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**Psychosocial factors influencing injury risk in competitive athletes:  
A systematic review.**

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MRes Psychology of Sport and Exercise

**Signed Declaration**

This systematic review constitutes of my own work and all material that is not my own is full acknowledged. No part of this work has been submitted for assessment elsewhere.

R.Bennett

Student Signature

Supervisor Signature

## **Abstract**

Sport injury prevalence ranges from 20-30 million per year within the UK and US impeding sports participation greatly. As well as the personal detriment for the players, this also results in significant financial cost., For example, sports injuries cost the English Premier League approximately 45 million per year between 2012/13 and 2016/17, and for European clubs an average of 500,000 euros per month which suggests a comprehensive understanding is important from both a health, and financial perspective. Electronic database searching, forward and backward citation searching and bibliography searching was completed on 08/03/23. Studies that included competitive athletes and psychosocial risk factors influencing injury risk were included. 52 studies evaluated 10,994 athletes, 13 coaches and 5 physiotherapists. Three core themes were identified, namely: Injury-related Cognitions such as Athletic Identity; Injury-related Emotions such as stress and anxiety and Injury-related Behaviours such as autonomy support. Psychosocial stress is the most widely reported risk factor for sports injuries, and in agreement with The Model of Stress and Athletic injury research commonly suggests that effective coping strategies can help to reduce this risk.

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## **Chapter 1: Introduction**

Despite an advanced understanding of physical, biomechanical, and physiological wellbeing, high injury, reinjury and poor return to sport rates are still prevalent (Ardern et al., 2016). This might be because most research attention has centred on physical/physiological and/or biomechanical considerations (Maaranen & Brewer, 2021; Marks et al, 2022). Despite there being over 40 years of research into the psychology of injury risk (Tranaeus et al., in press), psychosocial risk factors for sports injury are still comparatively under-appreciated in a competitive sports environment (Gledhill et al., 2021). This is noteworthy as psychological/psychosocial considerations can influence both injury risk and re-injury risk in competitive athletes (Forsdyke et al., 2016; Gledhill et al., 2018; Ivarsson et al., 2017; Tranaeus et al., 2022). Arguably, by not fully considering psychosocial risk factors for sports injury as part of competitive athlete care to the same degree as physical, physiological, and biomechanical considerations, practitioners may not be fulfilling their duty of care to athletes (Gledhill & Forsdyke, 2018). Part of the reason of the comparative lack of consideration is a lack of practitioner certainty over the importance of psychosocial factors and suggestions of a lack of formal education in this regard (Heaney, 2018; Gledhill et al., 2021). Hence, a systematic review that comprehensively considers all available evidence to date would support this practitioner need.

With high rates of injury being prevalent in sport Gledhill et al, (2018), alongside the potentially negative consequences that often follow, identifying psychosocial risk factors that can increase the risk of becoming injured should be a priority in both research and real-world application (Gledhill & Forsdyke, 2018). A comprehensive understanding of these risk factors would help to develop strategies to decrease injury risk in sport. Injuries have a significant impact on athlete mental health, with there being elevated incidence of severe mental illness in injured athletes (e.g., Putukian, 2016), with suicide and suicidality being a notable, longstanding consideration (Hamstra-Wright, 2024; Smith & Milliner, 1994; Timpka, et al 2020). As well as athlete health, injuries can have a significant impact on the performance health of organisations. For example, Hagglund et al, (2013) concluded that lower injury burden and incidence were associated with increased points per league match and lower injury burden and higher match availability was associated with an increase in the Union of European Football Association (UEFA) season club coefficient. This coefficient reflects success in European competitions such as the Champions or Europa league. More simply, fewer injuries are predictive of success. Injuries can also impact on the financial health of organisations. For example, Eliakim et al., (2020) reported that in the English Premier League between the 2012/13 and 2016/17 seasons, an average club lost approximately £45 million per season (£36 million due to injuries leading to underperformance and £9 million

paid out in injury players' salaries), with further suggestions being that injuries cost European football clubs 500,000 euros per month on average (Ekstrand et al, 2013). Therefore, a comprehensive understanding of injury risk factors would contribute to improving these multifaceted health considerations (Gledhill et al., 2021).

To provide an insight into developments in this area, the next section of this introduction will offer an overview and critique of existing models within the domain of the psychology of sports injury risk. To demonstrate a timeline of developments, The Model of Stress and Athletic Injury (Andersen and Williams, 1988; Williams and Andersen, 1998), The Biopsychological Sport Injury Risk Profile by Wiese-Bjornstal, (2010), The Biopsychosocial Model of Stress, Athletic Injury and Health by Appaneal and Perna, (2014) and A Working Model of Psychological Risk Factors for Overuse Injuries written by Tranaeus et al, (2014) will be chronologically discussed. Specifically, there will be a discussion of the key points of each model with a critical consideration of model limitations which underpin the development of subsequent models.

### **The Model of Stress and Athletic Injury**

The Model of Stress and Athletic Injury is a commonly cited model in psychology of sport injury research, Andersen & Williams, (1988) state that this is because stress-injury research appears to be much more consistent than other research such as personality-injury research, particularly in football. According to this model, injury risk can be influenced by how an athlete responds to stress. Specifically, an athlete's appraisal of a potentially stressful situation such as a big game or competition for places influences physiological/attentional changes and in turn therefore, injury risk. For example: history of stressors; which could include factors such as daily hassles, past injury history and daily life stress; individual personality characteristics such as hardiness, achievement motivation, locus of control and competitive trait anxiety; and coping resources such as general coping behaviours, social support, stress management and mental skills. All these factors can contribute in isolation, or interactively, to the stress response.

The revised version of this model Williams & Andersen, (1998) (Figure 1) states that both the extent of the stress reaction and the athlete's appraisal of the situation can be influenced by various psychosocial factors, which within the model are divided into three categories: (1) personality; (2) history of stressors; and (3) coping resources. The updated version of this model argues that an athlete's history of stressors can affect or influence the development of athletes' coping mechanisms and individual personality characteristics, due to this, bidirectional arrows were added to the model linking the three psychosocial categories. Recently, these relationships between psychological variables, stress response and injury risk have been supported, with the stress response and coping resources seen to have the strongest influence over injury risk (Ivarsson et al., 2017).

As an additional amendment from the original 1988 version, the 1998 version of the model included an intervention section and suggested that the influence of an intervention approach can help to buffer stress response and therefore decrease the injury risk an athlete is exposed to. Providing some support for this notion Gledhill, et al., (2018) reviewed 13

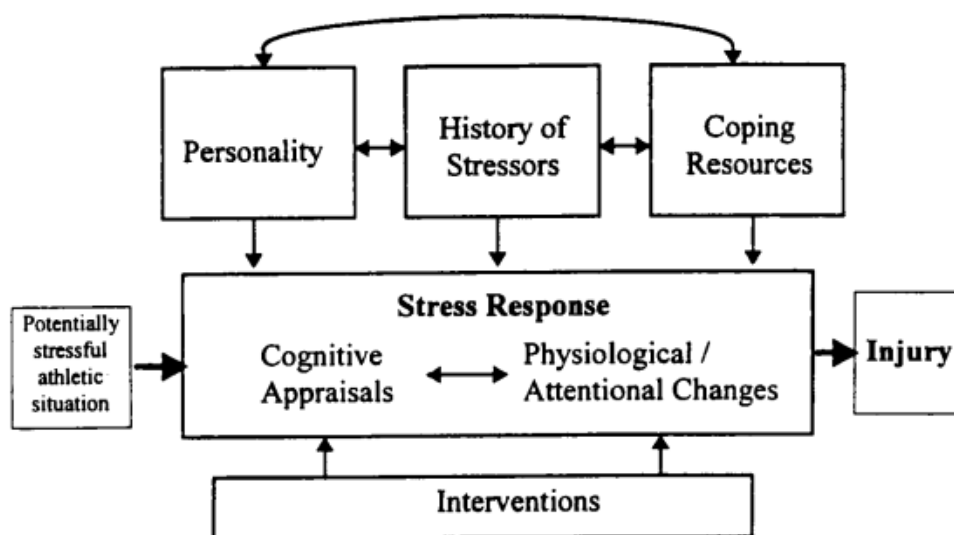


Figure 1: The model of stress and athletic injury (Williams & Andersen, 1998)

papers assessing the real-world effectiveness of psychological interventions in injury prevention. This study (which was dominated by studies underpinned by stress-management interventions) concluded that 93% of the intervention studies were associated with lower sports injury and/or injury time-loss.

Despite its success, Williams & Andersen, (1998) revised Model of Stress and Athletic Injury is not without limitations. For example, an acknowledged limitation of the model is its focus on the cognitive stress response such as negative appraisals and negates the influence of more behavioural considerations (Appanael & Perna, 2014). Moreover, the revised Model of Stress and Athletic Injury can account more for the impact of psychological

risk factors on traumatic or sudden onset injuries but may not be able to fully account for more overuse or gradual onset injuries (Ivarsson et al., 2017; Tranaeus et al., 2014). Finally, sociocultural contexts are not considered in this model whereas, more recently, expert opinion has reported factors such as team climate and club norms as further injury risk factors (e.g., Gledhill et al., 2021; Wiese-Bjornstal, 2010).

Owing to the above critiques and in an attempt to advance this area, Wiese-Bjornstal, (2010) developed the Biosychological Sport Injury Risk Profile, Tranaeus et al, (2014) developed the Working Model for Psychological Risk Factors for Overuse Injuries, and Appaneal and Perna, (2014) developed the Biopsychosocial Model of Stress, Athletic Injury and Health. Whilst the seminal work of Andersen and Williams, (1988) and Williams and Andersen, (1998) was the major catalyst for research into the psychology of sports injury risk Tranaeus et al, (in press) more recent models have invigorated the area in a way that suggests broader injury risk factors beyond the established norm of cognitive considerations.

### **The Biopsychological Sport Injury Risk Profile**

The Biopsychosocial Sport Injury Risk Profile by Wiese-Bjornstal, (2010) states that internal or personal variables which includes biological factors such as nutrition, health/recovery status, fatigue or hydration; as well as psychological factors like coping, risk behaviours, life event stress and attentional focus, can both influence the risk of injury an athlete is exposed to. In addition to internal/personal variables, Wiese-Bjornstal also stated that external and environmental risks exist such as physical factors including the weather, intensity of play, size of opponent or medical care, alongside sociocultural factors like coaching quality, social resources, sport norms and organisational stress can also increase the likelihood of sport/athletic injury. The combination of the aforementioned risks can in turn influence athlete behaviour and therefore risk vulnerability based on resultant exposures and choices (Gledhill & Forsdyke, 2021).

### **A Working Model of Psychological Risk Factors for Overuse Injuries**

Advancing our understanding from Williams and Andersen, (1998) Model of Stress and Athletic Injury. Tranaeus et al, (2014) developed the first injury risk model with the prime focus on risk factors for overuse injuries. Tranaeus and colleagues posited that risk factors for acute injuries differ from those of overuse injuries, as do the relationships between those factors. For example, risk factors such as stress load, exposure over time, and limited communication between coaches/managers and athletes, can all influence injury risk in an overuse injury more likely than an acute one, potentially due to the behavioural implications of these factors. In this model (figure 2) it states that history of stressors, personal factors, psycho-physiological and psychosocial factors, and coping resources can influence injuries

over time. Specifically, an athlete with a lack of coping resources and limited social support who is unable to discuss any concerns about stress or pressures are more likely to be at risk of sustaining an overuse injury; with an athlete showing signs of body carelessness or lack of adherence to recovery also being at risk.

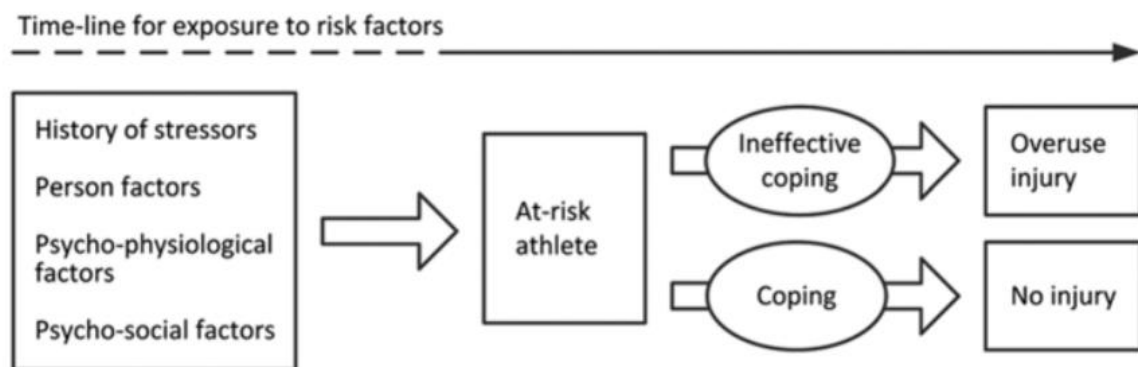


Figure 2: A working model of psychological risk factors in overuse injuries (Tranaeus et al, 2014)

### **Biopsychosocial Model of Stress and Athletic Injury and Health (Appaneal and Perna, 2014)**

The Biopsychosocial Model of Stress and Athletic Injury and Health (BMSAIH) Appaneal & Perna, (2014) expands Williams and Andersen's Model of Stress and Athletic Injury and illustrates the links and pathways between stress demands and an athlete's health (see Figure 3).

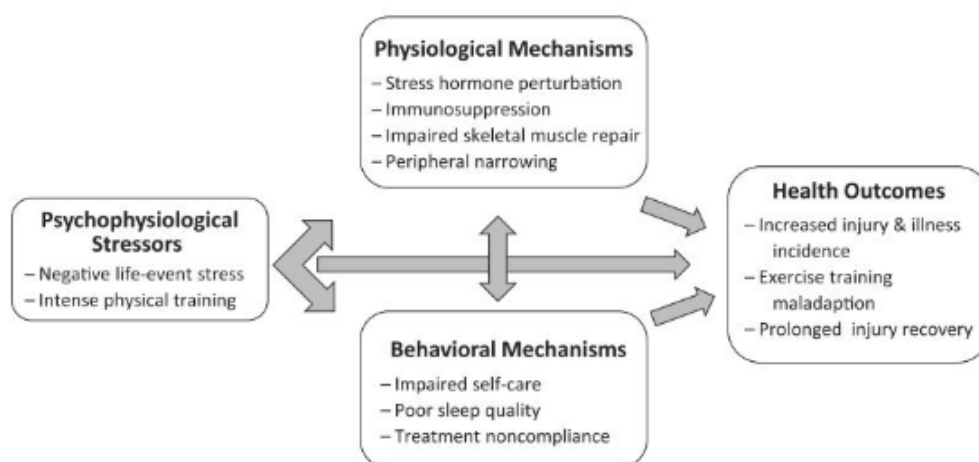


Figure 3: A Biopsychosocial Model of Stress and Athletic Injury and Health (BMSAIH) (Appaneal and Perna, 2014)

More specifically the BMSAIH clarifies physiological mechanisms and pathways between an athletes' stress response and health/sport injury outcomes; considers other health (illness) and behavioural (e.g., poor sleep) outcomes that can affect sport participation, not just injury; and the BMSAIH integrates the impact of exercise training on an athletes' overall health. Appaneal and Perna (2014) state that this model should be considered an independent extension of The Model of Stress and Athletic Injury (Andersen & Williams, 1988; Williams & Andersen, 1998) which informed the basis of the BMSAIH. Initial, and most of the research focus on the cognitive features of the stress response and injury risk, however it has been conceptualised above as multifaceted. Finally, this model posits that the relationship between psychosocial stress and sport injury is stated to be stronger in overuse or gradual onset injuries. These are not as dependant on the cognitive processing of an athlete (e.g., attentional, or decisional errors that can result in a traumatic injury) and more likely related to physiological and behavioural processes linked to exercise adaptation and recovery.

