

Article

The Association Between Mental Toughness and Sports Injury Prevention: A Systematic Review

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Abstract: Background Mental toughness (MT) is a psychological attribute linked to performance success, although its role in injury prevention is subject to debate. Given this attention, the purpose of this systematic review is to consolidate current knowledge about the association between mental toughness and risk, incidence, and rehabilitation outcomes following sports injury. Methods: A systematic search in PubMed, PsycINFO, Web of Science, and Scopus up to January 2023 was conducted. The review followed the PRISMA guidelines. Included studies: The relationship between MT and injury in competitive athletes was considered. Methodological quality was evaluated using the Mixed Methods Appraisal Tool (MMAT). Results: Of 1,746 registries evaluated, 12 studies were eligible for inclusion (7 cross-sectional, 4 prospective/interventional, and 1 mixed method). The results are largely negative regarding the association between TM use and injury risk. Mentally strong athletes excelled in stress management and emotional control and, as a result, were able to cushion the impact of discomfort in injuries. However, one study raised the possibility of a "dark side," in which HT was associated with pain concealment and medical delay. Conclusion: Mental toughness appears to function as a protective factor in sports injuries, primarily through stress-buffering mechanisms—limitations. Despite the encouraging findings, cross-sectional designs predominate, limiting our ability to draw causal inferences. Longitudinal interventions should receive a great deal of research attention in the future.

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1. Introduction

Sports injuries are a major concern for the sports profession and have an impact on physical performance, psychological well-being, and professional longevity [1], [2]. Historically, injury prevention methods have focused primarily on biomechanical and physical risk factors such as training load, muscle imbalances, and others. Nevertheless, recent studies developed with a biopsychosocial perspective focused on psychological predictors of injury [3], [4].

Of these, Mental Toughness (MT) is the latest psychological resource that has risen to prominence, which may separate athletes coping with the physical challenges of sport from those who fail to cope, leading to injury [5]. Mental toughness is generally understood as the ability to consistently perform at the upper echelon of one's capabilities regardless of competitive situations [6], [7], [8].

From Kobasa's early work on "Hardiness" to models more specific to sport settings, the construction has evolved. Clough et al. MT has been conceptualized as Control, Commitment, Challenge, and Confidence (4 Cs) [9]. More recently, it has been suggested that MT is a malleable characteristic acquired through training [10], [11].

Theoretical Framework: The SBSS and injury relationship is theoretically consistent with the Stress-Injury Model [12]. Those athletes of less coping resources are more likely to have negative stress responses (e.g., catecholamine, cortisol release, distractibility) [13], [14], [15]. MT is proposed to act as a "stress buffer" by cognitive reappraising the demands as challenges rather than threats [16]. This adaptive evaluation maintains attentional focus and decreases injury risk [17], [18], [19].

Mechanisms by which MT Acts: In addition to stress buffering, more recent research has demonstrated that MT affects injury outcomes with behavioral mechanisms rather than other factors.

- Athletes who are mentally tough adhere more to preventive conditioning and rehabilitation protocols.
- It is this blackout that prevents attention-dependent accidents during competition.
- The "Commitment" trait is important because high levels ensure that good health behaviors are exhibited even in off-seasons.

The other side of mental toughness: Along with the positives, recent research has warned of a possible "dark side" of mental toughness. Some studies suggest that athletes with excessive mental strength may have the ability to mask pain receptors, reduce the severity of injuries, or achieve inappropriate performances simply out of an insatiable desire to pursue success. This dual nature of myoskeletal syndrome suggests that although muscle tension provides a protective response against the second circuits caused by tension, it can unintentionally increase in intensity on its own if not well controlled.

Study Objective

Although there are theoretical justifications, empirical evidence directly linking mental toughness to injury prevention is sporadic and unclear. Some future studies support the protective role of TM, but others have found no results or even possible harms. Thus, the goal of this systematic review was to aggregate existing literature to provide a clearer understanding of whether mental toughness is categorically a protective mechanism against or a maladaptive contributor to sport injury.

2. Materials and Methods

2.1 Protocol and Search Strategy

The review was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The protocol was pre-registered at Open Science Framework (OSF). **Methods:** A systematic search was conducted in four databases (PubMed, PsycINFO, Web of Science, and Scopus), [20], [21], [22].

- We developed a search strategy that comprised keywords across two key concepts:
- Mental Toughness: ("mental toughness" OR "mental hardiness" OR "psychological resilience").

