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A Systematic Review of Cognitive Sports Psychology Interventions on High School and College Athletes

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ABSTRACT

In competitive sports, achieving peak performance extends beyond physical training and encompasses cognitive and emotional factors. This review evaluates the effectiveness of cognitive, physical, and emotional interventions in enhancing athletic performance, aiming to comprehensively understand their benefits and limitations. The primary objectives were to assess the impact of these interventions on mental resilience, physical metrics, and emotional well-being, and to offer actionable recommendations for practice and future research. The search strategy involved systematic querying of databases such as PubMed, PsycINFO, SPORTDiscus, and Scopus, using terms related to athletic performance and interventions. Inclusion criteria focused on studies with clearly defined interventions and reliable outcome measures, while studies were excluded based on methodological flaws or irrelevance. Data extraction encompassed details on study design, participant characteristics, intervention specifics, and outcome metrics, with the risk of bias evaluated using established tools. Results from fourteen studies revealed that cognitive interventions, such as Cognitive Behavioral Therapy (CBT), improved mental skills and performance under pressure; physical interventions, including hypoxic training and resistance programs, significantly enhanced physiological metrics such as VO2 max and strength; and emotional interventions positively impacted emotional regulation but showed mixed effects on athletic performance. Limitations included small sample sizes, short follow-up durations, and variability in methodological rigor. The review underscores the importance of integrating these interventions into athletic training, noting the need for larger rigorous studies to better understand their long-term effectiveness. Future research should address these limitations to refine and validate the impact of these interventions on overall athletic success.

Introduction

Various variables, both physical and mental, influence athletic performance, which can lead to a wide range of different competition results. While physical conditioning and natural athletic talent have conventionally been viewed as the cornerstones of athletic success, modern sports science increasingly recognizes that these factors alone are insufficient for achieving and sustaining peak performance (Murray, 2018). Most successful athletes have recently embraced a holistic approach that integrates cognitive, physical, and emotional training, understanding that true excellence is the product of scientifically validated strategies. Approximately 35% of elite athletes experience symptoms of mental health conditions such as stress, anxiety, and depression due to the pressures of competition (Pilkington et al., 2022). The psychological impact of physical injuries, which occur in 20-25% of athletes each year, further underscores the need for mental health support, as half of these injuries lead to depression or anxiety. Burnout is another critical issue affecting up to 60% of young athletes, often leading to early retirement or declining performance. Cognitive training has been shown to improve performance by 10-20%, with 70% of Olympic athletes regularly incorporating it into their regimens (Tang, 2023). Sleep plays a crucial role, as athletes who sleep fewer than 8 hours per night are 70% more likely to suffer an injury. In contrast, those increasing sleep to 10 hours see improvement in reaction times, sprint times, and overall mood. Nutrition is also crucial, with balanced diets leading to a 30% faster recovery and a 50% reduction in overtraining syndrome. Emotional well-being is also considered unequivocal, with solid

support systems reducing burnout by 50% and enhancing performance by 15% in high-pressure situations. As the demands on athletes continue to evolve, so must their training regimes. Modern athletes must engage in a holistic regiment that cultivates physical strength and endurance and sharpens mental acuity and emotional aspects. This integrated approach is essential for achieving and sustaining peak performance, recognizing that true athletic excellence is a synergy of physical, cognitive, and emotional elements.

Moreover, interventions affecting sports performance are critical for understanding/enhancing the longevity and well-being of modern athletes. As the sports landscape continues to grow with its rigorous demands and relentless competition, it has led to burnout, chronic stress, and psychological strain among athletes. The implications of interventions significantly impact sports psychology, coaching, and sports medicine. Professionals in these fields can better support athletes in reaching their full potential by identifying the most effective strategies for integrating interventions. This knowledge also contributes to developing more personalized and adaptive training methodologies, which are crucial for accommodating the diverse needs of athletes across different sports factors. Interventions are vital for advancing sports science and its application in real-world athletic settings. As our understanding of these interventions grows, so does our ability to innovate and refine training practices that can lead to a new performance baseline. By recognizing the interdependence of cognitive, physical, and emotional factors, the field of sports science can move closer to a future where every athlete is equipped to perform at their peak skill capacity, both on and off the field.

Interventions in athletic environments have evolved significantly over the past few decades, driven by advances in sports science and a deeper understanding of athletic performance. Traditionally, athletic training focused primarily on physical conditioning and exercise (Lancet, 2016). However, as the field has advanced, it has become clear that more than physical training is required to achieve substantial performance, particularly in demanding environments. This realization led to developing and implementing a wide range of interventions designed to enhance the physical, cognitive, and emotional aspects of athletic performance.

Cognitive interventions have emerged as a critical component of an athlete's development, addressing the mental processes that can influence performance. These interventions are designed to enhance vital cognitive functions during competition. By strengthening mental skills, athletes are better equipped to handle the psychological demands of their sport, leading to more consistent and high-level performances. Physical interventions remain a cornerstone of athletic training but have evolved to become more sophisticated. Beyond traditional strength and conditioning programs, advanced techniques such as hypoxic training, plyometrics, and resistance training are now utilized to optimize specific physical attributes. These interventions are tailored to the unique demands aiming to improve particular metrics. The focus has shifted from building muscle or endurance to enhancing overall athletic capacity through recovery, injury prevention, and long-term performance sustainability. Emotional interventions have gained recognition for their importance in athletic development as well. Emotional intelligence, the ability to regulate emotions, and the capacity to maintain positive relationships within a team environment increasingly gained traction in the success of sports. Interventions in this area often include counseling, emotional regulation strategies, and team-building exercises with one main goal of fostering a supportive and resilient emotional environment. These interventions help athletes manage the emotional challenges of competition by reducing the risk of burnout, fatigue, and insufficient recovery protocols (Psychol, 2022). The integration of these three categorized interventions represents a paradigm shift in how athletic performance is understood and optimized. By addressing the athlete as a whole, these interventions aim to create a more balanced and effective approach to training. This holistic perspective is essential for preparing athletes to meet the increasingly complex demands of modern sports, ensuring that they are equipped to excel in their chosen domains.

Methodology

Participants

The studies that were selected were performed interventions on athletes aged between 11 and 35 years, with a mean age of approximately 23 years. The percent error for the age distribution was calculated across the sample to ensure accuracy. Participants represented a diverse range of ethnic backgrounds and athletic disciplines, which allowed for a broad understanding of how cognitive, physical, and emotional interventions might impact athletes differently based on cultural and ethnic factors. This diversity ensured that the study's findings would be applicable across various demographic groups.

