridge, C. Arrington, M. et al. (2016). The IOC Consensus Statement: harassment and abuse (non-accidental violence) in sport. *British Journal of Sports Medicine, 0,* 1-11.

Nixdorf, I., Frank, R., & Beckmann, J. (2016). Comparison of athletes' proneness to depressive symptoms in individual and team sports: Research on psychological mediators in junior elite athletes. *Frontiers in psychology, 7,* 893.

Petito, A., Altamura, M., Iuso, S., Padalino, F.A., Sessa, F., D'Andrea, G. et al. (2016). The Relationship between Personality Traits, the 5HTT Polymorphisms, and the Occurrence of Anxiety and Depressive Symptoms in Elite Athletes. *PLoS ONE, 11*(6), e0156601.

Pluye, P., Robert, E., Bartlett, G. O' Cathain, A., Griffiths, F., Boardman, F., Gagnon, M.P. & Rousseau, M.C. (2011). *Proposal: A mixed methods appraisal tool for systematic studies reviews*. Retrieved on September 18th, 2018, from http://mixedmethodsappraisaltoolpublic.pworks.com. Archived by WebCite® at http://www.webcitation.org/5tTRTc9yJ

Putukian, M. (2016). The psychological response to injury in student athletes: a narrative review with a focus on mental health. *Br J Sports Med 50* (3): 145-148.

Raedeke, T.D. & Smith, A.L. (2001). Development and preliminary validation of an athlete burnout measure. *Journal of Sport & Exercise Psychology, 23,* 281-306.

Reardon, C.L. & Factor, R.M. (2010). Sport psychiatry: a systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Med, 40,* 961-980.

Rice, S.M., Purcell, R., De Silva, St., Mawren, D., McGorry, P.D. & Parker, A. G. (2016). The Mental Health of Elite Athletes: A Narrative Systematic Review. *Sports Med, 46,* 1333-1353.

Rumbold, J., Fletcher, D. & Daniels, K. (2012). A systematic review of stress management interventions with sport performers. *Sport, Exercise, and Performance Psychology, 1* (3), 173-193.

Sagar, S.S., Lavallee, D. & Spray, C.M. (2007). Why young elite athletes fear failure: Consequences of failure. *Journal of Sports Sciences, 25,* 1171-1184.

Sagar, S.S., Lavallee, D. & Spray, C.M. (2009). Coping with the effects of fear of failure: A preliminary investigation of young elite athletes. *Journal of Clinical Sports Psychology, 3,* 1-27.

Sagar, S.S. & Lavallee, D. (2010). The developmental origins of fear of failure in adolescent athletes: Examining parental practices. *Psychology of Sport and Exercises, 11,* 177-187.

Sarkar, M. & Fletcher, D. (2014). Psychological resilience in sport performers: Review of stressors and protective factors. *Journal of Sports Science, 32,* 1419-1434.

Sargent, C., Lastella, M., Halson, S.L. & Roach, G.D. (2014). The impact of training schedules on the sleep and fatigue of elite athletes. *Chronobiol Int, 31,* 160-168.

Schinke, R.J. & McGannon, K.R. (2015). Cultural sport psychology and intersection identities: An introduction to the special section. *Psychology of Sport and Exercise, 17,* 45-47.

Schinke, R.J., Stambulova, N.B., Si, G. & Moore, Z. (2017). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology,* 1-18.

Schnell, A., Mayer, J., Diehl, K., Zipfel, St. & Thiel, A. (2014). Giving everything for athletic success! – Sport specific risk acceptance of elite adolescent athletes. *Psychology of Sports and Exercise, 15,* 165-172.

Schwenk, T.L. (2000). The stigmatisation and denial of mental illness in athletes. *Br J Sports Med, 34,* 4-5.

Shanmugam, V., Jowett, S. & Meyer, C. (2014). Interpersonal difficulties as a risk factor for athletes' eating psychopathology. *Scandinavian Journal of Medicine & Science in Sports, 24,* 469-476.

Silva, A., Queiroz, S.S., Winckler, C. Vital, R. & Sousa, R.A. (2012). Sleep quality evaluation, chronotype, sleepiness and anxiety of Paralympic Brazilian athletes: Beijing 2008 Paralympic Games. *British Journal of Sports Medicine, 46,* 150-154.

Smith, R.E. (1986). Toward a Cognitive-Affective Model of Athletic Burnout. *Journal of Sport Psychology,8* (1), 36-50.

Stambulova, N.B (2017). Crisis-transitions in athletes: current emphases on cognitive and contextual factors. *Current Opinion in Psychology, 16,* 62-66.

Stambulova, N.B., Pehrson, S. & Olsson, K. (2017). Phases in the junior-to-senior transition of Swedish ice hockey players: From a conceptual framework to an empirical model. *International Journal of Sports Science & Coaching, 12*(2), 231-244.

Stillman, M.A., Ritvo, E.C. & Glick, I.D. (2013). Psychotherapeutic Treatment of Athletes and Their Significant Others. In D.A. Baron, C.L. Reardon & S.H. Baron (Hrsg.), *Clinical Sports Psychiatry. An International Perspective* (S. 117-123). Oxford [u.a.]: Wiley-Blackwell.

Sungot-Borgen, J. & Torstveit, M.K. (2010). Aspects of disordered eating continuum in elite high-intensity sports. *Scandinavian Journal of Medicine & Science in Sports, 20* (Suppl. 2), 112-121.

Sundgot-Borgen, J., Meyer, N.L., Lohman, T.G. et al. (2013). How to minimize the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health, and Performance, under the auspices of the IOC Medical Commission. *British Journal of Sports Medicine, 47,* 1012-1022.

Swann, Ch., Moran, A. & Piggott, D. (2015). Defining elite athletes: issues in the study of expert performance in sport psychology. *Psychology of Sport and Exercise, 16*, 3-14.

Tabei, Y., Fletcher, D., & Goodger, K. (2012). The relationship between organizational stressors and athlete burnout in soccer players. *Journal of Clinical Sport Psychology, 6*(2), 146-165.

Thiel, A., Diehl, K., Schnell, A., Schubring, A.M., Mayer, J., Zipfel, S. & Schneider, S. (2011). The German Young Olympic Athletes' Lifestyle and Health Management Study (GOAL Study): design of a mixed-method study. *BMC Public Health, 11,* 410.

Thiel, A., Schubring, A., Schneider, S., Zipfel, S. & Mayer, J. (2015). Health in Elite Sports-a „Bio-Psycho-Social"Perspective. *Dtsch Z Sportmed, 66,* 241-247. DOI: 10.5960/dzsm.2015.194

Tscholl, P., Feddermann, N., Junge, A. & Dvorak, J. (2009). The Use and Abuse of Painkillers in International Soccer Data from 6 FIFA Tournaments for Female and Youth Players. *The American Journal of Sports Medicine, 37*(2), 260-265.

Underwood, J. (2010). Sleep now clearly a predictor of performance. *Coaches Plan, 17*(1), 31-34.

Von Rosen, P., Frohm, A., Kottorp, A. et al. (2017). Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scandinavian Journal of Medicine & Science in Sports*.

Walker, N., Thatcher, J. & Lavallee, D. (2007). Psychological responses to injury in competitive sport: a critical review. *J R Soc Promot Health, 127,* 174-180.

Werner et al. (2013). Weight-control behavior and weight-concerns in young elite athletes-a systematic review. *Journal of Eating Disorders, 1,* 18.

Wiese, D. M. & Weiss, M.S. (1987). Psychological rehabilitation and physical injury: Implications for the sportsmedicine team, *The Sport Psychologist, 1,* 318-330.

Wiese-Bjornstal, D. M., Smith, A. M., Shaffer, S. M. & Morrey, M.A. (1998). An integrated model of response to sport injury: Psychological and Sociological Dynamics. *Journal of Applied Sport Psychology, 10,* 46-69.

Wiese-Bjornstal, D.M. (2010). Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: A consensus statement. *Scandinavian Journal of Medicine & Science in Sports, 20,* 103-111.

Wittchen, H-U. & Hoyer, J. (Hrsg.) (2011). *Klinische Psychologie und Psychotherapie*. 2., überarbeitete und erweiterte Auflage. Springer: Berlin, Heidelberg.

Wolanin, A., Gross, M. & Hong, E. (2015). Depression in athletes: prevalence and risk factors. *Curr Sports Med Rep., 14,* 56-60.

Wolfenden, L.E. & Holt, N.L. (2005). Talent Development in Elite Junior Tennis: Perceptions of Players, Parents, and Coaches. *Journal of Applied Sport Psychology, 17,* 108-126.

World Health Organization. (2019). *ICD-11: International classification of diseases* (11th revision). Retrieved from https://icd.who.int/

Appendix B: Additional files

Review 1

Table 2: *Overview of quantitative studies*

No	Authors	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
1	Perna & McDowell (1995)	39 elite athletes, age, M=24,9, SD=3,0	Cycling, rowing	Classification of elite athletes regarding Life Event Stress (LES) in high- & low-LES groups	the LESCA (Petrie, 1990, 1991), the Stress Audit (Miller, Smith, Mehler, 1987)), the CIRS (Hanson, McCullagh, & Tonymon, 1992) was used to track practice behavior over a 30-day period	exercise recovery
2	Andersen & Williams (1999)	196 intercollegiate athletes, males, n=79, females, n=117, age ranged from 18 to 23	gymnastics (n = 36), swimming (n = 48), cross country (n = 24), track and W eld (n = 27), wrestling (n = 7), American football (n = 2), baseball (n = 7), softball (n = 6), women' s volleyball (n = 21) and women' s basketball (n = 18)	Measurement of changes of state anxiety, visual perception and reaction during stress	the Life Events Survey for Collegiate Athletes (LESCA) (Petrie, 1992), the Social Support Questionnaire (SSQ) (Sarason et al., 1983), the state anxiety form of the STAI (Spielberger et al., 1970)	athletic injury, state anxiety as predictor variable

