Psychosocial predictors and psychological prevention of soccer injuries: a systematic review and meta-analysis of the literature

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Abstract

Objectives: To examine (a) the relationships between the psychosocial risk factors and injury rates and (b) the effects of psychological-based prevention interventions on the injury risk of soccer players.

Design: Scholarly electronic databases (PubMed/MEDLINE, Google Scholar, Scopus) were searched on 1 January 2017, complemented by manual searches of bibliographies.

Setting: Systematic review and meta-analysis.

Participants: We identified 13 eligible studies, including a total of 1,149 injured soccer players aged between 14 and 36 years.

Main Outcome Measures: Psychosocial risk factors, psychological-based prevention interventions and injury risk in soccer players.

Results: Personality traits, such as trait anxiety and perceived mastery climate, along with a history of stressors, like negative-life-event stress or high level of life stress, daily hassle, and previous injury, are the main predictors of injury rates among soccer players. Also, from injury prevention studies, it has been shown that psychological-based interventions reduce injury rates (effect size = 0.96; 95% CI 0.34-1.58; p = 0.002) in senior soccer players.

Conclusions: Practitioners need to ensure injured soccer players are psychologically and socially ready to play. They should also employ psychological-based interventions (i.e., mindfulness, imagery, self-talk, stress management, relaxation, goal setting) when designing injury prevention programs.

Key words: psychosocial predictors; psychological prevention; injury rates; football.

Introduction

Soccer is the most common sport in the world and has high mental and physical demands (Slimani et al., 2016; Slimani & Nikolaidis, 2017). It is one of the most complex contact sports whose frequency of practices during the season varies depending on the training phase or competing level (Kirkendall, 2011; Scott & Anderson, 2013). Accordingly, as competitive level rises, it is a common practice for some football teams to play one or two matches per week, and take part in international tournaments, such as world championships and the Olympic Games (Slimani & Nikolaidis, 2017). These heavy schedules of practice, matches, and high psychophysical demands, lead to high risks and rates of injury in professional (Hawkins & Fuller, 1996; Hawkins et al., 2001) and amateur players (Junge et al., 2004; Kofotolis et al., 2007). Furthermore, soccer players in an overreaching phase of training or intense competition would appear to be particularly vulnerable to injuries and psychophysical stress (Ekstrand, Hägglund, & Walden, 2011). In other words, this intensive phase may lead to the accumulation of stress, fatigue and its concomitants (i.e., non-functional overreaching or overtraining), and, consequently, can increase the risk of injury and illness to the athlete (Meeusen et al., 2013). For this reason, because the potential to eliminate physical stressors is limited in sport, a potential avenue for decreasing injury rates is to help players cope psychologically with stressors (Galambos et al., 2005). Previous studies suggest that psychosocial factors could affect injury risk among athletes. To provide a theoretical framework to explain the relationship between psychological variables and injury occurrence, the model of stress and athletic injury was developed (Williams & Andersen, 1998). Williams and Andersen (1998) provided a comprehensive, interactional model explaining the psychological antecedents (hardiness, sense of coherence, achievement motivation, sensation seeking, locus of control, and trait anxiety as personality traits) of sport injuries. In this model the stress response has a bidirectional relationship with the athlete's cognitive appraisals of potentially stressful situations (e.g., practice, game competition). Both the magnitude of the stress response and the athlete's appraisals of the situation may be influenced by the interplay between various psychosocial factors, which are divided into three broad categories: personality factors, history of stressors, and coping resources. Initially Andersen and Williams (1988) included hardiness, sense of coherence, achievement motivation, sensation seeking, locus of control, and trait anxiety as personality traits. Some authors have also included daily hassles, life events, and previous injuries as history of stressors (Van Mechelen et al., 1996; Williams & Anderson, 1998). Furthermore, in the model (Williams & Andersen, 1998) intervention approaches targeted to

influence/buffer the stress response through psychosocial, physiological, and attentional pathways may reduce injury rates. A recent meta-analysis (Ivarsson et al., 2016) showed that including psychological training programs into other types injury prevention programs (e.g., biomechanical, strength training) within sports has the potential to reduce the risk of sport injuries and may have positive outcomes for athletes, clubs, and communities.

