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Mindfulness en deportistas de resistencia: beneficios para el bienestar psicológico y el rendimiento deportivo – Una revisión sistemática

Mindfulness in Endurance Athletes: Psychological Well-Being and Sport Performance – A Systematic Review

Mindfulness em atletas de resistência: benefícios para o bem-estar psicológico e o desempenho esportivo – uma revisão sistemática

Rodríguez, Sabina Tamara^{1,2,3}; Rueda-Extremera, María¹; Bolló-Gasol, Salomé¹; Cantero-García, María¹

¹ *Universidad a distancia de Madrid (Udima), Madrid, España;* ² *Universidad de Flores (UFLO), Buenos Aires, Argentina;* ³ *Universidad de Málaga (UMA), Málaga, España.*

RESUMEN

El mindfulness ha emergido como una práctica relevante en la Psicología del Deporte, especialmente en los deportes de resistencia, donde las demandas físicas y psicológicas son particularmente elevadas. Esta revisión sistemática tuvo como objetivo analizar los efectos de las intervenciones basadas en mindfulness sobre el bienestar psicológico y el rendimiento deportivo en atletas de resistencia, considerando factores asociados como la regulación emocional, la ansiedad, el estrés y el estado de flow. La revisión se llevó a cabo siguiendo las directrices PRISMA (2020) y fue registrada en la plataforma PROSPERO (2024). Se realizó una búsqueda sistemática en diversas bases de datos, entre ellas PubMed, Scopus y Web of Science. Se incluyeron seis estudios que evaluaron intervenciones basadas en mindfulness en atletas de resistencia. La calidad metodológica de los estudios se evaluó mediante la escala PEDro y la herramienta ROBINS-I V2. Los resultados sugieren que el mindfulness puede actuar como un facilitador psicológico, favoreciendo la aceptación de experiencias internas, la mejora del enfoque atencional y la resiliencia, así como reducciones en ansiedad y estrés y una mayor experiencia de flow. Los tamaños del efecto en los estudios incluidos oscilaron entre pequeños y muy grandes ($d = 0.31-1.83$). Las variables relacionadas con el bienestar psicológico mostraron en general efectos de magnitud moderada a grande, mientras que los resultados vinculados al rendimiento deportivo presentaron resultados más variables. Las limitaciones metodológicas y el reducido número de estudios restringen la generalización de los hallazgos. En conclusión, el mindfulness se presenta como una intervención prometedora en los deportes de resistencia, aunque se requieren investigaciones con diseños más robustos para consolidar su efectividad y aplicabilidad práctica.

Palabras clave: mindfulness, atletas de resistencia, regulación emocional, flow.

ABSTRACT

Mindfulness has emerged as a relevant practice in Sport Psychology, particularly in endurance sports, where physical and psychological demands are especially high. This systematic review aimed to analyze the effects of mindfulness-based interventions on psychological well-being and sport performance in endurance athletes, considering associated psychological factors such as emotional regulation, anxiety, stress, and the flow state. The review was conducted following the PRISMA (2020) guidelines and was registered in the PROSPERO platform (2024). A systematic search was performed across several databases, including PubMed, Scopus, and Web of Science. Six studies evaluating mindfulness-based interventions in endurance athletes were included. The methodological quality of the studies was assessed using the PEDro scale and the ROBINS-I V2 tool. The results suggest that mindfulness may act as a psychological facilitator, promoting the acceptance of internal experiences, improving attentional focus and resilience, as well as reducing anxiety and stress and increasing the experience of flow. Effect sizes across the included studies ranged from small to very large ($d = 0.31-1.83$). Psychological well-being variables generally showed moderate to large effects, while sport performance outcomes presented more variable results. Methodological limitations and the small number of studies restrict the generalizability of the findings. In conclusion, mindfulness appears to be a promising intervention in endurance sports, although further research with more robust designs is required to consolidate its effectiveness and practical applicability.

Keywords: mindfulness, endurance athletes, emotional regulation, flow.

RESUMO

O mindfulness tem emergido como uma prática relevante na Psicologia do Esporte, especialmente nos esportes de resistência, onde as demandas físicas e psicológicas são particularmente elevadas. Esta revisão sistemática teve como objetivo analisar os efeitos das intervenções baseadas em mindfulness sobre o bem-estar psicológico e o desempenho esportivo em atletas de resistência, considerando fatores psicológicos associados, como a regulação emocional, a ansiedade, o estresse e o estado de flow. A revisão foi conduzida seguindo as diretrizes PRISMA (2020) e foi registrada na plataforma PROSPERO (2024). Foi realizada uma busca sistemática em diversas bases de dados, entre elas PubMed, Scopus e Web of Science. Foram incluídos seis estudos que avaliaram intervenções baseadas em mindfulness em atletas de resistência. A qualidade metodológica dos estudos foi avaliada por meio da escala PEDro e da ferramenta ROBINS-I V2. Os resultados sugerem que o mindfulness pode atuar como um facilitador psicológico, favorecendo a aceitação das experiências internas, a melhoria do foco atencional e da resiliência, bem como reduções na ansiedade e no estresse e uma maior experiência de flow. Os tamanhos do efeito nos estudos incluídos variaram de pequenos a muito grandes ($d = 0.31-1.83$). As variáveis relacionadas ao bem-estar psicológico apresentaram, em geral, efeitos de magnitude moderada a grande, enquanto os resultados relacionados ao desempenho esportivo mostraram maior variabilidade. As limitações metodológicas e o reduzido número de estudos restringem a generalização dos achados. Em conclusão, o mindfulness apresenta-se como uma intervenção promissora nos esportes de resistência, embora sejam necessárias mais pesquisas com desenhos metodológicos mais robustos para consolidar sua efetividade e aplicabilidade prática.

Palavras chave: mindfulness, atletas de resistência, regulação emocional, flow.

INTRODUCTION

Mindfulness has emerged as a valuable practice within the field of Sport Psychology, offering athletes new ways to optimize both their athletic performance and psychological well-being (Gardner & Moore, 2017). In endurance sports, where physical and mental demands are exceptionally high, mindfulness appears as a key skill for managing stress, maintaining concentration over extended periods, and regulating emotions (Ceberio & Rodríguez, 2023; Gardner & Moore, 2017; Jones et al., 2020). However, despite its potential benefits, the scientific literature shows

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significant gaps regarding its specific impact on this population, highlighting the need for further research (Kaufman et al., 2018).

From an applied perspective, mindfulness is integrated into Contextual Therapies, emphasizing mindful awareness as a present-centered, non-elaborative, and non-judgmental form of consciousness (Segal et al., 2013). Its relevance lies in the acceptance of internal experiences—known as experiential acceptance—which represents a key process for improving quality of life and fostering personal growth (Hayes et al., 2012). Unlike traditional cognitive-behavioral approaches and programs such as Psychological Skills Training (PST), which focus on controlling thoughts and emotions, mindfulness—within the framework of third-wave therapies—promotes an open and non-judgmental observation of internal experiences. This perspective facilitates experiential acceptance (Hayes et al., 2012), supports athletes' psychological well-being, and contributes to optimizing performance in high-demand sport contexts (Mañas et al., 2014; Palmi & Solé, 2016; Sappington & Longshore, 2015).

Beyond these psychological effects, mindfulness has also been associated with physiological regulation processes relevant to athletic performance. Research indicates that mindfulness practice can modulate the autonomic nervous system, promoting parasympathetic activation and improving heart rate variability, a marker associated with stress regulation and recovery capacity in athletes (Tang et al., 2015; Zeidan et al., 2010). In addition, mindfulness training has been linked to reductions in cortisol levels and improved neuroendocrine responses to stress, facilitating adaptation to prolonged physical and mental demands (Pascoe et al., 2017). These mechanisms are particularly relevant in endurance sports, where athletes must sustain effort, regulate fatigue, and maintain cognitive clarity under prolonged physical and psychological demands (Ceberio & Rodríguez, 2023; Jones et al., 2020; Knechtle & Nikolaidis, 2018). Furthermore, mindfulness has been associated with flow states (Gardner & Moore, 2007; Jackson & Eklund, 2004; Palmi & Solé, 2016), defined as a state of complete immersion in an activity (Csikszentmihalyi, 1990), which is closely linked to performance in demanding sport contexts (Jackson & Eklund, 2004; Swann et al., 2012). In this sense, mindfulness may facilitate flow by enhancing attentional focus, present-moment awareness, and reducing cognitive interference during performance (Gardner & Moore, 2007; Jones et al., 2020; Schwanhausser, 2009; Scott-Hamilton & Schutte, 2016). To maximize these benefits, mindfulness can be practiced formally or informally (Delgado et al., 2012; Kabat-Zinn, 1990). Formal practice includes structured exercises such as seated meditation and body scans in distraction-free environments, while informal practice integrates mindfulness into everyday activities like walking, training, or eating (Cepeda Salas & Romero Carrasco, 2014; Delgado et al., 2012). Both forms are complementary and, provided there is consistency and continuity, contribute to enhancing the athlete's psychological well-being and emotional management (Gardner & Moore, 2004).

