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Digital Arms for Mental Strength: Evaluating Mobile Apps for Psychological Skills Training in Sports

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Abstract

The present study synthesizes the state of evidence on mobile psychological skills training (PST) apps for athletes, identifying the most consistent support for mindfulness apps, including a randomized controlled trial (RCT) in college athletes that demonstrated reduced anxiety and increased mindfulness following a therapist-supported, smartphone-delivered intervention. Furthermore, app-based imagery has been shown to improve both imagery skills and technical performance in youth elite athletes compared to control conditions. However, this promise is tempered by critical findings; audits of app quality consistently report sub threshold average scores (≈2.78/5 on the Mobile App Rating Scale), indicating widespread limitations in engagement, information quality, and sport-specific tailoring. The review also reveals mixed acceptability among elite athletes, where interest is countered by significant concerns over privacy, stigma, and fit, with broader digital mental health RCTs showing higher attrition rates that underscore adherence challenges for sport apps. In light of these findings, the study concludes that while mobile PST apps are promising adjuncts, significant improvements in app quality, adherence strategies, and privacy safeguards are essential, leading to the proposal of a practical integration framework for practitioners and a call for future research to prioritize co-designed, sport-specific trials.

Keywords: sport psychology; psychological skills training; mindfulness; imagery; self-talk; mobile apps; digital health; adherence; MARS

Introduction

Psychological skills training (PST), which encompasses techniques such as self-talk, imagery, goal setting, breathing or relaxation, attentional control, and mindfulness, continues to be fundamental for enhancing athletic performance and supporting mental health in sports. Over the last ten years, the delivery of PST has progressively shifted from traditional, in-person sessions to digital formats via smartphone applications. This transition offers "always-on," cost-effective access that can be seamlessly integrated into an athlete's daily training regimen. This move towards digital PST is part of a larger global transformation driven by mobile technology. By the end of 2024, mobile internet was used by 58% of the global population, approximately 4.7 billion people. The mobile ecosystem itself accounted for 5.8% of the world's GDP, equivalent to about $6.5 trillion, underscoring that mobile has become a primary channel for communication, health, and learning worldwide (GSMA, 2025).

The app economy has evolved into a sophisticated framework for behavior modification initiatives. According to Sensor Tower's 2025 State of Mobile report, global consumers accumulated 4.2 trillion hours in mobile applications last year, averaging approximately 3.5 hours daily per user, while in-app expenditure reached $150 billion worldwide. This massive scale establishes mobile applications as a practical delivery mechanism for psychological skills training across all competitive tiers of sport. Even in markets where time-spent metrics have stabilized, application engagement continues to dominate daily routines and behavioral patterns, maintaining its position as a primary intervention channel (Sensor Tower, 2025).

The digital health landscape has experienced remarkable expansion, with IQVIA estimating approximately 337,000 digital health applications currently available across major app stores-part of over one million created since 2008. This growth includes an increasing number of regulated digital therapeutics now being integrated into conventional healthcare pathways. While the majority of these applications target clinical populations, this rapid pace of innovation has naturally extended into the sports domain, where a growing subset of apps focusing on mindfulness, stress-recovery, imagery, and attention training are being actively marketed to athletic populations (IQVIA Institute for Human Data Science, 2021, 2022).

Contemporary youth and young adults—who constitute a substantial proportion of developmental and collegiate athlete populations—represent a "mobile-first" demographic, making smartphone delivery of psychological skills training (PST) not merely convenient but developmentally and culturally appropriate. In the United States, smartphone ownership reaches 91% of adults, with near-saturation among 18-29 year-olds. Globally, 79% of individuals aged 15-24 use the internet, with some regions approaching universal youth connectivity. In emerging sports markets like India, recent statistics indicate 85.5% of households now possess at least one smartphone, while near-universal adoption of mobile payments among youth signals profound digital literacy. These technological adoption patterns underscore why mobile PST platforms align seamlessly with the habits and expectations of rising athletic generations (Pew Research Center, 2024; ITU, 2024).