Table 2: *Overview of quantitative studies (continued)*

No	Authors	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
3	Newcomer & Perna (2003)	283 athletes, males, n=143, females, n=140, injury history, n=43, no injury, n=240,0,0 age, M=16,7, SD=0,079	football, girls' soccer, basketball, and volleyball	Examination of features of posttraumatic distress related to sport injury	Injury-history status was determined by the athlete's self-report (''Have you experienced a loss of playing time due to injury?'') on a modified version of the Adolescent Perceived Events Scale (APES), the Impact of Events Scale (IES).	Psychological distress Posttraumatic distress
4	Wippert & Wippert (2008)	40 German athletes, career termination group, n=19, males, n=5, females, n=14, age, M=20, SD= 3,63 control group (=active members), n=21, males, n=12, females, n=9, age, M=18, SD=2,1	Skiing, Germany	Examination of traumatic stress resulting from a career-ending event and athlete's separation from social network	the Impact of Event Scale (IES), (Ferring & Filipp, 1994), Symptoms of traumatic stress were measured using the German version (Ehlers, Steil, Winter, & Foa, 1996) of the Posttraumatic Diagnostic Scale (PDS; Foa, Cashman, Jaycox, & Perry, 1997)	clinically relevant levels of traumatic stress
5	Nicholls, Backhouse, Polman & McKenna (2009)	16 male rugby players, age, M=19,3, SD=0,95	Rugby, United Kingdom	Examination of sources of sport and non-sport stress and associated symptoms on rest days, training days and match days, and temporal aspects of sources and symptoms of stress and affective states	DALDA questionnaire, the Activation Deactivation Adjective Check List (AD ACL; Thayer, 1989)	Symptoms of stress on rest days, training days and match days, affective states

Table 2: *Overview of quantitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
6	Nicholls, Jones, Poleman & Borkoles (2009)	5 male professional rugby union players, age, M=27,2, SD=5,7	Rugby, England, Wales, Fiji	Examination of sport-related stressors, coping and emotion among a sample of rugby union players	stressor checklist and open-ended stressor boxes, (e.g., Nicholls et al., 2006; Nicholls & Polman, 2007b) confirmed the appropriateness of the pre-selected stressors for elite rugby union athletes	Emotions such as anxiety and anger during training and matches, coping effectiveness
7	Brink et al. (2010)	53 elite soccer players, age ranged from 15 to 18 years, M=16,5	Soccer, The Netherlands	Investigation of measures to monitor stress and recovery	the Dutch version of the Recovery Stress Questionnaire for athletes (RESTQ-Sport)	Psychosocial stress: emotional exhaustion, decrease general well-being, sleep quality Physical stress: injury (traumatic and overuse) and ilnesses
8	Paul, Khanna & Sandhu (2011)	100 athletes, males, n=65, females, n=35, age, M=21,22, SD=1,85	Hockey (14%), Swimming (5%), Running (11%), Handball (12%), Cricket (2%), Volleyball (14%), Cycling (13%), Basketball (13%), Kabaddi (8%), Football (6%), Gymnast (1%), and Sprinting (1%), India	Compare and investigate relationship between training logs, MAPSS, ABQ, CSAI-2 and VTS	Mental and Physical State Scales (MAPSS), Modified Competitive State Anxiety Inventory (CSAI-2), Athletic Burnout Questionnaire (ABQ	Psychomotor performance, burnout risk, anxiety level, self confidence level
9	Johnson & Ivarsson (2011)	108 soccer players, males, n=85, females, n=23, age ranged from 17 to 19 years	Soccer, Sweden	Identifying psychological factors leading to an increased injury risk among soccer players	STAI (Spielberger et al., 1983), SAS (Smith et al., 1990), ACSI-28 (Smith et al., 1995) , LESCA (Petrie, 1992), SSP (Gustavsson et al., 2000)	Increased injury risk
10	Faude et al. (2011)	15 high level football players, age, M= 19,5, SD=3,0	Football, Germany	Describing changes in stress and performance indicators throughout a competition season	the RESTQ-Sport	Performance decrements, changes in psychological and hormonal parameters => non-functional overreaching, overtraining syndrome deteriorations in the recovery-stress state

Table 2: *Overview of quantitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
11	Ivarsson et al. (2014)	101 Swedish soccer players, males, n=67, females, n=34, age, M=16,7, SD=0,9	Soccer, Sweden	Investigation whether athletes' individual levels and changes in hassle and uplift levels	the Hassles and Uplifts Scale (HUS)	Injury Psychological fatigue associated with increased injury risk Decrease in cognitive functions
12	DeFreese & Smith (2014)	Collegiate athletes (n=429), 41% male and 59% female, age ranged from 18 to 24 years	swimming and diving (24%) and track and field (76%), America	Examination of social support and negative social interactions as potential moderators of the relationship of perceived sport stress with athlete burnout over an athletic season	Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983)	Athlete burnout
13	Laux, Krumm, Diers & Flor (2015)	22 professional football players, age, M=25,8, SD=5	Football, Germany	Examination of contribution of stress and recovery variables to the risk of injury in professional football players	the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport)	Risk of injury
14	Otter, Brink, Diercks & Lemmink (2016)	24 competitive middle- and long-distance runners, males, n=11, females, n=15, age, M=23, SD=4	Long distance running, The Netherlands	Investigate how negative life events affect aspects of perceived psychosocial stress and recovery	Dutch online version of the RESTQ-Sport	Perceived psychosocial stress, running economy, recovery
15	Fessi et al. (2016)	17 soccer players, age, M=23,7, SD=3,2	Soccer, Finland	Explore changes in weekly TL, quality of sleep, quantity of stress, fatigue, muscle soreness and affective valence between pre- and in-season periods, examine influence of specific training types on the affective valence of professional soccer players	10-point-Borg-scale (RPE), Hooper questionnaires (sleep, fatigue, stress & muscle soreness), FS (affective valence	Monotony, sleep, strain, fatigue, stress, muscle soreness, affective valence
16	Blakelock, Chen & Prescott (2016)	91 elite middle adolescent soccer players, age ranged from 15 to 18, M=16,31, SD=1,10	Soccer, England, Scotland	Examination of proportion of players experiencing clinical levels of psychological distress following selection procedures and whether player status had a significant effect on psychological distress	General Health Questionnaire-12 (GHQ-12; Goldberg & Williams, 1988)	psychological distress

Table 2: *Overview of quantitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
17	Madigan et al., 2017	106 junior athletes, males, n=90, females, n= 16, age, M=17,3, SD=0,8	60 in soccer, 36 in rugby, 18 in basketball, 14 in athletics and 13 in other sports (e.g., cycling, squash), United Kingdom	Investigate relationships between perfectionism and training distress, examining cross-sectional and longitudinal relationships between perfectionistic strivings, perfectionistic concerns and training distress	Perfectionism Scale (Dunn et al., 2006) and the Multidimensional Inventory of Perfectionism in Sport (Stoeber, Otto, Pescheck, Becker, & Stoll, 2007), the 7-item Sport Multidimensional Perfectionism Scale subscale capturing personal Standards, the TDS (Raglin & Morgan, 1994)	Elevated levels of training distress, overtraining
18	Von Rosen et al. (2017)	Adolescent elite athletes, n=496, males=54,4%, females=45,6%, age, M=17	Athletics, n = 137 Cross-country skiing, n = 100 Orienteering, n = 68 Ski-orienteering, n = 11 Handball n = 45 Downhill skiing, n = 15 Freestyle skiing, n = 14 Water skiing, n = 11 Canoe, n = 10 Rowing, n = 4 Wrestling, n = 14 Bowling, n = 13 Triathlon, n = 12 Golf, n = 22 Cycling, n = 13 American football, n = 7, Sweden	Identifying risk factors for injury in adolescent elite athletes	the Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire, The Swedish Nutrition Food Agency index (SNFA index), the Perceived Stress Scale	Injury risk

Table 2: *Overview of quantitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
19	Gouttebarge et al. (2017)	203 Dutch elite athletes, male=36%, female=64%, age, M=27, SD=7	48% in team sports; 52% in individual sports, the Netherlands	Establish the 12 – month incidence of symptoms of common mental disorders, explore potential association with several stressors (being injured, recent life events, career dissatisfaction)	the Distress Screener, the 12-item General Health Questionnaire (GHQ-12), sleep disturbance was assessed through four single questions, Level of alcohol consumption was detected using the 3-item AUDIT-C, the Eating disorder Screen for Primary care	(incidence) of symptoms of common mental disorders: Distress, eating disorders, sleep disturbance, adverse alcohol use, anxiety/depression
20	Pensgaard et al. (2018)	193 elite female football players, age, M=21,6, SD=4,2	Football, Norway	Examination of roles of different types of stressors and the effects of motivational climate on the occurrence of acute and overuse injuries	the Life Event Survey for Collegiate Athletes, the Perceived Motivational Climate in Sport Questionnaire (the Norwegian short version), all injuries that occurred throughout the 2009 competitive football season (April–November) were recorded	Perceived negative life event stress, depression, frustration, anger, risk of acute and overuse injuries
21	Gerber et al. (2018)	257 young elite athletes, 36% females M=16,82 years, SD=1,44	Soccer (n=61), handball (n=26), volleyball (n=23), swimming (n=19), judo (n=17), track and field (n=16), tennis (n=15), uni hockey (n=12), karate (n=10), mountain bike (n=7), golf (n=5), others (<5 athletes;n=46), North-Western Switzerland	Examination of a possible interaction of perceived stress and mental toughness in the prediction of burnout and depressive symptoms	10-item Perceived Stress Scale (PSS), the 18-item short form of the MTQ48 , the 14-item version of the Shirom-Melamed Burnout Measure (SMBM), the 9-item depression module of the Patient Health Questionnaire (PHQ-9)	increased psychological health complaints, higher burnout levels and depressive symptoms

Table 2: *Overview of quantitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
22	Strahler & Luft (2019)	International female elite ballroom dancer, age=25 years	ballroom dancing	Monitoring the dynamic, idiosyncratic responses to competitive stress	the 36 - item Short Form Health Survey [SF - 36], the 12 - item Screening Scale for the Assessment of Chronic Stress [SSCS], the International Physical Activity Questionnaire—Short form [IPAQ].	Self-reported well-being, biological stressmarkers
23	Nixdorf, Beckmann & Nixdorf (2020)	194 junior elite athletes, age, M=15,08, SD=1,95	badminton (n = 9), gymnastics (n = 5), hockey (n = 15), ice running (n = 19), mountain bike (n = 16), short track (n = 12), soccer (n = 113) and swimming (n = 10), Germany	Analysing predictors of depression and burnout in elite athletes	CES-D (depressive Symptomatology, the ABQ (athlete Burnout), the Trier Inventory of Chronic Stress (TICS; Schulz et al., 2004), short self-description protocol adopted from the RESTQ-Sport (Kellmann and Kallus, 2001), the GEQ (cohesion by four factors), the German Version of the Multidimensional Inventory of Perfectionism in Sport (MIPS; Stoeber et al., 2004), the Sport Attributional Style Scale (SASS; Hanrahan and Grove, 1990), the Dysfunctional Attitudes Scale (DAS-A; Weissman and Beck, 1978), the stress-coping questionnaire (SVF; Erdmann and Janke, 2008)	Burnout & depression