Among mindfulness interventions, the most empirically validated structured protocols are Mindfulness-Acceptance-Commitment (MAC) and Mindful Sports Performance Enhancement (MSPE). Both programs emphasize the acceptance of internal experiences, the enhancement of psychological skills, and improved athletic performance (Contreras Pérez & Crobu, 2018; Mañas et al., 2014; Palmi & Solé, 2016).

The MAC protocol, developed by Gardner and Moore (2007), consists of five phases: (1) psychoeducation, where athletes learn the principles of mindfulness and acceptance, understanding their relevance in the sports context; (2) mindfulness training, incorporating structured exercises to develop present-moment awareness and emotional self-regulation; (3) values identification, helping athletes clarify what is truly meaningful in their lives and sports, guiding their actions toward intrinsic goals; (4) acceptance, promoting a willingness to face challenging thoughts, emotions, and sensations without trying to control or avoid them, thereby fostering adaptive responses to competitive demands; and (5) integrated practice, aimed at consolidating the learned skills through their application in real training and competition settings (Gardner & Moore, 2007).

This comprehensive MAC approach not only reduces experiential avoidance and emotional reactivity but also fosters flow states, essential for performance in high-demand sports (Cepeda Salas & Romero Carrasco, 2014). Moreover, the program enhances athletes' ability to manage stress and competitive pressure, reinforcing their psychological well-being by integrating personal values into their performance (Gardner & Moore, 2007; Palicio Mayoral et al., 2022).

The MSPE protocol, developed by Kaufman et al. (2018), is structured in six phases and adapted to the specific needs of each sport modality: (1) introduction to mindfulness and initial assessment; (2) seated meditation and mindful awareness; (3) body scan and mind-body connection; (4) mindfulness applied to sports training; (5) mindfulness in competitive situations; and (6) autonomous and sustainable practice. These practices cultivate mindfulness skills and allow athletes to observe mental phenomena without judgment, reducing emotional reactivity and enhancing their ability to focus during competitions (Kaufman et al., 2009).

These structured interventions have proven particularly effective in endurance sports, reducing experiential avoidance, facilitating acceptance of negative emotions and thoughts, and increasing flow, while promoting states of full concentration (Gardner & Moore, 2007; De Petrillo et al., 2009). The benefits of mindfulness have been extensively studied in various individual sports, such as tennis (Hoja & Jansen, 2019), trampoline (Schwanhausser, 2009), virtual shooting (Gao & Zhang, 2023), biathlon (Josefsson et al., 2021), and in team sports such as football (MacDonald & Minahan, 2018; Carraça et al., 2018; Holguin-Ramirez et al., 2020) or basketball (Aherne et al., 2011), among others. However, there is limited in-depth research in endurance sports (Kaufman et al., 2018), despite the growing interest in mindfulness within these highly demanding disciplines (Baltzell, 2016; Kabat-Zinn et al., 1985).

In endurance sports, such as marathon, ultramarathon, triathlon, rowing, cycling, and long-distance swimming (Knechtle, 2012), athletes are exposed to specific characteristics due to the high demands of these disciplines. These sports require prolonged physical and mental effort, where aerobic capacity and muscular endurance are essential for performance (Knechtle & Nikolaidis, 2018), along with stress management, mental fatigue regulation, and the ability to maintain focus over long durations (Ceberio & Rodríguez, 2023).

For example, ultramarathon runners may compete over distances exceeding 160 kilometers, across challenging natural terrains filled with obstacles (Wardenaar et al., 2018). In this context, maintaining focus and making effective decisions are fundamental, including aspects such as strategic energy conservation, managing extreme fatigue, and handling environmental unpredictability (Ceberio & Rodríguez, 2023). Marathoners and triathletes may also face challenges such as boredom (Hill et al., 2021), pain, competitive anxiety, and the management of negative thoughts (Corbally et al., 2019). In team rowers, additional challenges include synchronization, high competitive stress, self-criticism and perfectionism, reinvestment risk, and pain management (Jones et al., 2020; Sparks et al., 2021; Sparks & Ring, 2022). Swimmers, on the other hand, compete in a rhythmic and physically demanding sport requiring precise pace control, concentration, and constant integration of kinesthetic, cognitive, and emotional information (Chen & Meggs, 2021; Ning et al., 2022). Among cyclists, the most challenging characteristics include prolonged exposure to discomfort, internal distractions, and the critical importance of focus (Scott-Hamilton & Schutte, 2016).

In this context, mindfulness may be particularly useful in high-demand environments (Kabat-Zinn, 2003), such as endurance sports. Its emphasis on present-moment awareness, along with the acceptance and observation of thoughts and emotions without attempting to control or eliminate them, may be key for athletes dealing with high levels of stress (Mañas et al., 2014). However, as noted by Sappington and Longshore (2015), it is essential to adapt interventions to the specific needs of each sporting discipline.

Sport performance, understood as the athlete's ability to successfully execute a sporting activity, encompasses not only physical capacities and technical skills, but also cognitive and emotional components that are crucial in high-demand contexts such as endurance sports (Knechtle & Nikolaidis, 2018). In this regard, mindfulness becomes a relevant psychological resource, as it enhances attentional control, reduces mental rumination, and promotes an attitude of acceptance toward discomfort and adverse internal experiences (Gardner & Moore, 2007; Sappington & Longshore, 2015).

The integration of mindfulness-based interventions in endurance sports can therefore optimize psychological functioning and improve performance, resilience, and overall well-being in athletes. Nevertheless, more research is needed to better understand the mechanisms through which mindfulness exerts its effects in these specific sports settings and to adapt protocols to the demands and particularities of each discipline (Ceberio & Rodríguez, 2023; Kaufman et al., 2018).

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In recent years, several systematic and narrative reviews have examined the role of mindfulness in sport contexts, highlighting its potential benefits for psychological functioning and performance among athletes (Kaufman et al., 2018; Sappington & Longshore, 2015). However, these reviews have generally focused on mixed sport populations, combining individual and team sports with substantially different performance demands. As a result, the specific characteristics of endurance sports -such as prolonged physical effort, sustained attentional demands, and exposure to extreme fatigue- have received comparatively limited attention in the literature. Furthermore, existing reviews have not systematically examined how mindfulness-based interventions may influence key psychological variables relevant to endurance performance, such as emotional regulation, stress management, and flow experiences.

Therefore, a focused synthesis of the available evidence in endurance sports is needed to clarify the potential role of mindfulness-based interventions in these highly demanding disciplines. In this context, the aim of this systematic review is to analyze the effects of mindfulness-based interventions on psychological well-being and sport performance in endurance athletes.

MATERIAL AND METHOD

Design

This study was conducted as a systematic review aimed at identifying, selecting, and synthesizing empirical evidence on mindfulness-based interventions in endurance athletes. The review was developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021), the PICOS framework for structuring the research question and eligibility criteria (Higgins & Green, 2011), and the methodological standards proposed for review studies in psychology (Fernández-Ríos & Buela-Casal, 2009).

The review protocol was prospectively registered in PROSPERO in 2024 (CRD42024603969).

Based on the PICOS strategy, the guiding research question was: In endurance athletes (P), do mindfulness-based interventions (I), compared with passive control groups or alternative interventions (C), improve sport performance and psychological well-being (O) according to experimental and quasi-experimental studies (S)?

Participants

In the present systematic review, the term participants refers to the empirical studies included in the analysis rather than to individuals directly recruited by the authors. Accordingly, the unit of analysis consisted of primary studies that met the predefined eligibility criteria. The final sample of this review comprised six empirical studies examining mindfulness-based interventions in endurance athletes. These studies included participants from different endurance sport modalities, such as swimming, rowing, cycling, and running, and involved both male and female athletes with varying levels of competitive experience.

The studies were selected through a criterion-based sampling strategy, characteristic of systematic reviews. Selection was carried out according to the previously established inclusion and exclusion criteria derived from the PICOS framework (Higgins & Green, 2011), which allowed for a systematic delimitation of the documentary corpus analyzed.

Instruments/ Materials

The instruments used in this study consisted of the electronic databases, search terms, and search strategies employed to identify the relevant literature.

The systematic search was conducted in the following electronic databases: Web of Science, Scopus, PubMed, PsycINFO, PsycARTICLES, Psycodoc, Dialnet, and SPORTDiscus, selected due to their relevance for research in psychology, sport sciences, and health.