### **Similarities and differences between models**

All three models mentioned above are well cited models in sport injury psychology research, and within these models' patterns emerge. For example, stress, or history of stressors and the quality of/or lack of, coping abilities are themes that occur in all three models and appear to be discussed as important injury risk factors to consider in promoting healthy athletes and/or recovery. Interestingly, only Tranaeus et al, (2014) of the models discuss the rest and the recovery process opening a different perspective and linking re-injury risk factors. Recent research has looked at studies relating to this, with a common bottom line being that rehabilitation adherence and re-injury risk factors are underrepresented (Gledhill et al, 2021). A strength of Appaneal & Perna, (2014) is that this model looks to progress Andersen and Williams, (1988) model by clarifying the mediating pathways between behavioural and physiological responses in addition to the well-informed factors like personality, history of stressors and coping resources.

Following discussing these key theories and models that have shaped understanding and encouraged research interest within this area. A clear example of this impact is evident in recent systematic reviews; therefore, the next section of this introduction will provide a critical overview of recent systematic reviews and expert statements within this body of research. This section will highlight the key contributions made by these systematic reviews and expert statements, whilst also using their limitations to demonstrate the rationale for the current systematic review.

The most prominent and recent systematic reviews and expert statements within this body of research are Ivarsson et al, (2017) systematic review and meta-analysis of psychological factors in injury risk and prevention, the British Association of Sport and Exercise Sciences Expert Statement on psychological considerations in injury risk reduction in sport Gledhill et al, (2021), and Tranaeus et al, (2022) systematic review of psychosocial risk factors for overuse injuries in sport. These three key sources of information are critically discussed below.

Drawing from Williams & Anderson, (1998) Stress Injury Model, Ivarsson et al., (2017) systematic review and meta-analysis had the objective of examining the effect sizes of relationships between psychosocial variables and injury rates within competitive sport. The results from the meta-analysis conducted within this review showed that history of stressors and stress injury response had the strongest relationship within injury rates. This is explained to be due to the fact that prolonged stress can decrease communication between the left and right hemisphere of the brain which cause increased poor-decision making which is linked to an increased injury risk. Ivarsson and colleagues also showed that stress associated with negative events - for example previous injury or negative life event stress - had the strongest associations with injury rates. This is believed to be due to negative or threatening information being processed more thoroughly and having a more severe impact on behaviours (Ivarsson et al., 2017). As the largest systematic review and meta-analysis of note within this body of research, Ivarsson and colleagues demonstrated the value of Williams and Anderson's, (1998) stress injury model. Specifically, their review indicates the importance of key psychological factors in injury risk which could then be used to inform injury risk reduction strategies.

Despite its valuable contributions as the first notable systematic review of its kind to explore injury risk factors in this context, it is not without limitation. For example, when interpreting results relating to the stress response variable and its relationship with injury, the number of effect sizes is small for a meta-analysis (4). As such, results should be interpreted with caution. Additionally, this study included an effect from outside of a sporting context which could have influenced its results. Moreover, this systematic review is underpinned by the Model of Stress and Athletic Injury by Andersen and Williams, (1998) and, as such, focuses more on the cognitive elements of the stress response. Given the importance of behavioural, psychological, physiological or health mechanisms in injury risk as discussed by Appaneal and Perna, (2014), a systematic review which comprehensively explores all psychosocial injury risk factors, irrespective of study design or theoretical underpinning, is warranted. Ivarsson and colleagues limited study inclusion to sudden onset injuries, suggesting that further understanding of gradual onset injuries would be beneficial. Finally,



this systematic review's inclusion criteria indicate that the included studies are at least eight years' old, suggesting that a more current understanding of the evidence base would be beneficial. Consequently, a contemporary systematic review that isn't restricted to a single theoretical underpinning and isn't restricted to specific study designs may provide a current and comprehensive understanding from which we can advance research and applied practice (cf. Forsdyke et al., 2016).

The BASES Expert Statement on psychological considerations in injury risk reduction in competitive sport Gledhill et al., (2021) also draws on the model of stress and athletic injury (Williams & Anderson, 1998). In doing so it instils the wider body of research suggesting that personality factors, psychological stress/stress response and poor coping resources are related to increased acute sports injury risk. It also notes that overuse injury risk mechanisms are not the same as acute injuries and reflects that research on psychological risk factors for overuse or gradual onset injuries are not as comprehensively investigated within the body of research (cf. Tranaeus et al, 2014). Gledhill and colleagues suggest that athletes are typically at a higher risk of overuse injuries when they experience built-in organisational stressors and cultures that have the potential to impact decisions and behaviours, such as poor athlete-coach relationships, poor communication between club multidisciplinary teams (coaches, physiotherapists, psychologists, athletes) and environments that emphasise negative social comparisons and that this is because these factors have the potential to heighten psychosocial stress via manifesting unrealistic training and performance demands. More simply, athletes who do not have the opportunity to correctly manage stress, or who demonstrate poor behaviours/lifestyle choices (poor sleep, over-training, insufficient recovery) are at a higher risk of overuse injury (Martin et al, 2021; Tranaeus et al, 2014). As such, this statement provides support for Tranaeus, et al, (2014) working model of psychological risk factors for overuse injuries by presenting a valuable expert opinion as a point of reference for practitioners and researchers.

Despite having a collection of international experts and renowned practitioners contributing to this statement and able to share expert opinion, this statement lacks a systematic process of study selection and screening and being limited to a small number of included studies, does not provide a comprehensive coverage of the research area. Furthermore, as an expert statement, the work offers theoretically and practically informed suggestions and recommendations but does not have the ability to assess any of the suggestions made. Hence, a systematic review that is not largely informed by a single dominant theoretical perspective and draws on primary research to explore key research questions and inform applied recommendations may be of greater value.

Most recently, Tranaeus et al, (2022) conducted the most prominent systematic review solely focused on psychosocial risk factors for overuse injuries in competitive athletes. In doing so Tranaeus et al, (2022) provide another review that draws from Tranaeus et al, (2014) working model of psychological risk factors for overuse injuries. This review identified 27 psychosocial risk factors from 9 quantitative and 5 qualitative studies and summarised that there are several intra-personal factors such as competitiveness, athletic identity, perceived stress, locus of control, risk taking and previous injuries. Linking this to overuse injuries, athletes who have suffered overuse injuries reported higher competitive and goal-orientated motivation in comparison with peers. Competitiveness, however, could not be used to discriminate between athletes with and without overuse injuries. This study also reports key details in sex differences, for example, female athletes who had overuse injuries scored higher than athletes without injuries in the subscales which related to motivation for exercise (stress-mood, weight management, physical health, skill development, muscle improvement, socialising, and fun enjoyment) and these observations were not apparent in male athletes. In addition to sex differences, this study also reported differences between sports. Exercise dependency for example was found to be a risk factor for overuse injuries in marathon runners and long-distance runners but was not a risk factor in elite track and field athletes. Athletes in a psychosocial risk profile for overuse injuries additionally showed higher values for perfectionistic concerns, perceived negative life stress, and athletic identity, but interestingly there was no link between perceived stress and recovery and overuse injuries.

Two interpersonal factors were identified within this review, these are coach-athlete relationships and inter-personal stressors. Athletes who were categorised into the risk of overuse injuries profile reported having poor relationships with their coaches, and suggested their coach was more of a source of stress in comparison with the non-risk profiles. A noteworthy point from this study is that only relationships with coaches had this effect on injury risk as teammates/friend's relationships did not have the same effect. Finally, only one sociocultural factor was investigated within this review. Perceived motivational climate which refers to an athletes' perception of the motivational climate within their sporting environment using an ego-orientated and task-orientated climate, however none of these two mentioned variables were found to be associated with risk of overuse injury.

Due to relatively few studies focusing on overuse injuries comparative to traumatic injuries, the sample size to choose from for Tranaeus et al, (2022) was limited meaning this systematic review had a small number of included studies. Additionally, the heterogeneity in study designs and methods makes it challenging to quantitatively synthesize evidence. Some of the methods used to measure psychosocial factors that are linked to overuse

injuries have limitations such as a risk of bias specifically relating to 'intra-personal' means when assessing inter-personal and sociocultural factors. Collectively this made the overall certainty of evidence for the above factors difficult to appraise.

Drawing on the above critique of the key systematic reviews in this area, a systematic review of literature which is not limited to a single dominant theoretical underpinning or restricted by study design is warranted. Having a more inclusive approach to systematic reviewing the literature would allow for a potentially greater understanding of injury risk factors, underpinning mechanisms of injury risk, and competitive athletes' experiences of injury risk factors within the competitive sport environments. This would be beneficial for many stakeholders (e.g., athletes, coaches, sport scientists, sports medicine practitioners) when seeking to shape environments in such a way that reduces the risk of sports injuries in competitive sport. As such, the research questions for this systematic review are:

1. Which psychosocial factors are associated with sports injury risk in competitive athletes?
2. What are the mechanisms behind how these risk factors can cause injury in competitive sport?
3. What is the methodological quality of available evidence?

## **Chapter 2: Method**

### **Protocol and Registration**

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines informed and the methodology of the systematic review (Page et al., 2021). The protocol was registered with Prospero (08/02/23) registration CRD42023394731, and this review was granted ethical approval by Leeds Beckett Ethics on 05/01/23.

### **Search Strategy**

Articles were identified through a search of relevant electronic databases (CINAHL, Medline, Psycinfo, Science Direct and SportDiscus). Databases were searched on 07/02/23.

Multiple key words and Boolean phrases were agreed on via breaking down the research questions, a scoping search on psychosocial injury risk factors and appropriate MeSH terms and used as search terms (Table 1). Forward and Backward citation searching was used to ensure that search results were maximised (cf. Gledhill et al., 2017); citation searching of similar reviews in the area was also conducted safeguard against any pertinent studies being missed (see figure 1 for additional sources results). Once full initial search results were garnered, studies were independently screened by two authors (RB and AG) based on title, abstract and full text and included or excluded based on alignment with the inclusion criteria. There were no discrepancies between the two authors as to whether a study should be included, so referral to a third author was not required.

**Table 1: Search Terms**

Electronic Database	Search Terms including truncations
EBSCO host: (Including: Sportdiscus, Psycinfo, MEDLINE, CINAHL)	Key Word: Risk Factors AND Abstract: Sport OR Athletic Inj* AND Abstract: Psycho* OR Abstract: Personality OR History of Stressors OR Coping OR Social Support AND Abstract: Athlet* OR Player NOT

	Key Word: Lit Review OR Meta Analysis OR Systematic Review
Science Direct	Sport* Injur* OR Athlet* Inj* (Title/Abstract/Key Word)

## Eligibility Criteria

Due to a potential for bias to arise from only reporting studies following a specific research design (e.g., randomised control trials), or reporting studies using only a particular population (e.g., male athletes) there is no restriction on date of publication, research design, sex of participants, age, or level/frequency of competition (cf. Forsdyke et al, 2016).

Included studies needed to meet Clarson and Bahr, (2014) definition of sport injury and a best practice definition for competitive athlete (Table 2 for definitions). Studies additionally contained a distinct psychosocial factor that influenced the risk of musculoskeletal injury from sport. Studies that related to non MSK injuries such as concussions were excluded based on specific psychopathology that can affect neurocognitive function. Additionally, only traumatic injuries (the injury had a sudden onset in association with trauma) and gradual onset injuries (overuse) were included, but injuries such as spinal fractures resulting in paralysis were excluded.

**Table 2:** Eligibility Data

Inclusion	Exclusion
-Unrestricted Date	Non-MSK Pathology
-Unrestricted Research Design	Non-English Language
-No age, sex, or performance level restriction	Only published as research notes/conference literature
-Contains an MSK sports injury	
-Contains a perceptible psychosocial risk factor	

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-Sport Injury: Any sport injury that results in an athlete missing at least one training session or competition

Psychosocial Factors: Pertaining to the influence of social factors on an individual's mind or behaviour, and to the interrelation of behaviour and social factors.

-Competitive Athletes or practitioners working with competitive athletes.

Competitive athlete defined as: Competes in sport at least once per week and/or trains at least once per week in competition preparation

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Search terms and eligibility/inclusion criteria were planned using the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research Type) approach (Methley et al., 2014; see table 3 for details). This was because the SPIDER tool demonstrates greater sensitivity and greater specificity for every included database, in comparison with PICO (Participant, Intervention, Comparator, Outcome) and PICOS (Participant, Intervention, Comparator, Outcome, Study Type) (Methley et al., 2014).

**Table 3:** Spider Tool Application

<b>Sample</b>	Competitive athletes meeting our definition of competitive, no restriction on age, sex, or level of competition.
<b>Phenomenon of Interest</b>	The relationships between psychosocial characteristics and sport injury risk.
<b>Design</b>	Published literature of any kind.
<b>Evaluation</b>	A psychosocial effect of A) Positive B) Adverse C) Null on injury risk.
<b>Research Type</b>	No restriction on research type.

## **Data Extraction**

Data was extracted as followed: participant demographics; study design; psychosocial risk factors/characteristics and their A) positive, B) adverse or C) null, relationship with sport injuries.

## **Methodological quality assessment**

The methodological quality of include studies was assessed by using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018), and independently appraised by three authors (RB, AG and GJ). Study appraisals were then combined, and any discrepancies discussed to reach a consensus. The final MMAT table (see appendix D) is the consensus output from the MMAT appraisals. The MMAT is composed of five key criteria: qualitative (all), randomised control (quantitative), non-randomised control (quantitative), observational (descriptive) and mixed methods. The revised 2018 version of the MMAT demonstrates strong internal validity and is used to provide an informative description of the overall methodological quality. It can indicate potential sources of bias (e.g., non-response bias) and demonstrates high inter-reliability rating (0.72-0.94).

## **Data Synthesis**

The aim of the study is to assess the relationships between psychosocial risk factors, and an athlete's injury risk within competitive sport. Once relevant studies were identified, a process of indwelling was completed where each included study was thoroughly read and familiarised with. Following this, studies were placed into tables (1) demographic characteristics, (2) study summary and (3) study quality appraisal, for reviewing. Finally, the MMAT was used to synthesise data from varied findings and to assess the methodological quality of included studies. Owing to the heterogeneity of studies, we did not complete a meta-analysis. We used a qualitative synthesis, specifically following a deductive analysis approach to align with previous models, to create themes demonstrating injury risk factors in competitive athletes.