Table 2: *Overview of qualitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
24	Silva III (1990)	Athletes representing 10 different intercollegiate sports (n=68, females, n=25, males, n=43), age range from 18-25 years, m=20,5, sd=1,3	Football (38.2%); Basketball (22.1%); Volleyball (11.8%); Swimming and Diving (7.4%); Fencing (7.4%); Soccer (5.9%); Lacrosse (2.9%); Field Hockey (1.5%); Golf (1.4%); Track and Field (1.4%), America	Derive descriptive data on training stress to assess athletes perceptions of training stress and athletes' perceptions of the causes and symptoms of negative responses to training stress	qualitative interview-based approach	Staleness, overtraining and burnout
25	Fletcher & Hanton (2003)	14 international performers (males, n=7, females, n=7), age, M=27,36, SD=3,13	Five individual & two team sports	Investigation of organizational stress in elite sport	standardized interview format	changes in sports performance
26	Hanton, Fletcher & Coughlan (2005)	10 male international performers, age ranged from 18 to 36 years, M=22,0, SD=5,3	Six individual sports and four team sports, United Kingdom	Comparison of content and quantity of competitive and organizational stressors in elite athletes	a semi-structured format was adopted during the interview itself	Competitive anxiety
27	Weston, Thelwell, Bond & Hutchings (2009)	5 elite male skippers, age, M=42,4, SD=7,83	Sailing	Examination of various stressors and coping strategies	a semi-structured interview approach was adopted, building on existing stress and coping qualitative research	Decrease in performance

Table 2 *Overview of qualitative studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
28	Kristiansen & Roberts, 2010	29 Norwegian young elite athletes (males, n=8, females, n=21) age ranged from 14 to 17, M=16,6, SD=0,77	track and field, basketball, cycling, gymnastics, handball, judo, swimming, table tennis, tennis, volleyball, and water polo, Norway	Investigation of perception of organizational and competitive stress in a major competitive event	Qualitative (semi-structured interviews), exploratory study design	Experience of competitive and organizational stress; coping with stressors
29	Fletcher, Hanton, Mellalieu & Neil (2012)	12 sport performers (6 elite and 6 non-elite), age , M= 27,33, SD=3,89	Six different sports, United Kingdom	Development of a conceptual framework of organizational stressors	qualitative interview-based approach	Changes of athletes' well-being and performance
30	Fletcher, Hanton & Wagstaff (2012)	10 sport performers, (males, n=5, females, n=5) age ranged from 19 to 21, M=20,3, SD=1,73	Five different team sports	Investigation of sport performers' responses to organizational stressors	qualitative interview-based approach	Competitive anxiety
31	Evans, Wadey, Hanton & Mitchell (2012)	5 high-level rugby players, 5 golfers, age, M=20,6, SD=2,72	rugby, golf	Examination of stressors experienced by injured athletes; exploration of differences in stressors experienced by team as compared to individual – sport athletes	qualitative interview-based approach	Injury: 3 phases-onset of injury, rehabilitation and return to competitve sport
32	Sohal, Gervis & Rhind (2013)	10 female athletes, age, M=28.5, SD=9.1	Individual sports (marathon, n=2, tennis, n=1, gymnastics, n=2, swimming, n=1), team sports (football, n=1, cricket, n=1, netball, n=1, hockey, n=1), India	Exploration of organizational stressors experienced by Indian female athletes and impact on psychological well-being	qualitative interview-based approach	Impact on psychological well-being; = >low environmental mastery and low personal growth

Table 2: *Overview of mixed-method studies (continued)*

No	Author	Participants	Sports type; country	Purpose	Measures, instruments	Outcome
33	Tabei et al., (2012)	98 (phase 1); 9 (phase 2); 20,25 (1,20) (phase 1); 20,89 (0,89)	Soccer; England, Japan	Investigation of relationship between organizational stressors in sport and burnout	Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001), qualitative interview-based approach	Burnout
34	Davis et al., (2019)	173 junior alpine skiers (males, n=78, females, n=93), age, M=17,5, SD=1,15	Alpine skiing, Sweden	Exploration of underlying factors that influence student-athletes' experience of academic and sport related stress	the multi-component training distress scale (MTDS), the college student-athletes' life stress scale (CSALSS; Lu et al., 2012), the Organizational Stressor Indicator for Sport Performers (OSISP. Arnold et al., 2013), process of comparing analyses to provide a more comprehensive understanding of stress adaptation within the dual career pathway of adolescent alpine athletes	Sport performance and well-being

Table 4: *Quality appraisal of evidence – Mixed Method Appraisal Tool (MMAT) (Pluye et al., 2011)*

Types of mixed methods study components or primary studies	**Methodological quality criteria**				**Responses**			
					Yes	**No**	**Can't tell**	**Comments**
Screening questions (for all types)		**Study**						
	Are there clear qualitative and quantitative research questions (or objectives), or a clear mixed method question (objective)?	**Tabei et al., 2012; Kristiansen & Roberts, 2010; Madigan et al., 2017 (1); DeFreese & Smith, 2014**; **Blakelock et al., 2016; von Rosen et al., 2017;**			Yes, Yes; Yes			
	Do the collected data allow address the research question (objective)?				Yes; Yes; Yes			
Qualitative	*Are the sources of qualitative data relevant to address the research question (objective)?*	**Kristiansen & Roberts, 2010; Silva III (1990); Fletcher & Hanton (2003); Sohal, Gervis & Rhind (2013); Hanton, Fletcher & Coughlan (2005); Weston, Thelwell, Bond & Hutchings (2009); Fletcher, Hanton & Wagstaff (2012); Fletcher, Hanton, Mellalieu & Neil**			Yes; Experience of competitive and organizational stress; coping with stressors (**Kristiansen & Roberts, 2010**); identifying organizational stressors experienced by Indian female athletes and studying Arnold & Fletcher's (2012) taxonomic classification of organizational stressors in a different cultural context (**Sohal, Gervis & Rhind, 2013**); to address research question a purposive sample was sought which had to meet certain selection criteria (**Fletcher & Hanton, 2003**); By focusing solely on athletes' emotions, attitudes and behaviours in organisational contexts, we hope to not only better reflect the true intensity of organisational dynamics but also inform practitioners attempting to enhance athletes' performances and well-being. **(Fletcher, Hanton & Wagstaff, 2012);** Semi-structured interviews were conducted using an interview guide designed to address the purpose of the study**. (Evans, Wadey, Hanton & Mitchell ,2012);**			

		(2012); Evans, Wadey, Hanton & Mitchell (2012);			
	Is the process for analyzing qualitative data relevant to address the research question (objective)?				Yes; a standardized interview format was used to ensure that participants were taken through an identical set of questions and being asked in a similar manner, qualitative validity criteria were satisfied, findings are reported using a combination of hierarchical content trees and direct quotes from the interview transcripts (**Fletcher & Hanton, 2003**); a semi-structured format was adopted during the interview itself, which involved the performers being led through an identical set of questions and being asked them in a similar manner (**Hanton, Fletcher & Coughlan, 2005**); a semi-structured interview approach was adopted, building on existing stress and coping qualitative research (Fletcher & Hanton, 2003; Thelwell et al., 2007). The interview guide contained three sections: Demographic and background details; identifying the stressors (organizational, competitive, personal, and other) faced (e.g., "what do you perceive to be the main demands that you face while alone at sea?"), and the related coping strategies employed by the skippers (e.g., "how do you try to cope with [demand]?"); and final comments (**Weston, Thelwell, Bond & Hutchings, 2009**); In order to address the research question, data were collected using a qualitative interview-based approach, at the start of every interview each participant was: introduced to the nature of the study; informed about issues of participant anonymity and data protection; and requested to provide written informed consent. These procedures were an important part of building trust and rapport, the interviews were semi-structured, and an interview guide was developed containing a series of open-ended questions and specific probes. (**Fletcher, Hanton & Wagstaff, 2012**); through these questions, the interviewer continually sought to challenge his own and the participants' conceptions of events to ensure that the data (and subsequent framework) truly represented the performers' experiences; all interviews were conducted at times and locations of participants' convenience; At the beginning of the interview each participant was provided with the following definition of what constituted a stressor, ''any demand that causes negative feelings and thoughts with respect to being injured'' (**Evans, Wadey, Hanton & Mitchell, 2012);**
	Is appropriate consideration given to how findings relate to the				Yes; all interviewed performers could speak freely about their experiences in a neutral and confidential setting; interviews were conducted away from an environment the participants might associate with the sport organization

	context, e.g. the setting in which data were collected?				(**Fletcher & Hanton, 2003**); an interview guide was developed to fully explore the performers' experiences of their competitive and organizational environments, the final guide contained four main sections: introduction; sources of stress; advice for sports scientists, coaches and organizations; and conclusion (**Hanton, Fletcher & Coughlan, 2005**); The analytical process involved the researchers scrutinising the content of the interview transcripts relating to the organisational stress process. Discussion and debate gave rise to a range of responserelated concepts and was, in part, inevitably influenced by the existing work relating to organisational stress-related responses (**Fletcher, Hanton & Wagstaff, 2012**); in the present study, which focused on conceptual rather than theoretical development, this process involved the researchers firstly identifying the environmental demands associated primarily and directly with the organization within which a participant was operating (cf. Fletcher et al., 2006). This progressed to categorizing emergent stressors according to their properties and dimensions. Finally, these categories were organized into a logical, systematic, and explanatory scheme of organizational stressors (**Fletcher, Hanton, Mellalieu & Neil, 2012),** During each interview participants were asked to reflect on their injury experience and respond to questions about the stressors they encountered during that phase. (**Evans, Wadey, Hanton & Mitchell, 2012);**
	Is appropriate consideration given to how findings relate to researchers' influence, e.g. through their interactions with participants?				Yes; one author was present at the Olympic Village to establish trust (Strength of qualitative research); Limitations of study not explicitly named (**Kristiansen & Roberts, 2010**); interviews were either conducted face-to-face or over the phone and participants were assured about complete anonymity of all information; interviews were conducted in both Hindi and English to ensure that participants felt comfortable during the interview (**Sohal, Gervis & Rhind, 2013**); although the authors acknowledge that ideally the performers and organizations should be considered within the context of their sport, we felt that respecting the participants' wishes and carefully preserving their identities was not only ethically correct, but also helped to enhance the trustworthiness of the data (cf. Fletcher & Hanton, 2003b; Woodman & Hardy, 2001a) (**Hanton, Fletcher & Coughlan, 2005**); the final analysis procedure involved triangular consensus of the thematic structure by a third researcher who was trained in qualitative methods. This individual, who was not involved in the data collection or initial analysis, played the role of a "critical friend" (Faulkner & Sparkes, 1999) in checking the analysis procedures adopted and