The search strategy was based on combinations of keywords related to mindfulness, endurance sports, and sport performance and psychological well-being. The main descriptors included: *mindfulness, awareness, mindfulness intervention, endurance sport, resistance sport, endurance athletes, ultramarathoners, triathletes, long-distance runners, cyclists, swimmers, psychological well-being, sport performance, athletic performance, and flow*. These terms were combined using the Boolean operators AND and OR, adapting the search equations to the specific syntax of each database.

Search filters were applied when available to refine the results, including publication period, language, document type, and subject area. The search was limited to studies published between 2014 and 2024 in English or Spanish. This period was selected to capture the most recent empirical evidence on mindfulness-based interventions in sport psychology, particularly following the growing development and application of structured protocols such as MAC and MSPE during the last decade.

A base search equation was developed and subsequently adapted to the syntax and search fields required by each database. When modifications were necessary, these were specified in the corresponding row of Table 1, where the complete search strategy and database-specific equations are presented.

All identified records were exported to the reference management software Mendeley, which was used to organize the references and remove duplicate records prior to the screening process.

Table 1

Search Strategy.

Database	Search Terms	Applied Filters
Web of Science	("mindfulness" OR "awareness" OR "mindfulness intervention") AND ("endurance sport" OR "resistance sport" OR "endurance athletes" OR "resistance athletes" OR "ultramarathoners" OR "ultrarunners" OR "long-distance runners" OR "ultra trail runners" OR "triathletes" OR "long-distance cycling" OR "long-distance swimming" OR "athlete") AND ("psychological well-being" OR "sport performance" OR "athletic performance" OR "performance")	Advanced search (all fields), date (2014–2024), language (English and Spanish), document type (articles and peer-reviewed articles), subject areas (sport sciences and psychology).
Scopus	Same descriptors adjusted to database format	Advanced search (all fields), date (2014–2024), language (English and Spanish), document type (articles and peer-reviewed articles), subject areas (psychology and neuroscience)
PubMed	Same descriptors adjusted to database format	Advanced search (all fields), date (2014–2024), language (English and Spanish), article type (case report, clinical study, randomized controlled trial, intervention, reviewed and republished articles), species (human)
PsycINFO	Same descriptors adjusted to database format	Advanced search (all fields), date (2014–2024), language (English and Spanish), document type (peer-reviewed articles), source type (scientific journals), subject (topics related to sport, mindfulness, psychological well-being, and sports performance)
PsycARTICLES	Same descriptors adjusted to database format. Through PROQUEST	Advanced search (all fields), date (2014–2024), language (English and Spanish), article type (peer-reviewed articles), source type (scientific journals), subject (topics related to sport, mindfulness, psychological well-being, and sports performance)
Psicodoc	Same descriptors adjusted to database format. Through EBSCOhost. Searches conducted in both English and Spanish	Advanced search (all fields), date (2014–2024), language (English and Spanish), source type (academic publications)
Dialnet	Same descriptors adjusted to database format. Searches conducted in both English and Spanish.	Advanced search (all fields), date (2014–2024), language (English and Spanish), document type (journal article), subjects (psychology, education, and sports), descriptors (basketball and baloncesto excluded)
SPORTdiscuss	Same descriptors adjusted to database format. Through EBSCOhost. Searches conducted in both English and Spanish.	Advanced search (all fields), date (2014–2024), language (English and Spanish), source type (academic publications, journals), subject (mindfulness, sport psychology)

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Each search strategy carried out for each database (including exact search terms, Boolean operators, applied filters, and any limitations used) was documented, specifying the date each search was conducted. The search results were exported for import into the reference manager Mendeley, and screenshots of the search strategies were taken. All of this was done to ensure the search strategy could be replicated.

The review procedure was carried out in sequential phases, following the methodological recommendations of the PRISMA 2020 statement (Page et al., 2021).

PICOS Strategy

First, the research framework of the review was established using the PICOS strategy (Population, Intervention, Comparison, Outcomes, and Study design) proposed by Higgins and Green (2011). This framework guided the formulation of the research question and the definition of the key components that structured the search and selection of studies.

Specifically, the population corresponded to endurance athletes, the intervention referred to mindfulness-based interventions, the comparison conditions included control groups or pre-post intervention comparisons, the outcomes considered were sport performance and psychological well-being, and the study designs included experimental and quasi-experimental studies. The operationalization of these components is presented in Table 2.

Table 2

PICOS Strategy.

Parameter	Description
Population (P)	Endurance athletes (middle- and long-distance runners, ultramarathoners, triathletes, rowers, cyclists, long-distance swimmers).
Intervention (I)	Mindfulness-based programs (Mindfulness-Based Stress Reduction - MBSR, Mindfulness-Based Cognitive Therapy - MiBCT, Mindful Sport Performance Enhancement - MSPE, Mindfulness-Acceptance-Commitment - MAC, and other programs designed for athletes).
Comparison (C)	Comparison between experimental and control groups (passive or alternative interventions).
Outcomes (O)	Psychological well-being variables (e.g., emotional regulation, anxiety, sleep quality, mental health, attentional focus, and flow states), assessed through validated psychological questionnaires and scales, and sports performance indicators, including objective measures (e.g., rowing performance or running economy) and subjective perceived performance.)
Study Design (S)	Experimental and quasi-experimental studies evaluating mindfulness-based interventions in endurance athletes.

Eligibility criteria

Based on the PICOS framework, the inclusion and exclusion criteria were established in order to delimit the scope of the review and ensure consistency in the study selection process.

Only studies examining mindfulness-based interventions applied to endurance athletes and reporting outcomes related to sport performance and/or psychological well-being with quantitative data allowing the evaluation of intervention effects were considered eligible. The detailed inclusion and exclusion criteria are presented in Table 3.

Table 3

Inclusion and Exclusion Criteria.

Inclusion criteria	Exclusion criteria
Studies involving endurance athletes (e.g., marathon, ultramarathon, triathlon, rowing, cycling, or long-distance swimming)	Studies did not provide full text.
Mindfulness- based interventions (e.g., MAC, MSPE, or other applied mindfulness training programs)	Studies without specific mindfulness interventions
Studies including a control group or pre–post intervention assessment.	Studies did not report psychological or performance outcomes
Psychological well-being variables (e.g., emotional regulation, anxiety, stress, flow) and/or sports performance indicators.	Studies that did not report quantitative results allowing the evaluation of intervention effects
Experimental and quasi-experimental studies	
Studies published in English or Spanish	

Literature Strategy

Once the eligibility criteria were established, the systematic search was conducted across the selected electronic databases. The search was performed on November 8, 2024, applying the search equations described in the Instruments/Materials section.

In addition to the database search, manual searches of reference lists and citation tracking were conducted in order to identify potentially relevant studies not retrieved through the initial search strategy.

Duplicate records were first identified and removed automatically using the reference manager Mendeley. Subsequently, a manual verification was conducted to ensure the complete removal of duplicate records before the screening process based on titles and abstracts, following PRISMA recommendations (Page et al., 2021).

Selection Process

The study selection process was conducted systematically in accordance with the PRISMA 2020 guidelines (Page et al., 2021). The PRISMA statement (Liberati et al., 2009) includes a 27-item checklist and a four-phase flow diagram (identification, screening, eligibility, and inclusion), designed to improve the reporting of systematic reviews and meta-analyses by ensuring transparency and methodological rigor in the selection of studies.

The study selection procedure was carried out in sequential phases. The initial screening and eligibility assessment were conducted by the first author, while the decisions regarding study inclusion were reviewed and discussed with the co-authors to ensure consistency and methodological rigor. Any uncertainties regarding study eligibility were resolved through discussion among the authors.

Identification: Following the initial database search, search terms were refined according to the characteristics of each database, and the predefined inclusion and exclusion criteria were applied. In addition, citation tracking and reference list screening were conducted in order to identify potentially relevant studies that might not have been retrieved in the initial search.

Screening: Titles and abstracts of the retrieved records were examined to assess their preliminary relevance to the research question. Studies clearly unrelated to the objectives of the review were excluded at this stage. In particular, studies that did not address mindfulness-based interventions, endurance sport populations, or outcomes related to sport performance or psychological well-being were excluded.

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Eligibility: Potentially relevant studies were then evaluated through full-text review to determine their compliance with the predefined eligibility criteria. Studies were excluded when they did not specifically involve endurance athletes, did not meet the required methodological design, or did not report statistical results relevant to the objectives of the review. In some cases, full-text examination was necessary when abstracts did not clearly specify the target population or methodological design.

Inclusion: Only studies that met all predefined eligibility criteria were retained for the final analysis. The complete study selection process is illustrated in the PRISMA flow diagram (Figure 1).

