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SYSTEMATIC REVIEW

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Psychological resilience and burnout in professional male athletes: a meta-analysis of injury-related outcomes

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Abstract

Background: This meta-analysis examined associations of psychological resilience, burnout, and perceived stress with injury outcomes (incidence/recurrence and return-to-play (RT-P) duration/time-loss) in professional and semi-professional male athletes. **Methods**: PubMed/MEDLINE, Scopus, Web of Science, and SPORTDiscus were searched (2010–September 2025; last updated September 2025). Eligible studies included validated psychological measures and extractable quantitative data. Random-effects models were applied; heterogeneity (Q, τ^2, I^2), publication bias (Egger's test; trim-and-fill), and robustness (leave-one-out) were assessed. **Results**: Seventeen studies (27 effects; n = 8947) were included. Resilience was negatively associated with injury occurrence ($r = -0.29$; 95% CI: −0.36 to −0.21; $I^2 \approx$ 65–68%) and with shorter RT-P duration (Hedges' $g = -0.48$), corresponding to ~5.3 fewer time-loss days. Burnout correlated positively with injury ($r = 0.34$; 95% CI: 0.24–0.43); high-burnout profiles showed higher odds of injury (OR = 1.75; 95% CI: 1.38–2.22). Perceived stress was positively related to injury ($r = 0.31$; 95% CI: 0.23–0.38). Meta-regression indicated stress predicted burnout ($\beta = 0.42$; SE = 0.08; $p < 0.001$) and the stress × resilience interaction was negative ($\beta = -0.19$; SE = 0.08; $p = 0.015$). **Conclusions**: Resilience appears protective for injury risk and recovery, whereas burnout and perceived stress are psychosocial risk factors. Integrating validated screening tools (CD-RISC, ABQ, PSS) alongside load–recovery and sleep optimization is recommended. **The PROSPERO Registration**: https://www.crd.york.ac.uk/PROSPERO/view/CRD420251165025, CRD420251165025.

Keywords

Professional sport; Men's athlete health; Psychological resilience; Athlete burnout; Perceived stress; Injury prevention; Return-to-play; Meta-analysis

1. Introduction

Professional sport represents the pinnacle of physical performance, but also exposes athletes to cumulative physical and psychological stressors that threaten long-term health. Among male professional athletes, intense physical exertion, competitive pressure, and sustained psychological stress may increase vulnerability to injury and burnout, with adverse consequences for career longevity and mental well-being. Beyond acute traumatic injury, repetitive loading, inadequate recovery, and persistent performance demands contribute to psychophysiological overload and have been associated with elevated injury risk and delayed rehabilitation [1, 2].

Psychological resilience refers to an individual's capacity to adapt effectively and restore equilibrium in response to stressors and adversity. In sport, resilience is recognised not only as an indicator of emotional stability, but also as a determinant of sustainable performance. Qualitative and experimental evidence suggests that higher resilience levels protect against stress and burnout by attenuating psychophysiological processes that predispose athletes to injury [3–5]. Nevertheless, existing research remains fragmented across sports disciplines, with substantial heterogeneity in measurement tools and study designs [6], limiting the synthesis of findings in professional male athletes [7].

The present meta-analysis quantitatively synthesised studies published between 2010 and 2025 to examine associations between psychological resilience, perceived stress, burnout, and injury-related outcomes in professional male athletes. By integrating psychological factors into injury prevention and rehabilitation frameworks, the study aims to support the sustainable management of athletes' physical and psychological health.

Meta-analytic evidence consistently supports the role of psychosocial variables in injury risk. Ivarsson *et al.* [1] demonstrated that stress responses and exposure to stressors

were significantly associated with injury incidence, while psychological preventive interventions reduced injury rates [8]. Prospective interdisciplinary studies further indicate that interactions between life-event stress and physiological markers increase injury likelihood [9]. A meta-analysis by Li *et al.* [10] reported a moderate reduction in injury risk following psychological interventions ($d \approx -0.55$), with robust effects confirmed through sensitivity analyses. Recent syntheses similarly highlight clinically meaningful reductions in injury risk through stress-management-based approaches [7, 11].

These findings suggest that effective injury prevention programmes should extend beyond physical conditioning to include psychoeducation, coping skills, and attentional regulation. Increasing evidence also links mental health indicators, such as anxiety, depression, and psychological stress, to higher injury incidence and prolonged recovery durations [12–14]. Psychological interventions, including mindfulness-based and self-regulation strategies, have been shown to facilitate both physical and psychological recovery in injured athletes [10, 15].

Within this framework, resilience emerges as a central protective resource. The Sporting Resilience Model conceptualises resilience as a dynamic and context-dependent process shaped by individual, social, and environmental factors [5, 16]. Athletes with higher resilience profiles tend to report more adaptive health behaviours, greater well-being, and superior performance, whereas lower resilience has been associated with increased burnout risk [17, 18]. Burnout itself is understood as a multidimensional response to prolonged stress, linked to mental health symptoms and physiological dysregulation [19, 20].

From a biopsychosocial perspective, resilience may influence stress regulation through neurophysiological pathways, including heart rate variability and hypothalamic–pituitary–adrenal axis functioning [5, 21], as well as endocrine responses under sustained training load [22]. Collectively, these mechanisms suggest that resilience plays a regulatory role within the stress–burnout continuum.

Despite growing evidence, systematic meta-analytical research focusing specifically on professional male athletes remains limited. Although associations between psychosocial factors, injury, and burnout have been reported [1, 4, 9, 11, 14, 17, 18, 23–26], few studies have quantitatively synthesised the resilience–stress–burnout axis in relation to injury-related outcomes such as incidence, recurrence, and return-to-play duration. Methodological heterogeneity across sports and measurement instruments further complicates the estimation of comparable effect sizes.

2. Materials and methods

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement [27] and the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines [28], which are recommended for the quantitative synthesis of observational research. The methodological framework was structured prior to data collection, and all procedural and reporting stages adhered to the PRISMA 2020 and MOOSE protocols. Observational studies were evaluated using the MOOSE principles, whereas any available randomized controlled trials (RCTs) were analyzed separately using the Cochrane RoB 2 tool. Design-based subgroup and sensitivity analyses were subsequently performed. The PRISMA 2020 checklist is available as **Supplementary material**.