The aforementioned model (Williams & Andersen, 1998) and meta-analysis review (Ivarsson et al., 2016) were limited by several methodological issues. First, some psychological variables, not included in the model of stress and athletic injury (Williams & Andersen, 1998), have been found to be related to increased injury risk, such as poor visual and verbal memory, high levels of psychophysiological fatigue, behaviors related to ignorance of stressors and/or neglecting recovery (Liederbach & Compagno, 2001; Richardson, 2008; Swanik et al., 2007). Second, the meta-analysis review (Ivarsson et al., 2016) in this area included studies that evaluated the psychosocial predictors and the effects of prevention interventions on injury rates in different sports, limiting applicability to specific sporting contexts. Thus, more review is required in order to single out those specific psychological risk factors targeting the many different groups of athletes, such as soccer players. More specifically, for example, Johnson and Ivarsson (2011) found that increased injury risk among players in junior soccer was predicted by players having ineffective coping skills, such as worry.

In the last two decades, the effectiveness of psychological interventions on injury rate reduction has also been demonstrated (Driediger et al., 2006; Edvardsson, Ivarsson, & Johnson, 2012). Some studies have shown that psychological preventive interventions, such as goal setting, positive self-talk, imagery, relaxation, mindfulness, and cognitive-behavioral biofeedback, contribute positively to the prevention of injuries, physical recovery from injury, improved self-confidence levels and the decrease of cognitive and physical anxiety (Driediger et al., 2006; Edvardsson, Ivarsson, & Johnson, 2012; Johnson, Ekengren, & Andersen, 2005). A review of soccer-specific intervention studies will complement the focus on psychosocial risk factors in this sport and together the two aims may present a broader knowledge base on which to generate practice guidelines and identify future research needs. Therefore, attempting to extend the previous studies, the aims of the present systematic review and meta-analysis were to examine (1) the psychosocial risk factors of soccer injuries and (2) the effects of psychological prevention interventions on the injury risk in soccer players.

Materials and methods

Search strategy

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Statement guidelines (Moher et al., 2009; Figure 1). Scholarly electronic databases (PubMed/MEDLINE, Google Scholar, Scopus) were searched from inception up to 1st January 2017. Moreover, we performed manual searches of relevant journals and reference lists obtained from published articles. Electronic databases were searched using the following keywords: "soccer" in combination with the terms "psychosocial predictors", "stress", "anxiety", "risk factors", "history of stressors", "personality traits", "coping", "psychological prevention", and "injuries".

Inclusion and exclusion criteria

To be suitable for inclusion, studies had to fulfill the following selection criteria: (a) studies examined either the relationships between the psychosocial risk factors (e.g., stress response, history of stressors, coping, and personality traits) and injury rates among soccer players or investigations studied the effects of psychological prevention interventions on injury rates; (b) studies recruiting male or female soccer players and at any age category and any level as participants and (c) original studies written in English. Reviews, comments, interviews, letters, posters, book chapters, and books were excluded.

Data extraction

Two authors independently extracted data (participant details, intervention details, outcome measures, and main conclusions), using an *ad hoc* structured form. We resolved discrepancies by referring to the original papers and through discussion.

Procedure and data analysis

Once the database of papers had been finalised, we followed procedures described by Edwards et al. (2014) and Sallis et al. (2000) to analyse the content. Each study was listed first by year, and then alphabetically according to first author within each year. Papers meeting the inclusion criteria are indicated in the reference list at the end of this manuscript with an '*'. The data tables were then analysed to create summary tables presented in the results section of this article, the creation of which involved a number of stages. First, the relationships the injury rates had with other variables were examined. Second, the effects of psychological-based prevention interventions on the injury risk in soccer players were also examined.

For each variable, the number of studies and observations and percentage of these observations in which the variable's relationship with the injury rates was positive (+), negative (−) or insignificant (0) are presented. Consistent with Sallis et al. (2000) and other systematic reviews (e.g. Edwards et al., 2014), the 'summary code' column reflects the consistency with which each variable related with the injury rates. A '0' indicates no consistent relationship and was applied when 0–33% of the studies supported an association (and the majority of studies had revealed no relationship with the injury rates). The '?' symbol indicates an indeterminate relationship and signifies that 34–59% of the studies were in agreement regarding a relationship (Sallis et al., 2000). A '+' or '−' symbol indicates a consistent association and was applied when 60% or more of the studies revealed either a significant positive or negative relationship (Sallis et al., 2000). For example, researchers had examined the relationship between the injury rates and history of stressors in eight studies. The summary code given was '+' (or positive) because the majority of studies had revealed positive relationship with the injury rates (75% for a positive relationship).