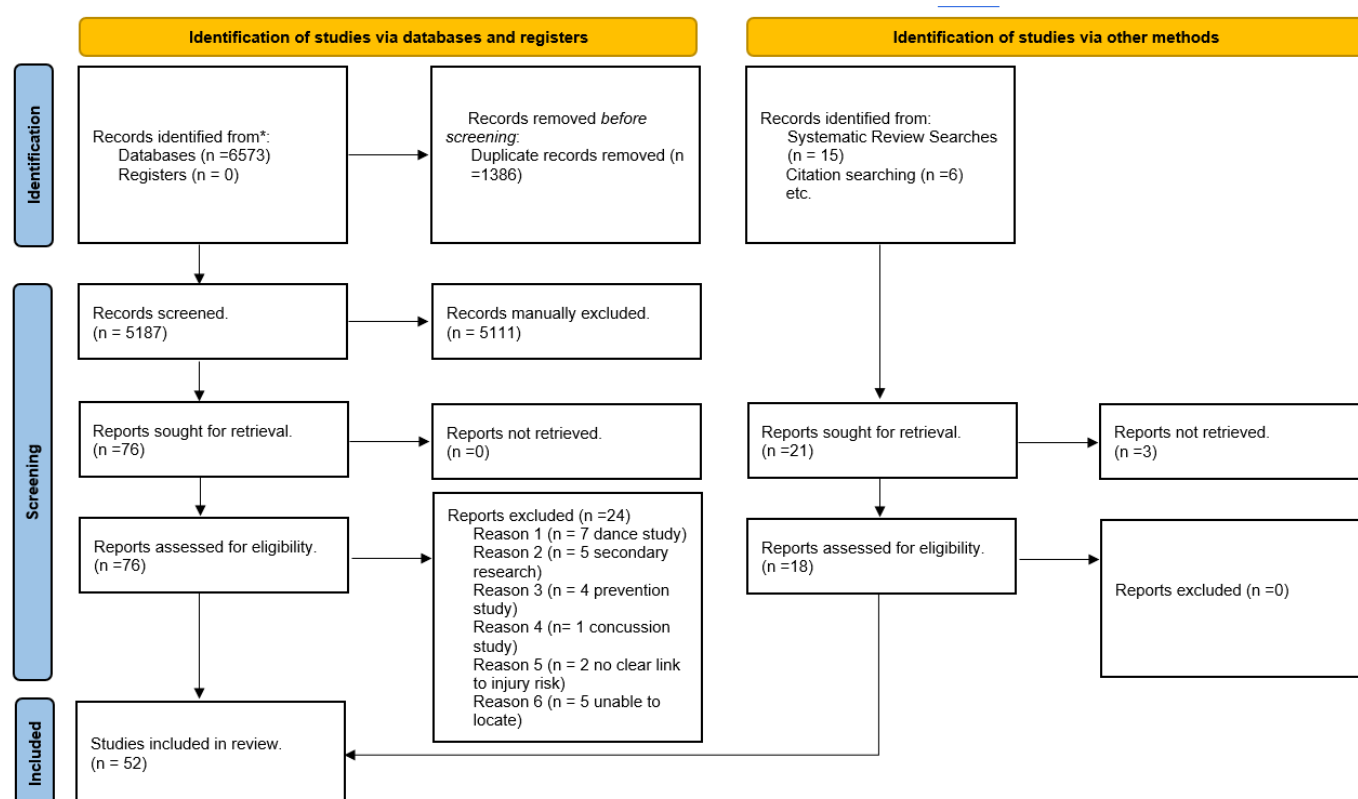
## **Establishing Rigour**

To ensure rigour was established the research team consisted of lead researcher (RB), MRes director of studies (AG), and MRes supervisor (GJ). To minimise bias or human error, discussions took place regarding search strategy, records screening, and final included studies, and in the event of any disagreements, we used critical discussion to reach consensus and/or a majority vote (cf. Forsdyke et al., 2016).

## Chapter 3: Results

An electronic database search generated 6573 records, 1386 of these were immediately removed as duplicated. An additional 6 were identified through forward and backward citation searching, and a further 15 through bibliography searching of relevant systematic reviews. Title and abstracts of 5187 records were screened with 5111 excluded at this stage. This subsequently left 76 articles for full text screening, in which 24 were excluded leaving 52 studies for inclusion (see Figure 4).

Figure 4: PRISMA flow diagram (Page et al, 2020)



## Demographic Characteristics

The 52 studies included 10,994 athletes, 13 coaches and 5 physiotherapists. Of the 52 studies, 51 reported sex, results showed that of the 10,994 athletes, 4912 (44.7%) were male and 5833 (53.1%) were female with the remaining 249 (2.2%) not reported. Coaches were male n=11;84.62% and female n=2;15.38% and physiotherapists male N=5;100%. 48 studies included age and included participants mean age was 21.2 years old.

Athletes included played a range of both individual and team sports and level of competition varied ranging from professional to regularly, and from international to regional. Reported sports football (soccer) 36.5%, running 19.2%, basketball 13.5%, gymnastics



11.5% tennis 9.6%, rugby and American football 7.7%, volleyball and wrestling 5.8%, hockey, swimming and handball, 3.8% and baseball, floorball and ice hockey 1.9%.

### **Study Characteristics**

Included papers in this review were 44 descriptive quantitative studies, six qualitative studies, one randomised and one mixed methods study. There was a range of definitions for sports injuries included, for example 18 of the studies used a time-loss definition which ranged from one to three days of no or restricted activity. 17 studies (32.7%) did not explicitly state a working definition of sports injury; however, it was still possible to consider them against the established definition of a sports injury. 43 (82.7%) of studies were focused on traumatic acute sports injuries, with the remaining nine (17.3%) focusing on overuse injuries.

### **Assessment Risk of Bias**

The methodological quality of included studies was assessed using the MMAT, and independently appraised by the research team. Whilst it is suggested that an overall quality score might not be appropriate using the MMAT (Hong et al., 2018), we used an overall quality score to give an easily interpretable value (cf. Gledhill et al., 2017; Gledhill et al., 2018).

Of the 52 included studies, 44 studies were assessed against the MMAT for quantitative (descriptive) criteria, one randomised control, one mixed-methods and six qualitative. The methodological quality of included studies varies from 60% and 100%, with a mean score of 93.1%. Studies measured against mixed methods and qualitative criteria had a mean score of 100%, descriptive quantitative studies mean score was 92.3% which leaves the lowest score randomised control at 80%. The MMAT does not specify specific thresholds in regards to studies, however in comparison with other studies of a similar nature this appears to be a low risk of bias (e.g. Forsdyke et al., 2016) (Appendix D for full risk of bias table).

### **Study Results**

Study objective A) the positive, negative, or null influence of psychosocial characteristics on sport injury risk factors in competitive athletes.

#### **Psychosocial risk factors**

From the 52 included studies that investigated psychosocial risk factors influencing sport injury in competitive athletes, we constructed three core themes within the literature through the qualitative synthesis: 1) Injury related cognitions, 2) Injury related emotions and

3) Injury related behaviours (table 4 for thematic analysis of included studies), (table 5 for included studies and their underpinning models).

<b>Table 4:</b> Thematic analysis of psychosocial risk factors studies (N=52)			
<b>Core Theme</b>	<b>Sub-Themes</b>	<b>Studies (study no:)</b>	<b>Mean MMAT Appraisal rating %</b>
Injury relation cognitions	Athletic identity, Perfectionism, BPN, Self Esteem, Internal Locus of Control, Courage, Education, Self-Determined Motivation	3,6,9,19,20,21,25,26,27,28,30,35, 37,40,46,48,49	89.4%
Injury related emotions	Anxiety, Tension, Toughmindedness, Stress, Daily Hassles	1,2,4,5,8,11,12,13,14,15,16,17, 20,22,23,24,28,33,34,38,43,44, 45,46,51	92%
Injury related behaviours	Social Support behaviours, Coping, Autonomy Support, Overactivity, Competitiveness, Previous Injury, Coach-Athlete Relationships	5,7,9,10,15,16,18,22,28,29,31,32, 36,39,41,42,45,46,47,48,50,52	96.4%
BPN-Basic Psychological Needs, MMAT-Mixed Methods Appraisal Tool			

### **Injury Related Cognitions**

Seventeen studies considered and discussed mental processes and topics regarding the self, sub themes are athletic identity, perfectionism, basic psychological needs satisfaction, education, self-esteem, internal locus of control, self-determined motivation, and courage.

Two studies discussed perfectionistic traits and an athlete's injury risk. These studies discussed relationships between perfectionism and injury, specifically how perfectionist

strivings such as 'I feel extremely stressed if everything does not go perfectly' and 'people will think less of me if things do not go as planned' can influence the risk of an athlete getting injured over time. Madigan et al., (2018) results showed that perfectionistic concerns show a significant positive correlation with injury in competitive athletes. More recently to this, Martin et al., (2021) also measured perfectionistic concerns and strivings and their effect on sports overuse injury risk. Inter-correlations between negative life stress, perfectionistic concerns, perfectionistic strivings, coach-athlete relationships, and athletic identity were identified and used to categorise participants into one of three profiles. Athletes who were placed into profile one showed a moderate coach-athlete relationship, average levels of athletic identity, perfectionistic strivings and concerns, and negative life stress variables were low, but this group trained less typically and competed on par with their counterparts. Profile two had an average level of perfectionistic strivings, however it was accompanied by poor coach-athlete relationships, high athletic identity, negative life stress and perfectionistic concerns. This group trained as much as the other profiles but had the lower competition exposure. The final profile, profile three was characterised with high levels of athletic identity and perfectionistic concerns, but on the other side these athletes have a better relationship with coaches and moderate levels of negative life stress. Perfectionistic strivings in this profile were the highest of the three, and this group were also the highest on training and competition exposure. In regards to the above criteria and overuse injuries, results found that athletes in profile two were significantly more effected by overuse injuries than profile one and three, and there was no significant difference between injury frequency in profile one and three.

Konter et al, (2022) assessed the link between sports courage and key performance variables such as injury past and level of participation through the use of the sport courage scale (Konter & Ng, 2012). Despite courage being a necessity for performance, it is possible that it can be accompanied by an increase to injury risk due to the presence of sacrifice behaviour, venturesome and determination. Results of this study concluded that female football (soccer) players who have previous injury history scored significantly higher on the venturesome scale which is associated with an increased injury risk of sustaining injuries lasting longer than one week.

Another injury related cognition identified in the included studies relates to basic psychological needs satisfaction and their relationship with sports injury amongst university athletes. Li et al., (2019) study was guided by Basic Psychological Needs Theory and additionally linked this to the model of stress and athletic injury, this study examined the relationships between basic needs satisfaction or frustration, perceived stress, and sports injuries. This paper is particularly relevant as it was the first of its kind to investigate the

outcome of basic psychological needs satisfaction/frustration via the lens of BPNT in relation to sport injuries (Ryan & Deci, 2000). Li and colleagues study found that basic psychological needs not being satisfied is a significant predictor of stress, Li et al, (2019) concluded that the manifestation of sports injury could be more relevant and related to the presence of basic psychological needs satisfaction than the presence of basic psychological needs frustration.

Multiple Cox regression analysis by Von Rosen et al, (2017) it was suggested that an increase by one score of competency-based self-esteem increased the injury-risk hazard by 1.02. Based on this, an athlete having all significant risk factors discussed in this paper (nutrition index, competence-based self-esteem, sleep weekdays, increased training load and decreased sleep volume)  $P < .05$ , with an average competence-based self-esteem score, they were three times more likely to become injured than those with a low competence-based self-esteem score. Kolt and Kirby, (1996) completed a multiple regression analysis in female gymnasts and added that an athletes' scores on the internal locus of control scale significantly predicted injury within the elite population (increased locus of control lead to increased risk of injury). The final injury-related cognition within this review relates to self-determined motivation. Chalabev et al, (2016) discussed this and its relationship with sports injuries. This paper measured self-determination for marathon runners via four intrinsic motivation measures and four extrinsic motivation measures. Results found that the self-determined indexes negatively predicted perceived susceptibility to injury, in other words, the more self-determined runners were towards marathon running, the less they perceived themselves as likely to adopt risky behaviours.

### **Injury Related Emotions**

Twenty-five studies within this review involved emotion related information. Specifically, anxiety, stress, toughmindedness, daily hassles, and tension were sub-themes that emerged.

Li et al, (2019) paper discussed above also linked stress as a risk factor, specifically, this paper found that stress can partially account for the relationship between the aforementioned BPNS and sports injury. In simpler terms, a direct path from BPNS to sport injury is significant after accounting for the role of stress.

Throughout this review stress and sport injuries are a common theme, which could involve getting upset unexpectedly Li et al, (2019), getting angry because of things out of your control and feeling nervous (Cohen et al., 1983). It is suggested that stress can significantly predict both acute and overuse injuries (Smith et al, 1997; Dunn et al, 2001; Johnson et al, 2005; Ivarsson & Johnson, 2010; Johnson and Ivarsson, 2011; Ivarsson, Johnson and Podlog, 2013; Laux et al, 2015; Clement et al, 2017; Pensgaard et al, 2018;

Lathlean et al, 2020; Martin et al, 2021; Sonesson et al, 2023) all link to emotional responses to stress, which can involve irritation, anger and disengagement, which according to Kebede & Rao, (2013) increases the risk of sport injuries in competitive athletes. Whilst Wiechman et al, (2000) results found that no injury variance was accounted for by life stress or coping skills that accompany this.

Dunn et al, (2001) assessed general life stress, sport specific stressors and sport injuries in high school athletes from three different sports (basketball, wrestling and gymnasts). Results found that sport-specific stressors predicted injury above which was accounted for by general life stress within female athletes, but this finding was not consistent with males, as total stress accounted for nearly twice as much injury variance for females in comparison with males, and sport-specific stressors accounted for a significant amount of injury variance only for female athletes. These findings suggest that the relation between life stress and injuries is stronger in female athletes than it is in male athletes suggesting sex differences in the stress-injury relationship. As per Dunn and colleagues could be due to females reacting to both forms of stress differently to males, this paper suggests that female athletes experience a higher emotional reaction to stress than male athletes.

Stress and sport-injury risk in football (soccer) players are commonly linked and studied, for example within this review (Ivarsson & Johnson, 2010; Johnson and Ivarsson, 2011; Ivarsson, Johnson & Podlog, 2013; Laux et al, 2015) all studied the links and significance of stress within sport injury risk with connections made with the Williams and Andersen, (1998) stress injury model. Firstly, one of Ivarsson and Johnson, (2010) key study aims was to assess the relationship between stress and injury risk in male soccer players. This paper found that injured players had a higher susceptibility to experiencing stress in comparison with non-injured players, meaning that players with higher stress susceptibility may have experienced higher levels of stress in potential stressful situations.

Another commonly reported injury related emotion relates to anxiety in a variety of forms. For example, Ivarsson & Johnson, (2010) study found that senior soccer players who picked up an injury had significantly higher levels of somatic trait anxiety and psychic trait anxiety in comparison with the athletes who did not pick up any injuries, one year later Johnson & Ivarsson, (2011) conducted a study to construct an empirical model for risk factors to sports injury within junior soccer players, and this study also predicted that somatic trait anxiety is a significant predictor of sports injury. These two studies combined suggest that anxiety is an injury risk factor at all ages within soccer players.