This meta-analysis was retrospectively registered in PROSPERO (CRD420251165025) on 10 October 2025. Registration was not completed prior to study initiation due to limited awareness of PROSPERO requirements; however, the research protocol had been pre-defined and strictly followed throughout the study in line with PRISMA 2020 and MOOSE standards.

2.1 Eligibility criteria (PICOS framework)

Population (P): Professional or semi-professional male athletes competing in elite leagues, national teams, or high-level individual sports.

Exposure (I/E): Psychological resilience, burnout, or stress levels assessed through validated psychometric instruments.

Comparator (C): Between-group comparisons of low versus high resilience profiles, temporal comparisons, or correlations reported against a reference level.

Outcomes (O): Injury incidence, recurrence, return-to-play duration, number of days lost to injury, and burnout/stress outcomes linked to performance or health.

Study Design (S): Observational designs (prospective or retrospective cohort, cross-sectional, case-control) and RCTs.

Inclusion criteria:

(i) Studies published in English between 2010–2025;

(ii) Samples comprising professional or semi-professional male athletes;

(iii) Quantitative outcomes relating psychological variables (resilience, stress, burnout) to injury indicators;

(iv) Availability of effect size data or calculable statistics (*e.g.*, *r*, standard deviation (SD), odds ratio (OR), risk ratio (RR)).

Exclusion criteria:

(i) Studies including female or mixed-gender samples without separate male data;

(ii) Amateur/recreational athlete populations;

(iii) Qualitative studies, case reports, conference abstracts;

(iv) Narrative reviews or studies without quantitative synthesis;

(v) Studies with insufficient data where author contact failed.

2.2 Information sources and search strategy

Electronic searches were conducted in PubMed/MEDLINE, Scopus, Web of Science Core Collection, and SPORTDiscus databases up to September 2025. The complete search strategy was developed using Boolean operators and adapted for each database. An example of PubMed query was: (“resilience” OR “psychological resilience” OR “mental toughness”) AND (“burnout” OR “stress”) AND (injur* OR musculoskeletal injur* OR time-loss) AND (athlete* OR “professional sport*”

OR "elite") AND (male OR men). Duplicate records were removed through automated and manual screening in EndNote X9 (Clarivate, Philadelphia, PA, USA), which was used for reference management and duplicate detection during the screening process. Manual citation chaining and grey literature screening were also performed to minimize publication bias, following the methodological recommendations of Engeroff *et al.* [2] and Tranaeus *et al.* [7] for comprehensive sport-related meta-analyses.

2.3 Study selection

Title–abstract and full-text screenings were conducted independently by two reviewers, with discrepancies resolved through consensus by a third evaluator. Inter-rater reliability had a Cohen's $\kappa = 0.82$, indicating high agreement. Comparable reliability was achieved at the full-text stage.

The full selection process is summarised in Fig. 1, following the PRISMA 2020 format.

2.4 Data items and measurement definitions

A standardised extraction form was used to collect:

Study metadata (year, country, sport type (team/individual), league level, design, follow-up duration);

Sample characteristics (N, mean age ± SD, continent, competition level);

Psychological instruments (*e.g.*, CD-RISC (resilience), ABQ or Maslach Burnout Inventory (burnout) [21], Perceived Stress Scale (PSS), Depression Anxiety Stress Scales (DASS), and International Olympic Committee (IOC) time-loss injury standard);

Injury definitions (IOC time-loss standard), incidence/recurrence rates, return-to-play (RT-P) duration;

Statistical indicators (r, M–SD, OR, RR).

Risk of bias was assessed using the Newcastle-Ottawa Scale (NOS) [29].

Multiple measurements within the same sample were aggregated using the Robust Variance Estimation (RVE) approach to handle dependent data structures [30]. When necessary, corresponding authors were contacted for missing data. Median-to-mean conversions were conducted under valid assumptions and verified through sensitivity checks.

2.5 Risk of bias and quality assessment

Observational studies were assessed using the Newcastle-Ottawa Scale (NOS) [29], while RCTs, if available, were evaluated using the Cochrane Risk of Bias 2 tool (RoB 2).

Two independent reviewers conducted scoring, resolving disagreements by consensus. Risk of bias categories (low, moderate, high) were derived from the total NOS and domain scores, in line with Wells *et al.* [29].

The main characteristics of the included studies are summarised in Table 1 (Ref. [21, 27, 28]) (**Supplementary material**).

2.6 Effect size computation

Correlations: Pearson's r values were Fisher z-transformed, weighted by sample size, and back-transformed after pooling.

Continuous variables: Hedges' g with small-sample correction.

Dichotomous outcomes: Odds Ratios (OR) or Risk Ratios (RR), log-transformed; Haldane-Anscombe correction used for zero-event cells.

All effect sizes are reported with 95% confidence intervals (CIs) using two-tailed tests.

2.7 Synthesis methods

Primary pooled estimates were derived using a random-effects model with the Restricted Maximum Likelihood (REML) estimator, and confidence intervals were adjusted via the Hartung-Knapp correction [30].

The DerSimonian-Laird [31] estimator was applied as a sensitivity model, yielding negligible difference ($\Delta < 0.02$).

Heterogeneity was quantified with Q, τ^2, and I^2, and 95% prediction intervals were reported.

Pre-specified subgroup analyses were conducted by: sport type, competition level, age, continent, instrument type, injury definition, follow-up duration, and study quality. Weighted least squares (WLS) meta-regressions explored potential moderators (*e.g.*, sample size, measurement scale).

2.8 Publication bias and sensitivity analyses

Publication bias was assessed via funnel plots and Egger's regression test [32]. When asymmetry was observed, bias adjustment was performed using the Duval and Tweedie trim-and-fill method [33].

Sensitivity analyses included:

(i) leave-one-out tests,

(ii) exclusion of high-risk studies,

(iii) estimator robustness (Restricted Maximum Likelihood (REML) + Hartung-Knapp adjustment (HK) ↔ DerSimonian-Laird estimator (DL)),

(iv) metric consistency ($r \leftrightarrow g \leftrightarrow$ OR/RR),

(v) influence diagnostics (DFBETAS (difference in betas), Cook's distance).