Meta-analysis of findings examining psychosocial predictors of injury rates among soccer players was not conducted. Most studies did not contain/disclose sufficient quantitative details to enable us to carry out a meta-analysis, without making too many inferences to data published in other articles or relying on assumptions not stated explicitly in the texts. Also, the meta-analyses would likely have been underpowered given the methodological heterogeneity within the included studies, combined with the sample number of studies within each analysis (Borenstein et al., 2009). A semi-quantitative synthesis, as that above-mentioned and described, is a good compromise to provide readers with a summary of consistent research patterns and trends.

However, for studies examining the effects of psychological prevention intervention on soccer injuries, it was possible to perform a meta-analysis. ES were computed from the Mann-Whitney's U test values, converting U figures in r coefficients (rank-biserial correlation, according to Cureton) and the latter in Cohen's *d*.

The magnitude of the effects was interpreted as changes using the following criteria: trivial (< 0.20), small (0.21–0.60), moderate (0.61–1.20), large (1.21–2.00), very large (2.01–4.00) and extremely large (> 4.00) (Hedges, 1981).

The 95% confidence interval (95%CI) for the Cohen's d was approximated using the formula derived from Nakagawa and Cuthill (2007).

Results

Search results

The initial search yielded 102 items, which, after removing the duplicates, reduced to 67. A number of studies (N = 37) were discarded and the full text of 19 studies was assessed for eligibility. Finally, only 13 studies were included concerning the psychosocial predictors and the effects of psychological prevention interventions of soccer injuries (Figure 1). More specifically, ten investigations studied the psychosocial predictors of injury rates among soccer players (Table 1). Three psychological prevention interventions were retrieved to determine its effects on soccer injuries (Table 2).

Figure 1 here

Table 1 here

Table 2 here

Demographic characteristics

The final 13 studies reported on 1,149 injured soccer players across an age range between 14-36 years old. From studies where there was clarity in gender ratio the total participant figure included 46.8% (n = 538) male and 32.9% (n = 378) female injured soccer players while in case of 233 (20.3%) participants' gender was not specified. The players included in this review were subdivided based on competitive level as follows: (a) international (6 studies: 46.1%), (b) national (1 study: 7.7%) and (c) amateur (4 studies: 30.8%).

Psychosocial predictors of injury rates in soccer players

Empirical research findings indicated that personality attributes (i.e., trait anxiety, perceived mastery climate [100%]) and history of stressors (i.e., negative-life-event stress or high level of life stress, daily hassle, previous injury [75%]) were positively correlated with injury rates among soccer players. Furthermore, there were insignificant relationships between stress responses [100%], coping [100%] and injury rates (Table 3).

Table 3 here

Psychological prevention interventions of injuries among soccer players

For injury prevention studies, only one study showed a statistically significant decreased injury rate in the treatment group compared to control group (Johnson et al., 2005). The intervention group involved five distinct treatments (a) somatic and cognitive relaxation, (b) stress management skills, (c) goal setting skills, (d) attribution and self-confidence training, and (e)

identification and discussion about critical incidents related to their football participation and situations in everyday life. However, although two studies reported no statistically significant differences between treatment and control groups in junior soccer players (p-values were found to 0.054 and 0.077, statistically borderline significant), the results were in the expected direction and were interpreted as having clinical significance (Edvardsson et al., 2012; Ivarsson et al., 2015). Methodological factors, such as small sample size, may account for the lack of statistical significance.

Cohen's *d* ES for the studies ranged from 0.59 (medium effect) to 1.41 (large effect). The pooled ES yielded a value of 0.96 [95% CI 0.34-1.58; p = 0.002] (large effect), as shown in the forest plot (Figure 1). Visual inspection of the funnel plot (Figure 2) seems to indicate publication bias.

Figure 1

Figure 2

Discussion

With regards to the purpose of the current review, the present data showed moderately large effect of psychological prevention interventions on reducing of injury rates in soccer players. Moreover, the review found that trait anxiety, perceived mastery climate, negative-life-event stress or high level of life stress, previous injury, and daily hassle were the main psychosocial predictor variables of injury risk among soccer players.