## **Injury Related Behaviours**

Twenty-two studies contributed to this core theme relating to the effect of social support, coping and autonomy support on sport injury risk. Five studies, (Ivarsson and Johnson, 2010; Johnson and Ivarsson, 2011; Ivarsson, Johnson & Podlog, 2013; Tranaeus et al, 2014; Tranaeus et al, 2022) investigated the effects of effective coping skills on sports injury risk. For example, Tranaeus and colleagues found that the coping skill positive reframing to be a main predictor of sporting injury, suggesting that athletes with the lower levels of this skill were at an increased risk of suffering a traumatic injury in comparison with those with higher levels of it. On the other hand, Johnson and Ivarsson, (2011) found no differences in regards to seeking coping resources between injured and non-injured athletes. Additionally, Ivarsson, Johnson & Podlog, (2013) noted no significant relationship between maladaptive coping, and daily hassles, sports injury occurrence or frequency.

Parker, Johnson & Ivarsson, (2021) study aim was to investigate the interaction between perceived autonomy support, self-determined motivation, planned behaviour and how these factors relate to golfers self-reported intention injury prevention behaviour. Results of this study found positive links between perceived autonomy support, effort of injury preventative behaviour and frequency of injury preventative behaviour. In regards to coach-athlete relationships, Parker and colleagues suggest that golfers who have a good relationship with their coaches and perceive greater autonomy support from them, will be more likely to engage in injury preventative behaviours more often than those who do not perceive autonomy support from coaches. Coaches who create an environment where athletes can discuss different types of stressors and any other sports related complaints can reduce injury risk, which suggests that building positive coach-athlete relationships is important when looking to mitigate sports injury risk within competitive athletes.

Another commonly reported injury-related coping behaviour links to social support, specifically, seeking or placing a high level of importance on social support is deemed to be a key factor in injury risk. Included studies within this review found that social support was shown to negatively influence injury risk (Smith et al, 1997; Codonhato et al, 2018). In addition, studies (Bolling et al, 2019; Martin et al, 2021) concluded that athletes who didn't demonstrate positive relationships or receive positive support within their sporting environment, for example if they hadn't built a positive relationship with their coaches, or had poor communication with coaches and physios, they were at an elevated risk of sport injuries. A noteworthy point by Codonhato et al., (2018) is that attributing a high level of importance to social support is typically a female characteristic, as females consider social support to be of greater importance in times of adversity, than their male counterparts.

<b>Table 5: Included Studies and underpinning models</b>	
<b>Studies (Reference no)</b>	<b>Underlining model</b>
1, 2, 3, 6, 7, 8, 9, 10, 13, 14, 18, 21, 23, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 39, 41, 42, 44, 45, 47, 49, 52	No discernible underlining psychosocial model discussed.
4, 5	Anderson & Williams, (1988) The Model of Stress and Athletic Injury.
11, 12, 15, 16, 17, 19, 20, 33, 34, 37, 38, 40, 43, 48, 51	Williams & Anderson, (1998) The Model of Stress and Athletic Injury (revised).
15, 16	Johnson & Ivarsson, (2011) Empirical Model of Injury Risk Factors
22	Tranaeus et al, (2014) A Working Model of Psychological Risk Factors for Overuse Injuries.
24	Timpka et al, (2015) Integrated Model of Overuse Injuries
38, 46	Appaneal & Perna, (2014) Biopsychosocial Model of Stress Athletic Injury and Health.
50	Konter, (2013) Model of Multidimensional Courage

## **Chapter 4: Discussion**

The aims of this systematic review were to determine the positive, negative, or null influence of psychosocial characteristics on sport injury risk factors in competitive athletes. These aims are underpinned by the research questions: 1. Which psychosocial factors are associated with sports injury risk in competitive athletes? 2. What are the mechanisms behind how these risk factors can cause injury in competitive sports? 3. What is the methodological quality of available evidence? These questions are also broken down into the 'SPIDER' research methods tool, specifically: sample, competitive athletes; phenomenon of interest, the relationship between psychosocial characteristics and sport injury risk; design, published literature of any kind; evaluation, a psychosocial effect of A) positive B) negative or C) null on injury risk; and research type, no limit. The purpose of this research is to develop a greater understanding of injury risk factors, the underpinning mechanisms on injury risk and competitive athletes' experiences of injury risk factors within the competitive sport environment in order to reduce risk factors and help stakeholders shape sporting environments to provide the best support possible for competitive athletes.

This review consists of 52 studies relating to psychosocial factors influencing sport injury risk (Appendix 3 for included study summaries). This section will discuss major findings of the current study and compare it with current literature, and finally consider applied implications of the review, its strengths and weaknesses and future research directions.

### **Psychosocial Risk Factors**

Findings from this review suggest that psychosocial risk factors influencing sport injury risk relates to one of three themes (injury-related cognitions, injury-related emotions, and injury-related behaviours) and these three themes are made up from a variety of specific risk factors. Research has also shown that the core themes can be interconnected, meaning for example that emotions can impact cognitions, and cognitions can impact behaviours and/or the vice versa.

### **Cognitions**

Evidence from this review suggests a link between injury related cognitions such as athletic identity (Martin et al. 2021; Johansson et al, 2022), perfectionism (Madigan et al 2018; Martin et al, 2021), basic psychological needs satisfaction as per Li et al, (2019), sports courage by Konter et al, (2022) and sports injury risk. Athletic identity refers to the



degree to which someone considers themselves to be an athlete, and when initially coined by Brewer et al, (1993) it was suggested that it could have positive or negative implications on athletes indicating that it could be an important factor to consider when aiming to reduce sports injury risk. Specifically, Stambulova et al., (2015) suggested that positive implications of athletic identity can include increased motivation, additionally better athletic achievement, and higher commitment (Horton and Mack, 2000). On the other hand, negative implications of athletic identity can include psychological distress following injury, likelihood to continue to train despite injury risking aggravation, and ignoring physical symptoms in order to protect athletic identity (Tranaeus et al., 2014). Included studies linked athletic identity to overuse injuries as high athletic identity increases the likelihood an athlete will play through pain; however, this estimate is not certain due to a wide confidence interval. Additionally, and paradoxically, athletes with high athletic identity could play through pain, and yet contract fewer overuse injuries. This is due to potential protective factors associated with athletic identity. Furthermore, Johansson et al, (2022) suggests that athletic identity can differ between levels of competitions which could be due to higher professionalism at a higher level, suggesting that an athletic identity sub-set study could be beneficial to identifying and reducing injury risk. A proposed explanation of this is that a strong athletic identity may influence an athlete to more thoroughly adhere to a 'culture of risk' which normalises pain and injury and glorifies athletes taking risks for the sport at the detriment of their body (e.g., Cavallerio et al., 2016). This theme also links to another sports-related cognition identified in this review. Konter et al., (2022) discussed the relationships between sports courage and performance variables in female soccer players. Sports courage was defined as 'a natural and developed, interactional and perceptual concept between person and situation, and the task at hand that enables a person to move in Mastery (self-confidence), Venturesome (coping with fear), Determination, Sacrifice Behaviour and Assertiveness on a voluntary basis in potentially dangerous or difficult circumstance.

Courage, like athletic identity differs between subsets, specifically ages, level of participation and injury history. Overall, although courage is important for performance, practitioners would find it beneficial to assess it in female soccer players if the aim is to assess sports injury risk. Within elements of courage, sacrifice behaviours have potential to inform an intervention by improving athlete courageous to reduce injury risk in this population. Konter et al., (2022) study is the first to study performance variables and courage and provides beneficial information for coaches in order to reduce risk of injury in this perspective. As this study was explorative however the findings were framed from correlations and associations rather than inferring causality, and moving forward longitudinal,

prospective tracking of players would increase the validity of these findings, finally larger participants and effect sizes between courage and comparison groups would be beneficial.

Another cognition discussed in this study relates to perfectionism, as per Madigan et al., (2018) perfectionism is a personality disposition that is characterised by a constant aim for flawlessness and involves setting exceedingly high standards of performance, additionally this can involve tendencies for overly critical evaluations of ones' behaviour. Perfectionism however has various aspects, and different dimensions with different characteristics, therefore it is best conceptualised as a multidimensional disposition (Hewitt & Flett., 1991). Research suggests that there is two-high order dimensions within perfectionism that should be differentiated, these are perfectionistic strivings which relates to perfectionist personal standards and a self-orientated striving for perfection, the second dimension is perfectionistic concerns which relates to concern over mistakes, feelings of discrepancy between standards and performance, and negative reactions to imperfection (Stoeber & Otto, 2006). Differentiating the two above dimensions is important because they demonstrate different and quite often, opposite patterns of relationships with psychological outcomes. Perfectionistic strivings are associated with positive processes/outcomes for example adaptive coping and positive affect (or inversely with negative processes/outcomes), whilst perfectionistic concerns are associated with maladaptive coping and negative affect.

Perfectionism as an injury-related cognition can be linked to the Williams and Andersen, (1998) model of stress and injury, this model states that personality factors, such as perfectionism can aggravate the stress response as these individuals may appraise a situation as more stressful than others. Causing an increased physiological activation and attentional disruption which can lead to increased injury risk. An athlete who demonstrates high perfectionistic concerns may be at a further risk of stress and therefore injury as per Flett & Hewitt, (2005), this is due to perfectionism being a vulnerability factor increasing the risk of chronic stress. Madigan et al, (2018) aimed to discuss relationships between perfectionism and injuries in junior athletes, linking and differentiating perfectionistic strivings and concerns, and was the first prospective investigation into all of these criteria. The use of the prospective design done in this study eliminates response bias and Madigan and colleagues also suggest it allows the elucidation of temporal precedence, therefore this study provides further evidence that the role of perfectionism as a personality factor positively predicts sport injury. Looking a bit further into this review, Madigan's paper suggests that only perfectionistic concerns emerge as significant predictors for sports injury predisposition. This supports previous research by Jowett et al, (2016) which also suggests that the concern element of perfectionism can be associated with maladaptive outcomes.

Finally, Madigan et al., (2018) compared athletes from its sample and concluded that those who had a higher level of perfectionistic concerns would demonstrate a higher risk of injury than those who had a lower level of concerns, and if two athletes with the same number of perfectionistic strivings, whomever had the higher level of concerns would again be at the highest risk of injury. Therefore, suggesting that perfectionistic concerns is the most important factor when considering the perfectionism-injury relationship, so stakeholders would benefit from monitoring this in the aim to reduce sport-injury risk from an injury-related cognition perspective.

To summarise, athletic identity can have both a positive and negative influence on injury risk. Positively it can increase motivation and involves higher commitment leading to better athletic achievement. Negatively it can increase likelihood of injury aggravation through not resting correctly, psychological distress following injury and the likelihood of overuse injuries through ignoring physical symptoms of injury. However as discussed above it is important to consider competition levels as at a higher level there is a 'culture of risk', and higher athletic identity can influence this. Sports courage differs between subsets such as competition level and should be assessed when assessing injury risk as it can be used to inform intervention programs. In relation to perfectionism, research suggests perfectionistic concerns are a key consideration in reducing risk of injury.

## **Emotions**

Evidence from this review suggests that there is a link between injury-related emotions such as stress and anxiety (Kerr & Minden, 1988; Lavalee & Flint, 1996; Dunn et al, 2001; Ivarsson & Johnson 2010; Johnson & Ivarsson, 2011; Ivarsson et al, 2014; Laux et al, 2015; Pensgaard et al, 2018; Lathlean et al, 2020), toughmindedness (Valient, 1981) and tension (Lavalee & Flint, 1996), and risk of sport injury within competitiveness sports.

The most widely investigated injury-related emotion is that of psychosocial stress (14 studies in this review), it has been linked to be prominent in both traumatic and overuse injuries within included studies. Despite mixed evidence, included studies in this review indicate there is a strong possibility that psychosocial stress can increase the risk of injury. Beginning with overuse injuries, it is suggested that an athletes' adaptation to extreme training could be impaired by psychosocial stress, exposing them to an increased susceptibility to overuse injuries. This evidence is in agreement with previous research Stults-Kolehmainen., et al (2014); Perna et al., (2003) and also in agreement with both the biopsychosocial model of stress and athletic injury and health Appaneal & Perna, (2014) and a working model of psychological risk factors for overuse injuries (Tranaeus et al, 2014). Specifically, factors relating to emotion, behaviour and physiology should be considered as

mechanisms influencing the relationship between psychosocial stress and injury. Overuse injuries are considered to be due to a response at a cellular level of repetitive overload at the systemic level as per Fischer, (2016), and chronic exposure to these psychosocial stressors may contribute to the systemic overload. Finally, athletes are found to gradually accommodate to overuse injuries due to the initially prominent affective reaction becoming weaker and the attention on it becoming reduced over time.

For traumatic injuries, an explanation for this is that prolonged stress can decrease the communication between the left and right hemispheres of the brain which leads to a decreased information flow and therefore can increase risk of poor decision-making increasing injury risk (Ivarsson et al., 2014). Therefore, similar to overuse injuries the stress response was found to be a significant mediator for the relationship between the psychosocial variables in the model of stress and athletic injury by Williams and Andersen (1998) such as history of stressors and personality and injury rates. Furthermore, Ivarsson and colleagues paper suggests that stress susceptibility can play a big part in identifying injury risk, which is supported by the Williams and Andersen model of stress and injury previously mentioned, it concludes that reducing an individual's susceptibility to stress will tend to decrease risk of injury. A noteworthy point in this regard is Ivarsson and Johnson's study only relates to males, so if compared with Dunn et al, (2001) who stated that female athletes may experience a higher emotional reaction to stress, a study comparing both sex's may be beneficial.

Laux et al, (2015) results also found that there was a significant relationship between recovery-stress variables and injury risk in professional footballers and findings also were in accordance with Williams and Andersen, (1998) model of stress and injury, as per papers mentioned above. Laux and colleagues suggest that the monitoring of recovery-stress scales such as fatigue, disturbed breaks and sleep is important due to injury risk being increased if sufficient rest periods are not met leaving athletes exhausted or over-worked. These deficits have the potential to lead to lack of concentration, or perception from a psychological perspective. Whilst this finding is important, a limitation with stress as an injury-related emotion is that the research is dominated by football (soccer) and football (soccer players) (Ivarsson & Johnson, 2010; Johnson and Ivarsson, 2011; Ivarsson, Johnson & Podlog, 2013; Laux et al, 2015). So therefore, there is a dominance in lower limb related injuries, specifically knee or ankle injuries within this reviews research, Laux et al, (2015) study for example, had 79.5% lower limb injuries.

