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Effectiveness of multi-session mindfulness-based interventions on sport performance and competitive anxiety in competitive athletes: a systematic review of controlled trials

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ABSTRACT

Competitive athletes perform under evaluative pressure, and competitive anxiety threatens sport performance. Mindfulness-based interventions (MBIs) are increasingly adopted in applied sport psychology, yet controlled evidence on their effects on performance and anxiety remains fragmented. This review synthesised controlled trials examining whether structured multi-session MBIs improve performance and reduce competitive anxiety in competitive athletes, and which programme characteristics accompany favourable outcomes. The review followed the PRISMA 2020 statement and a PICOS framework. Scopus was searched with a Boolean string combining mindfulness, athlete or sport, and performance or competitive anxiety terms, limited to English-language open-access journal articles published between 2016 and 2025, yielding 521 records. Eligible studies were randomised or non-randomised controlled trials of multi-session MBIs reporting objective or observer-rated sport performance or competitive or sport anxiety; single-session, uncontrolled, and non-athlete studies were excluded. Seventeen studies met the criteria. Most reported performance gains, particularly in precision and endurance tasks such as free throws, shooting, and rowing, whereas anxiety effects were less consistent and sometimes matched by psychological skills training. Sport-specific programmes lasting six to eight weeks appeared most promising. The findings support MBIs as a complementary performance tool, while larger preregistered trials with follow-up and objective outcomes are needed.

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Introduction

Competitive sport has become a setting in which small psychological margins can separate winning from losing, and national federations, universities, and professional clubs now invest heavily in the mental preparation of athletes alongside physical conditioning. Bibliometric mapping shows that psychological skills training for athletes has developed into a large and internationally distributed body of research spanning several decades (Park & Jeon, 2023). Within this expanding field, mindfulness has moved from a clinical construct into a mainstream performance resource. Narrative and systematic reviews describe mindfulness programmes being applied in tennis, shooting, archery, golf, running, hockey, swimming, and cycling (Ramalingam et al., 2021), and reviews in physical education report benefits for emotional education, self-

regulation, stress reduction, and sport performance (López & Gené-Morales, 2021). This widening uptake raises a practical question about whether structured mindfulness training produces measurable benefits in competitive settings.

Competitive anxiety is one of the most persistent threats to athletic performance. Athletes who compete under evaluative pressure often experience cognitive worry, somatic arousal, and reduced confidence, and these states can disrupt attentional control at critical moments such as penalty kicks (Shi et al., 2024). Vulnerability to anxiety is not evenly distributed. Female athletes with higher impulsivity report greater competitive anxiety (Terres-Barcala et al., 2022), athletes returning from injury face elevated competitive state anxiety linked to perfectionism and lower self-efficacy (Li et al., 2023), and choking-susceptible athletes show state-trait anxiety that is strongly shaped by perceived stress (Tang et al., 2023). Across these samples, higher trait mindfulness is associated with lower anxiety and more adaptive functioning (Li et al., 2023; Shi et al., 2024; Tang et al., 2023; Terres-Barcala et al., 2022). Athletes low in mindfulness also tend to judge their own performance decrements more harshly than their teammates do (Amemiya & Sakairi, 2021), suggesting that anxiety and self-evaluation are intertwined with present-moment awareness.

Research on how mindfulness might support performance has concentrated on emotional and cognitive mechanisms. Longitudinal and cross-sectional work indicates that dispositional mindfulness relates to sport-specific coping through reduced rumination and improved emotion regulation (Josefsson et al., 2017). Studies grounded in multi-states theory further suggest that mindful awareness and refocusing shape challenge and threat appraisals, which in turn predict lower anxiety and more functional emotional experiences before practice and competition (Robazza et al., 2024). Intervention research has compared mindfulness with traditional psychological skills training. A randomised trial with elite athletes found that a Mindfulness-Acceptance-Commitment programme produced greater gains in sport-specific mindfulness, emotion regulation, and self-rated performance than psychological skills training (Josefsson et al., 2019). Another randomised trial reported that psychological skills training and mindfulness training produced largely shared improvements in handling emotions and controlling attention, with a distinctive effect of mindfulness on experiential avoidance (Röthlin et al., 2020).

Recent work has diversified the formats in which mindfulness is delivered. Brief audio-guided practices have been tested as a countermeasure to ego depletion, with a 15-minute session helping basketball players maintain free-throw accuracy under pressure (Shaabani et al., 2020). Systematic reviews of mental fatigue interventions identify mindfulness among the strategies that can restore sport-specific motor and perceptual-cognitive performance after demanding cognitive tasks (Pan et al., 2024; Sun et al., 2024). At the same time, meta-analytic evidence pooling yoga and mindfulness studies has shown significant effects on mindfulness, flow, and stress in athletes (Kanaujia et al., 2023). Programme design has also evolved from adapted clinical protocols towards sport-tailored curricula, mixed-method evaluations, and blended digital delivery (Hägglund et al., 2025; Ramalingam et al., 2021). This diversification makes it harder to identify which forms of mindfulness training deserve priority and which outcomes they can be expected to change.

The first gap concerns the quality and type of evidence that currently supports claims about mindfulness and performance. A substantial share of the literature is correlational, linking trait mindfulness with anxiety, confidence, or coping rather than testing deliberate training (Li et al., 2023; Shi et al., 2024; Tang et al., 2023). When interventions are pooled, results are not uniformly positive. The meta-analysis by Kanaujia et al. (2023), which focused largely on recreational athletes and combined yoga with mindfulness, found no significant pooled effect on anxiety despite effects on stress and flow. Evidence from single-session designs is also inconsistent, as brief meditation was found to leave tennis return performance unchanged or even impaired in elite junior players (O'Connor et al., 2022), in contrast to the protective effect reported under ego depletion (Shaabani et al., 2020). Consequently, it remains unclear whether sustained, multi-session MBIs delivered to competitive athletes produce reliable change in performance and competitive anxiety.

The second gap is methodological and conceptual. Many trials rely on self-rated performance or satisfaction with performance, which can be influenced by the same expectancy and demand effects that mindfulness training targets (Josefsson et al., 2019; Röthlin et al., 2020). Programmes differ widely in length, session frequency, delivery mode, and degree of sport specificity, yet these characteristics are rarely compared systematically (Ramalingam et al., 2021). Reviews of related interventions stress that effects demonstrated in laboratory or simulated conditions still require validation in real competitive environments (Pan et al., 2024; Sun et al., 2024). In addition, anxiety has been treated inconsistently, sometimes as a primary outcome, sometimes as a mediator, and sometimes as part of broader distress indices (Kanaujia et al., 2023; Robazza et al., 2024). Without a synthesis restricted to controlled designs and sport-relevant outcomes, practitioners cannot judge how much confidence to place in MBIs or how to structure them.

A focused synthesis is therefore timely. Competitive athletes, coaches, and sport psychologists increasingly request evidence-based mental training, and investment decisions depend on knowing whether mindfulness changes what matters in competition (Hägglund et al., 2025; Park & Jeon, 2023). This review addresses that need by restricting the evidence base to controlled trials of structured multi-session MBIs with competitive athletes and outcomes that are either objective or observer-rated performance or validated measures of competitive or sport anxiety. The review is guided by three research questions. It contributes a design-sensitive appraisal of controlled evidence, a comparative account of performance and anxiety outcomes, and an analysis of programme features that can inform the design of future interventions and trials.

RQ1: How effective are structured multi-session mindfulness-based interventions in improving objective or observer-rated sport performance among competitive athletes across sports and competitive levels?

RQ2: How do structured multi-session mindfulness-based interventions affect competitive and sport-related anxiety in competitive athletes?