					confirming, or otherwise, the higher-order themes (**Weston, Thelwell, Bond & Hutchings, 2009**); In the final section, participants were invited to express their views about the interview process, reflect on whether they could tell their story fully, and voice any concerns about being influenced in any way. The interviews were conducted between 14:00–17:00, ranged in duration from 62 to 127 minutes (mean 87, s. 17.3), were tape-recorded in their entirety, and later transcribed verbatim yielding 338 double-spaced pages of text (**Fletcher, Hanton & Wagstaff, 2012**); [Grounded theory researchers] accept responsibility for their interpretive roles. They do not believe it sufficient merely to report or give voice to the viewpoints of the people, groups, or organizations studied. Researchers assume the further responsibility of interpreting what is observed, heard, or read . . . [by] developing theory of great conceptual density and with considerable meaningful variation (**Fletcher, Hanton, Mellalieu & Neil, 2012);** a number of procedures were employed to enhance trustworthiness. Peer debriefing with an independent researcher experienced in qualitative methods and the focus of the study occurred during study design, data collection, analysis and report writing (**Evans, Wadey, Hanton & Mitchell, 2012)**
Quantitative randomized controlled trials	*Clear description of the randomization (or an appropriate sequence generation)?*				No studies were included
	Clear description of the allocation concealment (or blinding when applicable)?				
	Complete outcome data (80% or above)?				
	Low withdrawal/drop-out (below 20%)?				
Quantitative non-randomized	*Are participants (organizations) recruited in a way that minimizes selection bias?*	**Blakelock et al. (2016) Brink et al. (2010); Gouttebarge et al. (2017); Laux, Krumm, Diers & Flor (2015); Ivarsson et al. (2014); Gerber et**			Yes most of all; risk of selection bias could not be minimized because of self-selection **Gouttebarge et al. (2017); Gerber et al. (2018);**

		al. (2018); Pensgaard et al. (2018); Otter, Brink, Diercks & Lemmink (2016);			
	Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?				Yes; Distress was measured using the Distress Screener (3 items scored on a 3-point scale) which is based on the four-dimensional symptom questionnaire (4DSQ), the 12-item General Health Questionnaire (GHQ-12) was used to assess psychological symptoms related to anxiety/depression, Based on the PROMIS (short form), sleep disturbance was assessed through four single questions, Level of alcohol consumption was detected using the 3- item AUDIT-C, the Eating disorder Screen for Primary care (5-items scored as 'yes' or 'no;' '0' for favorable answer, '1' for unfavorable answer) was used as a screening instrument to detect eating disorders (**Gouttebarge et al., 2017);** the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport) to the risk of injury in professional football players (**Laux, Krumm, Diers & Flor ,2015);** No-uni-dimensional measure was used to assess psychological distress (**Blakelock et al., 2016**); Perceived stress during the past month was assessed with the widely used 10-item Perceived Stress Scale (PSS), Mental toughness was assessed with the 18-item short form of the MTQ48 21, which measures propensity to handle the demands of environmental stressors, Burnout symptoms were assessed with the 14-item version of the Shirom-Melamed Burnout Measure (SMBM), Depressive symptoms were assessed with the 9-item depression module of the Patient Health Questionnaire (PHQ-9) (**Gerber et al., 2018);** the Life Event Survey for Collegiate Athletes, We used the Perceived Motivational Climate in Sport Questionnaire (the Norwegian short version) to assess the players perceptions of the motivational climate within their team, We recorded all injuries that occurred throughout the 2009 competitive football season (April–November) (**Pensgaard et al., 2018);** the Dutch version of the Recovery Stress Questionnaire for athletes (RESTQ-Sport) was administered monthly to assess the psychosocial recovery–stress state of players, Physical stress was quantified in two different ways. First, the duration of training sessions and matches in minutes was used as an objective measure. For every week, the sum of the duration of training and matches over the preceding week was calculated. The total duration over the preceding week was divided by 60 to transform minutes into hours. Second, the rate of perceived exertion (RPE) was used to determine the internal training load.

					26 Each player was instructed to rate the global intensity of each training session using the original Borg 15-point scale by answering the simple question, 'How was your workout? (**Brink et al., 2010);** at the end of each week, the athletes filled out a Dutch online version of the RESTQ-Sport, which has shown sufficient reliability and validity for the purpose of monitoring changes in perception of stress and recovery, to monitor training load, all runners kept an online training log in which duration and perceived exertion of each training session were recorded. Duration was recorded in minutes and perceived exertion was measured by session Ratings of Perceived Exertion (sRPE) on a scale from 6 to 20, 30 min after completing a training session or race (**Otter, Brink, Diercks & Lemmink, 2016);** the Hassles and Uplifts Scale (HUS)11was used to measure play-ers' levels of daily hassles and daily uplifts. The inventory consists of53 items addressing potential daily hassles and uplifts (e.g., familyissues, personal responsibilities, work relationships) **(Ivarsson et al. (2014**);
	In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?				No precise details were given in terms of this aspect
	Are there complete outcome data (80% or above), and when applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?				attrition rate from MT1 to MT3 = 47.62% (deselected players) & 16.09% (retained players) (**Blakelock et al., 2016**; a total of 726 elite athletes were contacted for the study by NOC*NSF, from which 203 gave their written informed consent to participate in the study (response rate of 28%). After the follow-up period of 12 months, a total of 143 athletes had completed the follow up (follow-up rate of 70%) (**Gouttebarge et al., 2017);** from January 2010 until April 2011, a total of 222 measures of stress and recovery data were thus included in the analysis. Of these 222 RESTQ-Sport 52 assessments, 187 (84.2%) were not followed by an injury event, whereas 35 RESTQ-Sport 52 assessments (15.8%) were followed by one or more injury events (**Laux, Krumm, Diers & Flor ,2015**); the participants were 101 elite junior soccer players (67 males and 34 females), aged between 15 and 19 years (mean age[16.7 ± _0.9 yr]). They were high

					school students whose soccer programmes were certified by the Swedish Soccer Association (fourschools in total). During the study period, the players practiced between 4.5 and 20 h per week [11.22 ± _3.22 h]. At the beginning of2012, all players included in the study were injury free and in full training **(Ivarsson et al., 2014);** descriptive statistics for the main study variables are shown in Table 1. At baseline, 31 participants (12%) reported clinically relevant burnout symptoms (SMBM 4.40), whereas 23 participants (9%) exhibited clinically relevant symptoms of depression (PHQ9 >14). At follow up, 27 (14%) of the athletes reported clinically relevant burnout symptoms, whereas the rate of clinically relevant depressive symptoms dropped to two percent (n=3) (**Gerber et al., 2018);** Prior to the main analyses we performed Bayesian t-tests to investigate potential differences in the three stress variables (coach, teammates and friends), as well as the two motivational climate variables (task and ego), between the players reporting just one type of injury (ie, acute or overuse) and the players reporting both type of injuries during the season. Before we conducted these tests the injured players were divided into four groups: (a) players who experienced only acute injuries (n=91), (b) players who reported at least one overuse injury before an acute injury (n=13), (c) players who reported only overuse injuries (n=35) and (d) players who reported at least one acute injury before an overuse injury (n=20) (**Pensgaard et al., 2018);** can't tell-no comment of the author (**Brink et al., 2010);** independent t-tests showed that there were no differences in age, height, weight, V˙O2max, RESTQ-Sport and training load between the entire group of 16 athletes and the subgroup of 7 athletes who completed the tests. The previously described analyses of the RESTQ and training load were done for both groups (**Otter, Brink, Diercks & Lemmink, 2016);**
Quantitative descriptive	*Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?*	**Nicholls, Jones, Polman & Borkoles (2009); Fessi et al. (2016); Strahler & Luft (2019); Nicholls, Backhouse, Polman & McKenna (2009);**			Yes

		Madigan et al., 2017; DeFreese & Smith, 2014; **Blakelock et al., 2016; von Rosen et al., 2017; Paul, Khanna & Sandhu (2011); Johnson & Ivarsson (2011); Faude et al. (2011); Nixdorf, Beckmann & Nixdorf (2020); Andersen & Williams (1999); Newcomer & Perna (2003); Wippert & Wippert (2008); Perna & McDowell (1995);**			
	Is the sample representative of the population understudy?				Yes;
	Are measurements appropriate (clear origin, or validity known, or standard instrument)?				Yes;10-point-Borg-scale (RPE), Hooper questionnaires (sleep, fatigue, stress & muscle soreness), FS (affective valence monitoring) (**Fessi et al. (2016);** 1) stressor checklist and open-ended stressor boxes, (2) open-ended coping response section, (3) perceived coping effectiveness Likert-type scale, (4) emotion response section, and (5) emotion intensity Likert-type scale, the previous studies by Nicholls and colleagues (e.g., Nicholls et al., 2006; Nicholls & Polman, 2007b) confirmed the appropriateness of the pre-selected stressors for elite rugby union athletes (**Nicholls, Jones, Polman & Borkoles, 2009);** the DALDA questionnaire contains 36 items – nine relate to sources of stress (e.g., diet, health, and sleep) and 17 relate to symptoms of stress (e.g., muscle pains and general weakness), the Activation Deactivation Adjective Check List (AD ACL; Thayer, 1989) assessed affective states. The AD ACL is a 20-item measure of two bipolar dimensions, namely energetic arousal (EA) and tense arousal (TA) (**Nicholls, Backhouse, Polman & McKenna, 2009);** to measure