Ivarsson & Johnson, (2010) results also linked anxiety as an injury related emotion. Results showed that athletes who were injured during this study had significantly higher

levels of somatic trait anxiety and psychic trait anxiety in comparison with their non-injured counterparts, a possible explanation of this offered by Ivarsson and Johnson's paper is that football (soccer) players with high levels of anxiety may appraise situations to be more stressful than those with lower levels of anxiety. Following this increase in stress, as discussed above by the papers of this review and the Andersen and Williams, (1998) model of stress and injury, it can lead to decreased peripheral ability and decision-making, leading to increased injury risk. These points were expanded a year later by Johnson & Ivarsson, (2011) discussed how athletes with a higher level of trait anxiety often reported more narrowing of concentration and attention than other athletes, which could explain why somatic trait anxiety predicts sport injuries. Furthermore, Johnson & Ivarssons 2011 paper conducted a regression analysis regarding personality factors and found that a high level of somatic trait anxiety and a low level of mistrust explained 11% of the total variance from this studies injury occurrence. At the time of this paper, levels of mistrust was something that had not been explored, an explanation of this is athletes without mistrust are not apprehensive of potentially dangerous stimuli and could put themselves into situations beyond their control causing injury risk, this point interestingly enough links to Konter et al, (2022) paper previously discussed relating to sports courage and its injury risk potential, which demonstrates a link between injury-related cognitions, and injury-related emotions.

In summary, stress is the most widely researched injury related emotion and links to both traumatic and overuse injuries. Emotional, behavioural and physiological factors should be considered as influences between psychosocial stress and overuse injuries. Additionally, the stress response and stress susceptibility both play a part in traumatic injury likelihood. The stress-injury relationship however is not fully explored, as research is dominated by lower limb injuries, and there is currently no comparison between male and females. Anxiety is also a prevalent topic when discussing emotions, injured athletes were shown to have higher somatic trait and psychic trait anxiety than their counterparts who did not get injured which could be due to narrowing of concentration or an increase of stress, which then links back to the previously mentioned stress injury model (Williams & Andersen, 1998).

## **Behaviours**

Evidence suggests that injury-related behaviours, or the absence of have the potential to influence injury risk. In this study, three main behaviours were identified, namely, social support (Smith et al, 1997; Van Wilgen & Verhagen, 2012; Codonhato et al, 2018), Coping (Wiechman et al, 2000; Ivarsson & Johnson 2010; Johnson & Ivarsson, 2011; Iperen et al, 2022; Tranaeus et al, 2022) and Autonomy support (Parker, Johnson & Ivarsson, 2021).

Social support is defined as behaviours perceived by the recipient to enhance well-being Rosenfield, (1980) which is added to by Sarason et al, (1990) with love and the knowledge of receiving help when problems arise. Providing social support is not limited to family and friends and often comes from the competitive environment, such as coaches, teammates, physiotherapists, and psychologists. Smith and colleagues study aim was to determine the incidence of sport injuries in high school ice hockey players whilst discussing the effect of physical, situational, and psychosocial risk factors in relation to it. Specifically for this section of the review, coping resources such as social support did not influence season injuries directly as the five athletes within this study with high stress and low social support were not at a higher risk of injury. At the time of publication (1997) this finding matches with the earlier version of the stress and injury model by Andersen and Williams, (1988) which argued that only history of stressors directly impacted the stress response, and coping variables had an indirect effect the stress response through history of stressors. Interestingly, one year following Smith and colleagues' paper, the stress injury model released an updated version by Williams and Andersen, (1998) which argued that history of stressors could influence the development of an athlete's coping mechanisms, and this led to bidirectional arrows being added to the three psychological categories (Gledhill & Forsdyke, 2021). Additionally, as previously discussed Ivarsson et al, (2017) point on stress influencing the brains neural networks effecting the decision-making process. There was a significant indirect effect found between the stress-response and coping strategies such as social support, an explanation of this is that adequate coping strategies will facilitate a person's decision-making and making quick and adequate decisions has been shown to be related to decreased injury risk.

On the topic of coping strategies, Van Wilgen & Verhagen, (2012) found that from a psychological perspective, social factors are important. For example, an athlete under high physical demands will be more likely to suffer an overuse injury if they feel themselves to be in a stressful situation, and in agreement with the more recent model of stress and injury, this paper suggests that it would be beneficial of coaches to focus their coaching behaviours on to the monitoring and supporting of psychosocial factors in order to reduce injury risk. Codonhato et al, (2018) discussed the relationship between resilience, stress, and injury in elite sports, in this context resilience refers to an athlete's ability to evaluate and deal with adversities. In relation to the psychological factors that may underpin the resilience process, it was concluded that social support was the most prevalent/important variable for these athletes to be able to deal with adversities that they may face, this is important in reducing injury, and in this context re-injury risk to remain in the elite context. A noteworthy point here is the importance of social support was attributed more to female athletes as a finding here

suggested that perception of social support at times of hardship was of more importance in regards to resilience in female athletes. Again, this links to the injury-related emotion paper by Dunn et al, (2001) who's finding suggested a difference in emotional reactions to stress between sexes.

Self-determination theory Ryan & Deci, (2010) suggests that when positive feedback is given within an autonomy-supportive environment it can promote and enhance intrinsic motivation. Parker, Johnson and Ivarsson, (2021) examined the interaction between injury preventative behaviours, perceived autonomy support and motivation. Results from a network analysis found that perceived autonomy support is positively associated with effort and frequency of injury preventative behaviours. Golfers who perceive greater autonomy support from their coaches show a higher likelihood of undertaking injury preventative behaviours, the fulfilment of basic psychological needs through perceived autonomy support is antecedent to autonomous regulation and subsequently more determined injury preventative behaviours.

Wiechman et al, (2000) assessed psychological coping skills in association with behaviourally defined athletic injuries in high school varsity-sport athletes. This paper stated a particular interest between the interaction of coping skills and life stress as this interaction could inform as a behavioural process to act as a protective factor against stress related sports injuries. Adding to this, Ivarsson and Johnson, (2010) discussed the coping skills behavioural disengagement and self-blame. Behavioural disengagement has potential to be effective when an athlete starts to deal with stressors, however over time this behaviour may become ineffective as it can interfere with more useful coping strategies, which could add to injury/reinjury risk (Carver, Scheier and Weintrub, 1989). Self-blame is categorised an ineffective coping strategy as it can decrease self-esteem and Smith et al, (1993) found that a low level of self-esteem can increase injury risk. Johnson and Ivarsson, (2011) found ineffective coping to be a significant predictor of sports injuries. This study created an empirical model of injury risk factors (figure 5) which fully supports the Williams and Andersen, (1998) model, and suggests that both life stress and coping skills/resources are important when looking to reduce injury risk.

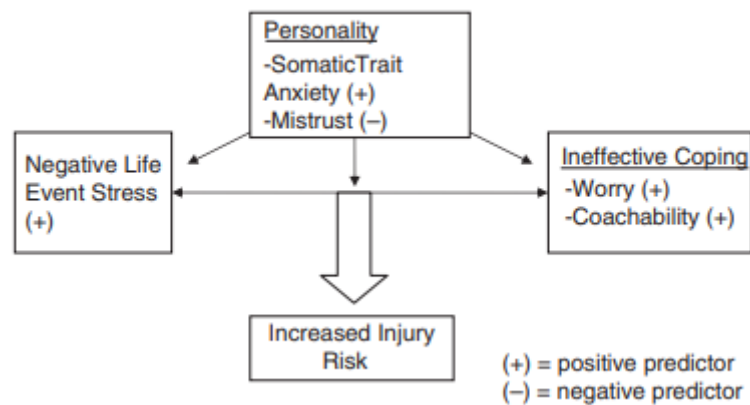


Figure 5: Empirical model of injury risk factors (Johnson & Ivarsson, 2011)

Tranaeus et al., (2022) concluded that the most significant predictor of traumatic injuries was the coping strategy 'positive reframing', and the main finding of this was that the combination high levels of positive reframing with high levels of physical performance decreased risk of injury. Specifically, the combination of psychological strategies with physiological skills to handle different forms of stressors such as psychological or physiological. This is consistent with the Williams and Andersen stress injury model and empirical model of injury risk factors.

In summary, initial research suggested that coping resources such as social support did not influence sport injuries throughout a season (Smith et al, 1997). Following this in 1998 the updated version of the stress-injury model by Williams & Andersen, (1998) suggested that the influence of stress can impact mechanisms which means social support can impact injury risk, which lead to bidirectional arrows being added to the model. It is also suggested that social support can be key in reducing overuse injury risk, as athletes under high physical pressure who feel to be in a stressful situation are more likely to suffer an overuse injury. A final point on social support is evidence above suggests that it can develop resilience and therefore reduce risk of injury, but this is deemed to be more important for female athletes. Autonomy supportive environments are positively associated with both effort and frequency of injury preventative behaviours in relation to the basic psychological need's theory. Therefore, both social and autonomy support should be something that coaches focus on in order to reduce injury risk in respective sporting environments. Coping skills can be used to reduce life stress and impact stress-related sports injuries, however skills such as behavioural disengagement can be effective initially, but longer term can interfere with more useful coping skills. Self-blame on the other hand can reduce self-esteem and increase injury risk. Finally, recent research suggests that positive reframing is an effective coping



strategy, and high levels of this alongside high levels of physical performance can reduce injury risk.

After considering the evidence above, the next section of this discussion will highlight key applied implications arising from this systematic review.

### **Applied Implications**

Findings from this review can provide some applied implications for practitioners to best support their athletes to best reduce injury risk. For example, providing a positive and supportive environment could provide a healthy coping resource for athletes who are experiencing stress, which findings have suggested will lead to stress reduction and therefore, injury-risk reduction. Additionally, creating an environment that encourages and supports autonomy has shown to be positively associated with effort and frequency of injury preventative behaviours. For example, Podlog, Dimmock and Miller., (2011) state that it is important to foster feelings of personal autonomy, this can be done by providing athletes with a full and meaningful rationale of their program and specific exercises, acknowledging athletes' feelings on this, and providing alternatives if requested. This is suggested to reinforce the feelings of autonomy during the recovery process. Podlog, Dimmock and Miller., (2011) add that the greater the extent to which an athlete feels the recovery process is meeting personal aims/objectives the more likely they are to adhere to the training program, which in turn reduces likelihood of reinjury concerns. Overall, this supports that, adopting an autonomous, communication centred environment within competitive sports will provide athlete's the best chance of remaining injury free.

As the most widely cited factors associated with injury relate to psychosocial stress, sports organisations would benefit from facilitating and encouraging access to support with this aspect of athletic life. Including stress management interventions within standard injury prevention programmes, an example of this was conducted by Olmedilla-Zafra et al, (2017) who conducted stress inoculation therapy (SIT) on youth football (soccer) players. This therapy is based on the premise that athletes who have unconscious bad coping habits, might make stressful situations, such as sports injuries in this context, worse. It is aimed at promoting skills that that would allow an athlete to cope with stress by showing the link between thoughts/emotions and how cognitive appraisals shape emotions which influence behaviour. In order to improve stress-management skills, techniques such as imagery and progressive muscle relaxation are taught. Results therefore found that a program that consists of the above-mentioned techniques, was able to reduce frequency of injuries in youth athletes, therefore interventions aimed at increasing stress management skills, particularly reducing muscle tension and/or attentional distractibility provoked by stressful

situations/conditions, would make athletes less vulnerable to sports injury risk. Yet, despite this, there is a reluctance on the part of athletes and sports organisations to engage with this type of athlete support as a commonplace activity; hence, understanding some of the barriers to engaging with this type of athlete support may also be warranted.

A key applied challenge for practitioners that is born of the findings of this systematic review is how to balance the 'win-at-all-costs' and often hyper-masculine culture with reducing the risk of injury with athletes. The pragmatic elements of competitive sport are that winning is considered essential and can sometimes come at a cost for athletes, a cost that can increase injury risk yet as practitioners there is a responsibility to also protect the health of competitive athletes.

## **Chapter 5: Strengths and Limitations**

### **Existing Research Strengths**

Unlike other systematic reviews of a similar nature, this review was not dominated by male athletes with 53.1% of the included participants being female, with 43 of included studies using female competitive athletes in comparison with 38 including males. This is important, with the success of England women's national team in recent years (Euro 2022 winners; World cup finalists 2023) female football has seen an increase of 15% in youth teams registered with the FA since the lionesses 2022 success. This increase in participation however comes with an increase in injuries as female athletes are 3-6 times more likely to suffer an ACL injury than their male counterparts (BOA, 2023). Suggesting injury prevention to be a priority.

Through the core themes of behaviours, emotions and cognitions results have focused on interpersonal and intrapersonal factors provides less emphasis and therefore information on environmental and sociocultural considerations of injury risk.

The overall body of research shows a low risk of bias (92.6%) demonstrated through the mixed methods appraisal tool (Appendix D for full details).

### **Existing Research Limitations**

There was a dominance of traumatic injuries within his review, with 82.7% of included studies discussing traumatic/sudden onset sports injuries leaving only 9 (17.3%) discussing the risk factors and underlying mechanisms linked to overuse injuries. There is also a bias within included sports as football (soccer) is heavily the most researched sport with 38.5% of studies discussing this sport, with running (17.3%) also a commonly reported sport. This systematic review also only includes competitive athlete's results are not transferable to recreational or none-athletes as research suggests these types of athletes respond differently to injuries (Colvin et al, 2009). Research regarding sport injury risk factors in literature is heavily dominated by what this review has coined injury-related emotions, specifically regarding stress-based literature that is underpinned by the Williams and Andersen (1998) model of stress and athletic identity.

A final limitation of the existing research relates to depth and clarity of samples in papers. Many studies had small sample sizes, and the definition of 'sports injury' varied between studies and/or wasn't always specified. Minimum time loss differed between studies and varied between 24 hours Smith et al, (1997), the next training session Steffen,

Pensgaard & Bahr, (2008), three plus days Ivarsson et al, (2013) or simply one that required surgery Kosaka et al, (2016), making comparisons difficult.

### **Future research directions from the existing literature**

Future research should look to include multi-wave, prospective longitudinal research to assess psychosocial risk factors for sports injury. A more regular and comprehensive assessment of psychosocial risk factors would allow for the development of interventions to reduce the overall risk of injury. Moreover, exploration of the interaction of intrapersonal and environmental factors, and the interaction between psychosocial, behavioural, and physiological variables would further extend our understanding of injury risk. For example, do athletes who perceive their sporting environments to be sub-optimal or psychologically unsafe experience greater psychosocial stress, experience differentiated hormone secretion or neurocognitive changes, and increased injury risk as a result?

### **Strengths and limitations of this systematic review**

The first strength of this systematic review is that it is the first of its kind to systematically review psychosocial risk factors for sports injuries, without being limited to a single theoretical underpinning, restricted by research design, or restricted by injury type. As such, this is the largest systematic review of its kind to date, and it provides a comprehensive coverage of psychosocial factors for sports injuries that sports stakeholders can use to inform injury risk reduction strategies. With 52 included studies, this review has a considerably larger study inclusion than other recent reviews of sport injury risk e.g., Tranaeus et al. (2022, n = 14). Additionally, it has more studies than the previous largest review of sport injury prediction and prevention Ivarsson et al., (2017, n = 48). Furthermore, unlike Ivarsson and colleagues, this systematic review is limited to prediction papers only and provides a more current and comprehensive picture of psychosocial risk factors influencing sports injury.