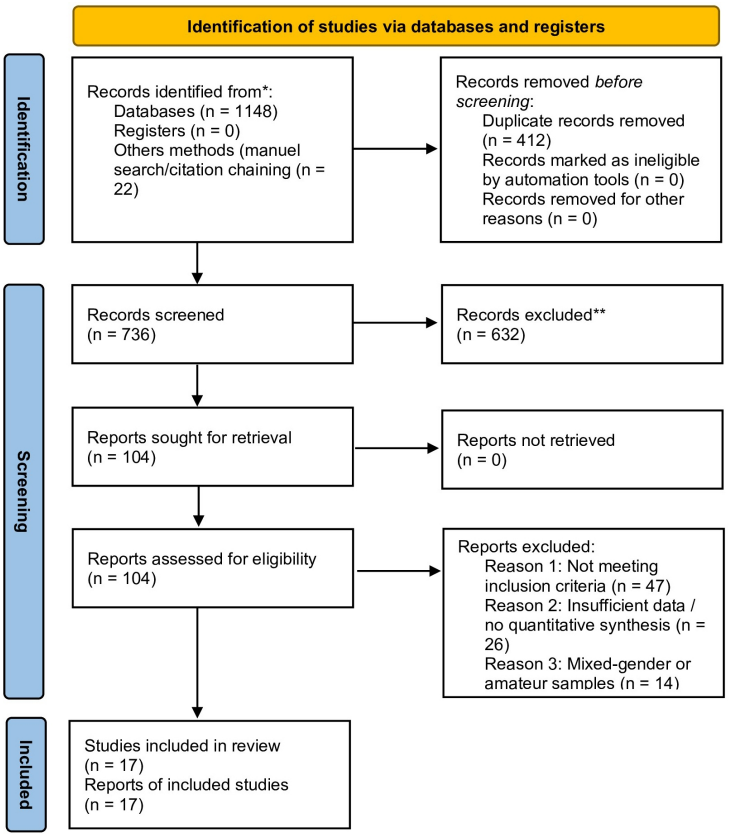
All checks confirmed stability in both direction and magnitude of pooled estimates.

2.9 Software and statistical thresholds

Analyses were conducted in R (v4.3.2) using the metafor and meta packages, with cross-validation in Stata 18 (StataCorp LLC, College Station, TX, USA), and JASP 0.18. The significance threshold was set at $\alpha = 0.05$ (two-tailed).

3. Results

This section first presents a quantitative description of the inclusion process and scope, followed by the results of the primary and secondary analyses, reported in accordance with the statistical framework outlined in the Methods section. A total of 1148 records were identified through database searches



*PubMed/MEDLINE (n = 384), Scopus (n = 312), Web of Science (n = 267), and SPORTDiscus (n = 163) databases were searched. An additional 22 records were identified through manual search and citation chaining.

**Duplicate removal and screening were conducted using EndNote X9. No automated exclusion algorithms were used; all exclusions were performed manually by two independent reviewers.

FIGURE 1. PRISMA 2020 flow diagram of study selection and inclusion process. Flow of information through the identification, screening, eligibility, and inclusion phases of the systematic review. Records were identified from PubMed, Scopus, Web of Science, and SPORTDiscus (n = 1126), with an additional 22 records identified through manual search and citation chaining. After removing 412 duplicates and applying eligibility criteria, 17 studies were included in the final quantitative synthesis.

TABLE 1. Summary characteristics of included studies.

Characteristic	Value
Number of studies (total)	17
Design	Prospective/retrospective cohort; cross-sectional; (if applicable) case-control/RCT
Sport type	Team sports (*e.g.*, football/soccer, basketball, rugby, handball) and individual sports (*e.g.*, combat sports, athletics, endurance disciplines)
Continent	Europe, North America, Asia, and Oceania
Psychological measures	Resilience: CD-RISC; Burnout: ABQ or Maslach Burnout Inventory [21]; Stress: PSS or DASS
Injury criterion	IOC “time-loss” definition; incidence, recurrence, return-to-play (RT-P) duration
Quality (NOS)	Median 7 (IQR 6–8)
Mean age (yr)	Study-level mean ages ranged approximately from 21 to 27 years

NOS: Newcastle-Ottawa Scale; CD-RISC: Connor-Davidson Resilience Scale; ABQ: Athlete Burnout Questionnaire; PSS: Perceived Stress Scale; DASS: Depression Anxiety Stress Scale; RCT: randomised controlled trial; IOC: International Olympic Committee; IQR: interquartile range. Detailed study-level characteristics (e.g., sport type, competition level, continent, design, sample size, and measurement tools) are summarised in the Results section (Table 1) in accordance with PRISMA 2020 and MOOSE recommendations [27, 28].

(PubMed: 384; Scopus: 312; Web of Science: 267; SPORTDiscus: 163; manual search/citation chaining: 22). After removing 412 duplicates, 736 unique records were screened at the title–abstract level. Following the initial screening, 104 studies were assessed in full text, of which 87 were excluded for not meeting the eligibility criteria. Ultimately, 17 studies were included in the meta-analysis (Fig. 1, PRISMA), representing a pooled sample of 8947 professional and semi-professional male athletes. Of these 17 studies, 14 contributed quantitative effects to the resilience–injury analyses (k = 27 effects), 12 contributed to the burnout–injury analyses (k = 16 effects), and 11 contributed to the stress–injury and stress–burnout models (k = 14 effects).

According to Table 1, the 17 studies included in the meta-analysis are summarised in terms of their sample and methodological characteristics. Most studies employed either a prospective cohort or cross-sectional design, and the distribution across multiple sport disciplines and competitive settings (team and individual sports in Europe, North America, Asia, and Oceania) supports the external relevance of the findings to elite male sport. Psychological assessments relied on the CD-RISC for resilience, the ABQ or Maslach Burnout Inventory for burnout [21], and the PSS or DASS for stress. Injury definitions were consistent across studies, all adhering to the IOC "time-loss" criterion for incidence and recurrence, and reporting return-to-play (RT-P) duration in days lost from sport. The median methodological quality, based on the NOS, was 7 (IQR: 6–8), indicating an overall moderate-to-high level of study quality. Across included samples, mean participant age fell in the early-to-late twenties, indicating that the analysed cohorts predominantly comprised young adult male professionals at the highest levels of competition.