Data extraction

A detailed analysis of the six selected studies was conducted through an exhaustive reading. Data extraction was performed using a structured charting process presented in the Results section (Table 4). The extracted information included author and year of publication, study design, population and sample characteristics (number of participants, age, gender, and sport modality), intervention characteristics (type, duration, and frequency), variables, instruments, and outcomes related to sport performance and psychological well-being, including the quantitative statistical results reported in each study.

The analysis included all statistical results reported in the studies in order to provide a comprehensive synthesis of the available evidence regarding the effects of mindfulness-based interventions on athletic performance and psychological well-being in endurance athletes.

For the purpose of synthesis, the findings of the included studies were organized according to the analytical subsections presented in the Results section of this review. These included study characteristics, methodological design, sample size, gender of the participants, country of origin, intervention characteristics, results by sport modality, main psychological effects of mindfulness interventions, methodological quality, and reported statistical outcomes. Given the limited number of studies included ($n=6$), findings were synthesized using a narrative approach.

Quality assessment

The PEDro scale (De Morton, 2009) was used to evaluate randomized controlled trials, while the ROBINS-I V2 tool — Risk of Bias In Non-randomized Studies of Interventions, Version 2 (Sterne et al., 2024) — was employed for quasi-experimental studies. The PEDro scale (De Morton, 2009) consists of 11 criteria related to scientific rigor. These include aspects such as random allocation, concealed allocation, baseline comparability, blinding of participants, researchers and outcome assessors, intention-to-treat analysis, and appropriate follow-up. Each of the items from 2 to 11 can be rated as 0 or 1, resulting in a total score ranging from 0 (no criteria met) to 10 (all criteria met). A study that fails to meet any of the criteria receives zero points, while one that satisfies all specified criteria receives the maximum of ten.

The ROBINS-I V2 tool (Sterne et al., 2024) was applied to assess the risk of bias in quasi-experimental studies. This tool evaluates seven key domains, such as bias due to participant selection, deviations from intended interventions, measurement of outcomes, and selective reporting. Each domain is rated at different levels of risk: low, moderate, serious, or critical. The ROBINS-I V2 provides a comprehensive assessment of internal validity in non-randomized studies. This updated version was preferred over the original (ROBINS-I, Sterne et al., 2016) due to its enhanced precision and applicability. Version 2 introduces a comparative framework based on a hypothetical target trial, allowing results to be evaluated against an ideal, unbiased study design. It also features a screening step to exclude studies with critical risk of bias and an algorithm that synthesizes domain ratings into an overall judgment, promoting greater consistency in bias assessment. Additional innovations, such as more detailed domain explanations and intermediate response categories, make it a more robust tool aligned with current standards for methodological rigor and scientific transparency. It is important to note that this tool was developed by the Cochrane Methods Bias Group and the Cochrane Non-Randomized Studies Methods Group. However, access to the most recent full reference of the tool (Sterne et al., 2024) was not available at the time of this review.

Quantification of effects

The statistical results of the studies were analyzed by evaluating effect sizes and limitations. Specific measures were employed depending on the type of outcome variable and the study design. For continuous variables such as psychological well-being and athletic performance, descriptive statistics (mean [M] and standard deviation [SD]) were used alongside inferential tests like analysis of variance (ANOVA) and Student's t-test, reporting the statistical indicators provided in the original studies (Cohen, 1992). When reported in the original studies, inferential analyses such as analysis of variance (ANOVA) and Student's t-tests were considered. (Altman et al., 2000). Since not all studies reported confidence intervals (CIs) associated with the observed between-group differences, these were calculated using SPSS version 25.0 to provide more precise estimates of variability and to strengthen the validity of the conclusions drawn (Altman et al., 2000). Additionally, effect sizes reported in the included studies were extracted or derived when possible and presented descriptively. These values were graphically represented using a scatter plot to facilitate comparison across studies (Cumming, 2012). Potential biases and model adjustments were considered to ensure the validity of the results (Sterne et al., 2016). To interpret the practical relevance of findings, the minimum clinically important difference (MCID) was also considered (King et al., 2017; Moher et al., 2009). This involved an effect size-based approach, considering that, according to Cohen (1988), $d > 0.5$ indicates a moderate effect and $d > 0.8$ a large effect, while $\eta^2 > 0.06$ indicates a moderate effect and $\eta^2 > 0.14$ a large effect, depending on the variable assessed. This interpretation allows the observed changes to be evaluated not only statistically, but also in terms of their practical significance, ensuring that the conclusions are applicable and useful in real-world settings. This approach supports the critical appraisal of findings, promotes replicability, and upholds transparency in the scientific process (De Morton, 2009; Liberati et al., 2009).

RESULTS

The study selection process is presented in the PRISMA flow diagram (Figure 1). The database search identified a total of 1,075 records. After removing duplicates, 1069 records remained for screening. Following title screening, 810 records were excluded, leaving 259 articles for abstract review. Subsequently, 131 studies were excluded after abstract screening for not meeting the inclusion criteria, resulting in 128 articles assessed for full-text eligibility. After full-text review, 124 studies were excluded for not meeting the predefined eligibility criteria, while six studies met all criteria and were included in the final analysis. A detailed list of the studies excluded at the full-text stage and the corresponding reasons for exclusion is provided in Supplementary Material 1.

Study characteristics

The six included studies feature mindfulness interventions applied to endurance sports, encompassing disciplines such as rowing, cycling, swimming, and running.

Methodological designs

Five of the studies employed an experimental design with passive or active control groups and pre- and post-intervention measurements (Hill et al., 2021; Jones et al., 2020; Ning et al., 2022; Scott-Hamilton and Schutte, 2016; Sparks and Ring, 2022). Chen and Meggs (2021) used a quasi-experimental design with comparative groups under less stringent conditions.

Sample size

Sample sizes ranged from 16 to 47 participants, with experimental groups comprising between 9 and 27 individuals.

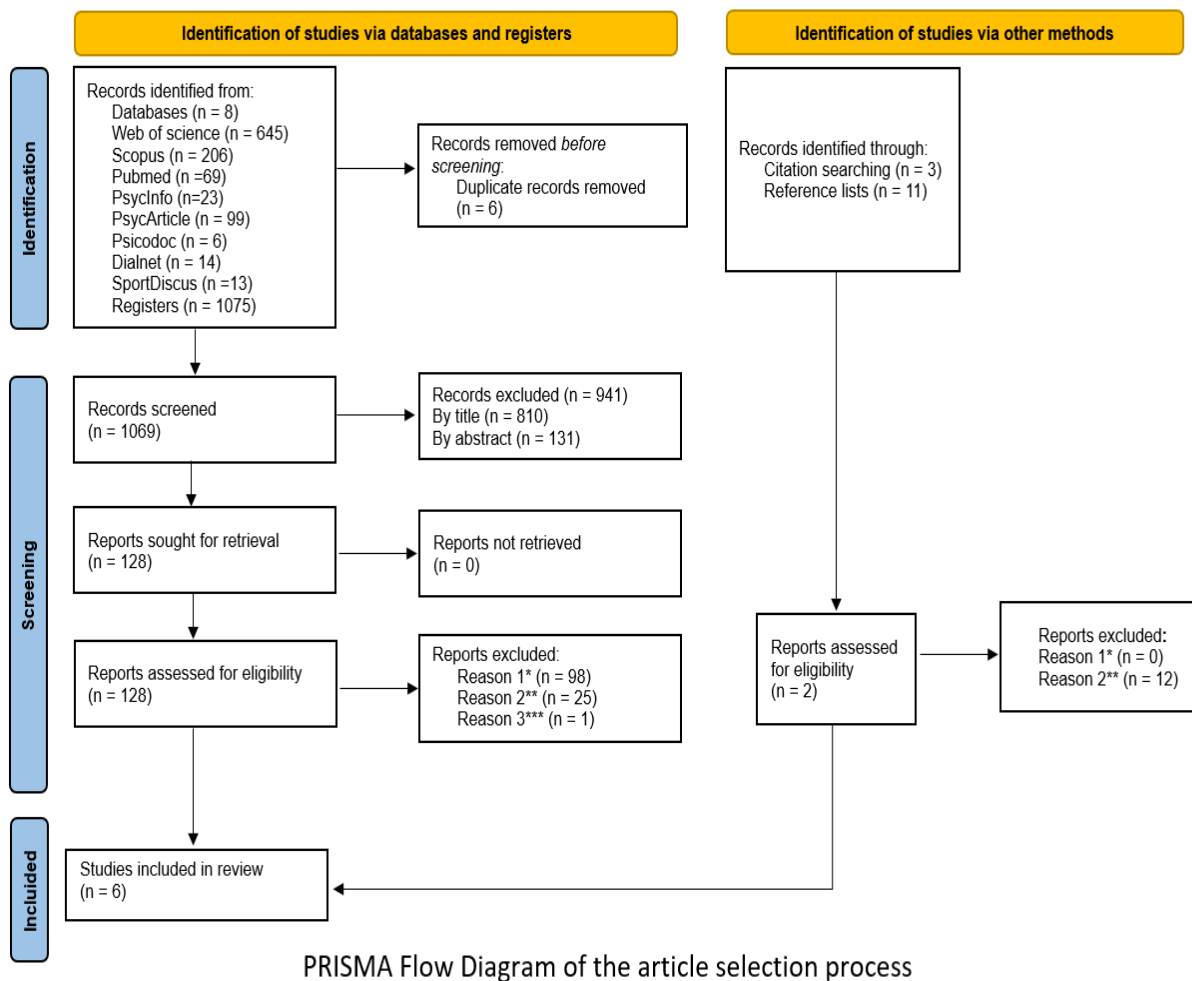
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Gender of the participants

The studies analyzed samples with varied gender distributions, including mixed-gender samples (Chen and Meggs, 2021; Hill et al., 2021; Ning et al., 2022; Scott-Hamilton and Schutte, 2016; Sparks and Ring, 2022) and exclusively female samples (Jones et al., 2020).