Interventions

Emotional. Need to focus on emotional regulation, emotional intelligence, or related constructs such as stress management, emotional resilience, and self-assessments of emotional states. The intervention techniques could include public posting, goal setting, feedback, counseling, team building, and emotional regulation strategies. Studies were required to assess outcomes related to both emotional and athletic performance, including measures of emotional intelligence, self-assessment of performance, and how these emotional factors influenced overall athletic performance. Studies needed a controlled design, such as RCTs, quasi-experimental designs, or pre-post-intervention studies.

Physical. Eligible studies need to focus on specific physical interventions to enhance athletic performance such as resistance, hypoxic, interval, muscle relaxation, or nutritional training. The interventions had to be clearly defined with a detailed description of training protocols, equipment used, and any specific conditions/variables to ensure reliability. Measurements were required to measure specific performance outcomes (e.g, VO2 max, sprint times, strength, endurance, body composition, and other relevant physiological metrics) with the use of validated and reliable tools or methods to assess these outcomes such as standardized fitness tests, laboratory measurements or wearable technology. Studies needed rigorous experimental designs such as RCT, crossover designs, pre-post intervention studies with control groups, or baseline measurements and follow-up assessments. Participants had to be free from injuries or health conditions that could interfere with their ability to complete the intervention safely or affect the outcomes.

Cognitive. Studies needed to focus on specific cognitive interventions aimed at improving mental processes relating to athletic performance. Specifically, these interventions could include CBT, mental imaging, goal setting, attention control, mindfulness training, and operant conditioning. Interventions had to be clearly defined with theoretical frameworks guiding the techniques used and how cognitive-based strategies were applied in an athletic context. The measurement of outcomes included measures of mental skills (e.g., focus, stress control, self-talk), psychological constructs (e.g., motivation, self-efficacy), or cognitive processes (e.g., decision-making, reaction time). Additionally, athletic performance outcomes related to the cognitive intervention had to be measurable and relevant such as in skill execution, decision-making under pressure, or overall game performance. The interventions need to be relevant to athletic contexts, such as practice sessions, pre-competition preparations, or competition-like scenarios, to ensure practical applicability. Studies that incorporated cognitive interventions into regular training or competitive routines were prioritized to assess their real-time impact on performance. Participants typically required baseline cognitive abilities appropriate for the intervention, with those having cognitive impairments excluded. Studies also needed to assess initial cognitive skills or mental resilience to better target the intervention,

Inclusion and Exclusion Criteria

The inclusion criteria were by the PICOS criteria. (1) The subjects were athletes, not limited to sports and their relative levels of skill; (2) Participants should be free from major injuries or health conditions; (3) The interventions include cognitive, physical, or emotional methods to improve athletic performance holistically; (4) The experimental design part of each source included controlled groups and intervention groups with clear defined protocols; (5) The outcome

indicators are relevant to the interconnectedness of values of indicators of physical, emotional, or cognitive practicality.

The exclusion criteria consisted of many factors: (1) Non - Athlete populations; (2) Non - Specific or undefined interventions lacking detailed descriptions of training protocols, equipment used, or environmental conditions; (3) Short term or inadequate duration with insufficient time to observe meaningful changes in performance metrics; (4) Lack of measurable outcomes; (5) A poor study design excluding control groups, RCT, or adequate sample sizes.

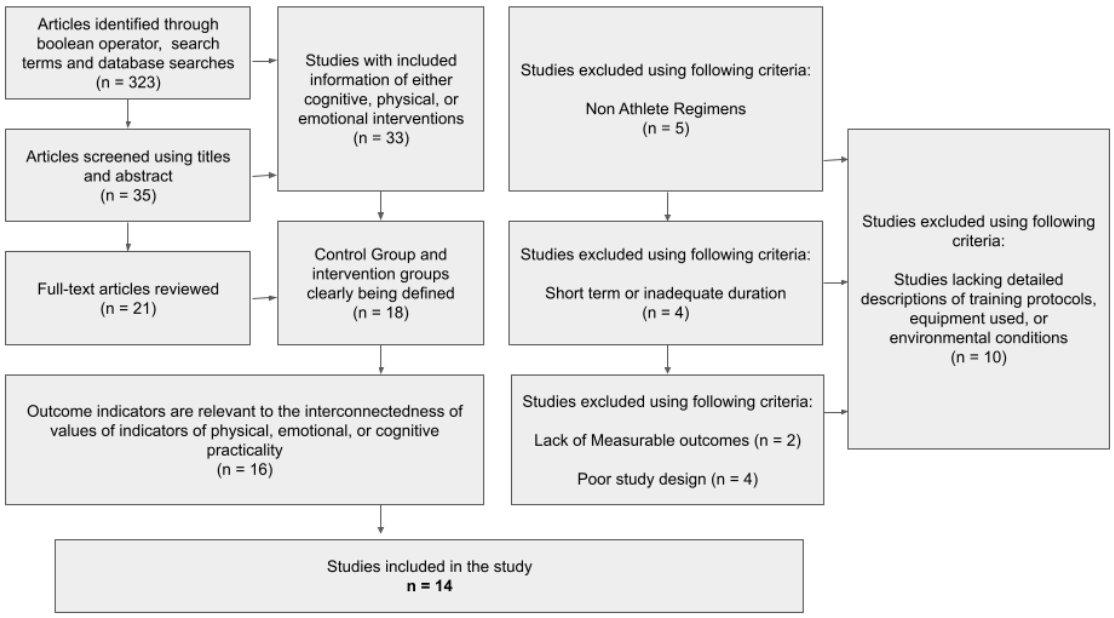

Figure 1. Study Selection Flowchart

Information Sources

The study utilized various information sources, including academic databases, clinical trial registries, journal websites, and additional resources. PubMed was essential for identifying studies on cognitive, physical, and emotional interventions in an athletic environment. While SPORTDiscus provided literature on physical training methods, PsycINFO was used to search for psychological and emotional interventions affecting athletic performance. ClinicalTrials.gov was accessed to identify ongoing or completed trials relevant to the research topic. Journal websites such as LWW Journals were utilized for articles related to hypoxic and resistance training. Additionally, Google Scholar and ResearchGate were accessed for full-text articles and preprints shared by researchers in the field.