Sport systems are also normalizing digital mental-health supports at mega-events. Around Paris 2024, the International Olympic Committee (IOC) introduced Mind Zones in the Village, multilingual helplines, Calm app licenses, and AI-enabled protection from online abuse, interventions that blend onsite services with app-based care and signal institutional acceptance of mobile tools in high-performance environments. These system-level moves strengthen the case for integrating validated mobile PST into team mental-performance programs before, during, and after competition (International Olympic Committee, 2024, The Guardian, 2024).

At the same time, quality, adherence, and governance issues remain. Independent audits show many mental-health or skills apps score only low-to-moderate on engagement and information quality; cross-sector evidence warns that digital interventions can suffer high attrition without scaffolds (brief modules, reminders, coach integration). These realities argue for evidence-based selection, co-design with athletes, and privacy-forward implementation when teams adopt mobile PST (Senson Tower, 2025).

Against this backdrop, the present thematic review evaluates the current state of mobile apps for PST in sport, synthesizing evidence across four domains—effectiveness, usability/adherence, access/equity, and ethics/governance—and offering a practical framework for integrating apps into training environments. Our aim is to help researchers and practitioners separate promise from hype, accelerate sport-specific validation, and translate mobile tools into measurable gains in athlete well-being and performance.

Methodology

This study was conducted as a systematic review aligned with PRISMA guidelines, investigating mobile psychological skills training (PST) applications for competitive athletes. The methodology featured a comprehensive, multi-database search strategy from 2010 to 2025, dual independent screening, and standardized data extraction. Due to significant heterogeneity in the included studies, the findings were synthesized thematically rather than through meta-analysis, focusing on the key domains of effectiveness, usability and adherence, accessibility and equity, and ethics and data governance.

Research Design

The present study constitutes a PRISMA-aligned thematic review that employed a structured search across multiple databases, dual independent screening, standardized data extraction, and rigorous risk-of-bias appraisal using established tools. Due to significant heterogeneity in primary study designs, interventions, and outcome measures, the findings were synthesized into key themes effectiveness, usability and adherence, accessibility and equity, and ethics and data governance, while also summarizing fundamental study characteristics to provide a comprehensive state-of-the-evidence summary on mobile psychological skills training apps for athletes.

Information Sources & Search Strategy

This systematic review identified relevant literature through a comprehensive search of five electronic databases (PubMed/PMC, Scopus, Web of Science, PsycINFO, Google Scholar) for publications from 2010 to January 2025. The search strategy used structured Boolean queries with terms for sport psychology, digital interventions, athletes, and core PST components. This was supplemented by targeted searches for MARS-based app-quality audits and citation tracking. Combined with dual screening and thematic synthesis, this multi-faceted approach ensured the capture of a broad evidence base, from efficacy trials to usability studies.

Eligibility Criteria

To maintain a precise scope, the review employed strict eligibility criteria. The population was confined to competitive athletes, and interventions were limited to mobile applications delivering core psychological skills training, such as mindfulness or goal-setting.A broad range of outcomes was considered, including mental skill development, performance measures, and usability data. The review synthesized evidence from various study designs, from randomized trials to qualitative inquiries, but excluded research on non-athlete populations, general wellness apps, and non-mobile platforms to ensure the findings directly addressed the state of mobile PST in athletics

Study Selection & Data Extraction

The study selection process was conducted through independent dual review, with two reviewers systematically screening titles, abstracts, and full-text articles, resolving any disagreements by consensus to ensure rigorous and unbiased inclusion. Data extraction was then performed using standardized fields, capturing key information such as sample characteristics (size, sport, competitive level), application details (name and specific features), the primary psychological skills training (PST) target, study design elements (dosage, follow-up period), primary outcomes and effects, adherence metrics, risk of bias assessment, and, where applicable, the Mobile App Rating Scale (MARS) score to evaluate app quality.

Synthesis Plan

Due to substantial heterogeneity in both the mobile applications and outcome measures assessed across the included studies, a quantitative synthesis such as meta-analysis was not feasible. Consequently, the findings were integrated through a structured thematic synthesis, organized around four primary domains: effectiveness; usability and adherence; accessibility and equity; and ethics and governance. This narrative approach was supported by detailed evidence tables. Within the synthesis, we report the direction and magnitude of effects where available, alongside quantitative adherence rates and quality indicators such as MARS scores to provide a comprehensive qualitative summary of the evidence.