Of the 17 included studies, 9 (53%) employed prospective or retrospective cohort designs, 7 (41%) were cross-sectional, and 1 (6%) was case-control or RCT. Ten studies (59%) examined team sports and seven (41%) individual sports. By continent, 8 (47%) were conducted in Europe, 5 (29%) in North America, 3 (18%) in Asia, and 1 (6%) in Oceania. These proportions indicate a balanced representation across study designs, sport types, and geographic regions.

According to Table 2, the pooled estimate of 27 correlation effects indicates that the resilience–injury relationship is negative and statistically significant (r = −0.29; 95% CI: −0.36, −0.21; $p < 0.001$). Heterogeneity was significant (Q = 141.2; $p < 0.001$; I^2 = 68.4%). The difference between team and individual sport subgroups was not statistically significant, but heterogeneity was significant (Cochran's Q statistic for moderators (QM) = 1.87; p = 0.17). In RT-P comparisons, athletes with higher resilience profiles demonstrated a shorter return-to-play duration after injury (g = −0.48; 95% CI: −0.70, −0.27; $p < 0.001$), corresponding to an approximately 5.3-day reduction in time-loss. The 95% prediction interval for the main association ranged from −0.45 to −0.11, indicating that the protective direction of the resilience–injury effect was consistent across settings.

This effect size corresponds to a moderate relationship according to conventional benchmarks ($r \approx 0.30$; $g \approx 0.50$ are typically interpreted as moderate). In this context, the impact of resilience on injury risk and recovery is both statistically significant and practically relevant for athlete availability.

According to Table 3, the relationship between burnout and injury incidence is positive, statistically significant, and of moderate magnitude (r = 0.34; $p < 0.001$). The emotional exhaustion subscale showed the strongest association with injury (r = 0.37; $p < 0.001$). Burnout was also positively associated with days lost from play due to injury (r = 0.28; p = 0.002), indicating a measurable functional impact on player availability. Finally, high-burnout profiles were associated with a higher likelihood of injury (OR = 1.75; 95% CI: 1.38, 2.22; $p < 0.001$), corresponding to approximately a 75% increase in injury odds relative to lower-burnout profiles.

According to Table 4, perceived stress showed a positive and statistically significant association with injury incidence (r = 0.31; $p < 0.001$). Higher perceived stress was also a significant predictor of higher burnout scores (β = 0.42; SE = 0.08; $p < 0.001$). The interaction term between stress and resilience was negative and statistically significant (β = −0.19; SE = 0.08; p = 0.015), indicating that resilience exerted a buffering effect, attenuating the association between stress and injury.

According to Table 5, age moderated the stress–injury association: younger athletes (≤25 years) demonstrated a stronger stress–injury relationship compared with older athletes (>25 years) (r = 0.36 *vs.* 0.25; p = 0.031). Other moderators (competition level, continent, scale type) showed consistent directional patterns across strata, although heterogeneity (I^2) varied by competitive context and geographic region. The multiple meta-regression model indicated that methodological quality (NOS), age, and instrument type together explained approximately 28% of the between-study variance. Publication bias and robustness checks are summarized in Table 6 (Ref. [30, 31]).

Amoderate level of heterogeneity was identified across analyses (mean $I^2 \approx 65\%$; $\tau^2 \approx 0.024$). The 95% prediction interval ranged from −0.45 to −0.11 for the primary resilience–injury association, suggesting that the protective effect of resilience on injury risk was directionally consistent across sports, although variable in magnitude. Influence diagnostics (DFBETAS, Cook's distance) confirmed that no single study exerted disproportionate leverage on the pooled estimates.

Overall, psychological resilience among professional male athletes was associated with reduced injury risk and shorter RT-P duration, whereas burnout and perceived stress were associated with increased injury risk, greater time-loss, and elevated odds of injury. Resilience further demonstrated a buffering effect on the stress–injury relationship. These pooled associations provide the empirical basis for the subsequent discussion regarding the integration of psychosocial monitoring and intervention into elite sport injury prevention and rehabilitation practice.

4. Discussion

This meta-analysis quantitatively synthesised evidence across 17 studies (n = 8947 professional and semi-professional male athletes) and demonstrated three core findings. First, higher psychological resilience was associated with lower injury risk ($r \approx -0.29$) and shorter return-to-play (RT-P) duration following injury ($g \approx -0.48$), corresponding to an average reduction

TABLE 2. Resilience–injury relationship: main and subgroup analyses.

Analysis	$k^{\dagger}$	Effect size	Estimate (95% CI)	p	I^2
Main analysis (correlation)	27	r	−0.29 (−0.36, −0.21)	<0.001	68.4%
Team sports	15	r	−0.26 (−0.34, −0.17)	<0.001	62.0%
Individual sports	12	r	−0.33 (−0.42, −0.23)	<0.001	56.0%
RT-P (high *vs.* low resilience)*	9	g	−0.48 (−0.70, −0.27)	<0.001	41.0%

**RT-P refers to return-to-play duration following injury (days lost from competition/training); negative g indicates shorter RT-P duration in favour of higher resilience. $k^{\dagger}$: number of effects (total of 17 studies contributing effects). 95% PI (prediction interval) −0.45 to −0.11. RT-P: return-to-play; CI: confidence interval.*

TABLE 3. Burnout in relation to injury and recovery indicators.

Outcome	$k^{\dagger}$	Effect size	Estimate (95% CI)	p	Note
Injury incidence (overall)	16	r	0.34 (0.24, 0.43)	<0.001	Moderate correlation
Emotional exhaustion subscale	10	r	0.37 (0.25, 0.48)	<0.001	Strongest subdimension
Days lost	7	r	0.28 (0.11, 0.44)	0.002	Functional impact
Increased risk	6	OR	1.75 (1.38, 2.22)	<0.001	Logit-transformed odds ratio (OR)

$k^{\dagger}$: number of effects. CI: confidence interval. Higher burnout is associated with increased injury incidence and greater time-loss.

TABLE 4. Stress–injury relationship and interaction effects.