Figure 1

Flow Diagram.



Note: Reason 1*: for not specifically including endurance athletes; Reason 2**: for not meeting the specified methodological design; Reason 3***: due to lack of statistical results.

Source: Page et al. 2021.

Country of origin

The studies were conducted in various regions of the world, including Australia (Scott-Hamilton and Schutte, 2016), the United Kingdom (Chen and Meggs, 2021; Sparks and Ring, 2022), the United States (Jones et al., 2020), China (Ning et al., 2022), and Germany (Hill et al., 2021).

Type of intervention

The interventions implemented varied in the duration of the programs, ranging from 6 to 8 weeks, with frequencies of 1 to 2 sessions per week, including complementary home practices, both formal and informal. They were distributed across four main approaches:

- *Mindful Sport Performance Enhancement (MSPE)*: Chen and Meggs (2021) in competitive swimming.
- *Mindfulness-Acceptance-Commitment (MAC)*: Ning et al. (2022) in university-level swimming.
- *Mindfulness-Based Stress Reduction (MBSR)*: Jones et al. (2020) in rowing.
- *Adapted/Customized Interventions*: Hill et al. (2021) in running, focusing on race economy and flow under different attentional conditions; Scott-Hamilton and Schutte (2016) in adapted mindfulness training for competitive cyclists (MiCBT); and Sparks and Ring (2022) in adapted mindfulness for competitive rowing.

Despite these adaptations, all interventions shared the goal of improving key psychological variables such as mindfulness and flow, and, in some cases, evaluating performance-related variables. All interventions were led by professionals in mindfulness and sport psychology, ensuring a high standard of implementation.

Results by sport modality

- *Swimming*: Chen and Meggs (2021) found significant improvements in flow and mindfulness after 8 weeks of MSPE. Ning et al. (2022) reported reductions in anxiety and depression, along with increases in flow and competitive satisfaction following the MAC intervention.
- *Rowing*: Sparks and Ring (2022) found a significant increase in flow and a reduction in cognitive reinvestment, with a positive impact on perceived performance. Jones et al. (2020) found improvements in psychological well-being, sleep quality, and correlated performance.
- *Cycling*: Scott-Hamilton and Schutte (2016) found increases in overall mindfulness and flow, along with reductions in anxiety and pessimism.
- *Running*: Hill et al. (2021) found an increase in perceived flow and improvements in running economy under specific attentional conditions.

Main effects of mindfulness

The most consistent results were observed in the variables of mindfulness and flow, where all studies reported significant increases, reinforcing the positive impact of mindfulness on athletes' psychological experiences (Chen and Meggs, 2021; Ning et al., 2022; Scott-Hamilton et al., 2016; Sparks and Ring, 2022). Additionally, variables related to psychological well-being, such as significant reductions in anxiety and depression (Ning et al., 2022) and improvements in sleep quality (Jones et al., 2020), highlight the potential of mindfulness to foster a more balanced and adaptive emotional state in endurance athletes. Satisfaction with training and competition also showed significant positive changes in several studies (Jones et al., 2020; Ning et al., 2022; Scott-Hamilton et al., 2016). However, the effects on perceived performance were less consistent, with studies like Chen and Meggs (2021) reporting improvements, while others, such as Sparks and Ring (2022), did not reach statistical significance. The positive relationship between increases in flow, mindfulness, and outcomes in well-being and performance underscores mindfulness as a key psychological facilitator in endurance sports. Nevertheless, the heterogeneity in sample sizes, sports contexts, and evaluated variables may explain some discrepancies in the results (summary and integration detailed in Table 4).

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Table 4
Results.

Study	Study design	Population Characteristics	Intervention implemented	Variables	Instruments	Effect Size	Results
Chen & Meggs (2021)	Quasi-experimental (control group with relaxation and experimental group with MSPE, repeated measures pre- and post-intervention)	$N = 16$ ($n=9$ EG, $n=7$ CG) Average age= 13,06 43,75% female, 56,25% male UK, competitive swimming	MSPE, 8 weeks 1 session/week (60 min) Experts in applied psychology for MDF and flow	MDF Flow	MAAS-A, TMS DFS- 2, FSS-2	$d = 0.73$; $d = 0.73$	MSPE intervention significantly improved global trait flow ($t(8)=4.61$, $p<.005$, $d=0.73$); between-group analysis also showed higher flow in the intervention group ($F(1,13)=19.38$, $p<.005$, $\eta^2=.60$)
Hill et al. (2021)	Experimental (passive control group and experimental group, comparison between attentional conditions)	$N=31$ ($n=16$ EG, $n=15$ CG) Average age = 37,23 58,1% female, 41,9% male Germany, endurance running	MDF training, 8 weeks 2 sessions/week (60 min) Informal practice via mobile app Professional instructor	Running economy Perceived Flow	Cortex Metamax 3B, oxygen consumption FSS2	$d=0.62$ $d=1.60$	Mindfulness training significantly increased flow experience ($F=16.12$, $p<.001$, $\eta^2=.37$; $d=0.51-1.32$)
Jones et al. (2020)	Experimental (passive control and experimental group, group comparison to assess intervention effects)	$N=27$ ($n=14$ EG, $n= 13$ CG) Average age = 20,5 100% female USA, collegiate rowing	MBSR, 8 weeks 1 session/week (45 min) Informal practice: before bed Professional instructor	MDF Psychological well-being Sleep quality Rowing performance	FFMQ BDI-II, BAI, PSS, SPWB PSQI, ESS, actigraphy Ergometer (6,000 m)	$d=0.68$ $d=0.76$ $d=0.75$ $d=1.11$	MBSR improved mindfulness ($t = -2.646$, $p = .019$, $d = 0.683$), psychological well-being ($t = 2.864$, $p = .013$, $d = 0.765$), subjective sleep quality ($F(1,24) = 8.079$, $p = .009$, $\eta^2p = .252$) and rowing performance ($t = 4.008$, $p = .002$, $d = 1.112$).

Note: MSPE = Mindful Sport Performance Enhancement; MDF = Mindfulness; EG = Experimental Group; CG = Control Group; MAAS-A = Mindful Attention Awareness Scale for Adolescents; TMS = Toronto Mindfulness Scale; DFS-2 = Dispositional Flow Scale; FSS-2 = Flow State Scale; MBSR = Mindfulness-Based Stress Reduction; FFMQ = Five Facet Mindfulness Questionnaire; BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; PSS = Perceived Stress Scale; SPWB = Scales of Psychological Well-Being; PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale; CAMS = Cognitive and Affective Mindfulness Scale-Revised; TEA = Test of everyday attention; MAIC = Mindfulness acceptance insight commitment; SFSS = Short Flow State Scale; CSAI-2 = Competitive State Anxiety Inventory-2; POMS = Profile of Mood State; TCSQ = Training and Competition Satisfaction Questionnaire; MiCBT = Mindfulness-integrated Cognitive Behavioral Therapy for competitive cyclists; FFMQ = Five Facet Mindfulness Questionnaire; SAS-2 = Sport Anxiety Scale-2; SASS = Sport Attributional Style Scale.

Table 4 (continued)
Results.