The second strength of this review comes through the methodological rigor. By independently selecting and appraising studies and engaging in critical debate within the author team surrounding these factors, this systematic review demonstrates best practice for these methodological aspects (Pace, 2021).

A further strength of this review is the heterogeneity of included studies. Whilst some may argue that this would be a limitation of a systematic review (e.g., Tranaeus et al., 2022), it is an arguable strength of a systematic review. This is because the heterogeneity facilitates a type of synthesis of findings from a breadth of schools of thought and provides

comprehensive understanding that can better reflect the dynamic, changeable, and less-controlled nature of competitive sport (Gledhill & Forsdyke, 2021). Heterogeneity also embraces the nuanced understanding that can be gleaned from acknowledging multiple philosophical standpoints (Gledhill et al., 2017).

## **Chapter 6: Conclusion**

The findings of this systematic review suggest that psychosocial factors are likely to influence sports injury risk in competitive athletes on both a traumatic and overuse basis. Through this systematic review, three key themes (cognitions (e.g. athletic identity), emotions (e.g. stress) and behaviours (e.g. coping)) underpinning injury risk in competitive sport were constructed. These themes are interconnected and therefore impact each other and present a complex picture of psychosocial factors underpinning injury risk. There is a growing representation of female athletes within the body of research, which is important given the increased risk of injuries and the increasing professionalisation of many female sports across the world. When seeking to reduce the risk of both traumatic and overuse injuries in competitive sport, sports stakeholders should look to consider how cognitive, emotional and behavioural factors can inform the development of robust injury risk reduction programmes, as well as critically considering their role in shaping and developing an autonomy supportive and psychologically safe environment.

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## Chapter 8: Appendices

### Appendix A: Prisma guidelines

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	X
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	x
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	x
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	X
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	X
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	X
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	x
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	X
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	X
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	X

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	x
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	X
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	x
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	n/a

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	X
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	X
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	x
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	x
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	x
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	x
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	x
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
<b>DISCUSSION</b>			

Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	x
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	x
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	x
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	n/a

## Appendix B: Study Screening

Author (Year)	Title	RB	AG	GJ	Reason for Exclusion
Bond, Miller & Chrisfield, (1988)	Psychological Prediction of Injury in Elite Swimmers	Included	Included		
Kolt & Kirby, (1996)	Injury in Australian female competitive gymnasts: A psychological perspective	Included	Included		
Johnson, (1996)	The Multiply Injured Versus the First Time-Injured Athlete During Rehabilitation: A Comparison of Nonphysical Characteristics	Excluded	Excluded		Focus on rehabilitation adherence not injury risk
Smith et al, (1997)	Predictors of Injury in Ice Hockey Player	Included	Included		
Larson, (1998).	Psychosocial Variables: Predicting and Preventing Athletic Injury	Excluded	Included	Excluded	No primary data
Wiechman, et al (2000)	Masking Effects of Social Desirability Response Set on Relations Between Psychosocial Factors and Sport Injuries: A Methodological Note	Included	Excluded	Included	
Dunn et al, (2001)	Do Sport-Specific Stressors Predict Athletic Injury?	Included	Included		
Noh & Morris, (2004)	Designing Research-Based Interventions for the Prevention of Injury in Dance	Excluded	Included		Excluded as not using dance
Kontos, (2004)	Perceived Risk, Risk Taking, Estimation of Ability and Injury Among Adolescent Sport Participants	Included	Included		
Johnson, Ekengren & Andersen, (2005).	Injury Prevention in Sweden: Helping Soccer Players at Risk	Included	Included		
Rip et al, (2006).	The Relationship between Passion and Injury in Dance Students	Excluded	Included	Excluded	Focus is on rehabilitation, and coping/I don't see a link between prevention and psychosocial risk, and dance

					AG notes: reports findings of passion associated with acute injury risk
Steffen, Pensgaard & Bahr (2008).	Self-reported psychological characteristics as risk factors for injuries in female youth football	Included	Included		
Brink et al, (2010).	Monitoring stress and recovery: new insights for the prevention of injuries and illnesses in elite youth soccer players	Included	Included		
Ivarsson & Johnson, (2010).	Psychological factors as predictors of injuries among senior soccer players. A prospective study	Included	Included		
Johnson & Ivarsson, (2011)	Psychological predictors of sport injuries among junior soccer players	Included	Included		
Shima et al, (2011)	Psychological profiling of young female handball and basketball players- A pilot study	Excluded	Excluded		No primary data AG notes: conference abstract
Tranaeus et al, (2011)	Psychosocial risk factors preceding overuse injury in floor-ball	Excluded	Excluded		No primary data AG notes: conference abstract
Van Wilgen & Verhagen, (2012).	A qualitative study on overuse injuries: The beliefs of athletes and coaches	Included	Included		
Sibold & Zizzi, (2012)	Psychosocial Variables and Time to Injury Onset: A Hurdle Regression Analysis Model	Included	Included		
Schnell et al, (2013).	Giving everything for athletic success! Sports-specific risk acceptance of elite adolescent athletes	Included	Included		
Ivarsson, Johnson & Podlog, (2013).	Psychological Predictors of Injury Occurrence: A Prospective Investigation of Professional Swedish Soccer Players	Included	Included		
Ivarsson et al, (2013).	Psychosocial stress as a predictor of injury in elite junior soccer: A latent growth curve analysis	Included	Included		

Maria & Catalin, (2013)	Study concerning the psychological coping skills of football players level C	Excluded	Excluded		I don't see a clear link between psychosocial factors and injury risk
Madrigal, (2015).	Psychological Skills for Injury Prevention and Recovery	Excluded	Excluded		No primary data
Laux et al, (2015)	Recovery–stress balance and injury risk in professional football players: a prospective study	Included	Included		
Timpka et al, (2015).	The psychological factor 'self-blame' predicts overuse injury among top-level Swedish track and field athletes: a 12-month cohort study	Included	Included		
Chalabaev et al, (2016).	Is motivation for marathon a protective factor or a risk factor of injury?	Included	Included		
Fagher et al, (2016).	Paralympic athletes' perceptions of their experiences of sports-related injuries, risk factors and preventive possibilities	Included	Included		
Kosaka et al, (2016).	Psychological traits regarding competitiveness are related to the incidence of anterior cruciate ligament injury in high school female athletes	Included	Included		
Bourbon et al, (2016)	Psychosocial and physical aspects of injured soccer athletes: structural equation modelling		Included	Included	I'm not sure if the data is primary or not.
Cathorall & Punches, (2017).	Descriptive study of female roller derby athletes' beliefs about risk factors for injury in roller derby	Included	Included		
Van der Does, (2017).	Injury Risk Is Increased by Changes in Perceived Recovery of Team Sport Players	Excluded	Included		Rb unable to locate



Clement et al, (2017).	Investigating the influence of intraindividual changes in perceived stress symptoms on injury risk in soccer	Included	Included		
Von Rosen et al, (2017).	Multiple factors explain injury risk in adolescent elite athletes: Applying a biopsychosocial perspective	Included	Included		
Li et al, (2017)	Preseason Anxiety and Depressive Symptoms and Prospective Injury Risk in Collegiate Athletes	Included	Included		
Cahalan et al, (2018)	Pain and Injury in Elite Adolescent Irish Dancers A Cross-Sectional Study	Excluded	Included	Excluded	Excluded as dancing no longer being classified as competitive sport
Madigan et al, (2018)	Perfectionism predicts injury in junior athletes: Preliminary evidence from a prospective study	Included	Included		
Putukian et al, (2018)	Preinjury and Postinjury Factors That Predict Sports-Related Concussion and Clinical Recovery Time	Excluded	Excluded		Concussion study
Li et al, (2019)	Basic Psychological Needs Satisfaction and Frustration, Stress, and Sports Injury Among University Athletes: A Four-Wave Prospective Survey	Included	Included		
Bolling et al, (2019)	Letting the cat out of the bag: athletes, coaches and physiotherapists share their perspectives on injury prevention in elite sports	Included	Included		
Skvarla & Clement, (2019)	The Delivery of a Short-Term Psychological Skills Training Program to College Dance Students A Pilot Study Examining Coping Skills and Injuries	Excluded	Included	Excluded	Excluded as dancing no longer being classified as competitive sport

Johnston et al, (2020)	General health complaints and sleep associated with new injury within an endurance sporting population: A prospective study	Included	Included		
Winden et al, (2020)	Limited coping skills, young age, and high BMI are risk factors for injuries in contemporary dance: A 1-year prospective study	Excluded	Included	Excluded	Participants are dance students, but I can't see any reference to sport competition
Lathlean et al, (2020)	Player Wellness (Soreness and Stress) and Injury in Elite Junior Australian Football Players Over 1 Season	Included	Included		
Kenny et al, (2021)	Association between pre-participation characteristics and risk of injury amongst pre-professional dancers	excluded	excluded		Dance study
Faltstrom et al, (2021)	Clinical Risk Profile for a Second Anterior Cruciate Ligament Injury in Female Soccer Players After Anterior Cruciate Ligament Reconstruction	Included	Included		
Olds & Webster, (2021)	Factor Structure of the Shoulder Instability Return to Sport After Injury Scale Performance Confidence, Reinjury Fear and Risk, Emotions, Rehabilitation and Surgery	Excluded	Excluded		Whilst fear of re-injury is mentioned it seems to be from a rehabilitation adherence perspective
Kvist & Silbernagel (2021)	Fear of Movement and Reinjury in Sports Medicine: Relevance for Rehabilitation and Return to Sport	Excluded	Excluded		No primary data
Alahmad et al, (2021)	Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies	Included	Included		
Parker, Johnson & Ivansson, (2021)	Is perceived autonomy support provided by a coach related to the intention of injury preventative	Included	Included		

	behaviour among national and international level golfers?				
Martin et al, (2021)	Psychological risk profile for overuse injuries in sport: An exploratory study	Included	Included		
De Wet, Africa & Venter, (2021)	Recovery-Stress States of Professional Ballet Dancers During Different Phases of a Ballet Season	Excluded	Excluded		
Iperen et al, (2022)	Linking psychological risk profiles to running-related injuries and chronic fatigue in long-distance runners: A latent profile analysis	Included	Included		
Tranaeus et al, (2022)	The Role of the Results of Functional Tests and Psychological Factors on Prediction of Injuries in Adolescent Female Football Players	Included	Included		
Sonesson et al, (2023)	Risk factors for injury and illness in youth floorball players A prospective cohort study	Included	Included		

#### Additional Studies

Cavallerio et al, (2016)	Understanding overuse injuries in rhythmic gymnastics	Included	Included		
Van Der Sluis et al, (2016)	Is risk-taking in talented junior tennis players related to overuse studies	Included	Included		
Pensgaard 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	Included	Included		

Konter et al, (2022)	Understanding the relationship between sport courage and female soccer performance variables	Included	Included		
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Forward and Backward Citation Searching.

Author	Title	RB	AG	GJ	Comments
Valliant, (1981)	Personality and injury in competitive runners	Included	Included		
Kerr & Minden, (1988)	Psychological factors related to the occurrence of athletic injuries	Included	Included (check competitive)		
Mainwaring et al, (1993)	Psychological correlates of dance injuries	Included	Excluded	Excluded	Dance
Lavalee & Flint, (1996)	The relationship of stress, competitive anxiety, mood state, and social support to athletic injury	Included	Included (check competitive)		
Liederbach & Compagno, (2001)	Psychological aspects of fatigue-related injuries in dancers	Included	Excluded	Excluded	Dance
Coddington & Troxell, (2010)	The effect of emotional factors on football injury rates A pilot study	Included	Included		
Olmedilla-Zafra et al, (2017)	Effectiveness of a stress management pilot program aimed at reducing the incidence of sports injuries in young football (soccer) players.	Included	Excluded	Excluded	Intervention study
Codinhato et al, (2018)	Resilience, stress, and injuries in the context of the Brazilian elite rhythmic gymnastics	Included	Included		
Johansson et al, (2022)	Athletic identity and shoulder overuse injury in competitive adolescent tennis players: The smash cohort study	Included	Included		

## Additional Studies

Author	Title	RB	AG	GJ	Comments
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Johansson et al, (2022)	Athletic identity and shoulder overuse injury in competitive adolescent tennis players: The smash cohort study	Included	Included		

# Appendix C: Study Demographics

No:	Study (date)	Definition of Injury	Population	Injury Type	Sample Number (N=)	Sex	Mean Age
1	Valient, (1981)	Physiological damage or bodily pain which interfered with ones ability to run	Competitive male runners	MSK	41	Male	Not specified
2	Bond, Miller & Chrisfield, (1988)	Physical damage sustained as a result of sports participation	Elite Swimmers	12-month MSK	33	Male N= 21 Female N= 12	18.5 years
3	Kerr & Minden, (1988)	No discernible definition of sports injury	Elite Gymnasts	2 years MSK sample	41	Female	14.5 years
4	Kolt & Kirby, (1996)	No discernible definition of sports injury	Elite/Competitive Gymnasts	Ongoing 12-month MSK	162	Female	12.6 years
5	Lavalee & Flint, (1996)	Grade I II or III classification of injury (Reid, 1992)	Varsity athletes (Football N=42, Rugby N=13)	MSK injuries	55	Male	22 years
6	Smith et al, (1997)	A hockey related event that kept a player out of practice or competition for 24 hours or required attention from the team physician	Varsity Ice Hockey players	Season long MSK	86	Male	16.5 years
7	Wiechman, et al (2000)	A medical problem resulting from athletic participation that restricted participation for at least one day beyond the day of occurrence	High school athletes (Basketball, wrestling and gymnastics)	Athletic MSK injuries	352	Male N=194 Female N=158	16.2 years
8	Dunn et al, (2001)	A medical problem resulting from athletic participation that restricted participation	High school athletes (Basketball,	Athletic MSK injuries	425	Male N=236 Female N=189	16.2 years

		for at least one day beyond the day of occurrence	wrestling and gymnastics)				
9	Ekenman et al, (2001)	No discernible definition of sports injury	Runners	Overuse Injuries	17	Male N= 8 Female N= 9	37.8 years
10	Kontos, (2004)	An 'injury' was recorded if occurred on during a soccer match or practice and kept the athlete out of the current match or any subsequent sport activities the day following injury	Soccer players	8-week pre-season MSK	260	Male N=148 Female N=112	12.7 years
11	Johnson, Ekengren & Anderson, (2005)	An athlete was considered to have incurred an injury if it was serious enough to cause him/her to miss practice or competition, or modify participation for at least one day.	Elite or highly competitive soccer players	Soccer related MSK injuries	235	Male N= 132 Female N=103	20.1 years
12	Steffen, Pensgaard & Bahr (2008).	An injury was registered if it made players unable to fully take part in match or training sessions the day following injury.	Football players	8-month MSK	1430	Female	15.4 years
13	Coddington & Troxell, (2010)	Minimum classification: damage that kept a boy out of effective participation from a day to under a week.	High school football players	Athletic injury	114	Male	15.9 years
14	Brink et al, (2010)	Any physical complaint sustained by a player	Elite soccer players	MSK over two seasons	53	Not specified	16.5 years