Model	Dependent variable	Predictor(s)	Coefficient (95% CI/SE)	p
Correlation (random effects)	Injury incidence	Stress (PSS/DASS)	r = 0.31 (0.23, 0.38)	<0.001
Meta-regression 1	Burnout score	Stress	β = 0.42 (SE = 0.08)	<0.001
Meta-regression 2	Injury incidence	Stress × Resilience	β = −0.19 (SE = 0.08)	0.015

β: standardised regression coefficient; SE: standard error; PSS: Perceived Stress Scale; DASS: Depression Anxiety Stress Scale; CI: confidence interval. Interpretation: higher perceived stress is associated with higher injury incidence and higher burnout; resilience moderates (buffers) the stress–injury link.

TABLE 5. Summary of subgroup and multiple meta-regression analyses.

Moderator	Level	Effect	p	Note
Age (yr)	≤25 *vs.* >25	r: 0.36 *vs.* 0.25	0.031	Stress–injury association stronger in younger athletes
Competition level	International	g = 0.54	-	Burnout effect more pronounced
Continent	Europe *vs.* North America	I^2: 72% *vs.* 58%	-	Difference in heterogeneity
Scale type	CD-RISC *vs.* others	r: −0.32 *vs.* −0.25	-	Stronger resilience association
Multiple model (REML)	NOS + age + scale	R^2_meta ≈ 0.28	-	∼28% of between-study variance explained

NOS: Newcastle-Ottawa Scale; REML: Restricted Maximum Likelihood; R^2_meta: proportion of between-study variance explained at the meta-analytic level; CD-RISC: Connor-Davidson Resilience Scale.

TABLE 6. Publication bias and robustness checks.

Test	Result	Interpretation
Egger regression	β = 1.27; p = 0.18	No evidence of small-study asymmetry
Trim-and-fill	+2 studies; r: −0.28 → −0.27	Pooled effect stable after adjustment
Leave-one-out	No single study distorted effect	High robustness
Estimator sensitivity	DL ≈ REML ($\Delta r < 0.02$)	Estimates consistent across estimators
Hartung-Knapp	Results unchanged	Small-sample correction had limited impact

DL: DerSimonian-Laird estimator [31]; REML: Restricted Maximum Likelihood [30]. Excluding studies judged high risk of bias (NOS <6) did not materially change the pooled resilience–injury, burnout–injury, or stress–injury effects (all $|\Delta r| < 0.03$), indicating robustness to study quality.

of approximately five days in time-loss from sport. Second, higher levels of burnout were associated with greater injury incidence ($r \approx 0.34$), greater days lost due to injury ($r \approx 0.28$), and ~1.75 times higher odds of injury (OR = 1.75). Third, perceived stress showed a positive association with injury incidence ($r \approx 0.31$) and a strong positive association with burnout ($\beta = 0.42$), while resilience buffered the stress–injury association (stress × resilience interaction $\beta = -0.19$). Together, these findings indicate that psychosocial functioning is not peripheral, but structurally embedded in injury vulnerability, availability, and rehabilitation in elite male sport. They also extend prior work linking psychosocial stress to injury risk in athletes [1, 7, 9, 10] by quantifying, in a male professional population, that resilience operates not only as a correlate of well-being, but also as a protective factor with direct relevance to physical health outcomes.

To our knowledge, this is the first synthesis focused specifically on professional and semi-professional male athletes that combines resilience, stress, burnout, and injury-related outcomes (injury incidence, recurrence, and RT-P duration) within one quantitative framework. Previous research has established that stress responses, adverse life events, and inadequate coping are associated with increased injury risk [1, 8–10] and that targeted psychological interventions can reduce this risk [10, 16]. However, most prior work has drawn on mixed-gender or general athletic samples, making it difficult to isolate mechanisms relevant to elite male sport. The present analysis addresses this gap by (i) restricting the population to male professional and semi-professional athletes—a group exposed to distinctive psychosocial pressures including contract insecurity, norms of emotional suppression, and expectations of uninterrupted availability—and (ii) examining clinically meaningful outcomes (*e.g.*, days lost to injury, return-to-play duration). In doing so, the findings provide sport medical and performance staff with effect sizes that can be directly interpreted in terms of time-loss, readiness to return, and exposure to reinjury risk.

The observed role of resilience is consistent with contemporary models conceptualising resilience in sport as a dynamic and context-dependent capacity, rather than a fixed trait [17, 18]. The Sporting Resilience Model proposes that resilience in elite performers emerges from the coordinated interaction of resources at the individual level (self-regulation, cognitive appraisal, attentional control), interpersonal level (coaching relationship quality, social support from teammates and staff), and environmental/organisational level (clarity of role expectations, recovery-supportive culture, psychologically safe communication norms) [17, 18]. In the present meta-analysis, higher resilience was associated with both reduced injury risk and more efficient return-to-play, and it attenuated the strength of the stress–injury association. Interpreted through this model, resilience appears to function as an adaptive regulatory process that helps athletes absorb and reorganise under high load rather than simply "toughing it out".

This interpretation is also congruent with qualitative work in elite athletes and Olympic champions, who describe resilience not as invulnerability, but as an active process of recovery, reframing, and resource mobilisation under pressure [3, 4]. Athletes with high-resilience profiles are more likely to engage in adaptive coping, maintain motivation, and sustain functional self-regulation in the face of ongoing demands [17, 18]. Conversely, lower resilience has been associated with emotional dysregulation, rumination, and withdrawal, patterns which have been linked to increased susceptibility to burnout and delayed recovery from injury [17–19, 26]. The present findings add a quantitative layer to that picture: resilience does not merely co-occur with better psychological health, it is meaningfully associated with reduced physical time-loss and lower injury exposure in professional male athletes.