In professional soccer it has been estimated there are 11.2 injuries per 1000 match hours and 3.9 injuries per 1000 training hours from a 10-season study (Le Gall et al., 2006). Traditionally, the treatment of injured athletes has involved only the physical aspects of injury. Moreover, the sports medicine field is becoming more aware of the importance of psychological factors for the treatment of sports injuries (Johnson, Ekengren, & Andersen, 2005; Heaney, 2006; Junge, 2000; Steffen, Pensgaard, & Bahr, 2009; te Wierike et al., 2013). In addition, by reviewing the evidence, the current review revealed the association between history of stressors, personality traits, and injury rates among soccer players (Devantier, 2011; Ivarsson, Johnson, & Podlog, 2013; Johnson & Ivarsson, 2011; Passer and Seese, 1983). Thus, in keeping with the stress-injury model presented above, the associations between history of stressors and injury rates could be explained by suggesting that prolonged stress can generate changes in the functions of the brain's neurological networks (i.e., decreased the communication between the left and right

cerebral hemispheres and the information flow between the brain functions), which may then decrease players' abilities in making decisions that have been related to increased injury risk (Fuchs & Flugge, 2003; Gabbett et al., 2012; Ivarsson et al., 2016). Furthermore, Ivarsson et al. (2016), for example, showed that the stress response (r = 0.27) was the predictor that had the strongest associations with injury rates. Moreover, history of stressors (r = 0.13) and coping (r= -0.07) had weaker relationships with injury rates, whereas, the association between personality traits and injury rates was marginal (r = 0.01). The evidence in the current review suggests that the player who can effectively manage life stress and anxiety will be less likely to be injured. Future studies are needed to examine the psychosocial factors of soccer players according to injury severity and type, playing positions, competitive levels and age. Such work may allow the tailoring of interventions to individual athletes' needs.

Since psychological predictor variables have received support it could be expected that interventions aimed at reducing them would reduce injury risk. Some studies haveshowed that psychological training can be used by injured athletes as a strategy to help them cope during rehabilitation (Beneka et al., 2013; Driediger, Hall, & Callow, 2006; Law et al., 2006; Slimani, Tod, et al., 2016). Preliminary evidence suggests that psychological skills contribute positively to the prevention of injuries, physical recovery from injury, improved self-confidence levels, and decreased cognitive and physical anxiety. These psychological skills are: (a) somatic and cognitive relaxation, (b) stress management skills, (c) goal setting skills, (d) attribution and self-confidence training, and (e) identification and discussion about critical incidents related to their football participation and situations in everyday life (Johnson, Ekengren, & Andersen, 2005). For example, Johnson et al. (2005) examined the effects of a psychological skills training package (i.e., relaxation, stress management, and goal setting) on the risk of injuries among 32 soccer players in Sweden. They showed that the treatment group sustained three injuries (0.22 per athlete) and the control group faced 21 injuries (1.31 per athlete), outcomes of significant difference. Edvardsson et al. (2012) studied the effects of a cognitive behavioral biofeedback intervention on the number of injuries among 27 Swedish soccer players from elite high schools. They attributed the non-significant differences between treatment and control groups as a reflection of the small sample size. In addition, Ivarsson et al. (2015) found that the mindfulness practice they implemented had an effect on injury occurrence that would be meaningful for soccer athletes, coaches, and sport administrators. There are many potential explanations for the mindfulness group having fewer injuries, as well as more non-injured players, than the control group. One possible explanation could be that mindfulness practice

leads to functional changes in the brain's different attention systems (Fox et al., 2006). Given that previous study has found changes in perception and attention (e.g., peripheral vision narrowing) to be related to sport injuries (Rogers & Landers, 2005), it is likely that if players are better in directing their attention towards important stimuli, the probability of them being injured will decrease. An overall hypothesis to be drawn from the present systematic review and meta-analysis is that injury reduction is possible to obtain for soccer players having high injury-risk profiles using combinations of psychological interventions in a brief therapy model.