Search Strategy

Each category was searched separately, and the results were combined using the Boolean operator. The search was conducted iteratively, refining terms as needed. Duplicates were removed, the remaining studies' titles and abstracts were screened to assess relevance, and full-text reviews were conducted for articles meeting the inclusion criteria. Using MeSH terms and text words, the search captures a wide range of articles, while the applied filters ensure the results are relevant and high-quality. Filters applied for all categories: Publication date: 1950 - 2023; Language; English; Study types: RCTS, controlled clinical trials, meta-analyses, cohort studies, and pre-post intervention studies.

For cognitive interventions, terms such as “cognitive Behavioral therapy,” “Mental Imagery,” and “Mindfulness” were combined with terms related to athletes and athletic performance. For physical interventions, terms such as “Resistance Training,” “Interval training,” and “VO2 Max” were combined with athletic performance metrics. For emotional interventions, terms like “emotional Intelligence,” “Stress management,” and “Team Building” were used in combination with athletic performance indicators.

Study Selection

The study selection process began with an initial screening of titles and abstracts retrieved from database searches conducted by two independent reviewers. Studies not meeting the inclusion criteria were excluded at this stage. The remaining full-text articles were then thoroughly assessed for eligibility by the same reviewers, who evaluated the study design, population characteristics, interventions, and outcome measures. Disagreements between reviewers were resolved by consulting a third reviewer, who independently reviewed the study and discussed it with the initial reviewers to reach a consensus. The decision was based on the majority opinion if consensus could not be reached.

Data Extraction

After the final selection of studies, the included studies were subjected to data extraction. This step involved collecting relevant information from each study, such as participant characteristics, intervention details, outcome measures, and results.

Risk of Bias Assessment

For randomized controlled trials, the Cochrane Risk of Bias tool (RoB 2) was employed to assess bias across several domains, such as bias arising from the randomization process deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting of outcomes. Each domain was rated as “Low risk”, “Some concerns,” or “High risk,” leading to an overall risk of biased judgment for each study.

Qualitative Synthesis

A qualitative synthesis was conducted for studies that were too heterogeneous in terms of outcomes, populations, or interventions to allow for quantitative analysis. This involved summarizing and comparing the results of individual studies to identify patterns, trends, and common themes. The synthesis provided a narrative description of the effectiveness and impact of the interventions across different studies.

Results

The articles selected each have variable studies that focus on the impact of interventions on sports performance. Studies showed a general overview of how cognitive, physical, and emotional interventions can significantly impact an athlete's performance. (Sentence that summarizes the proponents of the inclusion criteria) The first four studies focused on the cognitive impact of athletes throughout the intervention, taking into account various independent factors, including the age of participants, gender, ethnicity, and skill level in their athletic domain. Throughout the studies based on cognitive interventions, the studies focused on the effectiveness of interventions on the participants' outputs on specific performances such as “blocking” and “attendance rates”.

Table 1. Description of Selected Studies

Author Name	Purpose	N	Methodology	Results
Mary Ghesquiere Allison and Teodoro Ayllon	The paper focuses on skill acquisition methods through operant paradigms, specifically using positive reinforcement for correct performances. It explores reward-based learning processes that enhance cognitive and motor behaviors.	5 male athletes of a football team. (Jon, Alan, Steve, David, Ward)	Coaches followed a consistent format to improve blocking in football, using operant paradigms. The process included having athletes execute the play, freezing if a mistake was made, and receiving immediate correction. Coaches then described the error, modeled the correct position, and had players imitate it with verbal reinforcement.	Behavioral coaching proved highly effective in improving blocking performance for all five football players. Each player showed significant improvement from baseline to intervention, with the coaching consistently enhancing their execution. Even when performance dropped in a reversal design, reintroducing the intervention quickly restored and improved blocking effectiveness.
Manuel Isorna-Folgar, Raquel Leirós-Rodríguez, Santiago López-Roel, and José L. García-Soidán	The objective of this study was to evaluate a mental training intervention (cognitive-behavioral therapy) in youth rowers in preparation for their participation in the Junior European Championship. A quasi-experimental study was carried out with the complete team of the Spanish youth rowing team.	16 athletes from the Spanish youth rowing team	The study implemented a 10-session mental training program for adolescent athletes to improve skills like arousal management, concentration, and self-confidence. The program included group activities, psychologist feedback, and online monitoring, covering topics like motivation, goal setting, and relaxation techniques. Performance and psychological factors were measured using the CPRD questionnaire and various statistical methods, with significance set at $p < 0.05$.	Women initially had higher stress control (SC) scores. Post-intervention, SC and influence of performance evaluation (IPE) improved overall, with women improving only in IPE. Significant correlations were found between mental skills, motivation, team cohesion, SC, and IPE. Regression analysis showed age negatively impacted championship performance, with no other psychological factors having significant effects.
Darko Jekauc, Christoph Kittler, Marcel Schlagheck	This study aimed to examine the effectiveness of a mindfulness-based intervention in athletes.	72 sports science students from Humboldt University Berlin through simple random sampling.	Sport science students were randomly assigned to an experimental group (EG) or a control group. Both attended a 90-minute course, with the EG receiving 8 weeks of mindfulness training and the control focusing on sports psychology topics. Mindfulness levels were measured at three intervals using the German MAAS scale, and statistical analyses with IBM SPSS Statistics 23 included ANCOVA controlling for age and sex.	The intervention group improved MAAS scores, while the control group declined. The significant interaction between time and group indicated that the intervention was effective, with no notable effects from age or sex.