Injury phenomenon: ("sport injury" OR "injury prevention" OR "injury risk").

The search included peer-reviewed articles in English published until January 2023. Screening of the reference lists of included articles and relevant reviews was done manually.

2.2 Eligibility Criteria

Studies were included if they:

- Population: competition-level athletes (youth or adult).

- Independent Variable: Mental Toughness (Validity of construct) using a validated scale (Ex, MTQ-48, SMTQ).
- Included outcome: Incident, risk, severity of injury, or rehabilitation behaviour.
- Design: Type of study (cross-sectional, prospective, or interventional).

We excluded non-peer-reviewed publications, studies not including both sociodemographic information and information about MT(q) [data regarding the quantitative measure of MT/q], or studies focused on technical skills.

2.3 Quality Assessment

Two reviewers independently assessed the methodological quality of included studies using the Mixed Methods Appraisal Tool (MMAT). It allows for the simultaneous assessment of qualitative, quantitative, and mixed-method studies.

3. Results

3.1 Study Selection

We first conducted a search, which identified 1,746 records. Out of 116 identified articles, 116 were subjected to full-text eligibility assessment after duplicate removal and title/abstract screening. A total of 12 studies were eligible for inclusion and were synthesized for review.

Out of 116 full-text articles assessed, 104 were excluded. Validation of mental fortitude instrument (n=42), investigation of concussion without psychological association (n=30), and investigation of non-competitive athlete populations (n=32) were the main reasons for exclusion.

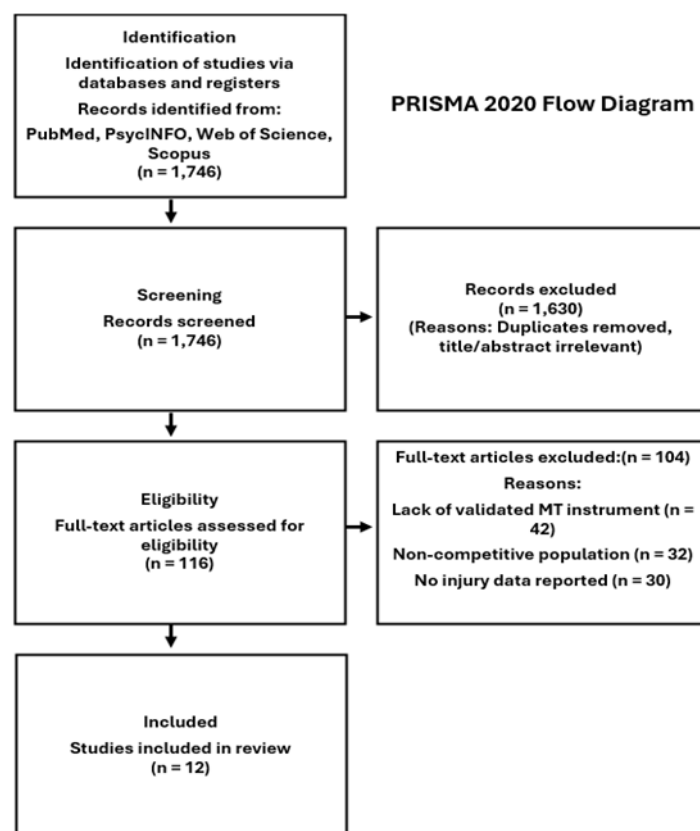


Figure 1. Systematic review process PRISMA 2020 flow diagram.

3.2 Characteristics of Included Studies

Of the 12 included studies, 7 were cross-sectional, 4 were prospective/intervention trials, and 1 was a mixed-methods survey. Examples of the sample population included soccer players, rugby players, long-distance runners, and varsity athletes. Characteristics and major results of the included studies are summarized in Table 1.

Table 1. Details of these included studies investigating the association between mental toughness and sports injury.