Collectively the results from existing research shows that practitioners and football players have a range of psychological interventions they can use to avoid injuries, such as goal setting, attribution training relaxation, and stress management. However, this was only evident in one third of studies reviewed. More specifically, only the study containing stress management and relaxation components had a significant effect on injury rates (Johnson et al., 2005). Simply, stress management interventions aimed at increasing athletes' stress management skills and, in particular, at reducing muscle tension and attentional distractibility usually provoked by stressful conditions, contributes to a reduction in the number of sport injuries youth athletes sustained (Olmedilla-Zafra et al., 2017). This observation can also be explained by taking into account that periods of high stress influence cortisol and oxytocin release, which may have a relationship to injury risk (Miller et al., 2007) *via* immune (Hänsel et al., 2010; Maes et al., 1998) and pain (Moberg, 2003) responses. Stress management interventions can have a beneficial effect on these immune and pain responses (Maddison and Prapavessis, 2005; Perna et al., 2005; Tranaeus et al., 2015). Reduced stress levels are also associated with amydgala activation and this may, consequently, reduce injury risk by improving attention and decision-making capacity (Ivarsson et al., 2015; 2017; Gabbett et al., 2012). Thus, relaxation intervention may decrease injury risk among athletes by increasing the activity of the parasympathetic nervous system and reducing the stress response (Davis et al., 2008). Olmedilla et al. (2015) performed a systematic review of 14 preventive intervention studies aimed at reducing the risk of injury in a sports setting. Only 7 studies used control groups and a sample large enough to compare groups meaningfully. The review showed that for 4 out of these 7 studies significant differences could be found. Therefore, it is difficult to determine the strength of the empirical support in favour of a psychological intervention being useful for preventing sports injuries. Some factors might lay at the root of these inconclusive results, such as the use of standardized interventions regardless of the reactivity to stress of each individual, the use of short-term

interventions, the wide range of intervention objectives, and the lack of well-controlled study designs (Olmedilla et al., 2015).

Furthermore, what existing research does not reveal, however, is the best way to implement these interventions. Future research is needed to explore best practice. For example, there may be a matching process, whereby certain interventions are best suited to particular athletes who are experiencing specific stressors or have high levels of particular traits. To illustrate, mindfulness may be suitable for athletes with high levels of cognitive anxiety. Future research could explore which interventions are best suited to which athletes. As another avenue of research, it is not known why these intervention work with injured athletes – what are the active ingredients in service delivery. Research that explores the active ingredients will lead to specific recommendations on how to use interventions.

A limitation of the present study is that we have not conducted a meta-analysis assessing the different psychosocial predictors of injury rates among soccer players. This was due to most studies not containing/disclosing sufficient quantitative data to enable us to perform an in-depth meta-analysis. Despite the low to moderate heterogeneity between studies, direct comparison among different levels of competition or playing level and its influence on experience of stressor could not be performed because of the low number of retrieved and included studies. Furthermore, this review excluded studies that 1) did not provide information that would allow us to complete the planned statistical analyses and 2) did not involve soccer players, having implications for clinical decision making on general athletic populations and not specifically on soccer.

Conclusion

The present review shows that history of stressors and personality attributes are the psychosocial variables with the most consistent evidence in predicting injury rates among soccer players. The data also suggests that psychological prevention interventions may reduce the frequency of soccer injuries. Psychological skills training, particularly somatic and cognitive relaxation, stress management skills, goal setting skills, attribution and self-confidence training, and identification and discussion about critical incidents related to their football participation and situations in everyday life, do probably reduce the injuries rates in soccer players, even though evidence of this was found only in one third of the studies reviewed. Psychological-based interventions should be considered by physiotherapists and other

358 professionals when designing injury prevention programs. However, given the above-
359 mentioned limitations, further high-quality research in the field is urgently needed.

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Highlights

- History of stressors and personality attributes are the main predictors of injury rates among soccer players.
- Psychological-based prevention interventions might have potential to reduce the frequency of soccer injuries.
- The evidence in this review suggests that the player who can effectively manage life stress and anxiety will be less likely to be injured.
- Since the effectiveness of psychological interventions was evident only in one third of studies, further research is needed.

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Table 1. Psychosocial predictors of soccer injuries.

Study	Participants characteristics (n; age; level; gender)	Study design	Predictor variables	Statistical analysis	Main findings
Brink et al. (2010)	n=53; 15-18 years (16.5±1.2 years); elite; NR	Prospective, longitudinal cohort	History of stressors, stress responses using the RESTQ-Sport and the RPE scores	Multinomial regression analysis	Stressors, namely duration (OR 1.14 [95%CI 1.06-1.23]), load (OR 1.01 [95%CI 1.00-1.02]), monotony (OR 2.53 [95%CI 1.22-5.50]) and strain (OR 1.01 [95%CI 1.00-1.01]) are statistically significant predictors of risk injury
Devantier (2011)	n=87 out of a list of n=143 subjects (regression analyses carried out on n=66); 18-34 years (24.61±4.15 years) ; elite; male	Prospective, longitudinal cohort	History of stressors, personality traits that may increase stress responses, coping, using the CTAT, the ACSI – 28, the Williams and Andersen inventory	ANOVA, Pearson's correlation analysis, and logistic regression analysis (backward likelihood-ratio)	Coping with adversity (OR 0.731 [95%CI 0.563-0.949]) is a predictor of risk injury (considering also primary injuries; OR 0.762 [95%CI 0.598-0.971] excluding primary injuries)