Study	Study design	Population Characteristics	Intervention implemented	Variables	Instruments	Effect Size	Results
Ning et al. (2022)	Experimental (passive control and experimental group, intra- and inter-group comparison)	<i>N</i> =47 (<i>n</i> =24 EG, <i>n</i> =23 CG) Average age = 22.34 50% female, 50% male China, swimming	MAIC training 8 weeks 1 session/week (60–90 min) Informal practice Psychologists specialized in MDF	Flow Anxiety Depression Competitive satisfaction	SFSS CSAI-2 POMS TCSQ	<i>d</i> = 1.02 <i>d</i> =1.83 <i>d</i> =0.66 <i>d</i> =1.25	Mindfulness intervention significantly reduced anxiety ($F(1,56)=10.68, p<.01, \eta^2=.16$) and depression ($F(1,56)=8.54, p<.01, \eta^2=.13$), while increasing flow ($F(1,56)=12.37, p<.01, \eta^2=.18$) and competitive satisfaction ($F(1,56)=9.21, p<.01, \eta^2=.14$)
Scott-Hamilton & Schutte (2016)	Experimental (waitlist control and experimental group, pre- and post-test comparison)	<i>N</i> =47 (<i>n</i> =27 EG, <i>n</i> =20 CG) Average age = 38.96 30% female, 70% male Australia, competitive cycling	MiCBT (spin-bike) 8 weeks 2 sessions/week (45 min) Formal practice at home Trained psychologist	MDF Flow Sport Anxiety Pessimism	FFMQ DFS-2 SAS-2 SASS	<i>d</i> =0.75 <i>d</i> =0.63 <i>d</i> =0.61 <i>d</i> =0.31	Mindfulness training increased dispositional mindfulness ($t=3.29, p=.004, d=0.86$) and flow ($t=2.44, p=.023, d=0.63$), while reducing anxiety ($t=-2.72, p=.013, d=0.71$) and pessimism ($t=-2.61, p=.016, d=0.68$).
Sparks & Ring (2022)	Experimental (passive control and experimental group, group comparison)	<i>N</i> =44 (<i>n</i> =22GC; <i>n</i> =22GE) Average age = 36.35 72.73% female, 27.27% male UK, competitive rowing	Rowing-based MDF 6 weeks 1 session/week (60 min) Formal home practice MDF instructor & sport psychologist	Flow MDF Reinvestment Perceived performance	DFS-2 MIS RSMSTS Self-assessed	<i>d</i> =0.61 <i>d</i> =0.61 <i>d</i> =0.66 <i>d</i> =0.55	Intervention significantly increased flow ($t=3.12, p=.005, d=0.71$) and reduced reinvestment ($t=-2.87, p=.009, d=0.66$), with a significant improvement in sport performance ($t=2.41, p=.022, d=0.55$)

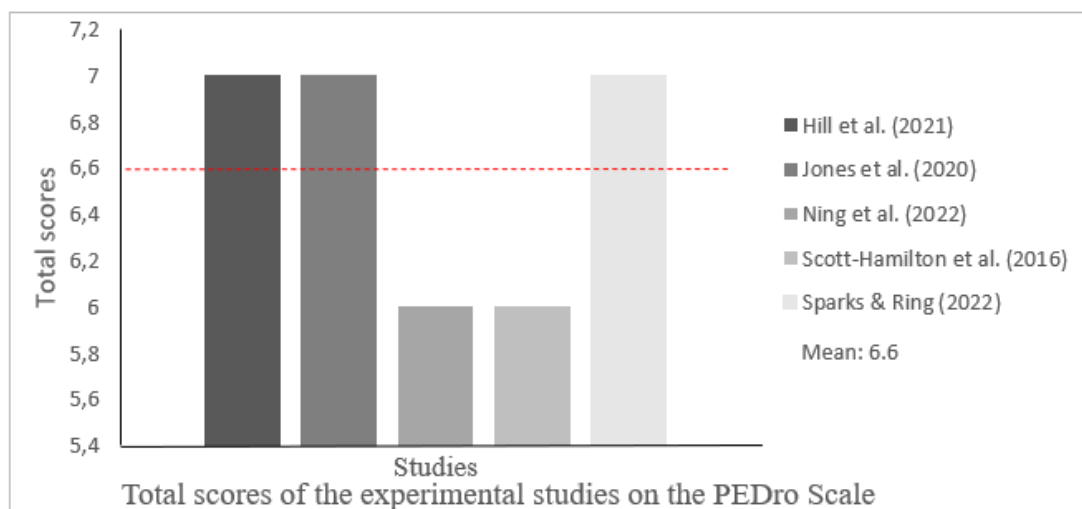
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Methodological quality of the selected studies

The quality of the six selected studies was assessed using two verification tools: the PEDro scale (De Morton, 2009) and the ROBINS-I V2 tool (Sterne et al., 2024). For experimental studies, the PEDro scale (De Morton, 2009) was employed, reflecting a solid design with an average score of 6.6 on PEDro (shown in Figure 2), with values ranging between 6 and 7. However, certain inherent limitations were observed due to the type of intervention investigated.

Figure 2

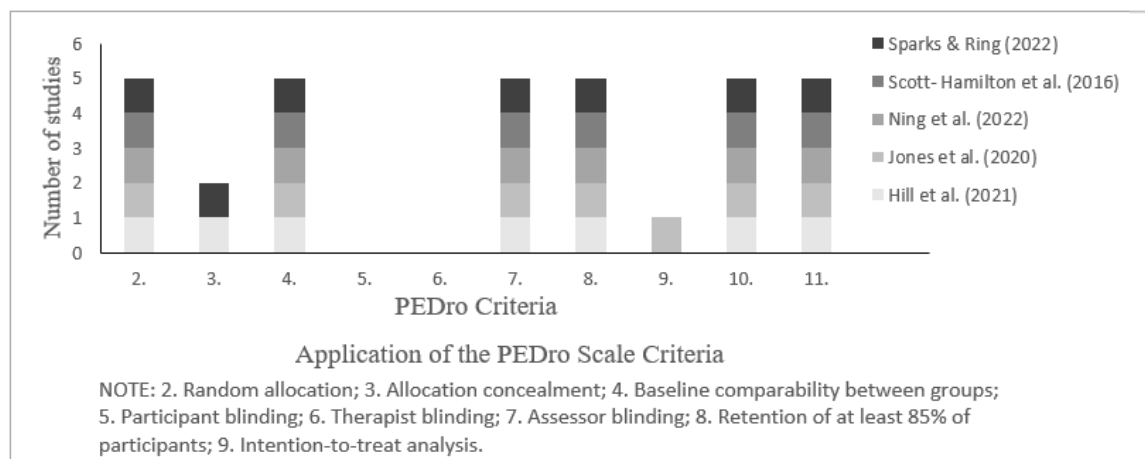
Total scores of the experimental studio on the PEDro Scale



A more detailed assessment of the PEDro criteria is shown in Figure 3, which displays the distribution of fulfilled methodological criteria across the included studies. The analysis indicates that most studies met key criteria such as random allocation, baseline comparability between groups, and adequate follow-up of participants. In contrast, criteria related to blinding procedures were less frequently satisfied, particularly those concerning participant and therapist blinding. Additionally, only one study reported the use of intention-to-treat analysis.

Figure 3

Application of the PEDro Scale Criteria



For the quasi-experimental study by Chen and Meggs (2021), the ROBINS-I V2 tool (Sterne et al., 2024) was used to assess the risk of bias across its seven domains. Following the corresponding evaluation procedure, each domain was assessed and an overall moderate risk of bias was identified for this study (see Appendix A).

Most domains presented a low risk of bias, including the classification of interventions, the management of missing data, and the absence of selective reporting of results. However, Domain 6 (measurement of outcomes) was rated as presenting a moderate risk of bias, as the outcomes assessed — such as mindfulness and flow — were based on self-reported measures. The detailed evaluation of the ROBINS-I domains is presented in Table 5.

Table 5

Risk of Bias Analysis in Quasi-Experimental Studies Using ROBINS-I V2

Bias Domains	Chen & Meggs (2021)
1. Bias due to confounding	Low*
2. Bias in classification of interventions	Low
3. Bias in selection of participants	Low
4. Bias due to deviations from intended interventions	Low
5. Bias due to missing data	Low
6. Bias in measurement of outcomes	Moderate**
7. Bias in selection of reported results	Low
<i>Overall Risk of Bias</i>	Moderate

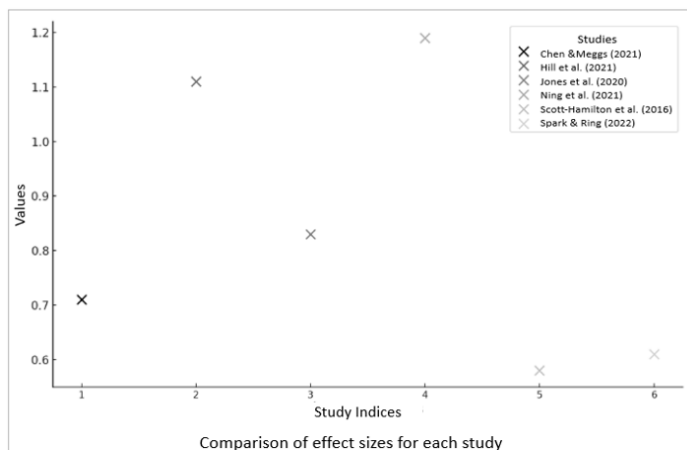
Note: * Low, but with concerns regarding uncontrolled confounding; ** Moderate due to measurement not being fully attributable to the intervention, owing to the nature of the tools used.