		that results from a soccer match or soccer practice, irrespective of attention or time loss from soccer activities.					
15	Ivarsson & Johnson, (2010)	Defined as all types of injuries that lead to at least one missed practice/game	Competitive soccer players	MSK	48	Male	22 years
16	Johnson & Ivarsson, (2011)	Defined as all types of injuries that occur in connection with sports participation	High school soccer players	8-month MSK injury	108	Male N=85 Female N=23	17-19 years (not specified)
17	Sibold & Zizzi, (2012)	Injury was defined as requiring 1 or more days missed from practice or competition	Competitive athletes (American football, soccer, volleyball, tennis & cross country running)	MSK	170	Male N=116 Female N=61	19.5 years
18	Van Wilgen & Verhagen, (2012)	Athletes who had recently experienced an overuse injury were included. With recently not defined as a specific time frame but have a good remembrance of 'cause' and preceding factors	Competitive athletes and their coaches	Overuse MSK	18: Athlete N=9 Coaches N=9	Male N=9 Female N=9	30.7 years
19	Ivarsson et al, (2013)	A condition meeting either (1) it occurred as a result of participation in a soccer practice or game or (2) it led to the restriction of athletes	Elite junior soccer	10-week MSK testing	101	Male N= 67 Female N=34	16.7 years



		participation for 3 days or more beyond the day of injury					
20	Ivarsson, Johnson & Podlog, (2013)	Defined as injured if the player missed at least one practice or competition	Professional soccer players	MSK	56	Male N=38 Female N=18	25.1 years
21	Schnell et al, (2013)	No discernible definition of sport injury	Young Olympic athletes	MSK risk linked	1138	Male N=638 Female N=500	16.3 years
22	Tranaeus et al, (2014)	Overuse injuries were defined as a result of sub-maximal repetitive mechanical load in the affected tissue when the ability of the tissue to regenerate was exceeded	Floorball players	Overuse Injuries	11	Male N=9 Female N=2	20-30 years
23	Laux et al, (2015)	The injury occurred during a football match or during training that led to an absence of the next training session or match (time-loss injury)	Professional Football Players	16-month MSK	22	Male	25.8 years
24	Timpka et al, (2015)	No discernible definition of sport injury	Track and field athletes	12-month MSK surveillance	266	Male N=118 Female N=148	24 years
25	Bourbon et al, (2016)	Injury definitions followed the model proposed by the union of European soccer associations and the	Professional soccer players	MSK	59	Male	26.2 years

		Brazilian soccer confederation					
26	Cavallerio et al, (2016)	No discernible definition of sport injury	16 elite rhythmic gymnastics	Overuse MSK injuries	16	Female	13.6 years
27	Chalabaev et al, (2016)	No discernible definition of sport injury	Competitive marathon runners	MSK	Study 1:378 Study 2:339	Study 1: Male N=272 Female N=106  Study 2: Male N=260 Female N=79	Study 1: 43 years  Study 2: 43 years
28	Fagher et al, (2016)	No discernible definition of sport injury	Swedish paralympic program	MSK injury link	18	Male N=11 Female N=7	27 years
29	Kosaka et al, (2016)	Any ACL injury (contact or non-contact) diagnosed after physical or magnetic testing resulting in reconstruction	Basketball N=194 Handball N=106	3-year prospective cohort ACL study	300	Female	15 years
30	Van Der Sluis et al, (2016)	Overuse injuries were defined as those injuries that could not be linked to a single, identifiable event	Junior tennis players	Overuse MSK injuries	73	Male N=45 Female N=28	12.4 years
31	Jelvegard et al, (2016)	No discernible definition of sport injury	Middle-Long distance runners	Overuse Injuries	14	Male N=8 Female N=6	28 years
32	Cathorall & PUNCHES, (2017)	No discernible definition of sport injury	Roller derby athletes	MSK traumatic injuries	19	Female	29.4 years

33	Clement et al, (2017)	Any injury occurrence during scheduled training sessions or matches that caused the player to miss the next training session or match	Soccer athletes	Any MSK injury	Sample 1: 71 Sample 2: 50	Sample 1: Male N=57 Female N=14 Sample 2: Male N=28 Female N=22	Sample 1: 17.7 years Sample 2: 19.4 years
34	Li et al, (2017)	Injury was defined as any event that required medical attention and resulted in loss of play for at least 1 day in either game or practice	Baseball, basketball, football, field hockey, softball, volleyball, and wrestling athletes	MSK injuries in collegiate sport	958	Male N=631 Female N=327	18-21 years
35	Von Rosen et al, (2017)	No discernible definition of sport injury	Elite high school athletes	MSK injuries	496	Male N=270 Female N=226	17 years
36	Codonhato et al, (2018)	No discernible definition of sport injury	Brazilian Olympic Rhythmic Gymnastics	MSK injuries	8	Female N=8	20.4 years
37	Madigan et al, (2018)	Athlete was defined as injured if they required medical treatment and missed at least one training session or competition	Soccer, basketball, athletics, rugby athletes	MSK injuries	80	Male N=65 Female N=15	17.1 years
38	Pensgaard et al, (2018)	Injuries were recorded if a player was unable to fully participate in football training or match play for at least 1 day beyond the day of injury	Football (soccer)	Overuse MSK injuries	193	Female	21.6 years

39	Bolling et al, (2019)	No discernible definition of sport injury	Olympic athletes N=10 Coaches N=4 Physiotherapists N=5	MSK Injuries	Athletes Male N=2 Female N=8 Coaches Male N=4 Physiotherapists Male N=5	Male N=11 Female N=8	Athletes 29.9 Coaches 40.3 Physiotherapists 31.2
40	Li et al, (2019)	An injury was included if it resulted in an athlete having to stop or limit sport participation for at least one day	Basketball, handball, soccer, and rugby athletes	MSK injuries	112	Male N=61 Female N=51	21.1 years
41	Van der sluis et al, (2019)	Overuse injuries were defined as those injuries that could not be linked to a single-identifiable event	Tennis Players	Overuse Injuries	73	Male N= 45 Female N= 28	12.4 years
42	Johnston et al, (2020)	An injury episode was defined as a physical MSK complaint/impairment solely due to participation in endurance training and/or competition	Runners, swimmers, triathletes, cyclists and rowers	MSK injuries	95	Male N=61 Female N=34	42.2 years
43	Lathlean et al, (2020)	A new injury was defined as arising from a distinct initial injury event unrelated to any other injury, whereas a recurrent injury was one defined as associated with a previously reported injury	Australian Football	MSK injuries	196	Sex not reported	17.7 years

44	Alahmad et al, (2021)	Injuries were classified as an event that occurred during a match or training that resulted in restriction of participation in one or more days	Soccer	MSK injuries	83	Female	25.4 years
45	Faltstrom et al, (2021)	New knee injuries were classified as any physical complaint that sustained by a player irrespective of the need for medical attention or time loss from soccer activities	Soccer	MSK (ACL specifically)	117	Female	20 years
46	Martin et al, (2021)	Overuse injuries were defined through the use of the OSTRC overuse questionnaire	Individual (track & field, long-distance running, triathlon, weightlifting) and team (basketball, rugby, soccer, volleyball, handball) sports	Overuse MSK injuries	149	Male N=105 Female N=44	27.9 years
47	Parker, Johnson & Ivarsson, (2021)	No discernible definition of sport injury	Golf	MSK injuries	60	Male N=26 Female N=24	20.6 years
48	Iperen et al, (2022)	A running related injury was defined as any injury or bodily damage which originated during running and caused athletes to change their running activities	Long-distance runners	MSK injuries	425	Male N=242 Female N=183	44.7 years

49	Johansson et al, (2022)	No discernible definition of sport injury	Tennis	52-week overuse MSK injury	269	Male N=156 Female N=113	14.5 years
50	Konter et al, (2022)	No discernible definition of sport injury	Football (soccer)	MSK injuries	210	Female	18 years
51	Tranaeus et al, (2022)	No discernible definition of sport injury	Football (soccer)	MSK injuries	419	Female	13.9 years
52	Sonesson et al, (2023)	Injury was defined as any physical complaint sustained by a player that results from floorball training or match, irrespective of the need for medical attention or time loss	Floorball	MSK injuries	471	Male N=329 Female N=142	Male 13.3 years Female 13.7 years

Appendix D: Mixed Methods Appraisal Tool

No:	Study (date)	Screening Questions	Qualitative	Quantitative (randomised)	Quantitative (non-randomised)	Quantitative (descriptive)	Mixed Methods	Quality score
1	Valient, (1981)	✓✓				✓✓✓✓✓		100%
2	Bond, Miller & Chrisfield, (1988)	✓✓				✓✓✓x✓		80%
3	Kerr & Minden, (1988)	✓✓				✓✓✓✓✓		100%
4	Kolt & Kirby, (1996)	✓✓				✓✓✓x✓		80%
5	Lavalee & Flint, (1996)	✓✓				✓✓✓✓✓		100%
6	Smith et al, (1997)	✓✓				✓✓✓✓✓		100%
7	Wiechman, et al (2000)	✓✓				✓✓✓✓✓		100%
8	Dunn et al, (2001)	✓✓				✓✓✓x✓		80%
9	Ekenman et al, (2001)	✓✓				✓✓✓✓✓		100%
10	Kontos, (2004)	✓✓				✓✓✓✓✓		100%
11	Johnson, Ekengren & Anderson, (2005)	✓✓		✓✓✓x✓				80%
12	Steffen, Pensgaard & Bahr (2008).	✓✓				✓✓✓x✓		80%
13	Coddington & Troxell, (2010)	✓✓				✓✓✓✓✓		100%
14	Brink et al, (2010)	✓✓				✓✓✓✓✓		100%
15	Ivarsson & Johnson, (2010)	✓✓				✓✓✓✓✓		100%
16	Johnson & Ivarsson, (2011)	✓✓				✓✓✓x✓		80%
17	Sibold & Zizzi, (2012)	✓✓				✓✓✓x✓		80%
18	Van Wilgen & Verhagen, (2012)	✓✓	✓✓✓✓✓					100%
19	Ivarsson et al, (2013)	✓✓				✓✓✓✓✓		100%
20	Ivarsson, Johnson & Podlog, (2013)	✓✓				✓✓✓✓✓		100%
21	Schnell et al, (2013)	✓✓				✓✓✓x✓		80%
22	Tranaeus et al, (2014)	✓✓	✓✓✓✓✓					100%
23	Laux et al, (2015)	✓✓				✓✓✓✓✓		100%
24	Timpka et al, (2015)	✓✓				✓✓✓x✓		80%
25	Bourbon et al, (2016)	✓✓				✓✓x✓✓		80%

26	Cavallerio et al, (2016)	✓✓	✓✓✓✓✓					100%
27	Chalabaev et al, (2016)	✓✓				✓✓✓x✓		80%
28	Fagher et al, (2016)	✓✓	✓✓✓✓✓					100%
29	Jelvegard et al, (2016)	✓✓				✓✓✓✓✓		100%
30	Kosaka et al, (2016)	✓✓				✓✓✓x✓		80%
31	Van Der Sluis et al, (2016)	✓✓				✓✓✓✓✓		100%
32	Cathorall & Panches, (2017)	✓✓	✓✓✓✓✓					100%
33	Clement et al, (2017)	✓✓				✓✓✓✓✓		100%
34	Li et al, (2017)	✓✓				✓✓✓x✓		80%
35	Von Rosen et al, (2017)	✓✓				✓✓✓x✓		80%
36	Codinhato et al, (2018)	✓✓					✓✓✓✓✓	100%
37	Madigan et al, (2018)	✓✓				✓✓✓✓✓		100%
38	Pensgaard et al, (2018)	✓✓				✓✓✓✓✓		100%
39	Bolling et al, (2019)	✓✓	✓✓✓✓✓					100%
40	Li et al, (2019)	✓✓				✓✓✓✓✓		100%
41	Van der Sluis et al, (2019)	✓✓				✓✓✓✓✓		100%
42	Johnston et al, (2020)	✓✓				✓✓✓✓✓		100%
43	Lathlean et al, (2020)	✓✓				✓✓✓✓✓		100%
44	Alahmad et al, (2021)	✓✓				✓✓✓✓✓		100%
45	Faltstrom et al, (2021)	✓✓				✓✓xx✓		60%
46	Martin et al, (2021)	✓✓				✓✓✓x✓		80%
47	Parker, Johnson & Ivarsson, (2021)	✓✓				✓✓✓✓✓		100%
48	Iperen et al, (2022)	✓✓				✓✓✓✓✓		100%
49	Johansson et al, (2022)	✓✓				✓✓✓x✓		80%
50	Konter et al, (2022)	✓✓				✓✓✓✓✓		100%
51	Tranaeus et al, (2022)	✓✓				✓✓✓✓✓		100%
52	Sonesson et al, (2023)	✓✓				✓✓✓✓✓		100%



## Appendix E: Included Study Summaries

No:	Study (date)	Summary
1	Valient, (1981)	Study aim was to identify the psychological, physical, and training measures that may separate injured and non-injured competitive runners. Results of the study found non-injured athletes where more toughminded and less forthright than injured athletes.
2	Kerr & Minden, (1988)	Study aim was to investigate the relationships between psychological factors and athletic injury and concluded that stressful life events were significantly related to injuries.
3	Bond, Miller & Chrisfield, (1988)	Aim was to investigate the relationship between injury rate and scores on Nideffer's test of attentional and interpersonal style. Results found that swimmers with a more effective attentional profiles sustained more injuries.
4	Kolt & Kirby, (1996)	Study aim was to assess the role of psychological variables in injury. Results found that in non-elite gymnasts' life stress was a significant predictor and for elite gymnasts' internal locus of control was significant in injury prediction.
5	Lavalee & Flint, (1996)	Aim was to study stress, competitive anxiety, mood state and social support in athletic injury. Results found that anxiety/tension mood states were related to injury frequency and anger/negative mood states were related to injury severity.
6	Smith et al, (1997)	Aim was to study psychological factors effect on the incidence of sport injury, results found that confidence, stress, social support, mood states and positive states of mind were shown to determine influences of injury.
7	Wiechman, et al (2000)	Study aim was to measure the effect social desirability has on psychosocial factors and sport injuries. Results from this longitudinal study concluded that there is virtually no injury variance was accounted for by life stress, psychological coping skills or their interaction. However, deletion from the sample of athletes with high social desirability response resulted in positive relations involving life stress and coping skills.
8	Dunn et al, (2001)	This study aimed to investigate if stressful life events occurring in the same context as the outcome can predict sport injury, results found that sport-specific stressful events accounted for statistically significant injury time loss.
9	Ekenman et al, (2001)	The aim of this study was to compare selected personality traits in runners who had previously sustained a tibial stress fracture, with a group of runners who had no history of this injury. Results indicated that the injured runners especially the females scored higher than the non-injured on inventories that measured type A behaviour pattern and exercise dependency. Since motivation, ambitiousness, and competitiveness are important parts of these inventories high scores may suggest high risk of injury.