Ivarsson and Johnson (2010)	n=48; 16-36 years (22 years); 3 different teams at a competitive level in Sweden (division 4 – 6, middle – low league) ; male	Prospective, longitudinal cohort	History of stressors, using the FWS, the SSP, the LESCA, the Daily Hassles Scale, the Brief COPE	ANOVA, MANOVA, linear regression analysis (backward method)	Coping variables acceptance and self-blame explain 14.6% of the variance of injuries (behavioral disengagement p=0.040 and self blame p=0.044). Personality traits like somatic trait anxiety (p=0.025), psychic trait anxiety (p=0.044), stress susceptibility (p=0.016), and trait irritability (p=0.023) predict injury risk, in particular stress susceptibility (beta=0.357, p=0.016, explaining up to the 10.7% of the total variance)
Ivarsson et al. (2013)	n=56 ; 16-36 years (25.05±5.46 years); professional; 38	Prospective, longitudinal cohort	Personality traits that may increase stress responses, history of stressors, coping, using the SSP,	MANOVA, path analysis	Trait anxiety, negative-life-event stress, and daily hassle explain 24% of the variance.of

	males and 18 females		the LESCA, the Brief COPE, the HUS		injuries. Path coefficient between daily hassle and injury frequency yielded statistical significance (0.55)
Ivarsson et al. (2014)	n=101; 15-19 years (16.7 ± 0.9 years); elite; 67 males and 34 females	Prospective, longitudinal cohort	History of stressors, using the HUS	Intraclass correlations, latent growth curve analysis	Level daily hassle and change daily hassle predict injury risk
Johnson and Ivarsson (2011)	n=82 out of a list of n=108 subjects; 17-19 years; high schools; 85 males and 23 females	Prospective, longitudinal cohort	History of stressors, personality traits that may increase stress responses, coping, using the LESCA, the ACSI – 28, the SAS, the SSP	ANOVA, linear and logistic regression analyses	Negative life event stress (p=0.047), somatic trait anxiety (p=0.02), negative coping (p=0.019) and mistrust (0.008) predict injury risk
Kontos (2004)	n=260 ; 11-14 years (12.68±0.92 years); NR; 148 males and 112 females	Prospective, longitudinal cohort	History of stressors, using the Risk of Injury in Sport Scale, the Risk-Taking Behaviors Scale, the Estimation of Ability and Overestimation of Ability	Pearson's correlation analysis, case-control analysis, MANOVA	Perceived risk and estimation of ability represent significant psychological risk factors
Passer and Seese (1983)	n=104 out of a list of n=123 subjects; NR;	Prospective, longitudinal cohort	History of stressors, using	ANOVA	Negative life change (p=0.02)

	collegiate varsity; NR		the LES, the STAI		predicts injury risk
Steffen et al. (2009)	n=157; 14-16 years; NR; female	Randomized trial	Stress responses, using the POSQ, the PMCSQ, the LESCA	MANOVA, logistic and Poisson's regression analyses, generalized estimated equations	LES total score (OR 1.03 [95%CI 1.01-1.05]) and motivational climate mastery (OR 1.34 [95%CI 1.04-1.72]) predict injury risk
Wilkerson (2012)	n=76; 19.8±1.5 years; national; NR	Prospective cohort study	Stress responses	Cross-tabulation and stratified analyses, ROC analysis	Neurocognitive reaction time predicts injury risk (OR 2.94 [90%CI 1.19-7.25]; RR 2.17 [90% 1.10-4.30])

ACSI – 28: Athletic Coping Skills Inventory – 28; ANOVA: analysis of variance; CTAT: Competitive Trait Anxiety Test; FWS: Football Worry Scale; HUS: Hassles and Uplifts Scale; LES: Life Experiences Survey; LESCA: Life Event Scale for Collegiate Athletes; MANOVA: multivariate analysis of variance; NR: not reported; OR: Odds-Ratio; PMCSQ: Perceived Motivational Climate in Sport Questionnaire; POSQ: Perception of Success Questionnaire; RESTQ-Sport: Recovery Stress Questionnaire for athletes; ROC: Receiver Operating Characteristic/Relative Operating Characteristic; RPE: Rate of Perceived Exertion; RR: Relative Risk; SAS: Sport Anxiety Scale; SSP: Swedish universities Scales of Personality; STAI: State-Trait Anxiety Inventor

Table 2. Effects of psychological prevention intervention on soccer injuries.