Burnout, in contrast, emerged as a risk factor. Across the included studies, higher burnout scores were associated with higher injury incidence ($r \approx 0.34$), more days lost ($r \approx 0.28$), and substantially elevated injury odds (OR = 1.75). The emotional exhaustion component—which reflects mental and physical depletion, reduced perceived energy, and loss of functional engagement—showed the strongest association with injury indicators ($r \approx 0.37$). This aligns with established theoretical frameworks of athlete burnout, including Smith's cognitive–affective model [20] and multidimensional approaches derived from Maslach and Jackson [21], which conceptualise burnout as a chronic maladaptive response to sustained stress, overload, and thwarted recovery rather than as simple "fatigue". Burnout in high-performance sport has been linked to adverse mental health outcomes (*e.g.*, depressive mood, anxiety, sleep dysregulation) [19, 22, 23], as well as physiological dysregulation (*e.g.*, altered autonomic balance, stress hormone irregularity) that may compromise decision-making speed, motor control, attentional selectivity, and recovery quality [22–25]. In practical terms, an athlete who is emotionally exhausted and psychologically detached from their sport is not only at increased risk of error and suboptimal movement under load, but may also experience slower rehabilitation engagement and poorer adherence, contributing to prolonged RT-P.

The finding that perceived stress was associated with both increased injury risk and higher burnout, while resilience moderated the stress–injury relationship, further supports a stress–resilience–burnout pathway in elite male sport. High perceived stress—which typically reflects cumulative psychosocial load, including competitive pressure, role insecurity, evaluation anxiety, and life-event strain [1, 8–10, 12, 14, 15]—appears to elevate both injury exposure and burnout risk. Burnout then links back to injury, suggesting a feedback process: sustained psychosocial stress promotes burnout; burnout amplifies both immediate injury risk and time-loss severity; prolonged injury and prolonged absence can in turn sustain or worsen stress. Within that loop, resilience operates as a buffer, weakening the stress → injury pathway ($\beta = -0.19$), which implies that resilience-building is not just "well-being work", but injury-prevention and availability work.

Although the present meta-analysis did not directly model physiological mediators, existing literature offers a plausible biopsychosocial mechanism that is consistent with the observed associations [17, 18, 22–25, 34]. Athletes with higher resilience tend to exhibit more adaptive autonomic regulation, often indexed through heart rate variability (HRV)—a marker

of parasympathetic regulation and allostatic flexibility that is widely used in elite sport to monitor load, readiness, and recovery [24, 34]. Similarly, resilience has been linked to more stable hypothalamic–pituitary–adrenal (HPA) axis responses, including less dysregulated cortisol secretion under high training or competitive load [22, 25]. By contrast, chronic stress and burnout have been associated with autonomic imbalance, sleep disruption, attentional fatigue, and motivational depletion [19–23]. From an applied standpoint, it is reasonable to infer—and future longitudinal research should explicitly test—that athletes with greater resilience may maintain a more favourable psychophysiological recovery profile across microcycles and mesocycles, thereby reducing cumulative breakdown risk.

Moderator analyses help contextualise these processes within elite male sport. First, age mattered: athletes aged ≤25 years showed a stronger stress–injury association than older athletes (>25 years), suggesting that self-regulatory and coping resources (*e.g.*, emotional regulation, attentional control, proactive recovery strategies) may be less established in younger professionals. This aligns with reports that early-career athletes often navigate intense contract pressure, status insecurity, and reduced perceived control, all of which can amplify stress reactivity and undermine adaptive coping [7, 13–15, 17]. Second, competition level influenced effect patterns, with international-level samples showing more pronounced burnout-related effects on functional outcomes (*e.g.*, RT-P). This supports the idea that cumulative travel demands, performance scrutiny, and limited recovery windows at the highest competitive tiers intensify psychosocial load. Third, geographical/organisational context (*e.g.*, European *vs.* North American systems) appeared to influence heterogeneity (I^2), implying that culture, sport governance structures, medical support models, and norms around disclosure of psychological distress may contribute to between-study variability. These contextual moderators reinforce that male elite sport is not psychologically neutral: it is an environment with embedded structural pressures that can either exacerbate or buffer stress.

From an applied sports medicine and performance perspective, the current findings support four interconnected recommendations for practice, which are also in line with prior calls in elite sport psychology and injury prevention research [1, 7, 10, 16, 17, 22, 23]:

(i) Screening and monitoring. Routine pre-season and in-season screening using validated tools—*e.g.*, CD-RISC for resilience, Athlete Burnout Questionnaire or Maslach Burnout Inventory for burnout [20–22], and Perceived Stress Scale/DASS for stress—can help identify at-risk athletes before injury manifests as time-loss. These instruments should be integrated into the same workflow as physical load monitoring, not treated as an optional adjunct. Importantly, psychological screening in male professional sport must be handled with attention to confidentiality and stigma, given that disclosure of stress or emotional exhaustion may be culturally penalised or perceived as a threat to selection and contract status [13, 14, 17, 18].

(ii) Targeted intervention. Interventions that target coping skills, attentional control, and stress regulation (*e.g.*, mindfulness-based training, cognitive restructuring, self-regulation training, and guided recovery strategies) have shown moderate preventive effects on injury risk [10, 16]. Embedding these modules within standard high-performance support—rather than only offering them reactively post-injury—may reduce both initial injury incidence and subsequent burnout progression.

(iii) Rehabilitation integration. Psychological skills training and resilience-supportive coaching behaviours should be considered part of rehabilitation planning, not an optional "mental add-on". The present findings suggest that resilience relates to shorter RT-P duration. Goal-setting, confidence rebuilding, and supportive communication around readiness to return may accelerate functional reintegration and reduce the emotional exhaustion component of burnout, which was most strongly associated with injury indices.

(iv) Load management plus psychosocial context. Medical/performance teams increasingly combine external/internal load metrics with physiological readiness markers (*e.g.*, HRV) to inform training decisions [24, 34]. The current synthesis suggests that adding psychosocial indicators—perceived stress, burnout exhaustion, resilience "buffer strength"—would create a more complete decision-support model. In particular, athletes presenting high stress + low resilience + high emotional exhaustion should be flagged not only for injury risk, but also for potential delayed recovery and prolonged time-loss. This has direct implications for squad rotation, return-to-play decisions, and ethical duty of care. It also raises cultural and governance questions in professional men's sport: performance environments must ensure that psychosocial monitoring is not weaponised contractually, but instead used to protect long-term health and availability.