10	Kontos, (2004)	Study aim was to determine the predictive validity of perceived risk, risk taking, estimation of ability, over-efficacy, and previous injuries on actual injuries among adolescents in sports and found that low level of perceived risk and estimation of ability were associated with injury risk, estimation of ability was also associated with risk taking, but this study did not find an association between risk-taking and injury. This study reported girls having higher levels of perceived risk and lower levels of risk taking than boys, however similar estimation and overestimation of ability, and subsequently similar levels of injuries incurred.
11	Johnson, Ekengren & Anderson, (2005)	This study examined the effectiveness of a prevention program to lower incidence of injury in soccer players with at risk psychological profiles such as sport anxiety and life event stress. Results found that mitigating for the above profiles can lower the number of injuries, meaning that sport anxiety and life event stress have shown to be psychosocial risk factors.
12	Steffen, Pensgaard & Bahr (2008).	This study aim was to examine whether psychological player characteristics assessed by a self-administrated questionnaire represent risk factors for injury. It was found a history of previous injury increased the risk of new injury to the same area. Additionally high life stress and perception of mastery climate were significant risk factors for new injuries.
13	Coddington & Troxell, (2010)	The aim of the study was to assess the effect of emotional factors on football injury rates using the life event scale for adolescents. Results found that players who experienced parental illnesses, separations, divorces, and deaths were more likely to sustain a significant injury. Therefore, meaning it is likely a players mental or emotional state may increase injury risk.
14	Brink et al, (2010)	Study aim was to investigate how measures to monitor stress and recovery and the subsequent analysis can provide useful information for the prevention of injuries and illnesses in elite youth soccer players. Results showed that physical stress was related to both injury and illnesses and psychosocial stress and recovery were related to the occurrence of injury.
15	Ivarsson & Johnson, (2010)	Study aim was to examine the relationship between A) personality factors B) coping variables and C) stress and injury risk amongst senior soccer players. Results have suggested that injury was predicted by four personality trait factors namely somatic trait anxiety, psychic trait anxiety, stress susceptibility and trait irritability. Additionally, self-blame and acceptance accounted for a significant number of injuries. Finally, more injuries were found among players who score highly in daily hassles.
16	Johnson & Ivarsson, (2011)	This study aim was to find psychological factors that could lead to increased injury risk among junior soccer players and to additionally construct an empirical model of injury risk factors within this population. Results concluded that four predictors that together can explain 23% of sport injuries and these are life event stress, somatic trait anxiety, mistrust and effective coping.

17	Sibold & Zizzi, (2012)	Study aim was to examine the influence of orthopaedic and psychosocial variables on time to injury in collegiate athletes, results found that concentration disruption and negative life-event stress were robust predictors of days to injuries.
18	Van Wilgen & Verhagen, (2012)	This study aim was to enhance preventative approaches for overuse injuries by better characterising athletes' belief of what an overuse injury is, as well understanding the intrinsic and extrinsic risk factors that underlie overuse injuries. Results concluded that intrinsic factors for overuse injuries were related to physical factors, technique, psychological factors and hereditary. Extrinsic factors were related to situational, social and training as well as coaches. Therefore if preventative approaches are developed for overuse injuries they should incorporate physical, psychological and social factors based on the input on both coaches and athletes.
19	Ivarsson et al, (2013)	This study aim was to examine whether athletes' individual levels and changes in hassles and uplift levels over a 10-week period could predict injury outcome in elite junior soccer players. Results identified that injury occurrence was significantly associated with both the level of daily hassle and changes to daily hassle. High initial daily hassle levels and a smaller decrease in daily hassles were associated with injury occurrence, however injury occurrence was significantly associated with a greater decrease in daily uplift.
20	Ivarsson, Johnson & Podlog, (2013)	The study aim was to investigate whether personality, stress and coping predicted injury occurrence in elite soccer players and results found that trait anxiety, negative life stress and daily hassles were significant predictors of injury within this population.
21	Schnell et al, (2013)	This study aim is to identify groups of athletes who are willing to take risks for success and the possible determinants of athletes' risk acceptance, in an attempt to prevent lasting damage to young athletes. This study's results found several high-risk groups, athletes who are willing to take physical risks attached high importance to their sports environment and minor importance to non-sports environment. Athletes who are perfectionists and are very focused on performance were particularly willing to accept physical and social risks.
22	Tranaeus et al, (2014)	The aim of this study was to identify psychological factors preceding overuse injuries, athletes were interviewed regarding their experiences of potentially stressful events prior to any overuse injuries and five key themes were identified namely; history of stressors, person factors, psycho-physiological, psychosocial factors and ineffective coping. Results suggest that stress, social support, motivation and pain should be considered.
23	Laux et al, (2015)	This study aim was to assess and examine the stress recovery variables as assessed by the recovery-stress questionnaire and how these factors can contribute to the risk of injury in professional football players. Results concluded that the stress related skills fatigue or disturbed breaks and injury; and the recovery related scale sleep quality significantly predicted injury.

24	Timpka et al, (2015)	The aim of this study was to examine psychological factors in an integrated model of overuse injury risk in track and field athletes. Results found athletes who had not suffered a severe injury in the previous year were at half the risk of sustaining an injury in comparison with the reference group.
25	Bourbon et al, (2016)	The aim of this study was to consider the link between physical and psychosocial risk factors to sport injury in professional soccer players. Results found that there is a strong association with psychosocial observed in the SF-36 questionnaire amongst lower limb soccer injuries. Suggesting that this tool could be used for identifying psychological disorders within athletes.
26	Cavallerio et al, (2016)	Study aim was to gain an understanding of overuse injuries from a psychosocial perspective and how sports culture can impact overuse injuries. This study extends research on overuse injuries by A) exploring the link from sociology and psychology from the athlete perspective B) using a rigorous method to elicit a more in-depth understanding of overuse injuries and C) via adopting an innovate form of representation to increase the accessibility of findings to a non-academic audience.
27	Chalabaev et al, (2016)	This research aim was to investigate how self-determined motivation can predict perceived susceptibility to injury during marathon competition. Results found that the predictive role of self-determination was driven by controlled forms of motivation, more particularly external regulation. Overall results in this study found that self-determined motivation for sport is a protective factor to injury.
28	Fagher et al, (2016)	The aim of this study was to explore paralympic athlete's perceptions of their experiences of sports related injuries, risk factors relating and any preventative possibilities. Categories were identified in the study and were related to; impairments, sport overuse; risk behaviour; functional limitations; psychological stressors; normalised pain and health hazards. This qualitative study revealed paralympic perceptions of injuries are complex and multifaceted, and in numerous ways differ from able bodied athletes.
29	Jelvegard et al, (2016)	The aim of this study was to identify associations with purposeful interpretations of body perceptions and balanced behavioural responses with the goal of providing information for the prevention of health problems in runners. Results found that symptoms interpreted to be caused by illness or injury with a sudden onset were found to lead to immediate action and changes to training/competition (activity pacing). On the other hand, symptoms interpreted to be due to injuries on a gradual onset basis led to behavioural reactions. These behaviours were planned with regards to short term consequences with a neglect towards long term implications and overactivity.
30	Kosaka et al, (2016)	The purpose of this study was to investigate the relationship between psychological competitive ability and the incidence of noncontact ACL injuries amongst a female high school athlete

		population. 8.3% of the cohort experienced a noncontact ACL injury, and the results found that injured players had a significantly higher psychological competitiveness total through the DIPCA test scores, this suggests that high psychological competitive ability is associated with the incidence of non-contact ACL injuries within the tested population.
31	Van Der Sluis et al, (2016)	This study aim is to focus on the relationship between risk taking and overuse injuries within talented junior tennis players. In males, risk-taking contributed significantly to time loss due to overuse injuries. In females, time loss overuse injuries and overuse severity were predicted by exposure time. Therefore, coaches and medical staff should consider that male tennis players who are inclined to take risks are more likely to maintain risky behavioural patterns that can lead to overuse injuries.
32	Cathorall & Punches, (2017)	This study aim was to examine skaters' belief about risk factors related to roller derby injuries. Results found factors split into either intrinsic or extrinsic, with the most common intrinsic factors relating to behavioural and psychological factors such as knowing one's body and pressures of not letting the team down. Extrinsic factors related to unmatched skill level and poor-quality equipment.
33	Clement et al, (2017)	Study objective was to investigate if within-person changes in perceived stress symptoms could predict injury rates during the subsequent 3-months. Results found that there was a clear positive effect of changes in stress symptoms on injury rates, which indicates that an increase in reported stress symptoms can lead to an increase in injury risk. Highlighting an overall importance for creating a supporting nurturing environment for soccer athletes.
34	Li et al, (2017)	The aim of this study was to determine the effect of reported pre-season anxiety and depressive symptoms on injury risk in collegiate athletes and it concluded that athletes with anxiety symptoms during pre-season were at increased risk of injuries during the prospective season.
35	Von Rosen et al, (2017)	This study aim was to identify risk factors for sports injury in adolescent athletes, by applying a biopsychosocial approach. The results main findings were that increased training load and increased intensity and sleep volume were linked to an increased injury risk. Additionally, competence-based self esteem was linked to hazard of injury.
36	Codinhato et al, (2018)	This study aim was to study the relationship between resilience, stress, and injuries in a sporting context. Participants included eight female rhythmic gymnasts from the Brazilian Olympic team. A key finding was that social support was considered the main psychological factor in the resilience process, and resilience acts as a key factor in the injury-recovery process.
37	Madigan et al, (2018)	This studies aim was to examine perfectionistic strivings, concerns, and sports injury in junior athletes in both individual and team sports. Results found that the likelihood of sustaining an injury was increased by over two times per 1 SD increase in perfectionistic concerns, suggesting

		that perfectionism positively predicts sports injury, and these traits and predispose an athlete to an increased risk of injury.
38	Pensgaard et al, (2018)	Study aim was to examine the roles of different types of stressors as well as the effect of motivational climate on the occurrence of acute and overuse injuries. Results found that perceived negative life stress from teammates was associated with increased risk of acute injuries, and there was a credible association with perceived negative life stress from coaches and overuse injuries.
39	Bolling et al, (2019)	The aim of this study was to explore how sports injury prevention takes place in elite sports practice and to describe the perspectives of athletes, coaches and physiotherapists regarding important factors that help prevent sports injury. Communication amongst athletes, coaches and physiotherapists was described as a key component of injury prevention.
40	Li et al, (2019)	The aim of this study was to investigate the relationships between basic psychological needs satisfaction and frustration, stress responses and sports injuries. Results found that BPN negatively predicted sports injuries, whereas stress was a positive predictor and BPN had an indirect effect on injury occurrence via stress.
41	Van der Sluis et al, (2019)	The aim of this study was to identify the relationship between metacognitive skills and overuse injuries in junior tennis players. Results found that low or moderate self-monitoring skills and exposure time were associated with more time loss overuse injuries. Results also found that this may only be the case for females.
42	Johnston et al, (2020)	This study aim was to examine the association between subjective health complaints, sleep quantity and new injury within an endurance athlete population. Seven-day lag psychological/lifestyle health complaints were associated with new injury risk, and new injury risk had a significant with 14-day lag (<7-hour sleep).
43	Lathlean et al, (2020)	The aim of this study was to investigate the link between player wellness and sports injury in elite Australian football players over a season long period. Results found that soreness was associated with injury at each time point across the week. Stress and injury were associated with injury for average stress values. Overall, this study demonstrated key associations between wellness and injury in elite junior football players. Specifically soreness, stress, fatigue and mood.
44	Alahmad et al, (2021)	This study aim was to explore injury profile, opinions on risk factors and injury prevention among Irish amateur women soccer players. Results found that there was negative association between injuries and players' general health state. Additionally, 50% of participants had never received any education on injury risk and prevention in regards to playing during menses, playing position, and joint hypermobility.

45	Faltstrom et al, (2021)	This study aim was to investigate the combinations of various clinical risk factors associated with a second ACL injury in female soccer players with a primary unilateral reconstruction. Results from the 'CART' analysis identified 9 of 19 independent variables that are associated with a second ACL injury. This analysis could accurately identify female soccer players at high risk for a second ACL injury and found that there was an interaction between functional performance, clinical assessment and psychological factors and therefore suggests that these factors should be considered in return to sport decisions and athlete screening.
46	Martin et al, (2021)	This study aimed to identify a psychological risk profile for overuse injuries in sport. This study was conducted over a 10-week period and athletes completed the OSTRC overuse injury questionnaire. Using a latent profile analysis participants were classified into one of three latent profiles in regards to their psychological characteristics. Athletes in latent profile number two, who were characterised with the combination of high athletic identity, perfectionistic concerns, negative life stress and poor coach-athlete relationships were found to be significantly more often affected by overuse injuries. This suggests that interactions of specific psychosocial traits can influence injury risk in athletes and sport.
47	Parker, Johnson & Ivansson, (2021)	This study aim was to investigate the interaction between perceived autonomy support, autonomous motivation, planned behaviour and how these factors relate to golfers self-reported intention injury prevention behaviour. Analysis of results was performed by assessing edge strengths and node centrality to guide inference of the network topology. The most central node was autonomous regulation and the results showed one cluster comprising positive interactions between perceived autonomy support, effort of injury preventative behaviour and frequency of injury preventative behaviour. This finding suggests that coaches should consider giving feedback that supports autonomous motivation.
48	Iperen et al, (2022)	This study aim was to explore the interplay between self-regulatory coping strategies and motivational aspects, using a person-centred approach this study investigated whether latent psychological profiles of runners were associated with running related injuries and fatigue. Latent profile analysis revealed three different psychological profiles and characterised these as low, medium, and high risk, the low risk profile showed low scores on obsessive passion and high scores on all recovery dimensions, whereas the high-risk profiles showed resembled the opposite. Ultimately, the low-risk profiles showed significantly lower running-related injuries and chronic fatigue than the high-risk.
49	Johansson et al, (2022)	The aims of this study were to determine if athletic identity is prospectively associated with shoulder overuse injuries, and to determine if athletic identity is prospectively associated with playing through pain and to describe how athletic identity relates to sex, age, playing level, weekly training load and match volume. Results found that for every ten unit increase in athletic

		identity measurement scale, the adjusted hazard rate ratio increased, as did the odds ratio of playing through pain.
50	Konter et al, (2022)	The purpose of this study was to examine the relationships between female football players' sport courage and key performance variables such as level of participation and injury past. Results found that female soccer players who have sustained an injury in the past scored significantly higher on the venturesome scale, than those who have not sustained injuries previously, additionally age and mastery have shown to be linked to courageous behaviour.
51	Tranaeus et al, (2022)	The aim of this study was to investigate if the combination of demographic, psychosocial and physiological factors can predict traumatic injuries in adolescent female soccer players. Results found that the coping strategy 'positive reframing' had the strongest association with the risk of traumatic injuries. The combination of more frequent use of coping strategies, positive reframing and high levels of physical performance capacity may prevent traumatic injury in this population.
52	Sonesson et al, (2023)	This study aim was to investigate risk factors for injury and illness in female and male youth floorball players. Results concluded that higher stress, poorer sleep quality and wellbeing increased the odds of injury in the subsequent weeks by 8% (2.0 13.5%), 10% (4.2 15.9%) and 8% (2.4 13.5%) per 1 unit increase on the Oslo sports trauma research questionnaire.