Author Name	Purpose	N	Methodology	Results
Marina Pavão Battaglini, Dalton Müller Pessôa Filho, Sandra Leal Calais, Maria Cristina Oliveira Santos Miyazaki,Cassiano Merussi Neiva, Mário C. Espada, Mayra Grava de Moraes, Carlos Eduardo Lopes Verardi	The purpose of the paper was to evaluate the effects of muscle relaxation programs on psychological and physiological variables in basketball athletes.	59 male basketball athletes.	Athletes in both groups completed a demographic questionnaire and were assessed with the CSAI-II for anxiety and confidence and the RESTQ76 Sport for stress and recovery. The intervention group (IG) underwent 12 sessions of Progressive Muscle Relaxation (PMR), while the control group (CG) did not. Pre- and post-intervention assessments included the CSAI-II, RESTQ76 Sport, blood pressure, and heart rate measurements. Data analysis used Cronbach's alpha for internal consistency and the Mann-Whitney test for group comparisons, with significance set at $p < 0.05$.	The study showed that Progressive Muscle Relaxation (PMR) effectively reduced cognitive anxiety and specific stress in basketball athletes, significantly improving heart rate during several sessions. However, PMR did not significantly impact somatic anxiety, self-confidence, general stress, or blood pressure. Overall, the findings suggest that PMR can effectively reduce negative cognitive behaviors.
Won-Sang Jung, Sung-Woo Kim, and Hun-Young Park	This study evaluated the effects of intermittent interval training in hypoxic conditions for six weeks compared with normoxic conditions, on hemodynamic function, autonomic nervous system (ANS) function, immune function, and athletic performance in middle- and long-distance runners	20 male, competitive, moderately trained middle- and long-distance runners, registered with the Korea Association of Athletics Federations.	Training occurred in a controlled chamber over 6 weeks, with pre- and post-testing spanning 5 days each. Sessions were 90 minutes, 3 times a week, including warm-up, interval training, and cool-down. Measurements included blood composition, hemodynamic and autonomic nervous system functions, immune function, and athletic performance. Blood samples and body metrics were collected before and after training, with athletic performance assessed via VO2max and a 3000 m time trial. Data analysis used two-way ANOVA with repeated measures and Bonferroni post hoc tests for group comparisons.	The study compared the effects of NTG and HTG training on competitive runners. While body composition remained unchanged, athletic performance improved notably in both groups, with HTG showing greater gains. HTG also exhibited better hemodynamic function, enhanced autonomic nervous system (ANS) function, and increased immune parameters. In contrast, NTG showed decreases in ANS metrics and B cell counts. Overall, HTG led to more significant improvements in VO2 max, ANS function, and some immune parameters compared to NTG.
Myong-Won Seo,Jong Kook Song,Hyun Chul Jung, Sung-Woo Kim, Jung-Hyun Kim, and Jung-Min Lee	The purpose of this study was to examine the associations of vitamin D status with athletic performance and blood-borne markers in adolescent athletes. This cross-sectional study included forty-seven Taekwondo athletes aged 15–18 years old.	47 male adolescent Taekwondo athletes	The study involved 47 male adolescent Taekwondo athletes with at least three years of training. Physical measurements, including height, weight, and skeletal maturity, were assessed using X-rays and the TW3 method. Body composition and bone mineral density (BMD) were measured with DEXA. Blood samples analyzed serum 25-hydroxyvitamin D (25(OH)D) levels and other markers. Performance was tested for aerobic and anaerobic capacity, power, agility, muscle strength, and fatigue resistance using established protocols. Dietary intake, including vitamin D, was tracked with 3-day records. Statistical analyses, including ANOVAs and regression models, explored the relationships between 25(OH)D levels, performance metrics, and other variables.	The study examined vitamin D levels in 47 adolescent Taekwondo athletes and found varying levels of deficiency and insufficiency. Despite these differences, there were no significant variations in athletic performance across the groups. Although a positive correlation was noted between vitamin D levels and mean power output, vitamin D was not identified as a key predictor of athletic performance.

Author Name	Purpose	N	Methodology	Results
Takashi Maruyama, Shinichi Sato, Mari Matsumura, Taisuke Ono, Masaki Nishida,and Seiji Nishino	In this study, the effects of HR mattress toppers on sleep, vigilance (measured by a psychomotor vigilance test), and athletic performance (including 40-meter sprint time, long jump distance, and star drill time) in male youth athletes aged 10 to 19 were extensively evaluated. These assessments were conducted over two sessions, involving 51 subjects in 2013 (Study I) and 23 subjects in 2014 (Study II).	74 student-athletes	The study assessed the impact of different mattress toppers on sleep quality and athletic performance in student athletes aged 10 to 19. Spanning two phases, the study recruited athletes from various sports programs and used the PSQI for screening. Study 1 involved 51 athletes testing HR and LF toppers over four weeks each, with performance measured through questionnaires, the PVT, and athletic tests. Study 2 focused on replicating findings with HR toppers using 23 athletes over six weeks, comparing sleep with and without the topper. Assessments occurred in the final two weeks of each period, with sleep tracked via actigraphy. Data analysis used the Wilcoxon rank-sum test and repeated measures ANOVA.	In Study I (2013), 47 participants found no significant differences between high-resilience (HR) and low-resilience (LR) mattress toppers in sleep quality, vigilance, or self-rated athletic performance. There was a slight improvement in 40-m sprint time with the HR topper, though changes in long jump and star drill performance were not significant. In Study II (2014), 23 participants also showed no significant differences in sleep quality, athletic performance, or vigilance with the HR topper. However, the HR topper did significantly improve star drill performance, while long jump and 40-m sprint times showed no notable changes.
Hun-Young Park, Chulho Shin, and Kiwon Lim	The aim of the study was to determine whether the IHT regimen ameliorates exercise economy and aerobic exercise performance in moderately trained swimmers.	20 moderately trained Korean swimmers	The study included an 8-day pre-test, a 6-week training period, and an 8-day post-test. It measured body composition, VO2max, and HRmax, and assessed exercise and metabolic parameters. The training involved normoxic and simulated hypoxic conditions, with additional normoxic swimming and resistance training. Evaluations were done before and after training using a hypobaric chamber, focusing on metabolic parameters, muscle oxygenation, and performance. Analysis used two-way ANOVA with repeated measures and Bonferroni post-hoc tests.	The study found significant improvements in VO2, VCO2, and blood lactate levels following training, with the IHT group showing notable reductions in these metrics. In contrast, the control group only saw a significant decrease in blood lactate. The IHT group also showed improved skeletal muscle oxygenation and aerobic performance, including increased VO2 max and better 400 m time trial results. Overall, the IHT group demonstrated greater improvements in metabolic parameters, muscle oxygenation, and aerobic performance than the control group.
Franck Brocherie, Grégoire P Millet, Anna Hauser, Thomas Steiner, Julien Rysman, Jon P Wehrlin, Olivier Girard	This study aims to investigate physical performance and hematological changes in 32 elite male team-sport players after 14 days of "live high-train low" (LHTL) training	36 elite male field hockey players from Belgium, Spain, and the Netherlands	The study investigated altitude training's effects on field hockey players' performance and hemoglobin mass. It included a 2-week sea-level lead-in, baseline testing, and a 14-day hypoxic intervention with LHTLH, LHTL, or LLTL conditions. Performance and hemoglobin mass were measured before and after the intervention. Training occurred in simulated altitudes of 2500-3000 meters. A 3-week follow-up period at sea level was also conducted. The study used a double-blind design and statistical analyses such as paired t-tests and ANOVA.	The study compared hypoxic exposure between the LHTLH and LHTL groups, finding similar room confinement and total hypoxic dose. Effective blinding prevented participants from identifying simulated altitudes. While mean heart rates were similar across groups, SPO2 levels were higher in the LLTL group compared to the hypoxic groups, with LHTLH having lower SPO2 than LHTL. There were no significant changes in body weight or training loads. Both hypoxic groups showed increased hemoglobin mass and improved YYIR2 performance, with significant sprint performance gains for LHTLH and LHTL but not LLTL. Sprint decrement scores were unchanged across conditions.

