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Artificial Intelligence and Robotic Technologies in Athlete Support: A Systematic Review of Implementation, Psychological and Performance Outcomes, and Human–Technology Interaction

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 3 August 2026 and was last updated on 3 August 2026.

INTRODUCTION

Review question / Objective This systematic review aims to map and critically synthesise how artificial intelligence and robotic technologies have been designed, implemented, and evaluated in sport and athlete-support settings.

The review addresses the following questions:

What types of artificial intelligence and robotic technologies have been used in sport settings, for what purposes, and how have these technologies been implemented and delivered?
Which psychological, physiological, performance-related, social, usability, acceptability, and human–technology interaction outcomes have been assessed, how have they been measured, and what findings and user experiences have been reported?
Considering the methodological quality and directness of the available evidence, which implementation practices appear promising, and what methodological limitations and research gaps remain?

The review focuses particularly on psychological outcomes, including motivation, self-efficacy, engagement, persistence, commitment, mental toughness, emotional states, psychological well-being, and technology acceptance, while also considering relevant physiological, technical, performance-related, social, and human–robot interaction outcomes.

Rationale Artificial intelligence and robotic technologies are increasingly being incorporated into sport training, athlete monitoring, psychological assessment, performance analysis, personalised feedback, and coaching. These technologies include AI-assisted coaching systems, intelligent monitoring platforms, wearable sensors, computer-vision systems, virtual or augmented reality, conversational agents, and socially assistive robots.

Existing reviews have predominantly focused on performance prediction, tactical analysis, injury prevention, rehabilitation, or the technical accuracy of AI systems. Far less attention has been given to systems that actively interact with athletes or deliver training and psychological support. Psychological outcomes—including motivation, engagement, self-efficacy, commitment, emotional regulation, mental well-being, and acceptance—have rarely been synthesised alongside implementation characteristics and human–technology interaction processes.

This represents an important gap because technological accuracy or perceived usefulness does not necessarily demonstrate improved athlete functioning, sustained engagement, psychological well-being, or sport performance. Moreover, the effectiveness of AI-assisted support may depend on implementation factors such as personalisation, feedback timing, embodiment, autonomy, human oversight, usability, trust, and integration with human coaching.

The review therefore provides a psychologically informed synthesis of AI- and robot-assisted applications in sport. It distinguishes athlete-level effectiveness from technological feasibility, algorithmic performance, and favourable user perceptions. It also critically evaluates the methodological quality and directness of the available evidence. The findings are intended to support the responsible development of technologies that complement, rather than replace, coaches, sport psychologists, and other sport professionals.

Condition being studied The review does not examine a single disease or clinical health condition. It investigates psychological functioning, training participation, and performance-related functioning among athletes and physically active individuals exposed to artificial intelligence or robotic technologies in sport-related contexts.

The psychological phenomena of interest include motivation, engagement, self-efficacy, persistence, commitment, mental toughness, attentional functioning, confidence, emotional states, anxiety, depressive symptoms, stress, resilience, satisfaction, technology acceptance, and perceived motivational support. These factors may influence sustained sport participation, training adherence, adaptation to training demands, psychological well-being, and athletic performance.

The review also considers associated physiological and performance-related domains, including technical skill acquisition, reaction time, training effectiveness, recovery, injury risk, physical activity, and sport-specific performance. Social and human–technology interaction factors—including trust, usability, acceptability, perceived usefulness, interaction quality, and attitudes toward AI or robots—are examined because they may influence whether technology-assisted support is adopted and used effectively.

METHODS

Search strategy Systematic searches were conducted on 15 February 2026 in Scopus, SpringerLink, and the EBSCO Discovery Service, the latter providing access to 88 databases. No publication-date restrictions were applied. Supplementary searches were conducted in OpenAlex in June 2026. Reference lists of all included studies were also screened using backward citation searching.

The following Boolean structure was used and adapted to the syntax of each information source:

("artificial intelligence" OR "AI" OR robot OR robotics OR "human–robot interaction" OR "human-robot interaction" OR "human-robot collaboration" OR "human-robot cooperation" OR "human-computer interaction" OR HRI OR HCI OR "socially assistive robots" OR "embodied agents" OR "emotion-aware robots" OR "intelligent system" OR "decision support system" OR "data-driven" OR "motion tracking" OR "coach assistant system" OR "computer vision" OR "wearable system")

AND

("sport performance" OR "athlete performance" OR "athletic performance" OR "sport persistence" OR "sport commitment" OR "sport engagement" OR "mental toughness" OR "exercise compliance" OR "training effectiveness" OR "team performance" OR "failure handling" OR "behavioral analysis" OR "behavioural analysis" OR "intrinsic motivation" OR "personalized training" OR "personalised training")

AND

(intervention* OR strateg* OR "best practice*" OR program* OR training OR framework*)

AND

(sport OR sports OR athlete*)

The database searches yielded 1,031 records. Records were deduplicated and managed in Zotero and Rayyan. Title and abstract screening was conducted between February and March 2026, followed by full-text screening. Backward citation searching identified one additional eligible study. The supplementary OpenAlex search used the same conceptual Boolean structure and did not identify further eligible studies.