					perfectionism, we followed a multi-measure approach (Stoeber & Madigan, in press) and used four subscales from two multidimensional measures of perfectionism in sport: the Sport Multidimensional Perfectionism Scale (Dunn et al., 2006) and the Multidimensional Inventory of Perfectionism in Sport (Stoeber, Otto, Pescheck, Becker, & Stoll, 2007). To measure perfectionistic strivings, we used two indicators: the 7-item Sport Multidimensional Perfectionism Scale subscale capturing personal standards (e.g. "I have extremely high goals for myself in my sport" **,** to measure training distress, we used the TDS (Raglin & Morgan, 1994) (**Madigan et al., 2017**)**;** Perceived sport stress was assessed using the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Participants rated 12 items describing stress-related experiences in the past month on a 5-point scale of 1 (never) to 5 (very often) (**DeFreese & Smith, 2014)**; data analyzed were limited to certain variables, data o injury mechanisms or other biomechanical variables were not collected (**von Rosen et al., 2017**); Mental and Physical State Scales (MAPSS): is multi-component assessment model developed by Grove (1996) used for monitoring training distress among athletes. This model combines measures of mood disturbance with measures of perceived stress and symptom intensity using three subscales - Perceived Stress Scale, Brunnel Mood Scale, and Training Stress Scale, Modified Competitive State Anxiety Inventory (CSAI-2), Athletic Burnout Questionnaire (ABQ): is a 15-item scale to determine the risk and status of burnout among athletes. (**Paul, Khanna & Sandhu, 2011);** **;** STAI (Spielberger et al., 1983) is used to measure current state anxiety, SAS (Smith et al., 1990) is used to measure an athlete's anxiety level, ACSI-28 (Smith et al., 1995) is used to measure an athlete's general coping skills, LESCA (Petrie, 1992) is used to measure an athlete's life history stressors, SSP (Gustavsson et al., 2000) is used to measure personality factors and was developed by the Karolinska Institutet Sweden. (**Johnson & Ivarsson ,2011);** the RESTQ-Sport was developed with particular regard to the requirements of high performance sports .**(Faude et al., 2011);** 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, The ABQ is a self-report scale designed to assess the three core dimensions in athlete burnout: physical and emotional exhaustion, sport devaluation

					and reduced sense of accomplishment., Chronic stress was assessed using the Screening of the Trier Inventory of Chronic Stress (TICS; Schulz et al., 2004), Current state of recovery was assessed using a short selfdescription protocol adopted from the RESTQ-Sport (Kellmann and Kallus, 2001). The RESTQ-Sport is often used for assessment and monitoring of stress and recovery states among athletes (for review see Kellmann, 2010) and provides good psychometric properties (Kellmann and Kallus, 2001), 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), 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), Attribution after failure was assessed using the relevant dimensions internality, stability and globality after the most recent failure according to the Sport Attributional Style Scale (SASS; Hanrahan and Grove, 1990), The Dysfunctional Attitudes Scale (DAS-A; Weissman and Beck, 1978) is a self-report scale designed to measure the presence and intensity of dysfunctional attitudes, Athletes' coping responses to life stressors were measured by using the stress-coping questionnaire (SVF; Erdmann and Janke, 2008), (**Nixdorf, Beckmann & Nixdorf, 2020);** the Life Events Survey for Collegiate Athletes (LESCA) (Petrie, 1992) is a 69-item life events survey that includes events considered stressful for college students and athletes, the Social Support Questionnaire (SSQ) (Sarason et al., 1983) is a 27-item survey that requires a two-part answer to each item, The state anxiety form of the STAI (Spielberger et al., 1970) measures the current state anxiety of participants (**Andersen & Williams, 1999);** Injury-history status was determined by the athlete's self-report (''Have you experienced a loss of playing time due to injury?'') on a modified version of the Adolescent Perceived Events Scale (APES), the Impact of Events Scale (IES).11 The IES is a highly reliable, 15-item self-report instrument designed to assess intrusive thoughts and avoidance behavior (subscales), and it has been used with a wide variety of clinical populations (**Newcomer & Perna, 2003);** the degree of individual stress resulting from the termination event was measured using the Impact of Event Scale (IES), which is a frequently used measure of posttraumatic stress reactions following a life event (Ferring & Filipp, 1994), Symptoms of traumatic stress were measured using the German version (Ehlers, Steil, Winter, & Foa, 1996) of the

					Posttraumatic Diagnostic Scale (PDS; Foa, Cashman, Jaycox, & Perry, 1997), The measure used for assessing psychosomatic responses involved totaling scores from a series of seven different questionnaires, including scales assessing sleep, health behaviors, alcohol use, reactions to the traumatic event, and event appraisal (**Wippert & Wippert, 2008);** athletes rated the intensity (6-213) of their current training period on a rate-of-perceived-exertion scale (TRPE; Borg & Noble, 1974) and second, on a nominal scale (light, moderate, heavy, and taper) developed by Tharp and Barnes (1990). Athletes also recorded the frequency, duration, intensity, and mode exercise for individual training sessions conducted the week before training camp, the LESCA (Petrie, 1990, 1991) was chosen as the measure of LES because it was specifically designed for young-adult athletes, the Stress Audit (Miller, Smith, Mehler, 1987) is a commercially available instrument measuring stressful life events and 50 symptoms divided equally among tive clusters (skeletal muscle, cognitive, emotional, autonomic, and immune), the CIRS (Hanson, McCullagh, & Tonymon, 1992) was used to track practice behavior over a 30-day period (**Perna & McDowell, 1995);**
	Is there an acceptable response rate (60% or above)?				can't tell-no comment from the author (**Fessi et al. (2016);** no-5 from 15 first team players participated (**Nicholls, Jones, Polman & Borkoles, 2009);** all of the players present (n516) agreed to participate in the research, Questionnaires were administered weekly as booklets because previous research showed that high non-completion rates resulted from adopting a single booklet for 28 days (**Nicholls, Backhouse, Polman & McKenna, 2009);** 35 participants did not complete measures (final cross-sectional sample size N=140, final longitudinal sample size N= 106) (**Madigan et al., 2017**;;response rate 34% (**DeFreese & Smith, 2014**); final cohort consisted of 496 adolescent elite athletes, 43.3% reported new injury over 52-week period (**von Rosen et al., 2017**); total numbers of participants were 100 with 65 (65%) males and 35(35%) females (**Paul, Khanna & Sandhu, 2011**); a total of 82 participants completed the five questionnaires correctly. This indicates an internal dropout rate of 24%. Of the 108 participating players, 42 (39%) athletes missed at least 1 day of sport practice due to an injury. In this group, 67 injuries were reported (**Johnson & Ivarsson ,2011);** a total of 15 players (19.5 ± 3.0 years, 181 ± 5 cm, 75.7 ± 9.0 kg, including 2 national team players) performed a test at baseline (before pre-season preparation) as well as 3 times (in-season 1, 10 weeks after baseline, in-season 2 after 21 weeks, in-season 3 after 36 weeks) during the season.**(Faude et al., 2011);**

					from the original n = 194 junior elite athletes recruited at T1, only n = 85 completed all three assessment times. No significant differences between non-completers and completers were observed at T1 [for burnout: t(182) = 0.73, p = 0.469; for depression: t(190) = 1.23, p = 0.219]. Also, comparisons of predictors between non-completers and completers revealed no significant t-test. Therefore, missing data was accounted for by list-wise deletion following Graham (2009) (**Nixdorf, Beckmann & Nixdorf, 2020);** can't tell-no comment of the author (**Andersen & Williams, 1999);** Twenty-four athletes (12 injured, 12 controls) were included in the postinjury analysis, however, 2 of the control group participants were subsequently injured and dropped from the analysis (**Newcomer & Perna, 2003);** since a number of athletes failed to provide full responses regarding the nature of their termination process, the sample for analyzing the influence of this experience was reduced to 10, with 5 participants in the ST group and 5 participants in the DT group. (**Wippert & Wippert, 2008);** thirty-day follow-up data were collected from 41 % of low-LES and 42% of high-LES athletes (11 = 16) **(Perna & McDowell, 1995);**
Mixed methods	*Is the mixed methods research design relevant to address the qualitative and quantitative research questions (objectives), or the qualitative and quantitative aspects of the mixed methods question (objective)?*	**Tabei et al., 2012; Davis et al. (2019)**			Yes; reasons for integrating qualitative & quantitative methods are explained; because of the multidimensionality of student-athletes' experience of stress and the role of significant others (i.e., coaches) potentially impacting upon the complexity of their stress, a MMR study design was used (**Davis et al., 2019**);
	Is the integration of qualitative and quantitative data (or results) relevant to address the research question (objective)?				The Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001) was used to assess relationship between organizational stressors and dimensions of burnout among potential participants ; qualitative interviews appear ideal for addressing this research question since they have been employed successfully in previous organizational stress; they are well suited to capture the complexity of psychosocial phenomena and, in this particular study, the relationships between multiple stressors and burnout (**Tabei et al., 2012**); the multi-component training distress scale (MTDS; Main and Grove, 2009) is a multidimensional questionnaire consisting of 22 items that aim to assess symptoms concerning training distress., the college student-athletes' life stress scale (CSALSS; Lu et al., 2012) is designed to capture the current state of

					stress among intercollegiate student-athletes. It is comprised of 24 items that reflect potential stressors respondents may encounter in their everyday life and in sports, the Organizational Stressor Indicator for Sport Performers (OSISP; Arnold et al., 2013) was developed to comprehensively measure the organizational pressures that sport performers may encounter. The OSI-SP consists of 23 items with five subscales: “goals and development,” “logistics and operations,” “team and culture,” “coaching,” and “selection.” Each of the findings from the quantitative and qualitative data were subsequently integrated through a process of comparing analyses to provide a more comprehensive understanding of stress adaptation within the dual career pathway of adolescent alpine athletes (**Davis et al., 2019**)
	Is appropriate consideration given to the limitations associated with this integration, e.g. the divergence of qualitative and quantitative data (or results) in a triangulation design?				Yes; findings only specific to organizations & cultures sampled; only male soccer players sampled (**Tabei et al., 2012**); potential challenges with the use of MMR in sport and exercise psychology research (e.g., problematic assumptions and integrating findings); These techniques can be typified by both focused descriptive cross-sectional data collection to identify relationships between multiple factors (Gratton and Jones, 2010), in combination with follow-up approaches aiming to collect rich, descriptive data depicting complex experiences and perspectives (**Davis et al., 2019**)