Author Name	Purpose	N	Methodology	Results
Bachero-Mena, Beatriz; Pareja-Blanco, Fernando; González-Badillo, Juan José	This study compared the effects of 2 resistance training programs during 25 weeks on physical performance and hormonal response in high-level 800 m athletes.	13 male athletes of national and international levels in 800 m	Thirteen male athletes were divided into two groups: the RTG, which followed a resistance training program with low load and volume including squats, plyometrics, and sprints, and the CTG, which engaged in high-volume circuit training. Testing involved sprinting, strength exercises, and blood hormone analysis in October, February, and June, measuring testosterone, cortisol, IGF1, and growth hormone. The RTG trained twice a week, while the CTG trained weekly.	Over 25 weeks, the resistance training group (RTG) improved more than the circuit training group (CTG) in sprint times and strength measures. RTG made significant gains in 200-m and 800-m sprints; countermovement jump, jump squat, squat load, and rate of force development. CTG also improved in 800-m sprints but showed less progress in strength and potentially harmful outcomes for the squat load. Hormonal changes indicated increased testosterone for RTG and increased cortisol for CTG. Overall, RTG achieved better performance, strength, and hormonal changes.
BRANDILEA BROBST UNIVERSITY OF NEBRASKA–LINCOLN AND PHILLIP WARD	The effects of public posting, goal setting, and oral feedback on the skills of 3 female high school soccer players during practice scrimmages.	3 female athletes	Using a baseline design, the study aimed to improve three specific soccer skills over 27 practices and 10 games. Data were collected via videotaped practices and games and analyzed by validated coders. The intervention included regular coaching feedback, public posting, goal setting, and oral feedback, with a goal of 90% correct performance. Skill maintenance and generalization to games were assessed. High interobserver agreement was achieved, and feedback was collected from participants and the coach.	The intervention improved soccer skills for Sam, Jan, and Amy, with noticeable gains in movement with the ball, during restarts, and after passing. While some skills showed immediate improvements, others took longer to change. Despite occasional lapses in performance, participants maintained and generalized the skills well. Social feedback was mixed, with some players feeling positive and others frustrated by performance dips. Overall, the coach noted significant improvements and supported continuing the intervention.
Phillip Ward and Michael Carnes	This study extends research using public posting in sports by demonstrating the effects of player-determined goals and public posting of goal attainment.	5 linebackers Form an NCAA Division II	The study targeted three skills: correct reads, correct drops, and proper alignment. Data was collected through videotaped practices and games, with the first 10 trials of each skill recorded and coded by independent coaches, achieving 95% agreement with benchmarks. The intervention involved setting individual goals for 90% correct performance and publicly posting daily practice results in the locker room.	Participants initially had a stable baseline performance of 60-80% correctness. After implementing the intervention, performance improved dramatically to 90-100% correctness. This approach effectively enhanced practice performance, with players meeting or exceeding their goals most days. While occasional goal shortfalls were linked to external factors like weather, the improved practice performance also correlated with better on-field performance, indicating the intervention's success.
Alexandra Kopp, Markus Reichert, and Darko Jekauc	The paper aims to evaluate and explore the relationship between emotional intelligence and athletic performance. Doing so, the paper compares two conceptualizations of emotional intelligence: ability (EI) and trait (EI).	323 athletes	An online survey was conducted from February 1 to June 27, 2019, with athletes recruited through sports associations, clubs, and media. It took about 30 minutes to complete, with a 19.5% response rate. The survey used the MSCEIT test for ability emotional intelligence and TEIQUE-SF for trait emotional intelligence. Sports performance was assessed through self-reported competition levels, sports success, and athletic performance. Data were categorized into three groups based on expertise and success, with statistical analysis performed using IBM SPSS Statistics.	The study found that 67% of athletes competed nationally and 10.2% internationally. Trait emotional intelligence (EI) positively predicted athletes' self-assessment of performance, while neither trait EI nor ability EI predicted sports expertise level or success. Trait EI influenced performance self-assessment independently of ability EI.

Author Name	Purpose	N	Methodology	Results
Thomas L. McKenzie and Brent S. Rushall1	This investigation aimed to determine the effects of applying psychology techniques in a sporting environment (swimming).	32 Shannon Heights Sharks competitive swimming team members from Dartmouth, Nova Scotia, Canada served as subjects.	Experiment 1 assessed the impact of a public posting intervention on swimmer attendance using a display board to track and display cumulative attendance and performance. The intervention included three phases: baseline, recording attendance only if swimmers participated, and requiring full attendance from the start of practice. Post-intervention checks occurred three weeks later. Experiment 2 investigated whether self-recording training-unit completion improved performance. Eight swimmers used program boards to track laps, with data collected during traditional coaching and board use phases. Post-checks three weeks later evaluated the intervention's lasting impact.	Experiment 1 found that the attendance board greatly improved swimmer attendance, reduced late arrivals and early departures, and decreased absenteeism. Swimmers engaged positively with the system, which also eased coaches' workloads and promoted self-motivation through visible tracking and feedback. Experiment 2 showed that program boards improved swimming performance, reduced absences, and minimized late arrivals and early departures. The boards enhanced self-direction and provided immediate feedback, leading to notable performance gains.