RQ3: Which intervention characteristics (duration, frequency, delivery format, programme type, and sport specificity) are associated with more favourable performance and anxiety outcomes?

Method

Research Design and Framework

This study adopted a systematic literature review design because the research questions required a transparent, replicable, and comprehensive identification and appraisal of intervention studies rather than a selective narrative summary. Systematic review methodology minimises selection bias by specifying the search, eligibility, appraisal, and synthesis procedures in advance and documenting each decision (Tranfield et al., 2003). Reporting followed the principles established in the original PRISMA explanation and elaboration document (Liberati et al., 2009) and was updated to the PRISMA 2020 statement, which provides a 27-item checklist and a revised flow diagram for reporting the identification, screening, and inclusion of studies (Page et al., 2021). Because the trials were heterogeneous in sports, instruments, comparators, and effect-size reporting, a structured narrative synthesis was performed instead of a meta-analysis.

Search Strategy

Because the review addresses the effectiveness of a deliberate intervention compared with alternative or no treatment, the PICOS framework was judged the most appropriate formulation among the available options (PICO, PEO, SPIDER, PCC, and SPICE). PEO and SPIDER were less suitable because the review did not examine exposures or qualitative phenomena, and PCC was not selected because the aim was a focused effectiveness question. PICOS elements structure both the search and the eligibility criteria and are recommended for questions about intervention effects (Methley et al., 2014). The PICOS elements used in this review are presented in Table 1.

Table 1. <PICOS framework used to structure the search and eligibility criteria>

Element	Definition in this review	Search keywords
Population (P)	Competitive athletes of any age, sex, sport, and competitive level (club, collegiate, national, or international)	athlete*, sport*
Intervention (I)	Structured multi-session mindfulness-based or mindfulness-acceptance-based programme (e.g., MSPE, MAC, ACT, MBSR, sport-specific mindfulness)	mindfulness, mindfulness-based intervention
Comparison (C)	No intervention, wait-list, placebo or active control, or alternative psychological training	Not used as a search term
Outcome (O)	Objective or observer-rated sport performance; competitive or sport-related anxiety	performance, competitive anxiety
Study design (S)	Randomised controlled trials and non-randomised controlled or quasi-experimental studies with a comparison group	Applied at eligibility stage

Each PICOS element was translated into a cluster of keywords and synonyms, which were then combined into a Boolean search string. The final string applied in Scopus was as follows.

TITLE-ABS-KEY (("mindfulness" OR "mindfulness-based intervention") AND ("athlete*" OR "sport*") AND ("performance" OR "competitive anxiety"))

The asterisk was used as a truncation operator so that athlete* retrieved athlete and athletes, and sport* retrieved sport, sports, and sporting. The TITLE-ABS-KEY field code restricted retrieval to article titles, abstracts, and keywords, which reduced records that mentioned mindfulness only incidentally in the full text. Database limiters were then applied for publication year (2016 to 2025), document type (article), language (English), source type (journal), publication stage (final), and access type (open access). The year range captured the decade in which sport-specific mindfulness protocols matured, and the open-access limiter ensured that every retained report could be retrieved in full. The string was piloted, and the broad performance term was retained because narrower outcome terms missed trials reporting anxiety only as a secondary outcome. The PICOS framework served solely to structure the search and eligibility decisions and is distinct from the quality appraisal procedure described below.

Database and Information Sources

Scopus was selected as the single information source because it offers broad multidisciplinary coverage of sport science, psychology, and medicine journals, supports field-coded Boolean searching, and allows the export of complete bibliographic records with abstracts and author keywords. The search was executed and exported on 15 September 2026. No supplementary databases, trial registries, or grey literature sources were searched, and this decision is considered in the limitations of the review.

Eligibility Criteria

Eligibility criteria were defined before screening and were derived from the PICOS framework and the database limiters. Studies were retained only if they tested a structured mindfulness-based programme delivered over more than one session to competitive athletes, used a concurrent control or comparison group, and reported at least one objective or observer-rated sport performance outcome or a validated measure of competitive or sport-related anxiety. The full criteria are shown in Table 2.

Table 2. <Inclusion and exclusion criteria>

Criterion	Inclusion	Exclusion
Publication period	2016 to 2025	Published before 2016 or after 2025
Document type	Original research article	Reviews, conference papers, book chapters, editorials, protocols
Language	English	Non-English
Source type and stage	Peer-reviewed journal; final publication stage	Other source types; articles in press
Accessibility	Open access with full text available	Restricted access or abstract only
Population	Competitive athletes (club to international level)	Non-athletes, recreational exercisers, dancers, coaches, or school students
Intervention	Structured multi-session programme with mindfulness as a primary component	Single-session or acute practice; programmes in which mindfulness was not a primary component
Design	Randomised or non-randomised controlled trial with a concurrent comparison group	Uncontrolled, case, observational, psychometric, or qualitative-only designs
Outcome	Objective or observer-rated sport performance, or validated competitive or sport-related anxiety measure	Only self-rated performance, well-being, or laboratory cognitive outcomes

Study Selection Process

Study selection proceeded in three stages. In the first stage, records retrieved from Scopus were checked for duplicates, and the automated database limiters were applied. In the second stage, titles and abstracts of the remaining records were screened against the eligibility criteria, and records that clearly did not describe a mindfulness intervention with athletes were excluded. In the third stage, the full texts of potentially eligible reports were assessed, and the reason for each exclusion was recorded. Screening was conducted independently by two reviewers, and disagreements were resolved through discussion, with a third reviewer consulted when consensus could not be reached. Agreement between reviewers at the full-text stage was quantified with Cohen's kappa and interpreted according to the Landis and Koch classification (Landis & Koch, 1977), yielding κ = [insert value]. The flow of records through each stage is reported in Figure 1.

Quality Assessment

Methodological quality was appraised independently of the PICOS-based search strategy, using design-specific critical appraisal tools so that each study was judged with the instrument most appropriate to its design. The appraisal followed four sequential steps. First, each included study was classified according to its reported methodology. Second, the appraisal instrument was selected on the basis of that design, as summarised in Table 3. Randomised controlled trials were assessed with the revised Cochrane Risk of Bias tool (RoB 2), which examines bias arising from the randomisation process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result (Sterne et al., 2019). Non-randomised controlled and quasi-experimental studies were assessed with the nine-item JBI Critical Appraisal Checklist for Quasi-Experimental Studies (Tufanaru et al., 2020). Third, each study was assessed against every criterion of the selected tool using the original response categories (low risk, some concerns, or high risk for RoB 2; yes, no, or unclear for JBI) without modifying the scoring system.

Table 3. <Design-specific critical appraisal tools>

Study design	Critical appraisal tool
Randomised controlled trials	Cochrane Risk of Bias 2 (RoB 2)
Non-randomised intervention studies	ROBINS-I or JBI Checklist for Quasi-Experimental Studies (JBI checklist applied in this review)
Cohort studies	JBI Checklist for Cohort Studies
Case-control studies	JBI Checklist for Case-Control Studies
Cross-sectional studies	JBI Checklist for Analytical Cross-Sectional Studies or AXIS
Qualitative studies	JBI or CASP Qualitative Checklist
Mixed-methods studies	Mixed Methods Appraisal Tool (MMAT)
Other primary designs	Most appropriate validated tool, documented explicitly

Fourth, appraisal results were integrated into the synthesis. Numerical scores were not used as exclusion thresholds; instead, findings from studies with greater concerns were interpreted with more caution. Appraisal results are reported criterion by criterion for each study in Table 6, which is preferable to reporting a single aggregated score. Two reviewers conducted the appraisal independently, disagreements were resolved through discussion or consultation with a third reviewer, and inter-rater agreement was quantified with Cohen's kappa (Landis & Koch, 1977).