The strengths of this meta-analysis include: (i) its exclusive focus on professional and semi-professional male athletes, a population under-represented in previous quantitative syntheses; (ii) simultaneous modelling of resilience, stress, and burnout in relation to clinically relevant injury outcomes (incidence, days lost, RT-P); (iii) a rigorous methodological approach (PRISMA 2020 [27], MOOSE [28]), including risk of bias assessment using the Newcastle-Ottawa Scale [29], random-effects estimation with Hartung-Knapp adjustment [30], and multiple sensitivity analyses (including leave-one-out, high-risk-of-bias exclusion, and trim-and-fill [31–33]); and (iv) moderator and interaction analyses (*e.g.*, stress × resilience), which move beyond simple bivariate correlations and begin to map a mechanistic pathway.

Nevertheless, several limitations must be acknowledged, and these influence interpretation. First, most included studies were observational in design, limiting causal inference. Although resilience was associated with lower injury risk and shorter RT-P, and burnout/stress with higher risk, we cannot definitively conclude causal direction, nor exclude bidirectionality (*e.g.*, injury leading to elevated stress and burnout). Second, although methodological quality was generally moderate to high (median Newcastle-Ottawa Scale score = 7, IQR 6–8), residual confounding was common. Variables such as prior injury history, accumulated training load, sleep disruption, or playing time exposure were not consistently controlled across studies; these factors may partially account for both psycholog-

ical strain and injury vulnerability. Third, heterogeneity across studies was moderate (mean $I^2 \approx 65\%$), reflecting differences in sport type, competitive context, measurement tools (*e.g.*, CD-RISC *vs.* alternative resilience instruments), and injury definitions. We addressed this using random-effects models, Hartung-Knapp adjustments, and moderator analyses, but the underlying diversity of elite sport environments remains a constraint on generalisability. Fourth, RT-P findings, while practically important, were derived from a smaller subset of studies, meaning that estimates for return-to-play duration should be interpreted as preliminary. Finally, the analyses were restricted to English-language publications; although this approach is consistent with previous sport and injury meta-analyses [1, 7, 10], it may introduce language or publication bias and under-represent non-English professional leagues.

Future research should build on these findings in four directions. First, longitudinal and multicentre designs are needed to track resilience, stress, burnout, physiological regulation (*e.g.*, HRV, cortisol), and injury outcomes across competitive cycles, rather than at a single time point [17, 18, 22–25, 34]. This would allow testing of temporal precedence—*e.g.*, does declining resilience predict injury the following month, or does injury trigger resilience decline? Second, high-performance organisations should implement and evaluate structured psychosocial interventions (*e.g.*, mindfulness-based stress management, cognitive-behavioural coping skills training, and social support facilitation) in controlled or quasi-experimental designs, to determine not just efficacy, but feasibility and cost-effectiveness in real professional environments [10, 16, 17, 22, 23]. Third, integration of psychosocial metrics with physiological load monitoring and medical decision-making should be studied directly. This includes assessing whether combined indicators (*e.g.*, high perceived stress + low HRV + elevated emotional exhaustion) outperform traditional load-based models in predicting time-loss injuries. Fourth, qualitative and mixed-method approaches are urgently needed. Elite male athletes often describe resilience, exhaustion, and pressure in ways that are culturally specific—linked to masculinity norms, job security, and expectations of constant availability [3, 4, 13, 14, 17]. Capturing those lived experiences is essential for designing ethically acceptable screening and support models that athletes will actually use, rather than resist.

In conclusion, psychological resilience in professional male athletes functions as a protective resource that is associated with lower injury risk and faster return-to-play, whereas elevated perceived stress and burnout are associated with greater injury susceptibility, longer time-loss, and higher odds of being unavailable for competition. These findings indicate that injury prevention and rehabilitation in elite men's sport should not be conceptualised solely in biomechanical or workload terms, but as part of an integrated biopsychosocial process in which psychological load, coping capacity, and recovery environment are central components of health management and player availability [1, 7, 10, 17, 18, 22–25].

5. Conclusions

This meta-analysis demonstrates that psychological factors are systematically and meaningfully linked to injury-related outcomes in professional and semi-professional male athletes. Across the included studies (n = 8947 athletes), higher resilience was associated with lower injury risk and shorter return-to-play duration following injury, whereas higher perceived stress and higher burnout were associated with increased injury incidence, greater time-loss from sport, and higher odds of being unavailable for competition. In addition, resilience showed a buffering effect on the stress–injury association, indicating that it functions as a protective resource rather than merely a marker of well-being.

These findings indicate that the health of male professional athletes cannot be understood solely in biomechanical or load-management terms. Injury risk and recovery are shaped not only by physical exposure, but also by psychosocial load, coping resources, and cumulative psychological strain. Accordingly, prevention and rehabilitation strategies in elite men's sport should incorporate systematic screening and targeted support for resilience, stress, and burnout, alongside traditional physical and medical practices.

Taken together, the present synthesis supports a holistic view of athlete health in which psychological resilience is considered part of performance availability and long-term health protection, while unmanaged stress and burnout represent modifiable risk factors for injury and prolonged time-loss in professional male sport.

ABBREVIATIONS

CI, Confidence Interval; OR, Odds Ratio; RT-P, Return-to-Play; DL, DerSimonian-Laird; REML, Restricted Maximum Likelihood; HK, Hartung-Knapp; CD-RISC, Connor-Davidson Resilience Scale; ABQ, Athlete Burnout Questionnaire; PSS, Perceived Stress Scale; DASS, Depression Anxiety Stress Scales; NOS, Newcastle-Ottawa Scale; RCTs, randomized controlled trials; RVE, Robust Variance Estimation; WLS, weighted least squares; HRV, heart rate variability; HPA, hypothalamic–pituitary–adrenal; SE, Standard Error; PICOS, Population, Intervention, Comparison, Outcomes, Study design; SD, Standard Deviation; RR, Risk Ratio; IOC, International Olympic Committee; RoB, Risk of Bias; DFBETAS, Difference in Betas; QM, Cochran's Q statistic for moderators.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and analyzed during the current study are derived exclusively from previously published research articles included in this meta-analysis. All data extracted for synthesis are available from the corresponding author upon reasonable request. No new datasets were generated for this study.

AUTHOR CONTRIBUTIONS

GA and KS—designed the research study. GA—performed data extraction, quality assessment, and statistical analyses, and drafted the manuscript. KS—contributed to critical review and editorial revisions. Both authors approved the final version and agree to be accountable for all aspects of the work.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval and consent to participate were not required for this study, as it is a meta-analysis based on previously published data. The ethical approval and informed consent procedures of the included studies were reported in their respective publications.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.jomh.org/files/article/2038440996209868800/attachment/Supplementary%20material.docx.