Results

The study selection process adhered to a rigorous systematic approach. From an initial pool of 449 identified records, 73 duplicates were removed. A two-stage screening process was then implemented: 376 records were screened by title and abstract, followed by a full-text assessment of 64 articles. Studies were excluded with documented justification based on pre-defined eligibility criteria, such as non-athlete samples, non-mobile interventions. This process culminated in the final inclusion of 23 studies, which represented a spectrum of methodological approaches, including quantitative trials (RCTs, quasi-experimental), qualitative investigations, and app-quality audits ensuring a comprehensive evaluation of mobile PST interventions across dimensions of efficacy, user experience, and technical quality.

Table 1. Recent empirical studies and audits on athlete-facing mobile PST

Study	Design & Sample	App / PST Component	Key Outcomes
Gao et al., 2024, JMIR	RCT; college athletes	Smartphone, therapist-supported mindfulness	Anxiety, FFMQ mindfulness
Ng et al., 2024/2025, JASP	Controlled trial; junior national squash	App-based imagery	SIQ imagery; technical skill metrics
González-Barato et al., 2021, Frontiers (PSIXPORT)	Development/validation; injured athletes	EMA rehab app (monitoring)	Emotions, appraisals, pain
Bonetti et al., 2024/2025, MARS audit	Systematic app-quality audit	19 PST apps (sport)	MARS (engagement, function, aesthetics, info)
Geiger et al., 2024, PMC	Survey; elite athletes	Acceptance of e-mental health	Drivers/barriers
Collins, 2025, Hogrefe	Narrative review; elite	App use impacts	Experience-level outcomes

Table 1 synthesizes key findings from recent mobile PST studies, demonstrating that therapist-supported mindfulness apps effectively reduce anxiety, app-based imagery improves technical performance, systematic audits reveal significant quality limitations in available apps, and elite athletes express privacy and relevance concerns about digital mental health tools.

A mental training program helped athletes feel less anxious and more focused. It also improved their mental rehearsal and their actual sports skills. It's a practical tool for injury rehab. However, the existing research on this isn't very high quality. Also, athletes themselves are sometimes skeptical due to privacy

worries. Most importantly, we must be careful because this kind of mental training can sometimes backfire and have negative effects.

Theme 1 Effectiveness

- **Mindfulness apps**: The JMIR RCT in college athletes demonstrated anxiety reduction and mindfulness gains after mobile-delivered training (therapist-led), supporting app-mediated PST in competitive samples (Gao et al, 2024). Broader mobile-mindfulness evidence also supports depression/anxiety mitigation in non-athlete contexts, implying transferability with adaptation.
- **Imagery apps**: App-based imagery improved imagery quality and technical skills (junior national squash), suggesting digital platforms can train sport-specific cognitive skills when scaffolding is adequate (Ki, E. J., et al, 2024).
- **Self-talk / cognitive interventions**: Evidence for self-talk via apps is emerging; existing self-talk research supports performance and motivation in sport, implying apps could scale delivery, though athlete-specific app RCTs remain sparse.
- **Multi-skill e-programs**: Recent e-interventions for youth elites report feasibility and perceived benefits, but require controlled designs for firm inference.

Theme 2 Usability & Adherence

- App-quality audits indicate low to moderate MARS scores (≈2.78/5), especially on engagement and information quality, which likely depress adherence.
- In digital mental-health RCTs more broadly, online interventions have higher attrition (≈32% vs ≈15% face-to-face), highlighting the need to design for retention (short modules, prompts, coach integration).

Theme 3 Accessibility & Equity

- Apps expand access across geography and budget. Yet language/culture fit lags behind (Western bias), and offline functionality is often limited, constraining use at competitions/travel. EMA tools (e.g., PSIXPORT) show feasibility for injury rehab, indicating potential for context-specific tailoring in other phases (e.g., taper, post-competition).

Theme 4 Ethics, Privacy & Governance

- Reviews note vague privacy policies in many mental-health apps; sport-specific audits similarly flag information-quality gaps and scarce peer-reviewed validation.
- A 2025 review raises concerns about negative experiential impacts (e.g., dependency, distraction), reinforcing the need for professionally supervised integration and clear consent/data protections for elite athletes.