Statistical results of the studies

Given that the present study was designed as a systematic review and not as a meta-analysis, a statistical aggregation of results across studies was not performed. Instead, effect sizes (Cohen’s d) reported or derived from the included studies were compiled to facilitate a descriptive comparison of the magnitude of the observed effects (Cumming, 2012). The effect sizes obtained for each study are presented in Figure 4 using a scatter plot representation, where each point corresponds to one of the included studies. This visual representation allows the comparison of the magnitude of the reported effects across the studies that analyzed mindfulness-based interventions in endurance sports. Detailed statistical outcomes for each study, including the evaluated variables and the statistical indicators reported in the original studies, are presented in Table 6.

Figure 4

Comparison of the effect sizes for each study.



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Table 6
Statistical Results, Effect Size, and Methodological Analysis of the Included Studies.

Study	Analyzed Variables	Reported Measure	Effect Size / CI	Avg. Effect Size / CI	MCID	Bias Adjustment	Observations / Limitations
Chen & Meggs (2021)	MDF	Week4: $M=15.11, SD=4.40$ Week8: $M=9.11, SD=4.59$ $ANOVA: F(3,24)=3.71, p<.05$	Large-moderate ($\eta^2 = 0.32, d=0.73$) Pre-post difference in the MDF group: 95% CI (2.82, 9.18)	Moderate ($d=0.71$) CI 95%: (1.82,14.41)	Possible ($d >0.50$)	Not reported	Significant variation in MDF between weeks 4 and 8. Notable changes in the overall flow measure
	Flow	Pre $M=126.22, SD=10.43$ Post $M=136.44, SD=13.82$ $Student's t(8)=4.61, p<.005$	Moderate ($d=0.73$) Pre-post difference: 95% CI (0.81,19.63)				
Hill et al. (2021)	Running economy Perceived Flow	Running economy: $ANOVA: F(1,13)=4.99, p=0.044$ $ANOVA: F(1,14)=35.71, p<0.001$	Large ($\eta^2 = 0.28, d=0.62$) 95% CI (0.30,0.94) Large ($\eta^2 = 0.72, d=1.60$) 95% CI (0.78,2.42)	Large ($d=1.11$) 95% CI (0.54,1.68)	Yes ($d >0.80$)	Yes, by design	Control group with a higher average age, which may have impacted the results on running economy. Retrospective flow measurement may involve memory biases
Jones et al. (2020)	MDF	$Student's T$ MBSR group: $t=-2.64, p=0.019$	Moderate ($d=0.68$) 95% CI in the MBSR group: (-26.79,-2.80)	Large ($d=0.83$) 95% CI (-0.32,33.72)	Yes ($d \geq 0.80$)	Yes, by design (except incomplete actigraphy)	A single measurement of MDF may not capture all the changes resulting from specific interventions. Assessing well-being through multiple questionnaires could introduce redundancy and complicate the interpretation of effects. The most significant improvements in sleep quality were found in subjective measures. Regarding performance, potential confounding variables related to rowing technique and participants' initial conditions may have influenced the results
	Psychological Well-Being	$Student's T$ MBSR group: $t=-2.86, p=0.013$	Moderate ($d=0.76$) 95% CI in the MBSR group: (11.84,84.61)				
	Sleep Quality	MBSR group ESS: $Student's t=2.95, p=.01, d=0.56, CI (95%): (0.023, 3.310)$ Sleep: $Student's t=2.78, p=0.02, d=0.92, CI (95%): (-3.155, -0.298)$	Moderate ($d=0.75$) 95% CI in the MBSR group: (-1.57, 1.51)				
	Rowing performance	Tiempo en ergómetro Grupo MBSR $Student's t=4.01, p=0.002$	Large ($d=1.11$) CI in the MBSR group: (15.24, 51.56)				
Ning et al. (2022)	Flow	$ANOVA: F(2,90)=46.62, p<.001$	Large ($\eta^2 = 0.50, d=1.02$) 95% CI (0.60, 1.44)	Large ($d=1.19$) 95% CI (0.70,1.68)	Yes ($d >0.80$)	Yes, design stated but no control for external confounders	Momentary flow states are captured without considering their relationship to long-term performance. Only competitive anxiety was measured, without accounting for external factors. In the case of depression, no follow-up assessments were conducted to determine whether the reductions were sustained. Regarding satisfaction, possible subjective biases may arise due to self-perception and the influence of external factors
	Anxiety	$ANOVA: F(2,90)=159.61, p<0.001$	Large ($\eta^2 = 0.77, d=1.83$) 95% CI (1.08, 2.58)				
	Depression	$ANOVA: F(2,90)=19.38, p<0.001$	Moderate ($\eta^2 = 0.30, d=0.66$) 95% CI (0.39, 0.93)				
	Competitive satisfaction	$ANOVA: F(2,90)=70.73, p<0.001$	Large ($\eta^2 = 0.61, d=1.25$) 95% CI (0.74, 1.77)				

Note: M = mean; SD = Standard Deviation; CI = Confidence interval; MCID = Minimal Clinically Important Difference; d = effect size for group differences, Cohen's d. 1Small ($d \geq .20$); 2Moderate ($d \geq .50$); 3Large ($d \geq .80$); η^2 = partial eta squared effect size. 1Small ($\eta^2 \geq .01$); 2Moderate ($\eta^2 \geq .06$); 3Large ($\eta^2 \geq .14$); ESS = Epworth Sleepiness Scale.

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Table 6 (continued)
Statistical Results, Effect Size, and Methodological Analysis of the Included Studies.

Study	Analyzed Variables	Reported Measure	Effect Size / CI	Avg. Effect Size / CI	MCID	Bias Adjustment	Observations / Limitations
Scott-Hamilton & Schutte (2016)	MDF	<i>T de Student</i> : MDF Vs control $t(26)=3.96$, $p=0.001$	Moderate- Large ($d=0.75$) 95% CI (-15.68,-5.43)	Moderate ($d=0.58$) 95% CI (-3.59,0.48)	Possible ($d > 0.50$)	Not reported	In MDF, the self-report questionnaire may introduce subjective bias. Flow, as a transient state, might not be fully captured by the DFS-2. Other types of anxiety that could have an influence are not considered. Regarding pessimism, individual changes within the experimental group were variable
	Flow	<i>T de Student</i> : Grupo MDF $t(26)=3.31$, $p=0.003$	Moderate ($d=0.63$) 95% CI (-0.38, -0.10)				
	Competitive Anxiety	<i>T de Student</i> : Grupo MDF $t(26)=3.12$, $p=0.004$	Moderate ($d=0.61$) 95% CI (1.49,7.02)				
	Pessimism	Interacción grupo x tiempo: <i>ANOVA</i> : $F(1,44)=4.40$, $p=0.042$	Moderate- Small ($\eta^2=0.09$, $d=0.31$) 95% CI (0.19, 0.44)				
Sparks & Ring (2022)	Flow	<i>T de Student</i> : Grupo MDF $t(22)=2.91$, $p=0.008$	Moderate ($d=0.61$) 95% CI (0.34, 0.88)	Moderate ($d=0.61$) 95% CI (0.34,0.88)	Possible ($d > 0.50$)	Strong design, no adjustment for self-report or external factors	Flow and MDF self-report introduce subjectivity. Other reinvestment factors may affect technical performance
	MDF	<i>T de Student</i> : Grupo MDF $t(22)=2.94$, $p=0.01$	Moderate ($d=0.61$) 95% CI (0.34, 0.88)				

Note: *M* = mean; *SD* = Standard Deviation; *CI* = Confidence interval; *MCID* = Minimal Clinically Important Difference; *d* = effect size for group differences, Cohen's *d*. ¹Small ($d \geq .20$); ²Moderate ($d \geq .50$); ³Large ($d \geq .80$); η^2 = partial eta squared effect size. ¹Small ($\eta^2 \geq .01$); ²Moderate ($\eta^2 \geq .06$); ³Large ($\eta^2 \geq .14$); ESS = Epworth Sleepiness Scale.

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DISCUSSION

The aim of this systematic review was to examine the available evidence on the effects of mindfulness-based interventions in endurance athletes, particularly focusing on variables related to psychological well-being, flow, and athletic performance. In line with this objective, the findings suggest that mindfulness-based programs, particularly protocols such as Mindfulness-Acceptance-Commitment (MAC) and Mindful Sport Performance Enhancement (MSPE), may positively influence several psychological variables in endurance athletes, especially those related to psychological well-being and flow, while their effects on athletic performance appear less consistent.