REFERENCES

[1] Ivarsson A, Johnson U, Andersen MB, Tranaeus U, Stenling A, Lindwall M, *et al.* Psychosocial factors and sport injuries: meta-analyses for prediction and prevention. Sports Medicine. 2017; 47: 353–365.

[2] Chyi T, Lu FJH, Hsieh YC, Hsu YW, Gill DL, Fang BB. Relationship Between Athletes' History of Stressors and Sport Injury: A Systematic Review and Meta-Analysis. Perceptual and Motor Skills. 2024; 131: 192-218.

[3] Fletcher D, Sarkar M. A grounded theory of psychological resilience in Olympic champions. Psychology of Sport and Exercise. 2012; 13: 669–678.

[4] Galli N, Vealey RS. "Bouncing back" from adversity: athletes' experiences of resilience. The Sport Psychologist. 2008; 22: 316–335.

[5] Jaiyeoba OM, Oguntuase SB, Ogunsanya JO, Adereti AA. The role of resilience on stress and recovery of elite athletes in Nigeria. Athens Journal of Sports. 2023; 10: 57–70.

[6] Park I, Jeon J. Psychological skills training for athletes in sports: Web of Science bibliometric analysis. Healthcare. 2023; 11: 259.

[7] Tranaeus U, Ivarsson A, Johnson U, Wadey R, Wiese-Bjornstal DM. 50 years of research on the psychology of sport injury: a consensus statement. Sports Medicine. 2024; 54: 1733–1748.

[8] Ivarsson A, Johnson U. Psychological factors as predictors of injuries among senior soccer players: a prospective study. Journal of Sports Science and Medicine. 2010; 9: 347–352.

[9] Fisher H, Gittoes MJ, Evans L, Bitchell CL, Mullen RJ, Scutari M. An interdisciplinary examination of stress and injury occurrence in athletes. Frontiers in Sports and Active Living. 2020; 2: 595619.

[10] Li S, Wu Q, Chen Z. Effects of psychological interventions on the prevention of sports injuries: a meta-analysis. Orthopaedic Journal of Sports Medicine. 2020; 8: 1–10.

[11] Patenteu I, Gawrych R, Bratu M, Vasile L, Makarowski R, Bitang A, *et al*. The role of psychological resilience and aggression in injury prevention among martial arts athletes. Frontiers in Psychology. 2024; 15: 1433835.

[12] Keyes CLM. The mental health continuum: from languishing to flourishing in life. Journal of Health and Social Behavior. 2002; 43: 207–222.

[13] Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The mental health of elite athletes: a narrative systematic review. Sports Medicine. 2016; 46: 1333–1353.

[14] Rogers DL, Tanaka MJ, Dreher GM. How mental health affects injury risk and outcomes in athletes. Sports Health. 2023; 16: 222–229.

[15] Nuetzel B. Stress and its impact on elite athletes' wellbeing and mental health—a mini narrative review. Frontiers in Sports and Active Living. 2025; 7: 1630784.

[16] Si X, Wang Y, Li J. A meta-analysis of the intervention effect of mindfulness training on athletes' performance. Frontiers in Psychology. 2024; 15: 1375608.

[17] Gupta S, McCarthy PJ. The sporting resilience model: a systematic review of resilience in sport performers. Frontiers in Psychology. 2022; 13: 1003053.

[18] Chrétien A, Hayotte M, Vuillemin A, d'Arripe Longueville F. Resilience profiles of elite athletes and their associations with health-related behaviors, well-being, and performance: a latent profile analysis. Psychology of Sport and Exercise. 2024; 74: 102689.

[19] Yu X, Xing S, Yang Y. The relationship between psychological capital and athlete burnout: the mediating relationship of coping strategies and the moderating relationship of perceived stress. BMC Psychology. 2025; 13: 64.

[20] Smith RE. Toward a cognitive–affective model of athletic burnout. Journal of Sport and Exercise Psychology. 1986; 8: 36–50.

[21] Maslach C, Jackson SE. The measurement of experienced burnout. Journal of Occupational Behaviour. 1981; 2: 99–113.

[22] Gustafsson H, DeFreese JD, Madigan DJ. Athlete burnout: review and recommendations. Current Opinion in Psychology. 2017; 16: 109–113.

[23] Glandorf HL, Madigan DJ, Kavanagh O, Mallinson-Howard SH. Mental and physical health outcomes of burnout in athletes: a systematic review and meta-analysis. International Review of Sport and Exercise Psychology. 2023; 18: 372–416.

[24] Addleman JS, Lackey NS, DeBlauw JA, Hajduczok AG. Heart rate variability applications in strength and conditioning: a narrative review. Journal of Functional Morphology and Kinesiology. 2024; 9: 93.

[25] Honceriu C, Roca M, Costache AD, Abălașei B, Popescu L, Puni AR, *et al*. Blood and salivary cortisol variations in athletes in relation to cardiopulmonary exercise testing. Medicina. 2023; 59: 1726.

[26] Cai C, Mei Z, Yang Y, Luo S. From adversity to adaptation: the struggle between resilience and athlete burnout in stressful situations. Frontiers in Psychology. 2025; 16: 1578198.

[27] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. The BMJ. 2021; 372: n71.

[28] Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, *et al*. Meta-analysis of observational studies in epidemiology: a proposal for reporting. JAMA. 2000; 283: 2008–2012.

[29] Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M, *et al*. The Newcastle–Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. 2011. Available at: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp (Accessed: 21 September 2025).

[30] Hartung J, Knapp G. On tests of the overall treatment effect in meta-analysis with normally distributed responses. Statistics in Medicine. 2001; 20: 1771–1782.

[31] DerSimonian R, Laird N. Meta-analysis in clinical trials. Controlled Clinical Trials. 1986; 7: 177–188.

[32] Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. The BMJ. 1997; 315: 629–634.

[33] Duval S, Tweedie R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. Biometrics. 2000; 56: 455–463.

[34] Dong JG. The role of heart rate variability in sports physiology. Experimental and Therapeutic Medicine. 2016; 11: 1531–1536.

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