Data Extraction Procedure

A standardised extraction form was developed and piloted on three included studies before being applied to the full set. The following information was extracted from each study: author(s), year of publication, country or setting, study design, sample size, sport, competitive level, age group, intervention name and components, duration, session frequency and length where reported, delivery format, comparator, performance outcomes and their measurement method, anxiety or stress outcomes and their instruments, follow-up assessments, and key findings. Characteristics not stated in the source were recorded as not reported, and extraction by one reviewer was verified by a second.

Keyword Co-occurrence and Descriptive Bibliometric Analysis

To describe the conceptual structure of the included evidence, a keyword co-occurrence analysis was performed on the author keywords and indexed keywords exported from Scopus for the 17 included studies. Keywords were harmonised into conceptual categories (for example, mindfulness training and mindfulness meditation were merged into mindfulness, and basketball shooting performance and athletic performance were merged into athletic performance). Co-occurrence was counted when two categories appeared in the same study record, and the network was drawn in Python using the NetworkX library, with node size proportional to the number of studies containing a category and edges displayed for category pairs that co-occurred in at least two studies. Publication year, design, and setting were also tabulated.

Data Analysis and Synthesis

Findings were synthesised narratively using a structured approach informed by thematic synthesis (Thomas & Harden, 2008) and by the Synthesis Without Meta-analysis reporting guideline (Campbell et al., 2020). Studies were first grouped by the research question they informed: performance outcomes (RQ1), anxiety outcomes (RQ2), and intervention characteristics (RQ3). Within each group, results were coded according to the direction of the effect relative to the comparator (favourable, mixed, or null), the type of outcome measure (objective, observer-rated, or self-reported), and the design and risk-of-bias judgement. Codes were organised into descriptive themes and refined into analytical themes across sports and programme types, and contradictory findings were examined with reference to design, sample, and outcome differences.

Reporting and Documentation

The review was reported in accordance with the PRISMA 2020 checklist and flow diagram (Page et al., 2021). The numbers reported in the abstract, methods, flow diagram, and results were cross-checked for consistency.

Results and Discussions

Study Selection

The Scopus search returned 521 records. Before screening, 14 duplicate records were removed and 350 records were marked as ineligible by the database limiters for publication year, document type, language, source type, publication stage, and open access, leaving 157 records for title and abstract screening. At this stage, 100 records were excluded: 53 used observational, correlational, or psychometric designs, 22 were reviews, conceptual papers, commentaries, or protocols, 17 involved non-athlete populations or non-mindfulness interventions, and 8 used qualitative designs only. All 57 reports sought for retrieval were obtained and assessed in full. Of these, 40 were excluded because the outcomes did not include objective or observer-rated sport performance or competitive or sport anxiety (n = 16), there was no control or comparison group (n = 11), the intervention was a single session or acute practice (n = 9), participants were not competitive athletes (n = 2), mindfulness was not the primary component of a combined programme (n = 1), or the report was a protocol without outcome data (n = 1). Seventeen studies were included in the synthesis, comprising eight randomised controlled trials and nine non-randomised controlled studies (Figure 1).

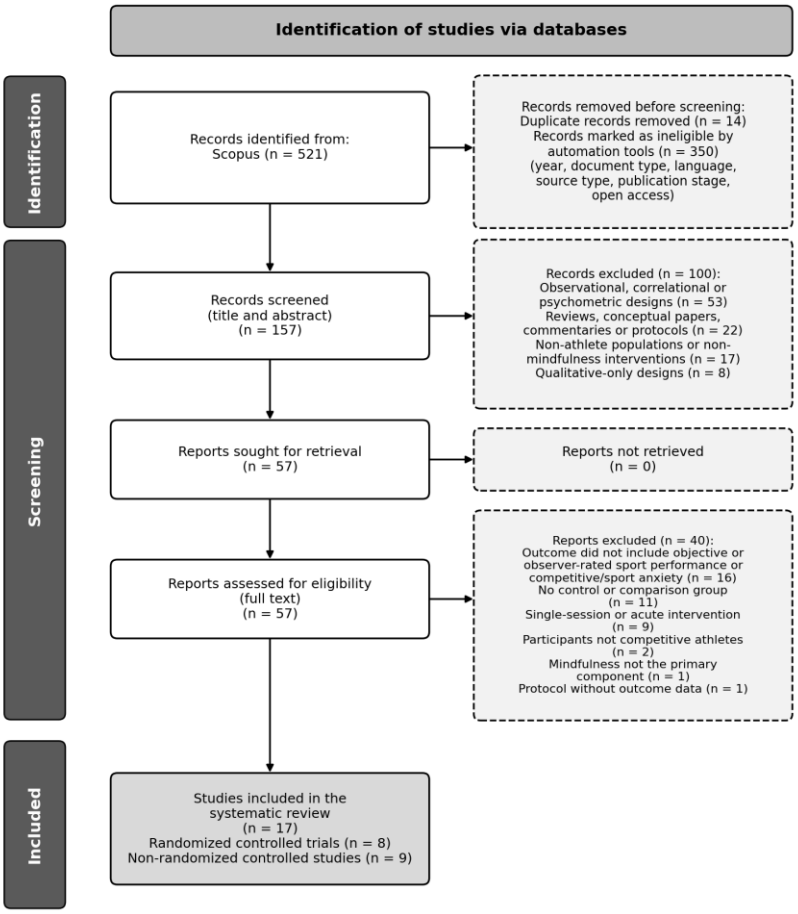

Figure 1. <PRISMA 2020 flow diagram of the study selection process (adapted from Page et al., 2021)>

Descriptive Characteristics of the Included Studies

Table 4 summarises the 17 included studies, and Table 5 classifies them by design, sample, intervention, comparator, and outcome. The studies were published between 2019 and 2025, and no eligible study appeared between 2016 and 2018. Output increased in recent years, with five studies published in 2025 alone (Figure 2).

Table 4. <Summary of included studies>

No	Title	Author(s)	Year	Country	Method	Key findings
1	Effects of group mindfulness intervention on high-level distance runners: a quasi-experimental study	Kelemen, Tóth, Benczenleitner, & Tóth	2025	Hungary	Quasi-experimental controlled study	Six-week group MSPE improved flow, cognitive anxiety, mindfulness, and emotion regulation; no change in controls.
2	The effect of mindfulness training interventions on free throw performance in basketball players in stressful situations	Wang & Zhang	2025	China	Randomised 2 × 2 factorial trial	Eight-week training improved mindfulness, mental toughness, and free-throw performance under stress versus placebo.

No	Title	Author(s)	Year	Country	Method	Key findings
3	The impact of Mindfulness and Mental Skills Protocols on Athletes' Competitive Anxiety	Dana, Shahir, & Ghorbani	2022	Iran	Quasi-experimental three-group study	Mindfulness and mental skills training both reduced competitive state anxiety, with no difference between them.
4	A rowing-specific mindfulness intervention: Effects on mindfulness, flow, reinvestment, and performance	Sparks & Ring	2022	United Kingdom	Randomised controlled trial	Six-week programme improved flow, mindfulness, and rowing performance within group; mindfulness and reinvestment did not differ from control.
5	Effect of a mindfulness programme training to prevent the sport injury and improve the performance of semi-professional soccer players	Zadeh, Ajilchi, Salman, & Kisely	2019	Iran	Randomised controlled pilot trial	Higher mindfulness in the intervention group was associated with fewer injuries and better expert-rated individual and team performance.
6	Mindfulness-Based Stress Reduction Benefits Psychological Well-Being, Sleep Quality, and Athletic Performance in Female Collegiate Rowers	Jones, Kaur, Miller, & Spencer	2020	United States	Non-randomised controlled trial	Eight-week MBSR improved well-being, sleep quality, coping skills, and 6,000-m ergometer performance versus training alone.
7	Mindfulness and acceptance-based training for elite adolescent athletes: a mixed-method exploratory study	Su, Si, Liang, Bu, & Jiang	2024	Hong Kong (China)	Mixed-method RCT	MAIC enhanced mindfulness, acceptance, performance satisfaction, and training performance; effects diminished at follow-up.
8	The effectiveness of rational emotive behavior therapy (REBT) and mindfulness-based intervention (MBI) on psychological, physiological and executive functions as a proxy for sports performance	Tóth, Turner, Mannion, & Tóth	2023	Hungary	Non-randomised three-group controlled study	REBT, not MBI, regulated competitive anxiety; MBI improved processing speed and set-shifting.