Study 1: Operant Paradigms

The methodology of using a contingency of response and consequence and incorporating it as a learning tool for performance enhancement, as proposed by Allison and Ayllon, significantly improved players' physical output on specific skills in the perception of the athletes' sport. The study was tested on several categories of athletics, including football and gymnastics, and included a variety of baseline procedures, such as the reversal design, to ensure the reliability of the study. Standardized coaching involved a stricter pattern of operant paradigms, including the lack of response toward an athlete's correctness and a harsher response toward an athlete's incorrectness. This included verbally commenting on a player's stupidity, lack of courage, awareness, or even worse. Continued errors sometimes resulted in the player running laps or moving on to a different skill without perfecting the initial one. The intervention proposed by Allison and Ayllon combatted the conventional style of standardized coaching by replicating a more inclusive and upbeat style under operant reinforcement. Specifically, the perception of behavioral coaching was prominent in the effects of sports enhancement across athletes. The changes in conventional coaching standards were used to emulate the operant paradigms used on athletes, creating promising results, as shown in the ten trials in the study's results (Allison & Ayllon, 1980).

Study 2: CBT

The study of Cognitive Behavioral Therapy (CBT) among Spain's national junior rowers demonstrated a relatively net positive effect on the participants. All athletes underwent a structured intervention with key study variables -stress control (SC), influence of performance evaluation (IPE), motivation, team cohesion, and mental skills- assessed to evaluate the outcomes. Pre-intervention assessments indicated that female athletes had higher SC scores than their male counterparts (61.4 ± 12.6 vs. 54.8 ± 6.3; $p = 0.01$; $d = -1.34$). Post-intervention results revealed improvements in SC and IPE across the entire sample ($p < 0.01$), with women showing significant progress only in IPE ($p = 0.04$). Noteworthy correlations emerged between the mental skills subscale and both motivation and team cohesion ($r = 0.6$; $p < 0.02$) as well as between SC and IPE ($r = 0.8$; $p = 0.0006$). Linear regression analysis indicated that age negatively impacted championship performance -2.58 ($p < 0.05$), while no significant effects were observed from other psychological variables. Overall, the study highlights the potential benefits of CBT interventions in enhancing specific psychological factors critical to athletic performance (Folgar et al., 2022).

Study 3 BATL

Studies such as the one conducted by Jekauc et al. investigate the effectiveness of a mindfulness-based intervention in athletes using the Berlin Mindfulness-based Training (BATL). Bachelor's students in sport science were randomly assigned to either an experimental ($n = 22$) or a control group ($n = 24$). Both groups participated in a practical sport psychology course, each lasting 90 minutes. Descriptive statistics revealed that the mean MAAS score for the intervention group increased from 3.95 ± 0.70 at the start of the intervention to 4.15 ± 0.67 by the end. In contrast, the control group's mean MAAS score decreased from 4.12 ± 0.63 to 3.83 ± 0.79 over the same period. Analysis of covariance with repeated measurements showed that the interaction between time and group was significant ($\eta^2 = 0.13$; $p < 0.01$), indicating that the development of MAAS differed significantly between the two groups. These results suggest that BATL is an effective program for increasing mindfulness as a trait. However, it remains unclear whether this program can influence performance in sports, emotion regulation strategies, concentration, or flow state, concluding that the intervention correlating BATL positively impacts increasing mindfulness as an attribute and needs further study to evaluate other cognitive factors (Jekauc et al., 2017).

Study 4 Muscle Relaxation

Another study of an intervention and its effects on sports performance is a muscle relaxation program. Calais et al. aimed to evaluate the effects of psychological and physiological variables on male basketball athletes. The study demonstrated that progressive muscle relaxation (PMR) significantly impacts psychological and physiological measures. The intervention group, for instance, showed a decrease in cognitive anxiety ($U = 299.000$, $p = 0.038$) and specific stress ($U = 275.500$, $p = 0.015$) throughout the 12 sessions PMR was available. Furthermore, there was a significant reduction in heart rate during specific sessions, particularly between the 5th and 10th sessions, with p-values ranging from 0.001 to 0.035. Although PMR affected bpm, it did not significantly alter somatic anxiety, self-confidence, general stress, or blood pressure. Only three sessions showed significant differences in systolic and diastolic blood pressure ($p < 0.05$). Findings suggest that PMR can effectively reduce negative cognitive behaviors (Calais et al., 2022).

Study 5 Intermittent Interval Training in Hypoxic Conditions

A study that involved intermittent interval training in hypoxic conditions on athletes registered with the Korea Association of Athletics showed results in a hypoxic and normoxic training group that bolstered athletes' performance, specifically in the domain of track and field. The study assessed changes in body composition, athletic performance, hemodynamic function, autonomic nervous system (ANS) function, and immune function in competitive runners subjected to normoxic (NTG) and hypoxic (HTG) training. Notably, VO2max, a critical measure of aerobic capacity, showed a significant interaction effect ($\eta 2 = 0.686$, $p < 0.001$), with the HTG group exhibiting a more substantial improvement of 6.3% ($p < 0.001$) compared to 1.5% in the NTG ($p < 0.01$). Additionally, the HTG group demonstrated significant enhancements in hemodynamic function, including increased cardiac output index (COi) ($\eta 2 = 0.575$, $p < 0.001$) and oxygen pulse (O2 pulse) ($\eta 2 = 0.588$, $p < 0.001$), indicating better cardiovascular efficiency during submaximal exercise. While both groups had enhanced VO2 max, hypoxic training may lead to a more substantial improvement in aerobic capacity, thus positively correlating with sports performance (Jung et al., 2020).

Study 6 Vitamin D Status

Examining the associations of vitamin D status with athletic performance and bloodborne markers in adolescent athletes, researchers found a modicum correlation between serum 25(OH)D levels and various performance indicators. Furthermore, there was no significant effect of vitamin D on performance metrics, such as mean power output ($r = 0.359$, $p < 0.05$) and VO2 max ($r = -0.317$, $p < 0.05$). Factors of health markers like FT were linked to power output and performance in some tests but disappeared after readjustment. C showed a negative correlation with power output and VO2 max, suggesting that vitamin D levels are not significant predictors of athletic performance in Taekwondo athletes (Seo et al., 2019).

Study 7 Mattress Toppers

A study of the effects of HR mattress toppers showed a significant correlation between sleep, vigilance, and athletic performance. 2 mattresses were used to examine athletic factors: the low-resilience mattress toppers and the high-resilience mattress toppers. Thus, there was a marginal improvement in the 40-m sprint time with the HR topper; repeated measures ANOVA indicated a significant improvement in the 40-m sprint with the HR topper but not in other metrics. Additionally, there were no significant differences in subjective athletic performance ratings, sleep quality, or psychomotor vigilance between using an HR topper and no topper. However, the HR topper significantly

improved star drill performance, while long jump distance and 40-m sprint time did not show significant changes (Maruyama et al., 2020).