These effects can be partly explained by the central principles of mindfulness, such as experiential acceptance, which facilitates emotional regulation and attention management, allowing athletes to focus on the present moment (Kabat-Zinn, 1990; Gardner & Moore, 2007). The reviewed studies indicate that these programs, as well as other sport-specific mindfulness interventions, provide potential benefits in variables such as flow (Chen & Meggs, 2021; Hill et al., 2021; Ning et al., 2022; Scott-Hamilton et al., 2016; Sparks & Ring, 2022), emotional regulation, resilience, and reduction of competitive stress (Ning et al., 2022; Scott-Hamilton et al., 2016), and even indirectly influence improvements in athletic performance (Hill et al., 2021; Jones et al., 2020; Sparks & Ring, 2022).

Regarding psychological well-being, the included studies (Ning et al., 2022; Jones et al., 2020) found a significant reduction in anxiety and depression levels, as well as improvements in satisfaction with training and sleep quality. This aligns with the findings of Gardner & Moore (2007), who highlight that mindfulness-based interventions are effective in promoting emotional regulation and well-being in athletes. Despite these improvements, studies like Sparks & Ring (2022) showed less pronounced changes, which could be attributed to differences in sample size and intervention intensity.

Another finding is the role of mindfulness in facilitating flow states (Chen & Meggs, 2021; Ning et al., 2022), a critical experience for endurance athletes, which has been noted in various studies (Csikszentmihalyi, 1990; Swann et al., 2012). Flow is facilitated by the attention management promoted by mindfulness, which helps athletes remain focused on the present and reduce cognitive distractions (Gardner & Moore, 2007). The results reinforce that mindfulness not only impacts isolated variables but acts as a bridge connecting psychological well-being with athletic performance.

However, Hill et al. (2021) introduces an interesting nuance by observing that the specific demands of the sport can influence the impact of mindfulness on flow, emphasizing the need to explore how contextual factors, such as the individual characteristics of the sport or athletes' prior psychological skills, influence the outcomes. Meanwhile, the effects on perceived athletic performance were less clear, possibly due to methodological limitations and lack of standardization. While Chen & Meggs (2021) reported significant improvements, Sparks & Ring (2022) did not find statistically significant results. Gardner & Moore (2007) suggest that mindfulness impacts performance indirectly, mediated by variables such as flow or emotional regulation, which partly explains the discrepancies between studies.

This finding reinforces the idea that mindfulness may not directly affect physical performance but may optimize psychological states that contribute to overall athlete performance. Future research should explore its direct influence or its mediation through factors such as emotional regulation or resilience.

Finally, the heterogeneity in the study designs and measured variables presents a challenge for drawing generalizable conclusions. This issue has also been highlighted in methodological literature, which emphasizes the importance of greater standardization in research designs to reduce bias and improve comparability between studies (Moher et al., 2009; Sterne et al., 2024).

In addition to this variability in study designs and outcomes, the methodological quality of the included studies was also examined. From a methodological perspective, the studies included in this review generally showed moderate to good methodological quality according to the PEDro scale, with relatively consistent scores across studies. Most studies fulfilled key criteria such as random assignment, baseline comparability between groups, and adequate follow-up of participants. However, some methodological limitations were observed. A common limitation was the

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difficulty in implementing complete blinding procedures, which is inherent to mindfulness interventions that require active and conscious participation from athletes. Some studies attempted to mitigate this limitation through strategies such as waitlist control groups or limiting participants' knowledge of the specific study hypotheses (Hill et al., 2021; Scott-Hamilton et al., 2016).

Another methodological issue was the absence of placebo interventions in control groups, which may partly influence observed effects due to attention-related factors such as the Hawthorne effect (Mayo, 1933). Furthermore, only one study applied an intention-to-treat analysis, which may affect the handling of participant dropout. Despite these limitations, most studies reported adequate measures of variability and statistical precision, supporting the reliability of the findings. These observations highlight the importance of strengthening methodological rigor in future research, particularly through improved reporting of blinding procedures and the inclusion of more robust control conditions.

An additional contribution of this review is the consideration of the Minimal Clinically Relevant Difference (MCRD) as a criterion for interpreting results, not only assessing statistical significance but also the practical and functional relevance of the findings in the sports context (King et al., 2017; Moher et al., 2009). This approach, complemented by methodological tools such as ROBINS-I V2 (Sterne et al., 2024), strengthens the validity of studies by mitigating bias risks in non-randomized research.

Limitations of the Study

Despite the findings, this review has limitations that should be considered. First, the scarcity of studies focused exclusively on endurance athletes, combined with methodological heterogeneity in terms of sample sizes, sports contexts, and duration of interventions, makes it difficult to directly compare the findings. As Moher et al. (2009) point out, this lack of homogeneity can increase the risk of bias and reduce the ability to generalize the results. The reviewed studies have small sample sizes (ranging from 16 to 47 participants), which limits statistical power. The diversity in sports contexts and intervention duration makes it difficult to establish generalizable conclusions (Moher et al., 2009). Additionally, the absence of confidence intervals (CIs) in many of the reported studies reduces the precision in interpreting the observed effects. This has been noted as a methodological limitation in the applied statistical literature (Altman et al., 2000). Furthermore, the lack of qualitative studies exploring athletes' subjective experiences with mindfulness practices hinders obtaining a deeper understanding of the mechanisms behind their effects. Finally, the absence of contextual factors, such as the influence of coaches or the social environment surrounding the athlete (Bronfenbrenner, 2005), limits the understanding of the impact of mindfulness in broader systems.

CONCLUSIONS

In summary, this systematic review highlights the potential of mindfulness as a key tool for addressing the specific demands of endurance sports.

Mindfulness-based interventions, particularly programs such as Mindfulness-Acceptance-Commitment (MAC) and Mindful Sport Performance Enhancement (MSPE), appear to support key psychological processes including experiential acceptance, attentional focus, emotional regulation, and the facilitation of flow states. These processes contribute to athletes' psychological well-being and may indirectly support athletic performance in high-demand endurance contexts.

However, questions remain, such as how to optimize interventions in various contexts and integrate more standardized measures. The limited number of available studies and the variability in their designs highlight the need for further research that strengthens the evidence base in this field.

Ultimately, the findings of this review suggest that mindfulness may represent a promising avenue for supporting endurance athletes in managing the psychological demands of their discipline. Perhaps within this ongoing challenge, research will continue to illuminate not only how athletes can better navigate the pressures of endurance

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performance, but also how mindfulness may contribute more broadly to understanding the relationship between psychological well-being and sustained human performance.

IMPLICATIONS FOR PRACTICE

To advance knowledge on the benefits of mindfulness in endurance athletes, it would be crucial to expand the research focus. First, conducting studies with larger sample sizes and more homogeneous methodological designs would increase external validity and strengthen the robustness of the findings. Additionally, exploring gender differences in response to mindfulness interventions would be relevant, as this dimension remains underexplored in the studies reviewed. Future lines of research could include analyzing the social and professional environment surrounding the athlete, particularly the influence of coaches, technical teams, and family (Bronfenbrenner, 2005; Maciel et al., 2021). Furthermore, incorporating qualitative methodologies, such as interviews or case studies, and longitudinal research to explore the individual experiences of athletes would be beneficial. Finally, directly comparing mindfulness with other psychological approaches, such as Psychological Skills Training (PST), could provide greater clarity on its relative advantages and limitations. Addressing these issues would enable the design of more effective interventions that meet the complex needs of these athletes and their context.

From a practical perspective, the integration of mindfulness into personalized psychological training programs may offer relevant benefits for endurance athletes. These applications could include group sessions within teams, specific stress-management training for prolonged competitions, and individual exercises designed to enhance attentional focus during training and competition. Athletes may benefit from both formal practices, such as guided meditation before competitions, and informal strategies that involve the application of mindfulness skills during long-duration races. In addition, mindfulness could be incorporated into psychological preparation workshops or recovery protocols following intense competitions. From an integrative perspective, mindfulness not only supports specific psychological processes such as emotional regulation and attentional focus, but may also act as a bridge linking emotional stability with sustained performance in endurance sports, which involve extreme physical and mental demands.

Appendix A and Supplementary material

ROBINS-I V2 Domain Evaluation (Sterne et al., 2024) according to the corresponding algorithms for Chen & Meggs (2021); PRISMA Checklist (2020), list of excluded studies.



URL: https://drive.google.com/file/d/1Xi3UDVu71Hs1DVYysSdA78EqDPHWKKG6/view?usp=drive_link

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