Review 2

Table 4: *Overview of publication details*

Authors	**Study Design**	**Purpose**	**N (Female/Male)**	**Sport; Country**	**Main findings**
Leprince, et al., 2018	Semi-structured Interview, qualitative design	Exploring stressors and communal coping strategies within **team sports**	10 team sport athletes (7 males, 3 females, age 26.3, +/-7.67)	team sports athletes (volleyball, football, basketball, ice hockey, rugby, France	Insight into the nature of communal coping in team sport and performance setting
Guo et al., 2019	Laboratory test, multiplication estimation task; single-factor inter-dependent design	Exploring the neural activity of the cerebral cortex under acute psychological stress in athletes with different CSE levels	106 high-level basketball players	Basketball, China	High CSE athletes can better cope with stressful events, adjust their behaviors in a timely manner according to the results of their coping and focus more on processing positive information
Hill et al., 2010	Quantitative design	Examination whether different coping tendencies mediate the relationship between self-orientated and socially prescribed perfectionism and burnout	206 junior elite athletes, age, M=15.15, SD=1.88	judo, swimming, track athletics, field athletics, United Kingdom	Higher levels of socially prescribed perfectionism were related to higher levels of avoidant coping which was in turn related to higher levels of athlete burnout; higher levels of self-orientated perfectionism were related to problem-focused coping and lower levels of avoidant coping which was in turn related to lower levels of athlete burnout

Table 4: *Overview of publication details (continued)*

Authors	**Study Design**	**Purpose**	**N (Female/Male)**	**Sport; Country**	**Main Findlings**
Gan et al., 2009	Factor analysis	Examining the extent to which sources of stressful events and cognitive appraisal of those events predict coping style and determine differences in coping style between Chinese college elite athletes and non-elite athletes	138 elite athletes (males, n=64 females, n=74), 253 non-elite athletes (males, n=193, females, n=60) ranged from 18 to 66 years, M=25,99, SD=9,95	volleyball, basketball, table tennis, track-field, Chinese martial arts and weightlifting, China	Three sources of stress and two cognitive appraisals were significant predictors for athletes' coping styles
Thellwell et al., 2007	Semi-structured interview	Examination of sources of stress and associated coping strategies	9 male professional cricket batters	Cricket, England	A total of 25 general dimensions for the sources of stress and 23 general dimensions for the coping strategies
Crocker & Graham, 1995	Correlation analysis	Evaluation of patterns of coping, relationships between coping and negative and positive affect, and gender differences in coping and affect	235 elite athletes (males, n=123, females, n=112), M=20.4 years, SD=2.5	football, volleyball, hockey, basketball, soccer, track and field, wrestling, Canada	Group means for coping indicated that athletes primarily used strategies, such as increasing effort, planning, suppressing competing activities, active coping and self-blame; females used higher levels of seeking social support for emotional reasons and increasing effort to manage goal frustration, males experienced higher levels of positive affect

Table 4: *Overview of publication details (continued)*

Authors	**Study Design**	**Purpose**	**N (Female/Male)**	**Sport; Country**	**Main Findlings**
Reeves et al., 2009	Semi-structured interviews	Examination of stressors and coping strategies among early and middle adolescents	40 male academy soccer players M=14.22, SD=2.58	Soccer, England	Middle adolescents reported more stressors than early adolescents, both groups experienced both common and different stressors; middle adolescents reported a greater number and repertoire of coping strategies than early adolescents, and used more problem- and emotion-focused strategies but fewer avoidance strategies than early adolescents
Bernacka et al., 2016	Prospective study	Investigation whether the personality dimension of conformism/nonconformism was a predictor of stress coping styles in athletes training combat sports, and to present the characteristics of this personality dimension in the context of competitors' adaptive/innovative sport performance	346 males, M=22, SD=3.5	combat sports (kick boxing, MMA, Thai boxing, boxing, and wrestling), Poland	Differences in stress coping styles between conformists and nonconformists training combat sporst were found as nonconformists tended to prefer task-oriented coping style
McLoughlin et al., 2021	Mixed-method design	Examination whether cumulative lifetime stress predicted depression, anxiety, and well-being in elite athletes, and to explain why cumulative lifetime stress exposure might have resulted in poor mental health and well-being	95 elite athletes (M=29.81, SD=10.88	Various sports (swimming, athletics, triathlon, football, netball, hockey, powerlifting, ultrarunning)	Hierarchical regression analysis revealed that total count and severity of lifetime stressor exposure significantly predicted greater depression and anxiety symptoms, and worse well-being; thematic analysis revealed that cumulative lifetime stress exposure fostered **poor mental health** and well-being by promoting maladaptive coping strategies

Table 4: *Overview of publication details (continued)*

Authors	**Study Design**	**Purpose**	**N (Female/Male)**	**Sport; Country**	**Main Findlings**
Anshel et al, 2009	Multivariate analysis of variance	Examination of sources of stress, which are performance or coach related and respective coping styles, depicted as approach and avoidance, as functions of both gender and race	332 (males, n=176 females, n=156), M=21.6, SD=4.86	Various sport disciplines, African Americans, Caucasians, and Hispanics	Caucasians experienced higher stress intensity and tended to use only an approach-behavior style; women reported higher stress intensity for coach-related sources of acute stress and used approach-behavioral and avoidance coping styles more often than their male counterparts; Hispanics did not differ from other groups on any measure
Skein et al., 2019	pre-post.design	To examine sleep characteristics, scheduling of activities, perceived stress and coping strategies between periods of high and low scheduling commitments in adolescent athletes	20 Australian adolescent athletes (males, n=10 females, n=10), M=15.0, SD=1.0	Netball, rugby league, basketball, softball, and athletics, Australia	Stress levels were significantly incresed in periods of high scheduling commitments with no differences between sexes
Kristiansen,& Roberts, 2010	Qualitative design, question focused analysis	To examine how young athletes experienced competitive and organizational stress and how they coped with these stressors	29 young Olympic athletes, males, n=8, females, n=21, age, M= 16.6, SD=0.77	track and field, basketball, cycling, gymnastics, handball, judo, swimming, table tennis, volleyball, water polo, Norway	Athletes xperienced competitve stressors because of the size and importnace of the competition, and organizational stressors because of the extrme heat during the competiton, athletes used cognitive coping strategies in addition to relying on different types of social support

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Litwick-Kaminska, 2020	pre-post design	To distinguish different types of sport competition appraisals and to verify if athletes' interpretation of a stressful situation changed their choice of coping methods	193 athletes (males n=97, females n=95), age M=20.27, SD=3.51, following Summer Olympic disciplines	shooting, handball, rowing, judo, taekwondo, volleyball, football, Poland	Three types of of sport competition analysis were identified: positive, negative and active; participants who revealed positive appraisals undertook the highest number of actions aimed at reaching goals and least frequently sought support
Pensgaard & Ursin, 1998	Mixed-method design, observational	To explore the different dimensions of the stress experience and the following coping efforts among elite athletes	70 Winter Olympic athletes, males, n=50, females, n=20, M=25.2, SD=3.8	various winter sports, Norway	Stress was mainly experienced during the time period prior to the competiton; external distractions and expectations were the most frequently reported stress experiences; the coach was seen as a major source of stress by some athletes; problem-focused coping strategies were employed at all times while cognitive strategies were used more days before and after the competition

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Yi et al, 2005	Correlation analysis	To examine whether resilient group would differ from nonresident group in using more adaptive coping strategies (e.g., problem-focused coping, seeking social support, rational reappraisal to minimize threat) and would be correspondingly less likely to favor the potentially maladaptive ones (e.g., blaming others, avoidance, wishful thinking; to further examine any interrelations between these two groups regarding the use of coping strategies	404 young women high school athletes (M=15.76, SD=1.08	basketball, gymnastics, cross-country, soccer	Coping profiles of the two groups differed significantly, with resilient athletes favoring problem-focused coping and seeking social support, and nonresilient athtletes reporting greater use of avoidance and blaming others; correltations among problem-focused coping, seeking social support, and minimize theat were higher in the resilient groupt
Szczypinska et al., 2021	Online-survey including four psychological questionnaires	To compare strategies of coping with stress during the COVID-19 epidemic in athletes involved in Olympic preparations and students of physical education	First group: 57 potential Olympians practicing individual sports, M=26.6, SD=5.562; second group:54 extramural students of physical education, M=25.69, SD=5.908	athletics, rowing, fencing, shooting, sport climbing, badminton, swimming, modern pentathlon, taekwondo, sailing, wrestling, canoeing, judo, cycling, equestrianism and weightlifting, Poland	Elite athletes and physical education students practicing sports most often dealt with the stress of the COVID-19 pandemic using cognitive and behavioral coping strategies; the sports level depended on the strategies of coping with stress more strongly than gender;

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Secades et al., 2016	pre-post design	To analyze the relationship among resilient qualities and coping strategies	235 athletes, males, n=126, females, n= 109, age, M=20.7, 79.1% team sports, 20.9% individual sports	various team sports (soccer, handball, volleyball, rugby) and individual sports (gymnastics, triathlon, athletics, cycling), Spain	No significant difference in resilience scores between evaluations performed during the last mesocycle or competition; a significant increase occurred in the scores for emotion-oriented and distraction-oriented coping during competition; resilience scores correlated positively to task-oriented and negatively to disengagement and distraction-oriented coping during both periods; athletes with high individual resilient qualities reached higher scores in task-oriented coping, using to a lower extent disengagement- and distraction-oriented coping
Fogagca, 2021	pre-post design	To teach college student-athletes coping skills to improve both performance and mental health and increase their social support from coaches and captains	88 college-student athletes (51% female, 83% white), M=19.8, SD=1.1, intervention and wait-list control groups	soccer, basketball, golf, swimming, and diving, United States	Athletic coping skills and anxiety significantly imporved for the intervention group, compared to the control group

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Nicholls et al, 2016	Prospective design	To examine a model, informed by self-regulation theories, which included goal adjustment capacities, appraisals of challenge and threat, coping, and well-being	212 athletes (team sports, n=135, individual sports, n=77, males, n=107, females, n=105) age, M=18.96, SD=5.74	team sports (soccer, rugby union or rugby league), individual sports (tennis, golf, martial arts), United Kingdom and Australia	The way an athlete responds to an unattainable goal is assoiciated with her or his well-being in the period leading up to and including the competition; goal reengagement positively predicted well-being, whereas goal disengagemnt negatively predicted well-being; goal reengagement was positively associated with challenge appraisals, which in turn was linked to task-oriented coping, and task-oriented coping positively associated with well-being
Cumming et al., 2012	Hierarchical regression analyses	To examine relations among body size, stress coping strategies, and mental health	44 female high school students, age, M=15.8, SD=1.1	Basketball and gymnastics, Caucasian (n=134), African Americans (n=6) and Asians (n=9)	The use of adaptive over maladaptive coping strategies was associated with more positive mental health and less distress in both sports; in gymnasts, BMI was inversely related to psychological well-being and the interaction between height and less adaptive coping strategies significantly predicted psychological distress