Study	Characteristics (age; gender; level; n; years of experience)	Intervention (length)	Measurement	Outcome
Edvardsson et al. (2012)	16–19 years; EG: (*n*=13 out of an initial list of 15 subjects) 9 males, 6 females CG: (*n*=14) 13 males, 1 female; high school	EG: self regulation technique (thought stopping, somatic relaxation, breathing) video clips and stress management (9 weeks; 7 sessions/30-60 minutes)	ACSI-28; LESCA; SAS; injuries frequency; time loss due to injuries	NSD between EG and CG in the injuries frequency (Cohen's d=0.89 [95%CI 0.14-1.63], p=0.054)
Ivarsson et al. (2015)	16-19 years ; 31 males and 10 females; EG: (n = 21) males and females, CG: (n = 20) males and females; junior elite	EG: mindfulness practice (6 months; 7 sessions/45 minutes)	Injury occurrence	NSD in injury occurrence during the study period between the EG and the CG (Cohen´s d =-0.59 ([80%CI -0.37 to -0.74], p=0.077) The participants in the EG experienced fewer injuries (total 8) than the participants in the CG
Johnson et al. (2005)	Male: 22.9 years, females: 20.1 years; EG: (n=13 out of an initial list of 16 subjects) 4 males, 9 females, CG: (n =	EG: Relaxation, stress management, goal setting, attribution, self	ACSI-28; LESCA; SAS; injuries frequency	SD between EG and CG in the injuries frequency (Cohen's d=1.41 [95%CI 1.06-1.76])

	16) 8 males, 8 females; high competitive level, out of an initial list of 132 screened and 32 potentially eligible subjects	confidence, critical incidence diary (19 weeks; 6 sessions/45-90 minutes)

SCS: Sports Confidence State; CAS: Competition Anxiety State; SD: significant differences between groups; NSD: no significant differences between groups; EG: experimental group; CG: control group; ACSI-28: Athletic Coping Skills Inventory-28; LESCA: Life Events Survey for Collegiate Athletes; SAS: Sport Anxiety Scale.

Table 3. Relationships between injury rates and psychosocial variables.

	No. of studies	% of effects supporting presence of effect			Sum code
		+	-	0	
History of stressors	8	75		25	+
Stress responses	3			100	0
Personality traits	3	100			+
Coping	3			100	0

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow-chart.