No	Title	Author(s)	Year	Country	Method	Key findings
9	Effects of the SmartACT Intervention on Motor and Psychological Variables in Adolescent Athletes: A Controlled Trial Using BlazePod and Microgate	Timea et al.	2025	Romania	Controlled three-group trial	SmartACT improved agility and reaction speed and reduced symptoms more than the standard MAC protocol and control.
10	The Effect of Mindfulness Intervention on the Psychological Skills and Shooting Performances in Male Collegiate Basketball Athletes in Macau: A Quasi-Experimental Study	Wang, Lei, & Wu	2023	Macau (China)	Quasi-experimental controlled study	Seven-week training improved mindfulness, acceptance, attention, and three-point and free-throw shooting (d = 0.565 to 1.117).
11	The effect of mindfulness training on flow and spike performance in volleyball with non-dominant hand	Taghimolla, Yaali, Omidi, & Orangi	2025	Iran	Randomised four-group trial	Mindfulness plus spike training improved flow and non-dominant spike performance more than spike training alone; gender had no effect.
12	Acceptance and Commitment Training for Ice Hockey Players: A Randomized Controlled Trial	Lundgren et al.	2021	Sweden	Randomised controlled trial	ACT improved goals, assists, shots, and blinded coach ratings; coach ratings, but not objective gains, persisted at three months.
13	Mindfulness Training Enhances Endurance Performance and Executive Functions in Athletes: An Event-Related Potential Study	Nien et al.	2020	Taiwan	Quasi-experimental controlled study	Five-week training increased mindfulness, exhaustion time, and Stroop accuracy and reduced N2 amplitude versus wait-list.
14	Effect of hypnosis and mindfulness on sports performance in basketball	Muñoz-Avendaño, Téllez-López, Almaraz-Castruita, & Tellez-Ramos	2024	Mexico	Randomised three-group trial	Hypnosis improved free throws versus control; mindfulness showed a large, near-significant within-group gain; stress was unchanged.
15	Effects of Mindfulness for Performance Programme on Actual Performance in Ecological Sport Context: Two Studies in Basketball and Table Tennis	Tebourski, Bernier, Ben Salha, Souissi, & Fournier	2022	Tunisia	Two controlled field studies	MFP increased mindfulness and in-game free-throw accuracy; higher adherence yielded greater table tennis ranking gains.

No	Title	Author(s)	Year	Country	Method	Key findings
16	Mindfulness-based intervention for tennis players: A quasi-experimental pilot study	Hoja & Jansen	2019	Germany	Quasi-experimental pilot study	Seven-session programme improved the concentration disruption component of sport anxiety relative to controls.
17	Enhancing psychological skills and well-being in sport through an app-based blended intervention: a randomized controlled pilot study	Bordo, Costanzo, & Villani	2025	Italy	Randomised controlled pilot trial	Eight-module app-based blended programme improved self-confidence, arousal control, awareness, and refocusing and reduced anxiety.

Note. MSPE = Mindful Sport Performance Enhancement; MBSR = Mindfulness-Based Stress Reduction; MAIC = Mindfulness-Acceptance-Insight-Commitment; MBI = mindfulness-based intervention; REBT = rational emotive behaviour therapy; MAC = Mindfulness-Acceptance-Commitment; ACT = Acceptance and Commitment Training; MFP = Mindfulness for Performance; RCT = randomised controlled trial. Country refers to the study setting.

Table 5. <Classification of included studies by design, sample, intervention, comparator, and outcome>

No	Author(s), Year	Design	Sample and sport	Intervention and dose	Comparator	Outcomes	Direction
1	Kelemen et al., 2025	NRS	n = 20; national and international distance runners	MSPE, group-based, 6 weeks	No mental training	Competitive anxiety, flow	Favourable
2	Wang & Zhang, 2025	RCT	n = 79; male college basketball players	Mindfulness training, 8 weeks, 2 × 90 min per week	Placebo videos	Free throws under stress	Favourable
3	Dana et al., 2022	NRS	n = 45; male shooters aged 19 to 30	Mindfulness training, 6 × 60 min over 6 weeks	Mental skills; no training	Competitive state anxiety (CSAI-2)	Favourable
4	Sparks & Ring, 2022	RCT	n = 44; rowers	Rowing-specific mindfulness, 6 weeks	No intervention	Rowing performance, flow	Mixed
5	Zadeh et al., 2019	RCT	n = 45; male semi-professional soccer players	Mindfulness programme; dose not reported	No intervention	Expert-rated performance, injury	Favourable
6	Jones et al., 2020	NRS	NCAA female rowers; n not reported	MBSR, 8 weeks, plus training	Training only	6,000-m ergometer, sleep	Favourable
7	Su et al., 2024	RCT	n = 40; elite adolescent athletes	MAIC programme; follow-up assessed	No intervention	Training performance, acceptance	Mixed

No	Author(s), Year	Design	Sample and sport	Intervention and dose	Comparator	Outcomes	Direction
8	Tóth et al., 2023	NRS	n = 46; junior ice hockey players	MBI (REBT as second arm)	REBT; no intervention	Competitive anxiety, executive functions	Null
9	Timea et al., 2025	NRS	n = 193; adolescent athletes aged 15 to 18	Standard MAC and SmartACT, 7 weeks	No intervention	Agility, reaction time, DASS-21	Mixed
10	Wang et al., 2023	NRS	n = 43; male collegiate basketball players	Mindfulness training, 7 weeks, about 60 min weekly	Regular training	Shooting tests, SCAT	Mixed
11	Taghimolla et al., 2025	RCT	n = 42; semi-skilled volleyball players	Mindfulness plus spike practice, 8 weeks, 2 sessions per week	Spike practice only	AAHPERD spike test, flow	Favourable
12	Lundgren et al., 2021	RCT	n = 34; junior elite ice hockey players	Group ACT; 3-month follow-up	Wait-list	Match statistics, coach ratings	Favourable
13	Nien et al., 2020	NRS	n = 46; university athletes	Mindfulness training, 5 weeks	Wait-list	Time to exhaustion, Stroop, ERP N2	Favourable
14	Muñoz-Avendaño et al., 2024	RCT	n = 20; university basketball players	Mindfulness (hypnosis as second arm)	Hypnosis; control	Free-throw percentage, RESTQ-Sport	Null
15	Tebourski et al., 2022	NRS	Basketball and table tennis players; n not reported	Mindfulness for Performance (three phases)	Control; adherence levels	In-game free throws, ranking points, mindfulness	Favourable
16	Hoja & Jansen, 2019	NRS	Tennis players; n not reported	Mindful emotions, 7 sessions	No intervention	Serve accuracy, competition anxiety	Mixed
17	Bordo et al., 2025	RCT	n = 41; tennis players	App-based blended, 8 weekly modules	No intervention	Anxiety, self-confidence	Favourable

Note. RCT = randomised controlled trial; NRS = non-randomised controlled study; CSAI-2 = Competitive State Anxiety Inventory-2; SCAT = Sport Competition Anxiety Test; DASS-21 = Depression, Anxiety and Stress Scale; RESTQ-Sport = Recovery-Stress Questionnaire for Athletes; ERP = event-related potential. Direction refers to the primary mindfulness comparison: favourable = benefit over comparator; mixed = partial or within-group benefit only; null = no clear benefit.