Study 8 IHT Regimen

The study determined whether the IHT regime ameliorates exercise economy and aerobic exercise performance in moderately trained swimmers. After 6 weeks of IHT, the group demonstrated notable reductions in VO2 ($F=11.773$, $p=.004$), VCO2 ($F=13.017$, $p=.003$), and blood lactate levels ($F=41.683$, $p<.001$), with significant decreases in VO2 ($p=.016$), VCO2 ($p=.010$), and blood lactate ($p=.001$) compared to pre-training values. Intermittent hypoxic training in 3000 m hypobaric hypoxia conditions improved overall across metabolic parameters, skeletal muscle oxygenation, and aerobic performance compared to the group without IHT treatment. Additionally, the IHT group exhibited significant improvements in skeletal muscle oxygenation, including increased O2Hb ($F=11.649$, $p=.004$) and TOI ($F=7.245$, $p=.018$), and decreased HHb ($F=6.847$, $p=.020$). Exercise performance metrics also improved, with significant main effects in VO2max ($F=26.742$, $p<.001$) and the 400 m time trial ($F=12.226$, $p=.004$), showing enhanced aerobic capacity (VO2max $p=.001$) and better performance in the 400 m time trial ($p<.001$). Furthermore, there is a notable improvement in removing fatigue substances and aerobic exercise performance in moderately trained swimmers, thus suggesting a positive effect on athletic performance (Park et al., 2018).

Study 9 LHTL Training

Physical performance and hematological changes were observed while elite male team sport players underwent live high train low training. The study comprised a preintervention period for baseline testing and a post-intervention period, as well as an evaluation of the effects of altitude training on physical performance. Participants of 2 intervention groups (LLTL and LHTL) showed comparable hypoxic dose and exposure with similar mean daily room confinement. Results indicated positive effects on athletic performance for participants in the hypoxic training groups (LHTLH and LHTL), increasing by 21% and LHTL by 22% ($P < 0.01$ and $P < 0.001$, respectively), and further gains at Post-2). Specifically, there were significant improvements in YYIR2 performance and reductions in cumulated sprint times during the RSA test for both hypoxic groups, demonstrating enhanced aerobic capacity and sprint performance LHTLH (−3.6%) and LHTL (−1.9%) from Pre to Post-1, with LHTLH maintaining shorter times at Post-2 ($P < 0.001$). Findings suggest that hypoxic training can positively affect athletic performance, particularly in aerobic endurance and repeated sprint ability. However, no significant changes were observed in vertical jump performance, except for a time effect in CMJ height. Overall, the hypoxic interventions led to notable improvements in specific aspects of athletic performance (Franck et al., 2015).

Study 10 Resistance Training Program

Another study by Mena et al. compared the effects of 2 resistance training programs (RTG and CTG) during 25 weeks on physical performance and hormonal response. Over 25 weeks, the resistance training group (RTG) showed greater improvements in performance and strength compared to the circuit training group (CTG). RTG achieved notable gains in 200-m and 800-m sprint times (112.79 ± 6.42 vs. 117.97 ± 1.97 seconds, effect size: 85/11/4%) and excelled in countermovement jump, jump squat, and strength measures. RTG also likely increased testosterone levels. In contrast, CTG made less pronounced gains and showed potential adverse effects on some strength measures, with a likely increase in cortisol levels. The resistance training group (RTG) improved performance, strength, and hormonal changes more than the circuit training group (CTG), indicating a more effective intervention for enhancing sports performance (Mena et al., 2021).

Study 11 Public Posting, Goal Setting, and Oral Feedback

The effects of public posting, goal setting, and oral feedback on the skills of 3 female high school soccer players during practice scrimmages were observed to determine if it positively affected the athlete's performance. The intervention significantly improved soccer skills, including movement with the ball, during restarts and after passing. Participants showed varied improvement rates: some experienced immediate gains, while others saw more gradual progress. Although there was substantial overall progress, the set performance goal was occasionally unmet, indicating it might have been too high. Improvements in movement with the ball were largely retained after the intervention but skill generalization to game situations needed to be more consistent. This inconsistency may be due to differences between practice and game environments, such as opponent familiarity and the level of direct coaching, suggesting that there were still variables that contributed to the inconsistency of the experiment (Brobst and Ward, 2002).

Study 12 Public Posting

The study of public posting among linebackers from an NAIA Division II football team was evaluated to extend the research of public posting and its effects on goal attainment. Results showed that the intervention led to significant improvements in performance during practice, which were also evident in-game settings. Although there were a few instances where players did not meet their goals, these were associated with unusual conditions, such as a rainstorm. The findings support that enhancing practice performance can lead to better game outcomes, emphasizing the value of performance-based interventions over less effective methods (Ward and Carnes, 2002).

Study 13 Emotional Intelligence

A study examining the impact of emotional intelligence (EI) on sports performance found that trait EI positively influenced athletes' self-assessment of their performance. Specifically, each 1-point increase on the trait EI scale (1 to 7) was associated with a 1.02-point increase in self-assessment scores (on a scale of 1 to 5, B = 1.02 B=1.02, t (1) = 3.69 t(1)=3.69, $p < 0.01$ p<0.01, R 2 = 0.04 R 2 =0.04). In contrast, neither trait EI nor ability EI significantly predicted athletes' level of expertise (for trait EI: O R = 1.07 OR=1.07, p = 0.83 p=0.83; for ability EI: O R = 1.01 OR=1.01, p = 0.40 p=0.40) or sports success (for trait EI: O R = 1.53 OR=1.53, p = 0.08 p=0.08; for ability EI: O R = 0.98 OR=0.98, p = 0.80 p=0.80). The effect of trait EI on self-assessment was independent of ability EI, indicating that while trait EI is linked to how athletes evaluate their performance, it does not directly affect their level of expertise or sports success (Kopp et al., 2021).

Study 14 The Swimmers

Another study such as that of Mckenzie and Rushall included reinforcement contingencies developed to remedy sporadic and poor attendance behaviors. Two experiments were conducted with a baseline design verifying the effects of publicly marking attendance and a reversal design to assess the effects of employing program boards to increase work output. Both interventions had a net positive output of improved performance of swimmers relating to their attendance and skill levels. Results included swimmers engaging with the system positively, with some even scheduling additional practices to make up for missed sessions in experiment 1. Additionally, the attendance board streamlined the process, reducing the coaches' workload and fostering a self-motivated environment among the swimmers. The results in experiment 2 included the improvement of late arrivals in a controlled environment of 8 swimmers. Using these boards resulted in fewer absences, reduced instances of late arrivals, and eliminated early departures (McKenzie and Rushall, 1974).