Participant or population Professional, elite, competitive, amateur, recreational, or novice athletes and physically active individuals participating in organised or sport-related training activities are eligible. Studies involving coaches, trainers, or sport professionals may also be included when they evaluate the implementation or perceived effects of AI- or robot-assisted athlete-support technologies.

The primary population of interest is athletes aged 16 years or older. Studies with mixed-age samples may be included when the relevant sport or athlete data can be identified or when they provide directly relevant implementation, feasibility, or human–technology interaction evidence.

Studies focusing exclusively on clinical populations or health conditions unrelated to sport participation or sport injury are excluded.

Intervention Eligible technologies include artificial intelligence or robotic systems used for athlete support, sport training, psychological support, performance assessment, or personalised feedback. Examples include:

AI-assisted or automated coaching systems;
embodied or socially assistive robots;
conversational AI and virtual coaches;
intelligent monitoring and decision-support systems;
computer-vision and motion-analysis systems;
AI-integrated wearable technologies;
AI-supported virtual or augmented reality;
adaptive psychological assessment systems;
personalised sport or training recommendation systems;
emotion-recognition and biofeedback systems.

Both embodied and non-embodied technologies are eligible. The technology may deliver an intervention directly, assist a human coach or sport psychologist, monitor athlete functioning, generate personalised feedback, or support sport-related decisions.

Comparator No specific comparator is required. Eligible studies may compare AI- or robot-assisted support with conventional human-led training, usual practice, an alternative technology, another AI or robot configuration, passive or active control conditions, or no comparator.

For observational, feasibility, usability, acceptability, and technology-development studies, the absence of a formal comparison condition does not result in exclusion.

Study designs to be included Original quantitative, qualitative, or mixed-methods studies, including randomised and non-randomised controlled trials, quasi-experimental studies, pre–post studies, field evaluations, cross-sectional studies, feasibility and usability studies, psychometric studies, and relevant technology-development or validation studies.

Eligibility criteria Studies must:

investigate an AI- or robot-assisted technology in a sport, exercise-training, or athlete-support context;
report original empirical data;
assess at least one athlete-related psychological, behavioural, physiological, performance, social, usability, acceptability, implementation, or human–technology interaction outcome;
provide sufficient information to determine the technology's function and relevance to athlete support;
be available as a full-text publication in English.

Studies focusing only on algorithmic or simulation outcomes may be retained as a separate technology-development evidence stream but will not be used to support conclusions about athlete-level effectiveness.

Reviews, meta-analyses, theoretical articles, editorials, commentaries, conference abstracts without sufficient empirical information, and protocols without reported results are excluded. Studies unrelated to sport or athlete support, studies involving only non-sport clinical rehabilitation, and publications that merely mention AI without evaluating an identifiable AI or robotic application are also excluded.

No publication-date restriction is applied.

Information sources The principal electronic information sources are Scopus, SpringerLink, and EBSCO Discovery Service, which provides access to 88 databases. Searches were conducted on 15 February 2026.

Additional searches were conducted in OpenAlex in June 2026 using the same conceptual Boolean search strategy. Backward citation searching was performed by examining the reference lists of all studies meeting the inclusion criteria.

Search results and bibliographic records were imported into Zotero and Rayyan. Duplicate records were removed before screening. No formal search of trial registries or unpublished dissertations was undertaken. Authors may be contacted if essential information regarding study eligibility, participant characteristics, intervention content, or reported results cannot be determined from the publication.

Main outcome(s) The main outcomes are psychological and behavioural outcomes associated with athlete functioning and sustained sport participation. These include motivation, intrinsic motivation, amotivation, self-efficacy, engagement, persistence, commitment, confidence, mental toughness, resilience, psychological readiness, emotional states, emotion regulation, attentional functioning, stress, anxiety, depressive symptoms, psychological well-being, satisfaction, and perceived motivational support.

Technology-related psychological outcomes include acceptance, perceived usefulness, trust, willingness to use, attitudes toward technology, perceived suitability of an AI coach, interaction quality, intrinsic motivation during interaction, and other human–technology or human–robot interaction outcomes.

Outcomes measured immediately after exposure, following an intervention, or at any reported follow-up point are eligible. Quantitative effect estimates, group differences, pre–post changes, associations, descriptive results, and qualitative themes are extracted where available. Results are interpreted according to study design and methodological quality.

Additional outcome(s) Additional outcomes include:

objective or self-reported sport performance;
technical skill acquisition and movement execution;
training effectiveness and adherence;
reaction time, stroke accuracy, serve speed, and other sport-specific indicators;
physiological responses and physical activity;
injury risk, fatigue, recovery, and training load;
algorithmic classification or prediction accuracy;
system usability and feasibility;
implementation fidelity, duration, frequency, and setting;
personalisation and feedback characteristics;
level of embodiment and autonomy;
human oversight and coach involvement;
adverse events, safety concerns, and unintended consequences;
implementation barriers and facilitators;
privacy, fairness, transparency, trust, and data-governance considerations.