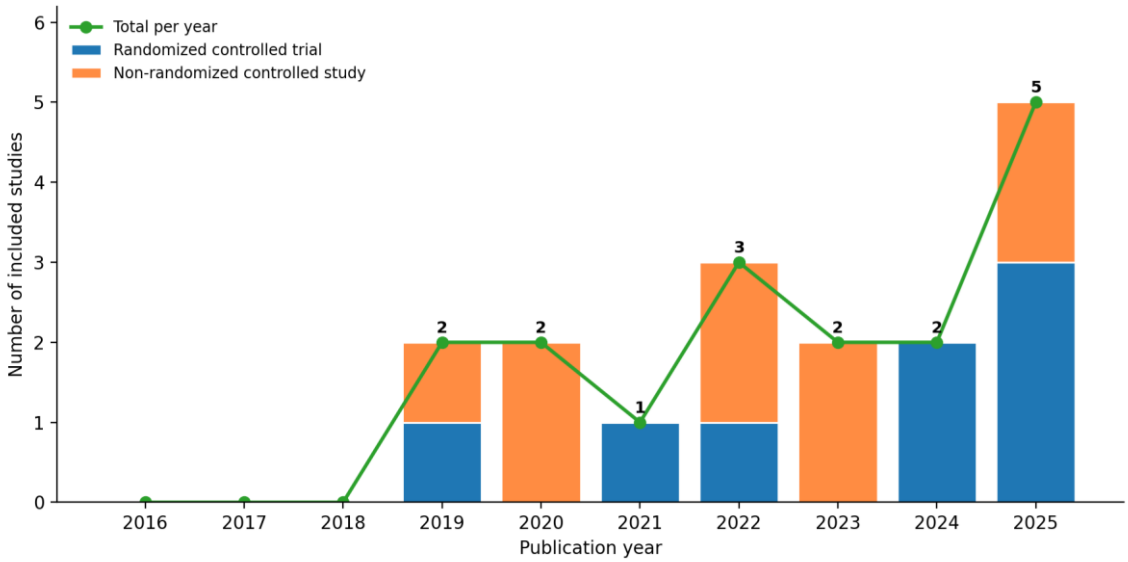

Figure 2. <Publication trend of the included studies by year and research design>

The evidence came from 15 settings (Figure 3). Iran contributed three studies (Dana et al., 2022; Taghimolla et al., 2025; Zadeh et al., 2019) and Hungary two (Kelemen et al., 2025; Tóth et al., 2023). Settings in mainland China, Hong Kong, Macau, and Taiwan together accounted for four studies (Nien et al., 2020; Su et al., 2024; Wang et al., 2023; Wang & Zhang, 2025), and single studies were conducted in the United Kingdom, the United States, Sweden, Germany, Italy, Romania, Mexico, and Tunisia. Fourteen studies reported sample sizes, involving 738 athletes in total, with samples ranging from 20 to 193 participants. Basketball was the most frequently studied sport (four studies), followed by tennis or table tennis (three), rowing (two), and ice hockey (two), while soccer, shooting, volleyball, and distance running were each examined once, and three studies recruited athletes from several sports. Thirteen studies reported objective or observer-rated performance, seven reported anxiety outcomes, and three reported both.

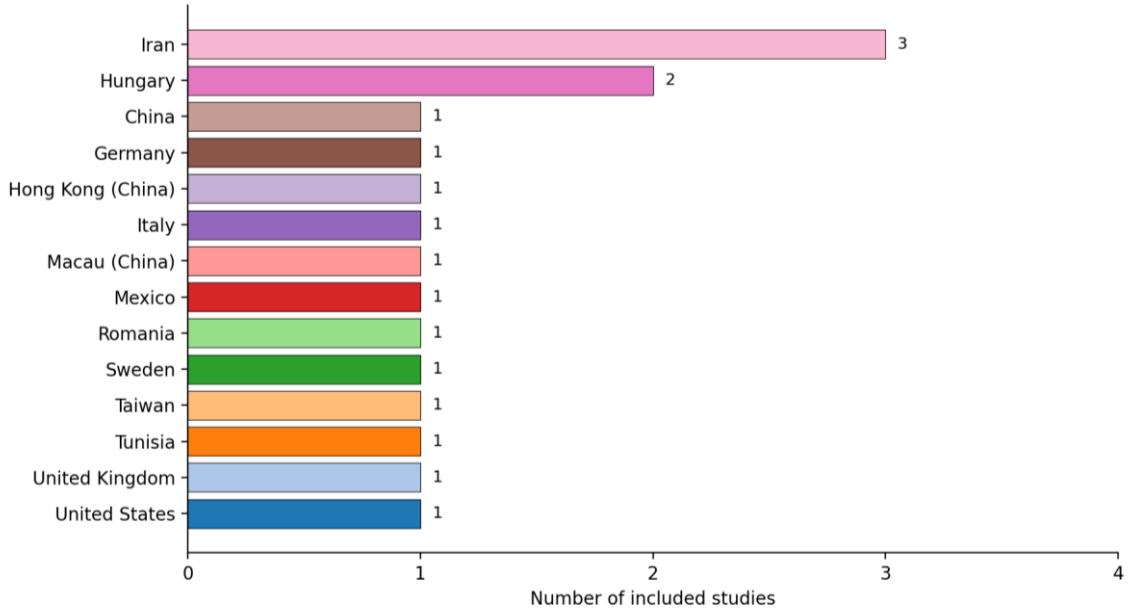

Figure 3. <Geographical distribution of the included studies by study setting>

The keyword co-occurrence network (Figure 4) placed mindfulness and athletic performance at the centre of the evidence, with the strongest links connecting both terms to randomised or controlled trial descriptors, anxiety, stress, acceptance-based approaches, and executive function. Sport-specific terms such as basketball, tennis, and rowing formed peripheral nodes connected mainly through the performance category, whereas

anxiety was linked to stress and trial descriptors but less closely to specific sports. The field thus appears to frame mindfulness primarily as a performance tool, with anxiety as a secondary pathway.