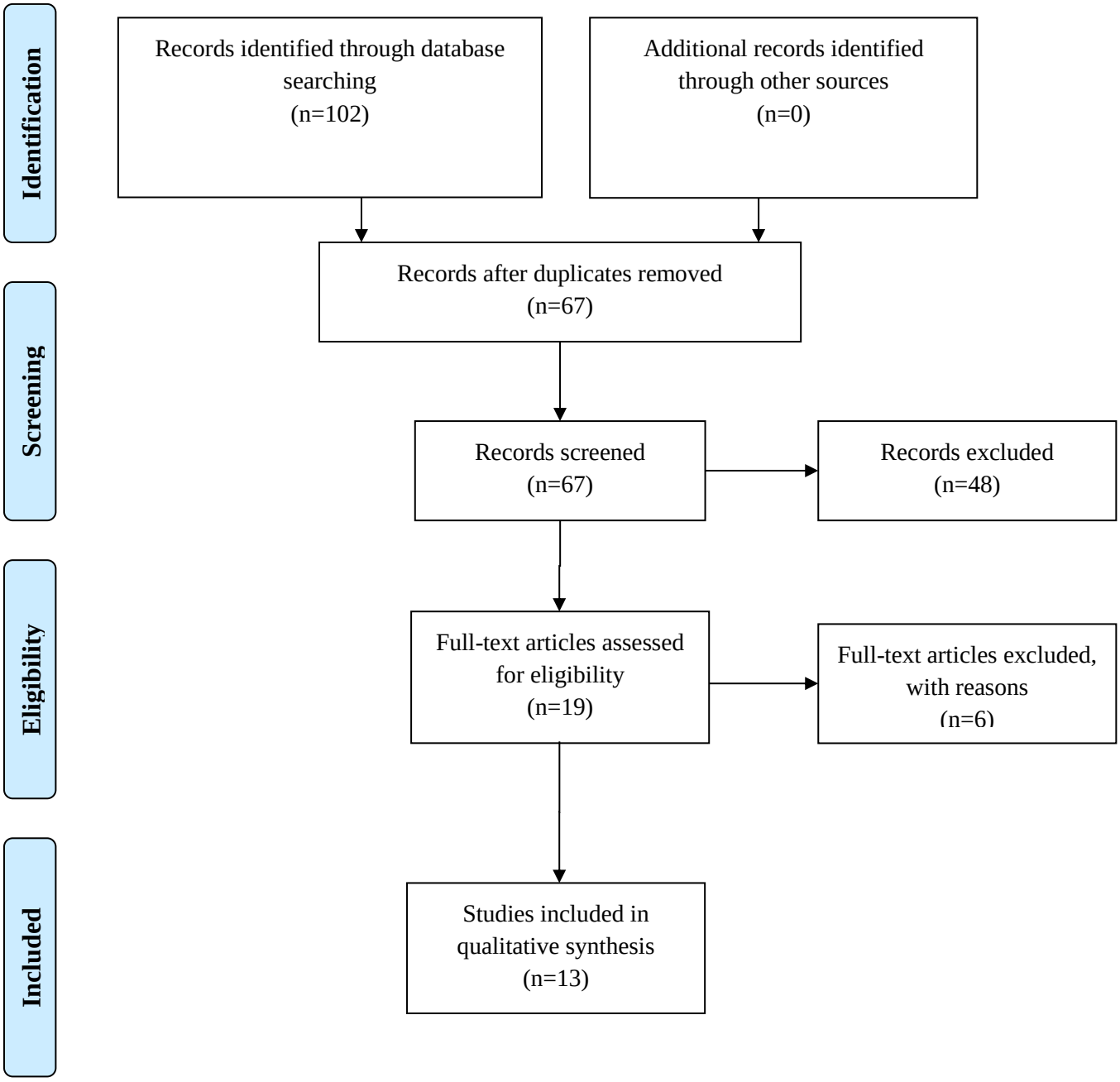

Figure 2. Forest plot of psychological prevention interventions of injuries among soccer players.

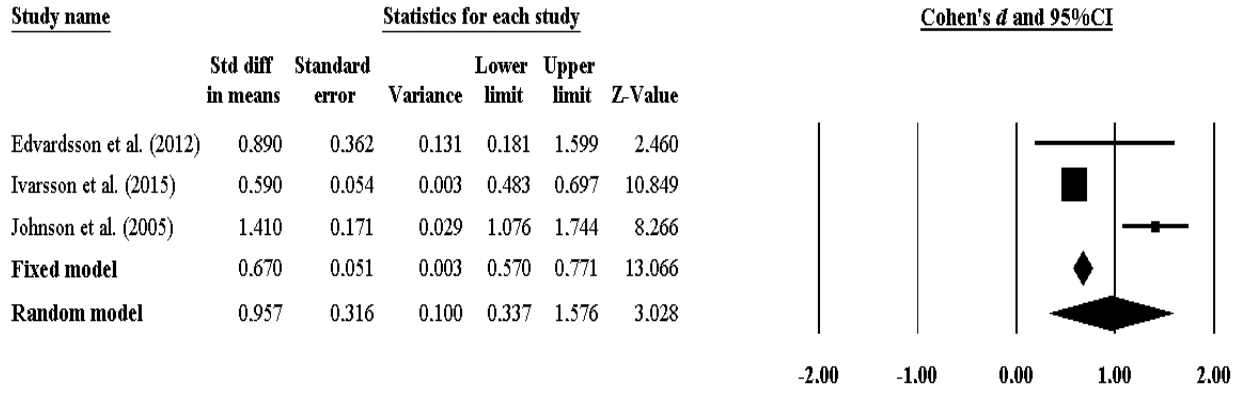

Figure 3. Funnel plot showing evidence of publication bias for the meta-analysis concerning psychological prevention interventions of injuries among soccer players.