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Krokosz & Jochaimek, 2018	Correlation and multiple regression analysis	To analyze relationships between strategies of coping with stress used by male and female extreme athletes, perception of threat associated with their sport, and their satisfaction with life	144 athletes, males, n=89, females, n=55, age, M=23.85, SD= 5.78	Poland, watersports (kitesurfing, windsurfing, wakeboarding, freediving, BMX, roller skating, extreme scooter, skateboarding, motocross, downhill mountain biking, parkour)	Significant relastionships were found between the use of certain strategies for coping with stress and the assessment of risks associated with extreme sports in both men and women; only in the case of men were relationships observed between coping strategies used and satisfaction with life; women were more likely to use emotional and instrumental support and less likely to use humor than men
Deroche et al., 2011	Hierarchical regression analysis	To examine whether pain coping strategies, including distraction from pain, praying, reinterpreting pain sensations, ignoring pain, pain catastrophizing, are related to athletes' inclination to play through pain	205 athletes, males, n=158, females, n=47, age, M=22.73, SD=6.45	Combat sports (judo, taekwondo, karate, and wrestling)	Pain catastrophizing led athletes to reduce their physical involvement in their sport activity; moderating effect of ignoring pain such that ignoring pain significantly attenuated the negative effect of pain intensity on on athletes' inclination to play through pain

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Kerdijk et al., 2016	Diary study, qualitative design	To examine whether the social environment (significant others) is of influence on the stress and coping of team athletes	6 athletes, males, n=2, females, n=4, M=23.0, 6 team athletes of different sports, males, n=2, females, n=4, , M=25.8	Belgium, Netherlands, hockey, soccer, futsal, cricket	In particular teammates are important for the appraisal of stress and coping in teamsports; team athletes experienced the highest stress intensity during competition, or when they appraised the situation as a threat; when others were of influence the team athletes were most likely to appraise the situation as a challenge and use problem- or emotion-focused coping strategies
Dolenc, 2015	Multiple regression analysis	To examine self-esteem, anxiety level and coping strategies among secondary school students in relation to their involvement in sports	280 secondary school students, males, n=140, females, n=140, two groups, athletes, n=140, M=16.6, SD=1.1, non-athletes, M=16.7, SD=1.2	Slovenia, various sports	Athletes exhibited higher self-esteem scores and lower anxiety scores in comparison to non-sport participants; differences between the two groups have also been identified with respect to the use of certain coping strategies; sport participants reported an active and problem-focused approach to dealing with everyday problems; gender diffrences have also been studied with female athletes exhibting higher levels of anxiety than male athletes; female participants were also found to use more non-productive coping than males, focused mainly on reducing emotional effects of stress

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Daumiller et al., 2021	Online survey Regression analysis	To examine the effects of elite athletes' achievement goals on their burnout levels and psychosomatic stress symptoms, and to what extent they can be explained by athletes' use of adaptive coping strategies	165 elite athletes, males, n=97, females, n=28, M=23.7, SD=4.0	football, badminton, handball, gymnastics, ice hockey, skiing, basketball, volleyball, swimming, boxing, squash, tennis Germany	Path modelling revealed that mastery approach goals were negatively associated with burnout levels and psychosomatic stress symptoms, while mastery avoidance and performance approach goals were positively associated with burnout levels; coping stregies partially mediated the effects of mastery approach goals on burnout levels and psychosomatic stress symptoms
Anshel & Anderson, 2002	Test battery	To test the extent to which highly skilled table tennis players used coping strategies that were consistent with their coping style, both of which were categorized as approach and avoidance, in response to performance-related sources of acute stress on a table tennis task	36 male elite athletes, M=32.0, SD=1.67	Australia, table tennis	Primary results indicated significant correlations between the athletes' approach and avoidance coping styles and their respective use of coping strategies; an approach coping style was a significant predictor of performance on the first block of 20 trials, whereaas a combination of positive affect, avoidance coping strategies and negative affect best predicted performance on the second block of 30 trials

Table 4: *Overview of publication details (continued)*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Raedke & Smith, 2004	Structural equation modeling, hierarchical multiple regression analysis	To examine whether coping behaviors and social support satisfaction had indirect stress-mediated or moderated influences on athlete burnout	244 senior age-level athletes, males, n=112, females=131, M=15.8, SD=1.3	United States, swimming	Results demonstrated that general coping behaviors and social support satisfaction had stress-mediated relationships with overall burnout levels; hierarchical multiple regression analysis failed to support the disjunctive and conjunctive moderation hypotheses
Britton et al., 2019,	Path analysis	To examine a path analysis of adolescent athletes' individual differences in perceived stress reactivity, competition appraisals, emotions, coping and performance satisfaction	Adolescent athletes (n=229, males, n=150, females, n=79), M=18.55, SD=2.40	team sports (rugby, football and cricket) and individual sports (golf, karate and badminton), United Kingdom	A path analysis revealed that perceived stress reactivity had direct and indirect effets on the appraisal of higher stressor intensity, lower perceived control, higher perceived threat, positive and negative emotions and maladaptive coping were associated with performance satisfaction; task-orientated coping was not associated with performance satisfaction

Table 4: *Overview of publication details (continuedI*

Authors	Study Design	Purpose	N (Female/Male)	Sport; Country	Main Findlings
Nicholls et al., 2007	Data was collected using concept maps (Nowak & Gowin, 1984), which were used as an open-ended questionnaire	To examine stressors, coping and coping effectiveness as a function of gender, type of sport and skill	749 undergraduate athletes (n=455, males, n=294, females), 217=individual sports 532=team sports M=19.8, SD=2.33	individual sports (e.g., badminton, golf, martial arts and swimming), team sports (e.g., basketball, cricket, football, hockey and rugby), 711 Caucasian, 20 Black and 18 Asian athletes	The results revealed gender, type of sport and skill differences in relation to stressor frequencies, coping strategy development, and coping effectiveness; females used more freqeuntly problem-focused (e.g. planning, communication, technique-orientated) strategies; team sport athletes reported a variety of sport-specific stressors relating to the demand of playing in a team environment; the group of national/international athletes reported using more planning, blocking and visualization and reported that their coping was more effective than that of less-skilled athletes
Goyen & Anshel, 1998	Quantitative design	To examine sources of acute stress and related coping processes following stressful events in competitive sport	Adolescent-aged athletes, n=74 (n=39, males, n=35, females), M=15.4, SD=1.61; adult-aged athletes, n=65 (n=37, males, n=28, females), M=26.6, SD=2.26;	Various team sport disciplines (netball, soccer, cricket, hockey, rugby union, basketball), Australia	Chi-square analysis indicated significant age and gender differences in the frequency with which selected coping strategies were used as a function of the stressor; males preferred problem-focused coping, females used emotion-focused coping after the stressors; younger athletes use more maladaptive coping skill more often than older-aged competitors, they are more susceptible to both acute and chronic forms of stress in sport

Table 5: "*Qualsyst" quality assessment*

Publication	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristics sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Appropriate sample size	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Rating
Leprince e t al., 2018	2	2	1	2	0	0	0.	1	1	2	2	2	2	2	**medium**
Guo et al., 2019	2	2	2	2	0	0	0	2	2	2	2	2	2	2	**high**
Hill et al., 2010	2	2	2	2	0	0	0	1	2	1	2	2	2	1	**medium**
Gan et al., 2009	2	2	2	2	0	0	0	1	2	2	2	2	2	1	**medium**
Daumiller et al., 2021	2	2	2	2	0	0	0	1	2	2	2	2	2	2	**high**
Anshel & Anderson, 2002	2	2	2	2	0	0	0	2	1	1	2	1	2	1	**medium**
Britton, Kavanagh & Polman, 2019	2	2	2	2	0	0	0	2	2	2	2	N.A.	2	2	**high**
Raedke, & Smith, 2004	2	2	2	2	0	0	0	1	2	2	2	N.A.	2	2	**medium**
Nicholls et al., 2007	2	2	2	2	0	0	0	1	2	2	2	2	2	1	**medium**

Table 5 *continued: Qualsyst" quality assessment (continued)*

Publication	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristics sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Appropriate sample size	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Rating
Goyen & Anshel, 1998	2	2	2	2	0	0	0	1	1	2	2	2	2	1	**medium**
Reeves, Nicholls & McKenna, 2009	2	2	2	2	0	0	0	2	1	2	N.A	2	2	1	**medium**
Crocker & Graham, 1995	2	2	2	2	0	0	0	1	2	1	2	2	2	1	**medium**
Thellwell, Weston & Greenlees, 2007	2	2	2	2	0	0	0	1	1	1	N.A.	2	2	1	**medium**
Cumming, Smith, Grossbard, Smoll & Malina,2012	2	2	2	2	0	0	0	1	1	2	2	2	2	1	**medium**
Nicholls, Levy, Carson., Thompson & Perry, 2018	2	2	2	2	0	0	0	1	1	2	0	2	2	1	**medium**

Table 5 *continued: Qualsyst" quality assessment*

Publication	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristics sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Appropriate sample size	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Rating
Krokosz & Jochaimek, 2018	2	2	2	2	0	0	0	1	1	2	N.A.	2	2	1	**medium**
Deroche, Woodman, Stephan, Brewer & Le Scanff, 2011	2	2	2	2	0	0	0	2	1	2	N.A	2	2	0	**medium**
Fogagca, 2021	2	2	2	2	0	0	0	1	1	1	2	2	2	1	**medium**
Nicholls, 2007	1	2	2	2	0	0	0	1	0	1	N.A.	1	1	1	**low**
Rutkowska, Bergier, & Witkowski, 2014	2	2	1	2	0	0	0	1	0	1	N.A.	1	1	1	**low**
Sagar, Lavallee & Spray, 2009	2	2	1	2	0	0	0	1	1	1	N.A.	1	2	1	**low**
Secades, Molinero, Salguero, Barquin, de la Vega & Marquez, 2016	2	2	2	2	0	0	0	1	2	2	2	1	2	1	**medium**