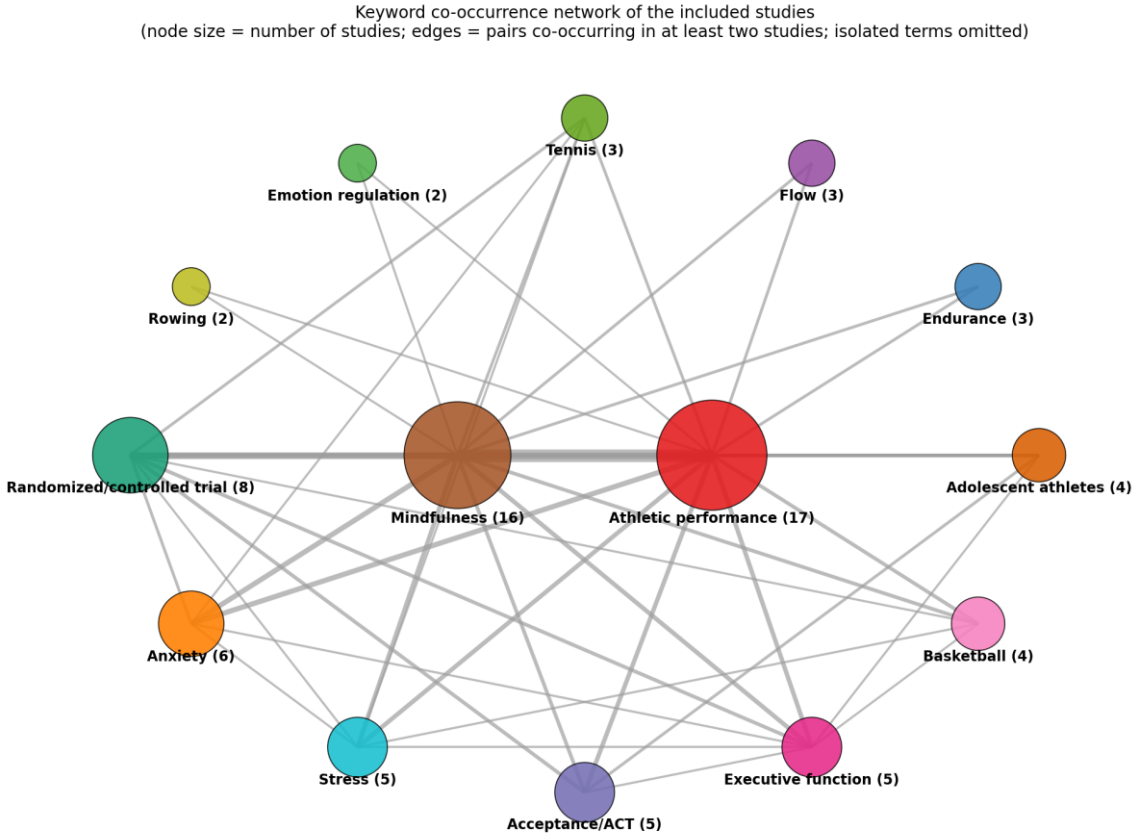

Figure 4. <Keyword co-occurrence network of the included studies>

Methodological Quality of the Included Studies

Appraisal results are presented in Table 6. All eight randomised trials were judged to have some concerns overall. The most frequent sources of concern were insufficient reporting of random sequence generation and allocation concealment, the unavoidable awareness of participants about their allocation, and the absence of prospective trial registration, which limited the assessment of selective reporting. Outcome measurement was judged at low risk when objective performance tests or blinded observers were used, as in the trials by Lundgren et al. (2021), Taghimolla et al. (2025), and Wang and Zhang (2025). Among the nine non-randomised studies, all used concurrent control groups, repeated pre-post measurement, and appropriate analyses, but baseline comparability and completeness of follow-up were frequently unclear. Six non-randomised studies were interpreted as having moderate quality and three as high quality. Overall, the evidence is of moderate quality, constrained mainly by small samples and limited follow-up.

Table 6. <Quality appraisal summary of the included studies>

No	Author(s), Year	Study design	Appraisal tool	Criterion results	Overall interpretation
1	Wang & Zhang, 2025	RCT	RoB 2	D1 SC; D2 SC; D3 L; D4 L; D5 SC	Some concerns
2	Sparks & Ring, 2022	RCT	RoB 2	D1 SC; D2 SC; D3 L; D4 L; D5 SC	Some concerns
3	Zadeh et al., 2019	RCT	RoB 2	D1 SC; D2 SC; D3 L; D4 L; D5 SC	Some concerns
4	Su et al., 2024	RCT (mixed-method)	RoB 2	D1 SC; D2 SC; D3 SC; D4 SC; D5 SC	Some concerns

No	Author(s), Year	Study design	Appraisal tool	Criterion results	Overall interpretation
5	Taghimolla et al., 2025	RCT	RoB 2	D1 SC; D2 SC; D3 L; D4 L; D5 SC	Some concerns
6	Lundgren et al., 2021	RCT	RoB 2	D1 L; D2 SC; D3 SC; D4 L; D5 L	Some concerns
7	Muñoz-Avendaño et al., 2024	RCT	RoB 2	D1 SC; D2 SC; D3 SC; D4 L; D5 SC	Some concerns
8	Bordo et al., 2025	RCT (pilot)	RoB 2	D1 L; D2 SC; D3 L; D4 SC; D5 SC	Some concerns
9	Kelemen et al., 2025	Quasi-experimental	JBI	Y, U, Y, Y, Y, U, Y, Y, Y	Moderate methodological quality
10	Dana et al., 2022	Quasi-experimental	JBI	Y, Y, Y, Y, Y, U, Y, Y, Y	High methodological quality
11	Jones et al., 2020	Non-randomised controlled	JBI	Y, U, Y, Y, Y, U, Y, Y, Y	Moderate methodological quality
12	Tóth et al., 2023	Non-randomised controlled	JBI	Y, U, U, Y, Y, U, Y, Y, Y	Moderate methodological quality
13	Timea et al., 2025	Non-randomised controlled	JBI	Y, U, U, Y, Y, U, Y, Y, Y	Moderate methodological quality
14	Wang et al., 2023	Quasi-experimental	JBI	Y, Y, Y, Y, Y, U, Y, Y, Y	High methodological quality
15	Nien et al., 2020	Quasi-experimental	JBI	Y, Y, Y, Y, Y, U, Y, Y, Y	High methodological quality
16	Tebourski et al., 2022	Controlled field studies	JBI	Y, U, U, Y, Y, U, Y, Y, U	Moderate methodological quality
17	Hoja & Jansen, 2019	Quasi-experimental pilot	JBI	Y, U, Y, Y, Y, U, Y, Y, U	Moderate methodological quality

Note. RoB 2 domains: D1 = randomisation process; D2 = deviations from intended interventions; D3 = missing outcome data; D4 = measurement of the outcome; D5 = selection of the reported result; L = low risk; SC = some concerns. JBI items Q1 to Q9: clarity of cause and effect, similarity of participants, similarity of treatment apart from the intervention, control group, multiple pre-post measurements, complete follow-up, same outcome measurement, reliable measurement, appropriate statistical analysis; Y = yes; U = unclear.

Effects on Sport Performance (RQ1)

Most studies that measured objective or observer-rated performance reported benefits of mindfulness training. The clearest effects appeared in precision tasks performed under pressure. An eight-week programme with two 90-minute sessions per week improved the free-throw performance of college basketball players in both high-stress and low-stress conditions compared with a placebo group that watched biographical videos (Wang & Zhang, 2025). A seven-week intervention with weekly sessions of about one hour improved three-point and free-throw shooting among collegiate players in Macau, with moderate to large effects (Wang et al., 2023), and the Mindfulness for Performance programme increased free-throw accuracy during actual basketball games more than a control condition (Tebourski et al., 2022). In volleyball, mindfulness combined with spike practice

improved non-dominant-hand spikes more than spike practice alone (Taghimolla et al., 2025). MBIs therefore appear to strengthen closed or semi-closed skills that depend on stable attention.

Evidence for endurance and team-sport performance was also favourable but more varied in measurement. A five-week programme lengthened time to exhaustion in a graded exercise test and improved Stroop accuracy, accompanied by a smaller N2 amplitude that points to more efficient conflict monitoring (Nien et al., 2020). An eight-week MBSR course added to regular training improved 6,000-metre ergometer performance in female collegiate rowers, together with sleep quality and coping skills (Jones et al., 2020). In team sports, acceptance and commitment training increased goals, assists, and shots among junior elite ice hockey players, as well as blinded coach ratings, although the objective gains were not maintained at the three-month follow-up (Lundgren et al., 2021). Mindfulness training was also associated with improved expert-rated individual and team performance and fewer injuries in semi-professional soccer (Zadeh et al., 2019), and the MAIC programme enhanced the sport training performance of elite adolescent athletes, with effects that diminished at follow-up (Su et al., 2024).