System-level technical outcomes are reported separately from athlete-level psychological or performance outcomes.

Data management All retrieved bibliographic records are managed using Zotero and Rayyan. Duplicate records are removed before eligibility screening. Title and abstract screening and full-text screening are conducted independently by reviewers, with disagreements resolved through discussion or assessment by an additional reviewer.

A piloted, standardised data-extraction form is used. One reviewer extracts each study and a second reviewer independently verifies all entries. Extracted information includes publication characteristics, country, participant characteristics, sport and competitive level, study design, sample size, technology type and function, embodiment, autonomy, human oversight, intervention duration and frequency, comparator, personalisation, feedback, outcome measures, assessment time points, effect estimates, adverse events, and implementation barriers and facilitators.

Records of inclusion and exclusion decisions are retained in Rayyan. Extracted data and quality-appraisal judgements are stored in structured tables, with disagreements resolved by consensus.All retrieved bibliographic records are managed using Zotero and Rayyan. Duplicate records are removed before eligibility screening. Title and abstract screening and full-text screening are conducted independently by reviewers, with disagreements resolved through discussion or assessment by an additional

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feedback, outcome measures, assessment time points, effect estimates, adverse events, and implementation barriers and facilitators. Records of inclusion and exclusion decisions are retained in Rayyan. Extracted data and quality-appraisal judgements are stored in structured tables, with disagreements resolved byconsensus.

Quality assessment / Risk of bias analysis Methodological quality and risk of bias are assessed independently by two reviewers using the design-appropriate Joanna Briggs Institute critical appraisal tools. Each applicable item is judged as "yes," "no," "unclear," or "not applicable."

Assessment domains include participant selection, clarity of inclusion criteria, exposure and outcome measurement, identification and management of confounding factors, group comparability, allocation procedures, completeness of follow-up, reliability of measurement, appropriateness of statistical analysis, and congruity of qualitative methodology.

Domain-level judgements and the reasons supporting them are reported rather than relying solely on numerical summary scores. Disagreements are resolved through discussion and consensus or, if necessary, consultation with another reviewer.

Simulation-only or algorithmic studies for which no appropriate human-study JBI tool is applicable are labelled "not assessable" and synthesised separately. Such studies are not used to support conclusions regarding athlete-level effectiveness. The certainty of conclusions is qualified according to methodological quality, design, directness, and relevance to real-world athlete support.

Strategy of data synthesis Study characteristics and results will be summarised in structured evidence tables. Studies will first be grouped into three evidence streams:

intervention and effectiveness studies;
feasibility, usability, acceptability, and observational studies;
technology-development, algorithmic-validation, or simulation studies.

Within these streams, studies will be organised according to technology type and function and the following outcome domains: psychological and behavioural; physiological; technical and performance-related; and social, usability, acceptability, or human–technology interaction outcomes.

A meta-analysis will be considered only if at least two studies are sufficiently comparable in population, technology, design, comparator, outcome definition, and effect measure. If statistical pooling is inappropriate because of substantial clinical or methodological heterogeneity, findings will be synthesised narratively in accordance with SWiM principles where applicable.

The direction and magnitude of effects, associations, descriptive findings, and qualitative experiences will be reported. Controlled athlete-level evidence will be prioritised when drawing effectiveness conclusions. Findings from uncontrolled surveys, user-perception studies, and algorithmic or simulation studies will be presented separately and interpreted according to their evidentiary directness. Conclusions will be qualified by study design, risk of bias, sample representativeness, measurement quality, and length of follow-up.

Subgroup analysis If sufficient comparable evidence is available, findings will be explored according to:

technology type: embodied robot versus non-embodied AI;
technology function: coaching, monitoring, assessment, feedback, recommendation, or performance analysis;
competitive level: elite/professional versus amateur/recreational/novice;
sport type: individual versus team sport;
intervention exposure: single or short-term exposure versus repeated or longer-term use;
comparator: conventional human-led training, alternative technology, or no comparator;
outcome domain: psychological, physiological, performance, or human–technology interaction;
study design and methodological quality;
participant age and sex/gender, where adequately reported.

Because substantial heterogeneity and a limited number of studies are anticipated, subgroup comparisons will primarily be descriptive and exploratory rather than inferential.

Sensitivity analysis If a quantitative synthesis becomes feasible, sensitivity analyses will be conducted by excluding studies judged to have a high risk of bias, studies with non-athlete or mixed populations, studies relying exclusively on self-

reported outcomes, and studies without a comparator.

For the narrative synthesis, sensitivity will be examined by comparing conclusions based on:

controlled athlete-level intervention studies;
all human-participant studies;
the full evidence base, including technology-development and simulation studies.

Conclusions about effectiveness will be reassessed after excluding indirect evidence, including hypothetical user evaluations, cross-sectional perceptions without verified technology exposure, and algorithmic or simulation outcomes. Any change in the direction, strength, or certainty of the conclusions will be reported.

Language restriction Only full-text studies published in English will be included because translation resources are unavailable.

Country(ies) involved Hungary.

Keywords artificial intelligence; robotics; sport psychology; athlete support; human–robot interaction; athletic performance.

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