Discussion

When comparing different types of interventions, each category possessed unique strengths and challenges in improving athletes' performance.

Cognitive-based interventions, for instance, throughout studies 1-3 demonstrated the clear benefits of enhancing both psychological factors and athletic performance. Operant paradigms, Cognitive Behavioral Therapy, and Berlin Mindfulness-based Training significantly improved psychological factors like stress management, motivation, and team cohesion. The interventions underscore the importance of addressing the mental aspects of sports, often as critical as physical training in determining success. Specifically, operant paradigms in coaching showed a clear shift from traditional, punitive methods to a more positive reinforcement approach, which improved athletes' skill execution and fostered a supportive and motivating environment. This trend is similarly shown in CBT as junior rowers highlighted its efficacy in enhancing psychological resilience and performance-related mental skills. Moreover, in Study 3, the use of BATL assessed on the MAAS indicated it as an effective program to increase mindfulness as a trait. However, the results of the study also indicate that the BATL performance does not directly influence the concentration, performance, emotional regulation strategies, and flow, indicating that the generalizability of findings of the three studies can be limited by the specificity of the populations studied which may not fully represent the broader athletic community.

Physical interventions, including intermittent hypoxic training, progressive muscle relaxation program, vitamin D status, mattress toppers, IHT regimen, LHTL, and resistance training programs, demonstrated significant improvements in measurable physical factors such as VO2 max, spring performance, and overall exercise tendencies. The IHT training study, for example, showed a significant enhancement in aerobic capacity and metabolic efficiency, suggesting that interventions can lead to profound physiological adaptations. Similarly, resistance training programs focused on building strength and endurance, showing effectiveness in enhancing specific performance metrics; resistance programs showed a net positive result in the physicality aspect of the study. Physical interventions are shown to tend to a more immediate observable result in terms of physical/athletic performance. The consistency of outcomes across different studies epitomizes that physical interventions are particularly beneficial in optimizing physical aspects of performance. While physical interventions showed general reliability in their effects on athletic performance, their impacts can significantly vary based on the athlete's baseline statistics, the general intensity of the intervention, and individual differences.

Emotional interventions offered a more nuanced or subtle approach to performance enhancement. Focusing on factors such as emotional intelligence, goal setting, questionnaires, and feedback mechanisms positively influenced athletes' assessments and skill development. For instance, the study on public posting and goal setting in soccer players indicated in Study 11 surmised significant improvements in specific skills during practice. Similarly, the evaluation of emotional intelligence revealed that while trait EI positively influenced an athlete's self-perceptions, it did not directly correlate with higher levels of expertise or success in the athlete's particular domain. The variability in outcomes from emotional interventions suggests that while the interventions can be effective in enhancing certain aspects of performance, their broader impact on overall success or expertise is less predictable. The inconsistency is speculated based on the complex interplay between an athlete's emotional state, environment, and specific demands. Moreover, emotional interventions may also be more sensitive to external factors such as the quality of coaching, team dynamics, and the psychological climate of competition or social factors.

Throughout the studies reviewed, methodological approaches varied, with studies employing baseline and reversal designs to ensure the reliability of findings and the use of a more straightforward experimental design. Studies employing baseline and reversal designs mainly revolved around cognitive and emotional interventions. This methodology was useful in cognitive/emotional-based interventions as changes in psychological variables needed to be carefully monitored to establish a causation relationship. However, using a rigorous design may also limit the generalizability of the results, often requiring controlled environments and specific populations that may not fully represent the broader scope across athletes in different professions and levels of competition.

Studies using a more straightforward experimental design correlated with physical interventions. Given the more tangible and measurable outcomes physical interventions produce, the results from these studies tended to be more generalizable; such as the physical performance metrics like VO2 max or sprint times, their relevancy was corroborated by the tangibility of results across many sports. The effectiveness of these interventions can still vary based on the athletes' characteristics, such as their baseline fitness, training history, and specific sports demands, indicating the malleability of physical, cognitive, and emotional interventions.

Despite the differences across the interventions and methodology, the interventions shared similar objectives accordingly. Regardless of their specific focus, all interventions aim to enhance athletic performance, whether through improving psychological factors, physiological metrics, or emotional regulation. Their shared emphasis on performance underscored the goal to maximize athletes' capabilities within their respective boundaries. Positive outcomes were another shared feature across the studies, with most interventions all demonstrating improvements in various areas. For example, studies from all categories (1-14) showed a positive outcome in various aspects of athletic performance, ranging from psychological improvements to measurable gains in physical performance metrics. Motivation and adherence were critical factors influencing the success of these interventions across all categories as well. Whether through cognitive strategies, emotional, or physical training regiments, the importance of athlete commitment and psychological readiness was a significant theme that reoccurred throughout the studies, underscoring the role of motivation in maximizing the benefits of any intervention. Additionally, the adaptability of these interventions to different sports and contexts was evidence suggesting that while techniques may vary, their core ideals can be suitable for various athletic environments. Ultimately, interventions, despite their differences, are tailored to the positive outcomes of athletic performance.

Conclusion

The review evaluated the effectiveness of cognitive, physical, and emotional interventions in enhancing athletic performances across 14 studies. The studies showed the positive effects of athletic-based interventions on sports performance, positively impacting cognitive, physical, or emotional functions. However, the included studies had notable limitations. The interventions and outcome measures varied widely, making it difficult to draw definitive conclusions. Many studies had small sample sizes and short follow-up periods, limiting the generalizability and long-term applicability of the results. Methodological issues such as variability in study design, inconsistent binding, and randomization also introduced potential bias regarding the studies as less of an objective paper. The review process was constrained by potential selection bias as studies in languages other than English might have been overshadowed. The subjective interpretation of results and inconsistent use of biased assessment tools further limited the expansive scope of the review. The findings have significant implications for practice and policy. Coaches and sports psychologists should integrate a holistic approach of cognitive, physical, and emotional interventions into more comprehensive individualized training programs emphasizing long-term development. Sports organizations should also support evidence-based approaches and invest in research to further refine these interventions. Future research should focus on conducting longitudinal studies with larger, more diverse populations to assess the sustained impact of these interventions. Thus, standardizing outcome measures across studies would facilitate more meaningful comparisons, helping to identify the most effective strategies for different sports and competitive levels.

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