Several studies qualify this positive picture. A rowing-specific programme improved performance, flow, and mindfulness within the intervention group, but mindfulness and reinvestment did not change more than in the control group (Sparks & Ring, 2022). In a small three-arm basketball trial, active-alert hypnosis outperformed the control condition for free throws, whereas mindfulness produced a large but only near-significant within-group improvement (Muñoz-Avendaño et al., 2024). The pilot study by Hoja and Jansen (2019) found no reported group difference in tennis serve accuracy, and the standard MAC protocol produced smaller improvements in agility and reaction time than SmartACT, a hybrid programme that added guided imagery and hypnosis (Timea et al., 2025). Taken together, the evidence indicates that multi-session MBIs are more often beneficial than neutral for performance, but effect sizes vary with the task, the outcome measure, and the strength of the comparator.

Effects on Competitive Anxiety (RQ2)

Findings for anxiety were less consistent than those for performance. The group-based Mindful Sport Performance Enhancement programme reduced cognitive anxiety and increased flow in national and international distance runners, while the no-training control group showed no change (Kelemen et al., 2025). In male shooters, six weekly mindfulness sessions reduced competitive state anxiety, but the reduction did not differ from that produced by mental skills training (Dana et al., 2022). A seven-session programme for tennis players improved the concentration disruption component of sport anxiety relative to controls (Hoja & Jansen, 2019), and an app-based blended intervention with eight weekly modules reduced anxiety and improved self-confidence, arousal control, awareness, and refocusing among tennis players (Bordo et al., 2025).

Other studies found weaker or no anxiety effects for mindfulness itself. In junior ice hockey players, rational emotive behaviour therapy regulated competitive anxiety, perfectionism, and irrational beliefs, whereas the mindfulness intervention improved processing speed and set-shifting without a comparable reduction in competitive anxiety (Tóth et al., 2023). The SmartACT programme reduced psychological and somatic symptoms more than both the standard MAC protocol and the control condition (Timea et al., 2025), and the Macau basketball trial reported significant changes in mindfulness, acceptance, and attention without reporting a significant change in competition anxiety (Wang et al., 2023). MBIs thus appear to reduce cognitive and attentional components of anxiety more reliably than overall anxiety intensity, and established cognitive or skills-based approaches can achieve comparable reductions.

Intervention Characteristics Associated with Outcomes (RQ3)

Programme characteristics varied considerably, but some patterns emerged. Among the ten studies that reported programme length, durations ranged from five to eight weeks, and all four eight-week programmes reported favourable primary findings (Bordo et al., 2025; Jones et al., 2020; Taghimolla et al., 2025; Wang & Zhang, 2025), as did two of the three six-week programmes (Dana et al., 2022; Kelemen et al., 2025) and the five-week programme (Nien et al., 2020). Mixed findings clustered among six- and seven-week programmes that either compared mindfulness with a strong alternative or measured anxiety alongside performance (Sparks & Ring, 2022; Timea et al., 2025; Wang et al., 2023). Figure 5 displays these patterns. Session dose ranged from weekly one-hour sessions (Dana et al., 2022; Wang et al., 2023) to two 90-minute sessions per week (Wang & Zhang, 2025).

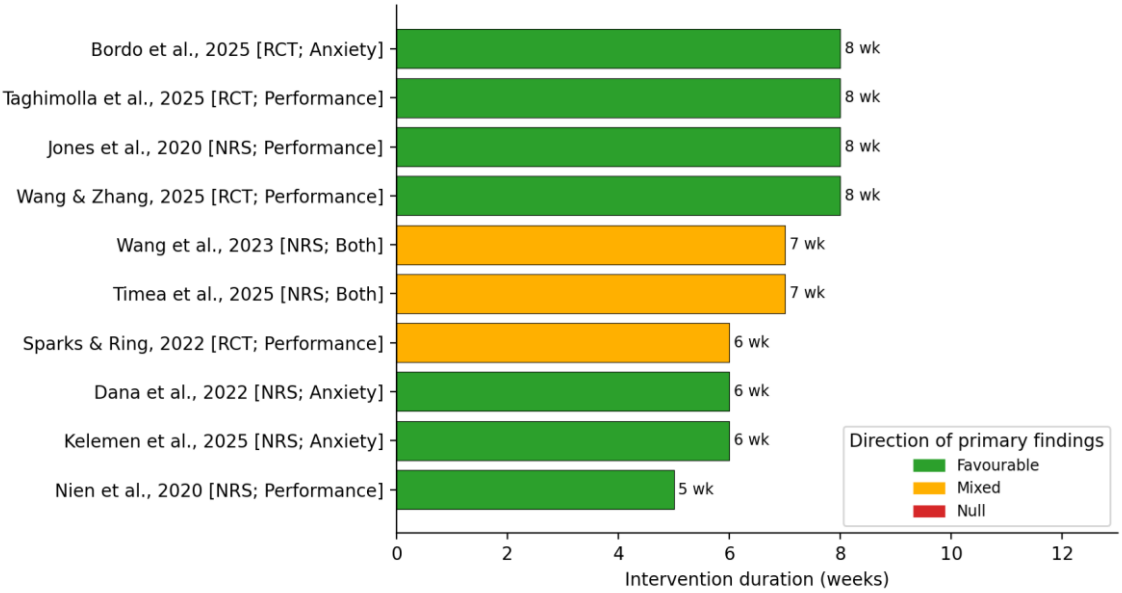

Figure 5. <Intervention duration and direction of primary findings in studies that reported programme length>

Sport specificity and integration with training appeared to matter. Programmes that embedded mindfulness into sport tasks, such as the rowing-specific curriculum (Sparks & Ring, 2022), the Mindfulness for Performance programme (Tebourski et al., 2022), and mindfulness combined with spike practice (Taghimolla et al., 2025), tended to produce performance benefits in the trained skill. Adherence also shaped outcomes, because table tennis players who engaged more fully with the programme gained more ranking points than those with lower adherence (Tebourski et al., 2022). Where delivery format was described, programmes were delivered face-to-face, often in groups (Kelemen et al., 2025; Lundgren et al., 2021), and only one used blended smartphone delivery, which nonetheless produced favourable anxiety outcomes (Bordo et al., 2025). Effects on performance tended to fade at follow-up where this was assessed (Lundgren et al., 2021; Su et al., 2024), indicating that maintenance strategies are an important design consideration.

Interpretation of the Findings

This review indicates that structured multi-session MBIs are more likely than not to improve sport performance in competitive athletes, with the strongest and most consistent effects appearing in precision skills executed under pressure and in endurance tasks (Nien et al., 2020; Wang et al., 2023; Wang & Zhang, 2025). These results fit the view that mindfulness supports performance mainly by stabilising attention and reducing the interference of task-irrelevant thoughts. Cross-sectional evidence showing that mindfulness is linked to better attention control through lower competitive state anxiety and higher confidence (Shi et al., 2024) is consistent with the free-throw, shooting, and spike improvements observed in the included trials (Taghimolla et al., 2025; Tebourski et al., 2022). Reductions in cognitive anxiety and concentration disruption (Hoja & Jansen, 2019; Kelemen et al., 2025) likewise align with findings that mindfulness operates through reduced rumination and improved emotion regulation (Josefsson et al., 2017) and through more adaptive challenge appraisals (Robazza et al., 2024).

The weaker pattern for anxiety deserves emphasis. Mindfulness does not aim to eliminate unpleasant internal states but to change the athlete's relationship with them. Trained athletes may still notice anxiety but be less disrupted by it, a distinction that intensity-based questionnaires may not capture (Robazza et al., 2024; Röthlin et al., 2020). The finding that REBT reduced competitive anxiety more clearly than mindfulness in ice hockey players (Tóth et al., 2023) and that mindfulness and mental skills training reduced anxiety to a similar degree (Dana et al., 2022) suggests that anxiety reduction is not a unique advantage of mindfulness, which echoes the shared effects reported by Röthlin et al. (2020).