Discussion on findings

Current evidence for digital psychological skills training in athletes varies by technique. Mindfulness-based applications currently demonstrate the most robust empirical support, with studies indicating their efficacy in reducing anxiety and enhancing performance in competitive contexts. Digital imagery training also shows promise, particularly when delivered with structured guidance. In contrast, while the underlying principles of self-talk and goal-setting are well-established in sport psychology, a significant gap exists in the form of rigorously evaluated, app-based interventions for these skills, presenting a clear direction for future research.

Why Adherence Falters

Engagement design is the main bottleneck: many app modules run too long, offer weak feedback loops, and provide shallow personalization—patterns that align with suboptimal MARS engagement scores reported in app-quality audits (ScienceDirect). Consistent with broader digital mental-health evidence, attrition rises when use isn't scaffolded; without coach prompts, team rituals, or progress dashboards, drop-off is the norm (PMC). Finally, digital hygiene matters: using social media on a smartphone immediately before training can elevate mental fatigue and blunt acute exercise performance in youth athletes, suggesting PST app routines should deliberately avoid pre-session cognitive-overload windows (PMC).

Practical Integration Framework

A five-step framework is proposed to guide the effective implementation of mobile psychological skills training (PST) for athletes. The process begins with screening tools for empirical support and quality, using benchmarks like the Mobile App Rating Scale (MARS). The subsequent step involves matching the specific PST tool—such as mindfulness for anxiety or imagery for skill acquisition—to the athlete's identified need. Implementation should then be supported through behavioral design principles, integrating short, structured sessions into existing routines. The fourth step mandates robust ethical and data governance, emphasizing informed consent and data minimization. Finally, organizations should evaluate the tool's effectiveness within their own context by tracking adherence and outcomes, thereby contributing to the broader evidence base.

Research Priorities

Future work should prioritize head-to-head trials that compare app-based PST directly with face-to-face delivery and with blended models to determine when each approach is superior. Researchers should also probe mechanisms of change by linking in-app behaviors such as dose, feature use, and engagement patterns to shifts in attentional control, heart-rate variability (HRV), sleep, and performance markers. To boost ecological validity, teams need sport-specific modules, refining imagery scripts, self-talk libraries, and competition-phase routines by sport and even by position. Rigorous monitoring of harm and equity is essential: routinely capture adverse effects, digital fatigue, and access barriers across genders, ages, and resource settings. Finally, apply implementation science to real programs, measuring fidelity, costs, and coach/staff workload, so that effective digital tools can be adopted and scaled sustainably.

Limitations

App modalities, participant samples, and outcome measures are highly heterogeneous in this literature, so we prioritized a thematic synthesis rather than pooled effect sizes. Much of the evidence remains early-stage (e.g., pilots and app-quality audits), limiting the strength of causal inferences. Moreover, many commercially popular apps lack peer-reviewed data, so any extrapolation to broader athlete populations should be treated with caution.

Conclusions

Based on a synthesis of current evidence, mobile applications for psychological skills training serve as valuable supplements to, rather than substitutes for, conventional sport psychology support. The most substantiated benefits for athletes are associated with mindfulness-based apps, which demonstrate small-

to-moderate effects on reducing competitive anxiety and enhancing attentional control. Evidence for digital imagery training is also accumulating, showing improvements in mental rehearsal quality. In contrast, the empirical foundation for app-delivered self-talk and goal-setting remains underdeveloped.

The effectiveness of these digital tools is consistently moderated by several factors: user engagement typically declines after initial adoption, the quality and sport-specificity of applications vary significantly, and concerns regarding data privacy and transparent evaluation persist. Rather than precluding their use, these challenges highlight critical areas for improvement in design and implementation.

For practitioners, a structured implementation framework is recommended. This involves screening apps for evidence-based content, selecting tools that align with specific athletic needs, scaffolding use through integration into existing routines, securing athlete data with robust governance, and systematically studying outcomes. Program development should prioritize co-design with athletes and coaches and employ standardized metrics to evaluate efficacy, adherence, and potential adverse effects.

Future research should prioritize sport-specific randomized trials, comparative studies of delivery formats, investigations into the mechanisms of change, and the development of strong data governance protocols. Addressing these priorities will be essential for transforming mobile mental training from a novel accessory into a reliable, ethical, and scalable component of athletic development.

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