Table 5*: Qualsyst" quality assessment (continued)*

Publication	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristics sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Appropriate sample size	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Rating
Bernacka, Sawicki, Mazurek-Kusiak, & Hawlena, 2016	2	2	2	2	2	0	0	1	1	2	1	2	1	1	**medium**
McLoughlin, Fletcher, Slavich, Arnold & Moore, 2021	2	2	2	2	2	0	0	1	2	2	2	2	2	1	**high**
Anshel, Sutasrso & Jubenville, 2009	2	2	2	2	0	0	0	1	2	2	2	2	2	1	**medium**
Skein, Harrison & Clarke, 2019	2	2	2	2	0	0	0	1	0	2	2	2	2	1	**medium**
Krisitiansen, & Roberts, 2010	2	2	2	2	0	0	0	1	0	2	N.A.	2	2	2	**medium**
Litwick-Kaminska, 2020	2	2	2	2	0	0	0	1	1	2	2	2	2	1	**medium**
Yi, Smith, & Vitiliano, 2005	2	2	2	2	0	0	0	1	1	2	N.A.	2	2	1	**medium**

Table 5*: Qualsyst" quality assessment (continued)*

Publication	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristics sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Appropriate sample size	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Rating
Szczypinska, Samelko & Guszkowska, 2021	2	2	2	2	1	0	0	1	1	2	1	2	2	2	**medium**
Kerdijk, van der Kamp, & Polman, 2016	2	2	2	2	0	0	0	1	1	2	N.A.	2	2	1	**medium**
Dolenc, 2015	2	2	2	2	2	0	0	1	1	2	2	2	2	2	**high**
Pensgaard & Ursin, 1998	2	2	2	2	0	0	0	1	1	2	1	2	2	1	**medium**

N.A.: not applicable; 2 = yes; 1 = partial; 0 = no quality; quality score >= 75% high, 55-75% medium, <= 55% low

Review 3

Table 8: *Quality appraisal of evidence – Mixed Method Appraisal Tool (MMAT) (Pluye et al., 2011)*

Types of mixed methods study components or primary studies	**Methodological quality criteria**				**Responses**			
					Yes	**No**	**Can't tell**	**Comments**
Screening questions (for all types)		**Study**						
	Are there clear qualitative and quantitative research questions (or objectives), or a clear mixed method question (objective)?	**Hammond et al., 2013; Tabei et al., 2012; Petito et al., 2016; Kristiansen & Roberts, 2010; Gulliver et al., 2012; Arthur-Cameselle, et al., 2017; Biggin et al., 2017; Gouttebarge et al., 2016; Madigan et al., 2017 (1); Madigan et al., 2017 (2); DeFreese & Smith, 2014; Blakelock et al., 2016; von Rosen et al., 2017; Francisco et al., 2013; Krentz & Warschburger, 2013; Shanmugam et al., 2014**			Yes; Yes; Yes; Yes			
	Do the collected data allow address the research question (objective)?				Yes; Yes; Yes; Yes			
Qualitative	*Are the sources of qualitative data relevant to*	**Kristiansen & Roberts, 2010; Gulliver et al.,**			Yes; Experience of competitive and organizational stress; coping with stressors (**Kristiansen & Roberts, 2010**); Perceived barriers and facilitators to help-seeking for common mental health problems of depression, anxiety			

	address the research question (objective)?	**2012; Arthur-Cameselle, et al., 2017; Biggin et al., 2017;**			and general emotional distress (**Gulliver et al., 2012**); Factors related to eating disorder onset, (**Arthur-Cameselle et al., 2017**); Perceptions of mental health problems amongst athletes and coaches (**Biggin et al., 2017**)
	Is the process for analyzing qualitative data relevant to address the research question (objective)?				Yes
	Is appropriate consideration given to how findings relate to the context, e.g. the setting in which data were collected?				Yes
	Is appropriate consideration given to how findings relate to researchers' influence, e.g. through their interactions with participants?				Yes; one author was present at the Olympic Village to establish trust (Strength of qualitative research); Limitations of study not explicitly named (**Kristiansen & Roberts, 2010**); purpose of group (to engage in a general discussion about help-seeking behavior for mental health problems in young elite athletes) was explained before commencement; field notes were recorded by one researcher; modest sample size; participants were largely self-selected or invited by coaches; thematic analysis conducted by one researcher (**Gulliver et al., 2012**); each interview was recorded and transcribed verbatim; comparison group of non-athletes included; participants' responses were not based on their ED diagnosis or sport type; athlete and non-athlete labels refer to collegiate sport participation (**Arthur-Cameselle et al., 2017**); sample did not include participants from aesthetic sports; participants were self-selecting (risk of bias); small sample size –not representative for a broader sport population; use of two expert panels strengthen credibility of results (**Biggin et al., 2017**)
Quantitative randomized controlled trials	*Clear description of the randomization (or an appropriate sequence generation)?*	**Gouttebarge et al., 2016;**			Yes; assessment of outcome measures through self-report (most feasible in population of elite athletes) (**Gouttebarge et al., 2016**)
	Clear description of the allocation concealment (or blinding when applicable)?				Participants were selected at random; procedures being blinded to responsible researcher (**Gouttebarge et al., 2016**)
	Complete outcome data (80% or above)?				Response rate = 31% (204), follow-up rate = 69% (108) (**Gouttebarge et al., 2016**)
	Low withdrawal/drop-out (below 20%)?				48 not available for follow-up (**Gouttebarge et al., 2016**)
Quantitative non-randomized	*Are participants (organizations) recruited in*	**Madigan et al., 2017 (1); Madigan et al., 2017 (2);**			can't tell-no comment from the author (**Madigan et al., 2017(1)**); no-61% of athletes were seen by psychologists and 38% by physicians (=professional bias); can't tell-no comment from the author (**Madigan et al., 2017(2)**);

	a way that minimizes selection bias?	**DeFreese & Smith, 2014**; **Blakelock et al., 2016; von Rosen et al., 2017; Francisco et al.2013; Krentz & Warschburger, 2013; Shanmugam et al., 2014**			can't tell-no precise information "Athletes were then invited to participate…" (**DeFreese & Smith, 2014**); can't tell-"I order to recruit participants, email and/or telephone contact was made …" (**Blakelock et al., 2016**); can't tell-athletes were invited by email (**von Rosen et al., 2017**); can't tell-was not commented by the author (**Francisco et al., 2013**); yes (**Krentz & Warschburger, 2013**); can't tell-recruitment of participant wasn't described in detail (**Shanmugam et al., 2014**)
	Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?				Yes; No-uni-dimensional measure was used to assess psychological distress (**Blakelock et al., 2016**); data analyzed were limited to certain variables, data o injury mechanisms or other biomechanical variables were not collected (**von Rosen et al., 2017**); disordered eating not clinically evaluated (**Francisco et al., 2013**); only 4 potential risk factors (related to sports environment and participation) were included, general risk factors remained unconsidered => important to understanding complex etiology of disordered eating in elite athletes, (**Krentz & Warschburger, 2013**); in this study only direct role of interpersonal relationships in athletes' eating psychopathology was examined => interpersonal difficulties however do interact with other core psychopathological processes (Fairburn et al., 2003) (**Shanmugam et al., 2014**)
	In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?				No-sample comprised exclusively junior athletes (**Madigan et al., 2017 (1)**); no-sample comprised exclusively junior athletes, only training distress examined (**Madigan et al., 2017(2)**); sample delimited to collegiate athletes, non-experimental longitudinal study design=>no definitive causal evidence (**DeFreese & Smith, 2014**); have affected response rates and attrition, small effect of recall bias (questionnaires were not completed on specified days) (**Blakelock et al., 2016**); monitored athletes exposed to different conditions in terms of injury risk (athletes being in competitive season, in base training or preseason), study focused not only on absolute variables but also on repeated measured data to monitor changes in variables before an event (**von Rosen et al., 2017**); male participants underrepresented => small number may have skewed results, problem of underreporting in terms of disordered eating behaviors (**Francisco et al., 2013**); small sample size => generalization of results limited, study focused only on 1 high risk group (aesthetic sport), problem of underreporting in terms of disordered eating behaviors => bias in data is therefore possible (**Krentz & Warschburger, 2013**); findings are essentially correlational => identifying true causal risk factors not possible (Jacobi et al., 2004) (**Shanmugam et al., 2014**)
	Are there complete outcome data (80% or above), and when				35 participants did not complete measures (final cross-sectional sample size N=140, final longitudinal sample size N= 106) (**Madigan et al., 2017(2)**; ;response rate 34% (**DeFreese & Smith, 2014**); can't tell-no

	applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?				precise information – 14.0% of first league players & 39.2% of second league players were absent when asked to fill in the questionnaire; approximate mean response rate = 16.08%; attrition rate from MT1 to MT3 = 47.62% (deselected players) & 16.09% (retained players) (**Blakelock et al., 2016**); final cohort consisted of 496 adolescent elite athletes, 43.3% reported new injury over 52-week period (**von Rosen et al., 2017**); can't tell-was not commented by the author (**Francisco et al., 2013**); follow-up rate 67% of baseline sample (97 athletes), high drop-out rate (33.0% attrition from initial assessment) (**Krentz & Warschburger, 2013**); can't tell-no precise information available (**Shanmugam et al., 2014**)
Quantitative descriptive	*Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?*				
	Is the sample representative of the population understudy?				
	Are measurements appropriate (clear origin, or validity known, or standard instrument)?				
	Is there an acceptable response rate (60% or above)?				
Mixed methods	*Is the mixed methods research design relevant to address the qualitative and quantitative research questions (objectives), or the qualitative and quantitative aspects of the mixed methods question (objective)?*	**Hammond et al., 2013; Tabei et al., 2012; Petito et al., 2016**			Yes; reasons for integrating qualitative & quantitative methods are explained
	Is the integration of qualitative and quantitative data (or results) relevant to address the research question (objective)?				The Beck Depression Inventory II (BDI-II); DSM-IV-TR criteria as base for semi-structured interviews (**Hammond et al., 2013**); Relationship between organizational stressors and dimensions of burnout (**Tabei et al., 2012**); Relationship between personality traits, presence of polymorphism in the 5HHT promoter region (SLC 6A4), anxiety and depressive symptoms (**Petito et al., 2016**);

	Is appropriate consideration given to the limitations associated with this integration, e.g. the divergence of qualitative and quantitative data (or results) in a triangulation design?				Yes; small sample size (50 swimmers); no monitoring of athlete depression over time (**Hammond et al., 2013**); findings only specific to organizations & cultures sampled; only male soccer players sampled (**Tabei et al., 2012**); assessment of stress is exclusively based on self-report rather than clinical interview, small sample size (males only), sample represented a selected sub-sample of original population => therefore reduced generalizability (**Petito et al., 2016**)