Theoretical Implications

The findings extend acceptance-based models of performance by showing that change in performance can occur even when anxiety intensity changes little (Tóth et al., 2023; Wang et al., 2023). This supports theoretical accounts that position acceptance, defusion, and attentional flexibility, rather than symptom control, as the active ingredients of mindfulness in sport (Josefsson et al., 2019; Röthlin et al., 2020). The

evidence also supports multi-states theory, in which appraisals and the functionality of emotions, rather than their mere presence, determine performance outcomes (Robazza et al., 2024). Mechanistic evidence from the included trials, such as improved Stroop accuracy with reduced N2 amplitude (Nien et al., 2020) and improved processing speed and set-shifting (Tóth et al., 2023), suggests that executive control is a plausible pathway linking mindfulness practice with performance, consistent with reviews that highlight self-regulation and attention resources as mechanisms of interventions against mental fatigue (Sun et al., 2024).

Practical Implications

For coaches and sport psychologists, the evidence favours programmes of roughly six to eight weeks that are integrated into regular training and tailored to the demands of the sport (Sparks & Ring, 2022; Taghimolla et al., 2025; Tebourski et al., 2022). Precision-dependent sports such as basketball, shooting, and volleyball appear to be particularly suitable targets (Dana et al., 2022; Wang & Zhang, 2025). Practitioners should monitor adherence, because engagement predicted performance gains (Tebourski et al., 2022), and should plan booster sessions, because performance effects faded after the programmes ended (Lundgren et al., 2021; Su et al., 2024). Blended digital delivery may extend access to athletes with demanding schedules (Bordo et al., 2025). Brief practice can complement these programmes against mental fatigue (Pan et al., 2024; Shaabani et al., 2020), although single sessions may not improve complex, well-learned skills (O'Connor et al., 2022). Coaches who practise mindfulness themselves may be better positioned to model and reinforce these skills (Hägglund et al., 2025).

Comparison with Prior Reviews

The present findings are more favourable for performance than those of the meta-analysis by Kanaujia et al. (2023), which pooled yoga and mindfulness studies with recreational athletes and found significant effects on mindfulness, flow, and stress but not on anxiety. This difference may reflect the present focus on competitive athletes and objective performance, whereas its non-significant anxiety effect mirrors the inconsistent anxiety findings observed here. The current review also agrees with systematic reviews of mental fatigue interventions that identify mindfulness as a viable strategy for protecting sport-specific performance (Pan et al., 2024; Sun et al., 2024), while adding evidence that longer programmes yield benefits outside acute fatigue paradigms. Compared with narrative overviews that described mindfulness programmes across many sports (López & Gené-Morales, 2021; Ramalingam et al., 2021), this review contributes a design-restricted appraisal that distinguishes controlled evidence from correlational support (Li et al., 2023; Tang et al., 2023).

Contradictions in the Literature

Several contradictions emerged. Brief mindfulness protected free-throw performance after ego depletion (Shaabani et al., 2020), yet a single meditation session failed to improve, and possibly hindered, tennis serve returns (O'Connor et al., 2022), and multi-session programmes did not consistently improve tennis serve accuracy (Hoja & Jansen, 2019). Task complexity and automaticity may explain these differences. A second contradiction concerns the comparative value of mindfulness. Some trials found mindfulness-acceptance approaches superior to psychological skills training (Josefsson et al., 2019), whereas others found equivalent effects (Dana et al., 2022; Röthlin et al., 2020) or found alternative approaches more effective for anxiety (Tóth et al., 2023) and performance (Muñoz-Avendaño et al., 2024). Comparator strength, outcome timing, and sample size are likely explanations, and within-group gains were sometimes not matched by between-group differences (Sparks & Ring, 2022).

Research Gaps

Three gaps stand out. First, no included trial was large enough to test moderators such as sex, age, sport type, or competitive level with adequate power, even though trait-level research indicates that female, injured, and choking-susceptible athletes may be especially vulnerable to competitive anxiety (Li et al., 2023; Tang et al., 2023; Terres-Barcala et al., 2022). Second, performance was rarely measured in official competition, with the notable exceptions of in-game free throws and ranking points (Tebourski et al., 2022) and match statistics (Lundgren et al., 2021), which echoes calls for ecological validation of mental interventions (Pan et al., 2024). Third, the dose-response relationship remains poorly defined because session length, frequency, and home practice were inconsistently reported (Ramalingam et al., 2021; Su et al., 2024). Studies with athletes with disabilities, combat sports, and coaches' perspectives are also scarce (Hägglund et al., 2025).

Limitations of This Review

This review has several limitations. First, only Scopus was searched, and the restriction to English-language, open-access, final-stage journal articles may have excluded relevant trials indexed elsewhere or published behind paywalls, introducing possible language and availability bias. Second, the heterogeneity of outcomes,

comparators, and reporting precluded meta-analysis, so the synthesis relies on the direction and consistency of effects rather than pooled estimates. Third, several included studies did not report sample size, programme dose, or randomisation procedures in sufficient detail, which constrained both extraction and risk-of-bias judgements. Fourth, the requirement for objective, observer-rated, or anxiety outcomes excluded well-designed trials that reported only self-rated performance or psychological mediators (Josefsson et al., 2019; Röthlin et al., 2020), which may have narrowed the picture of how mindfulness works. Fifth, publication bias could not be formally assessed.

Future Research Agenda

Future research should pursue at least four directions. First, adequately powered, prospectively registered randomised trials with active comparators, such as psychological skills training or REBT, are needed to establish the specific added value of mindfulness (Röthlin et al., 2020; Tóth et al., 2023). Second, trials should measure objective performance during official competition and include follow-up assessments of at least three to six months to test the durability of effects and the value of booster sessions (Lundgren et al., 2021; Su et al., 2024). Third, researchers should systematically vary programme duration, session frequency, home practice, and sport specificity to establish dose-response relationships (Sparks & Ring, 2022; Taghimolla et al., 2025). Fourth, studies should assess anxiety with instruments that capture both intensity and directional interpretation, alongside mediators such as rumination, emotion regulation, and cognitive appraisal (Josefsson et al., 2017; Robazza et al., 2024).

Summary of Answers to the Research Questions

In response to RQ1, structured multi-session MBIs improved objective or observer-rated performance in most controlled studies, particularly in precision and endurance tasks, although effects were not universal and tended to fade after the programmes ended. In response to RQ2, MBIs reduced cognitive anxiety and concentration disruption in several studies, but effects on overall competitive anxiety were inconsistent and often comparable to those of psychological skills training or REBT. In response to RQ3, sport-specific programmes lasting about six to eight weeks, integrated with regular training and supported by good adherence, were most often associated with favourable outcomes, while blended digital delivery appears promising but is not yet well tested.

Conclusions

This review of 17 controlled trials concludes that structured multi-session mindfulness-based interventions can improve objective and observer-rated sport performance in competitive athletes, most clearly in precision and endurance tasks. Their effects on competitive anxiety are less consistent, with benefits appearing mainly for cognitive anxiety and concentration disruption and often matching, rather than exceeding, those of other psychological approaches. Sport-specific programmes of about six to eight weeks, embedded in training and supported by strong adherence, appear most promising. The review contributes a design-restricted synthesis that offers practical guidance for coaches and sport psychologists planning mental training. These conclusions are tempered by small samples, reliance on a single database, incomplete reporting, and limited follow-up. Larger preregistered trials with competition-based outcomes, active comparators, and longer follow-up are needed to confirm and refine these findings.

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