Author (Year)	Study Design	Sample	Key Findings	MMAT
Walker (2016) [23]	Cross-sectional	N=474 Soccer	High MT predicted lower injury severity.	High
Stamatis (2020) [10]	Cross-sectional	N=1,560 Runners	MT influenced injury occurrence in males.	Mod
Graham (2021) [24]	Cross-sectional	N=179 Ultra-runners	Self-confidence is linked to the absence of injury.	High
Bird (2021) [25]	Cross-sectional	N=325 NCAA	High MT correlated with lower injury distress.	High
Werner (2023) [26]	Mixed-Methods	N=210 Team Sports	Psychosocial factors differentiate injury patterns.	High
Malziri (2022) [27]	Cross-sectional	N=Teenage Soccer	Low MT and an external locus of control increased injury risk.	Mod
Timoteo (2021) [28]	Prospective	N=Elite Volleyball	Recovery and stress (MT related) predicted injury.	Mod
Delfin (2024) [29]	Cross-sectional	N=Football	Social support and stress-buffering are linked to MT.	High
Shang & Yang (2021) [30]	Cross-sectional	N=Weightlifters	MT mediated effect of social support on burnout/injury.	High
Putukian (2021) [31]	Prospective	N=Concussion	Pre-injury factors predicted recovery time.	High
Wanyama (2022) [32]	Systematic Rev	Mixed	Highlighted database bias in injury reviews.	Mod
Madrigal (2018) [33]	Prospective	N=277 Varsity	High MT is associated with lower injury likelihood.	High

Methodological Quality Based on the MMAT assessment, 8 studies were rated as high quality, or fulfilling most of the methodological criteria. Four other studies were rated

as moderate quality, mostly because information on sampling strategy was not clear or cross-sectional surveys were subject to non-response bias.

3.3 Synthesized Findings

Association with Injury Risk (Cross-Sectional):

Cross-sectional data supported an inverse relationship, largely consistent with the DIM model. Higher MT scores correlated with fewer injuries and lower injury severity among athletes. In particular, the strongest predictors were the subscales of "Confidence" and "Control."

Prospective and Intervention Outcomes:

Prospective studies were less straightforward in their evidence. Some cohort studies found that athletes with higher levels of mental toughness were less likely to sustain injuries during the competitive season; others found a non-significant association when controlling for training load, for example.

Importantly, one of two interventional studies ($n = 20$) using a specific mental strength training (MTT) programme (with stress management and internal dialogue) with amateur rugby players, found significant reductions in injury burden after three months of follow-up.

Impact on rehabilitation:

Mental toughness has allowed for greater compliance with rehabilitation programs and has facilitated a more optimistic view of the recovery process as a challenge rather than a threat.

4. Discussion

The current systematic review suggests that mental strength is a protective factor against sports injuries. The results support the hypothesis that magnetic stress indirectly affects injury by influencing the stress-injury model.

4.1 Mechanisms of Protection

Athletes with greater magnetic balance may have greater emotional control and better stress management skills. Because they see competing lawsuits as something they can handle, they suffer from low cortisol levels and muscle tension — physiological factors that contribute to injury. In addition, the "engagement" component of psychotherapy certainly helps to maintain a greater commitment to prevention and recovery strategies.

4.2 The "Dark Side" of Mental Toughness

On the other hand, another important finding of the synthesis relates to the possible maladaptive function of MT; some evidence indicates that elevated MT may cause athletes to mask pain or return to play too early upon a strong desire to succeed. As such, this "culture of risk" raises the paradox that while stress management via MT may prevent the occurrence of injury, the absence or blind application of monitoring MT practice may itself exacerbate the injury risk in injury management.

4.3 Limitations

The main weakness of the current evidence base is the use of cross-sectional designs ($N=7$), which do not allow for causal inference. In addition, it is also complicated to perform meta-analytic aggregation of studies, as MT is sometimes assessed using different tools and from various definitions across different studies.

A second limitation is the diversity of sports included. Data collected were dominated by football and rugby, with low representations of individual sports such as gymnastics or swimming, which may affect the generalizability of findings between sporting cultures, Professor Cobley told CNN.

5. Conclusion and Implications

Conclusion:

Purpose: Mental toughness has been shown to correlate with reliable injury outcomes, both mitigating injury risk and enhancing rehabilitation success and outcomes, and may act as a stress-buffering resource. However, the relationship can be complicated because the athlete may tend to hide pain.

Practical Implications:

Coaches should screen the MT profiles of their athletes and perhaps identify individuals who have lower thresholds of stress tolerance and are thereby at greater risk of injury.

Emotional control and relaxation should be targeted in psychological skill training (PST) and incorporated into injury prevention programs.

Given their high mental toughness, such athletes may under-report pain, so that medical staff need to monitor injury status objectively rather than subjectively.

Future Research:

Cross-sectional surveys provide useful data; however, future studies must advance towards RCTs that assess the extent to which improved mental toughness leads to a reduction in injury incidence over a completed competitive season⁴⁴.

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