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Quality in Sport. 2026;52:69361. eISSN 2450-3118.

<https://doi.org/10.12775/QS.2026.52.69361>



Quality in Sport. eISSN 2450-3118

Journal Home Page

<https://apcz.umk.pl/QS/index>

PYZIK, Alicja, POLAKOWSKA, Anna, DZIEGCIARCZYK, Anna, SOBCZAK, Wiktoria Laura, BORKOWSKA, Karolina, PIELUSIŃSKI, Kamil Tomasz, SWOBODA, Kamil and OLEJNIK, Michał. Restoring the Athlete: The Role of Sleep in Athletic Performance and Recovery. Quality in Sport. 2026;52:69361. eISSN 2450-3118. <https://doi.org/10.12775/QS.2026.52.69361>

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).

Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). © The Authors 2026.

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The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 27.02.2026. Revised: 05.03.2026. Accepted: 05.05.2026. Published: 06.03.2026.

Restoring the Athlete: The Role of Sleep in Athletic Performance and Recovery

Alicja Pyzik, ORCID <https://orcid.org/0009-0001-5260-4178>

alicjapyzik19@gmail.com

Medical University of Warsaw, Warsaw, Poland

Anna Polakowska, ORCID <https://orcid.org/0009-0009-6710-1184>

anna.polakowska@gmail.com

Medical University of Warsaw, Warsaw, Poland

Anna Dziegciarczyk, ORCID <https://orcid.org/0009-0008-5233-4826>
dziegciarczyk.ania@gmail.com

Medical University of Warsaw, Warsaw, Poland

Wiktoria Laura Sobczak, ORCID <https://orcid.org/0009-0004-6765-7012>
w.sobczak1234@gmail.com

Medical University of Warsaw, Warsaw, Poland

Karolina Borkowska, ORCID <https://orcid.org/0009-0008-0886-8273>
karolina.borkowska13@gmail.com

Medical University of Warsaw, Warsaw, Poland

Kamil Tomasz Pielusiński, ORCID <https://orcid.org/0009-0006-6721-5454>
kamilpielusinski@gmail.com

Medical University of Warsaw, Warsaw, Poland

Kamil Swoboda, ORCID <https://orcid.org/0009-0000-8093-9699>
kamil.swoboda@gmail.com

Medical University of Warsaw, Warsaw, Poland

Michał Olejnik, ORCID <https://orcid.org/0009-0007-7664-600X>
molej2001@gmail.com

Medical University of Warsaw, Warsaw, Poland

Abstract

Background: Sleep is a fundamental biological process influencing recovery, performance, and psychological well-being in athletes. Despite growing recognition of its importance, sleep duration and quality often remain suboptimal across professional and amateur sporting populations.

Aim: This narrative review synthesizes current evidence on the role of sleep in athletic recovery and performance, methods of assessment, and strategies to optimize sleep in competitive settings.

Material and methods: Literature was identified through PubMed, Scopus, and Web of Science searches (2015–2025) and evaluated following SANRA criteria.

Results: Evidence supports that both objective (polysomnography, actigraphy) and subjective (questionnaires, diaries) assessments can identify sleep disturbances and guide interventions such as sleep hygiene education, sleep extension, strategic napping, mindfulness, and management of travel fatigue and caffeine intake.

Conclusions: Although improvements in sleep duration and efficiency translate into measurable cognitive and physical benefits, inter-individual variability, gender differences, and methodological limitations persist. Future work should standardize sleep assessment, expand inclusion of female and youth athletes, and integrate sleep management into individualized recovery programs.

Key Words: Sleep quality; Athletes; Recovery; Polysomnography; Athletic Performance; Training; Sleep hygiene; Mindfulness

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1. Introduction

Sleep is a critical determinant of physiological and psychological recovery in athletes. It regulates multiple systems including neuromuscular repair, metabolic homeostasis, immune function, and cognitive processing (1,2). Insufficient or poor-quality sleep has been linked to increased fatigue, impaired accuracy, delayed reaction time, reduced endurance, and higher injury risk (3,4). Despite this, research consistently shows that both elite and amateur athletes frequently fail to achieve the recommended 7–9 hours of sleep per night, with elite athletes often reporting fragmented or delayed sleep (5,6).

The complexity of athletic training—encompassing physical load, competition schedules, psychological stress, and travel—exacerbates sleep disruption (7). Sleep inadequacies are influenced by sport type, gender, training time, and environmental factors such as light exposure or room temperature (8). The influence of exercise timing on sleep quality is an aspect that cannot be overlooked. (9) Furthermore, cultural and behavioral contributors, including technology use and academic obligations, may worsen sleep patterns in collegiate and amateur populations (10).

Recognizing sleep as both a biomarker and a modifiable component of recovery, recent consensus statements emphasize the need for individualized assessment and intervention (1). This review summarizes current methods for evaluating sleep in athletes and critically appraises evidence-based strategies to enhance sleep health, emphasizing their impact on performance and recovery.

2. Methods

2.1 Search Strategy and Scope

This review followed SANRA (Scale for the Assessment of Narrative Review Articles) guidelines to ensure a transparent, reproducible narrative synthesis. An electronic search of PubMed, Scopus, and Web of Science was performed to identify English-language papers published between January 2015 and December 2025. Search strings combined key terms related to sleep and athletic recovery (sleep, athletes, performance, recovery) with intervention and measurement terms (napping, actigraphy, mindfulness, hygiene) and were adapted for each database using Boolean operators and truncation where appropriate. To reduce the risk of missing relevant work, reference lists of all included full-text papers were hand-searched, and forward citation screening was undertaken when available. Records were exported, duplicates removed, and titles/abstracts were screened prior to full-text evaluation.

2.2 Inclusion and Evaluation

Eligible studies comprised original research, consensus statements, and systematic reviews that examined sleep characteristics, sleep monitoring, or sleep-related interventions in athletes or physically active adults. Both experimental (randomized and non-randomized) and observational (cross-sectional, cohort, and case-series) designs were considered to capture real-world practice as well as controlled efficacy data. Studies were required to report outcomes directly relevant to sleep (e.g., duration, efficiency, latency, fragmentation, subjective quality) and/or sport-related performance or recovery markers. Exclusion criteria included non-human studies, papers without extractable sleep-related outcomes, and publications where the population or intervention could not be clearly attributed to athletic or physically active cohorts.

2.3 Quality Assessment

Methodological quality and strength of evidence were appraised using the Oxford Centre for Evidence-Based Medicine (OCEBM) 2011 levels alongside SANRA-focused checks of clarity, justification, and transparency. In keeping with a narrative review approach, studies were not pooled quantitatively; instead, findings were weighted by design rigor, consistency across studies, and plausibility of mechanisms. This approach was selected because interventions, populations, and outcome measures were heterogeneous (e.g., different sports, training phases, and sleep metrics), limiting the interpretability of a single pooled effect size.

2.4 Data Presentation

Evidence was organized into three overarching domains to mirror applied decision-making in sport:

- (1) sleep measurement and monitoring methods (objective and subjective tools, feasibility, and validity),
- (2) habitual sleep behaviors among athletes (quantity, quality, timing, and contextual disruptors), and
- (3) interventions for sleep optimization (behavioral, scheduling, psychological, nutritional, and travel-related strategies).

Within each domain, key outcomes and practical implications for screening, monitoring, and intervention delivery were summarized to support translation into sport settings.

Figure 1.

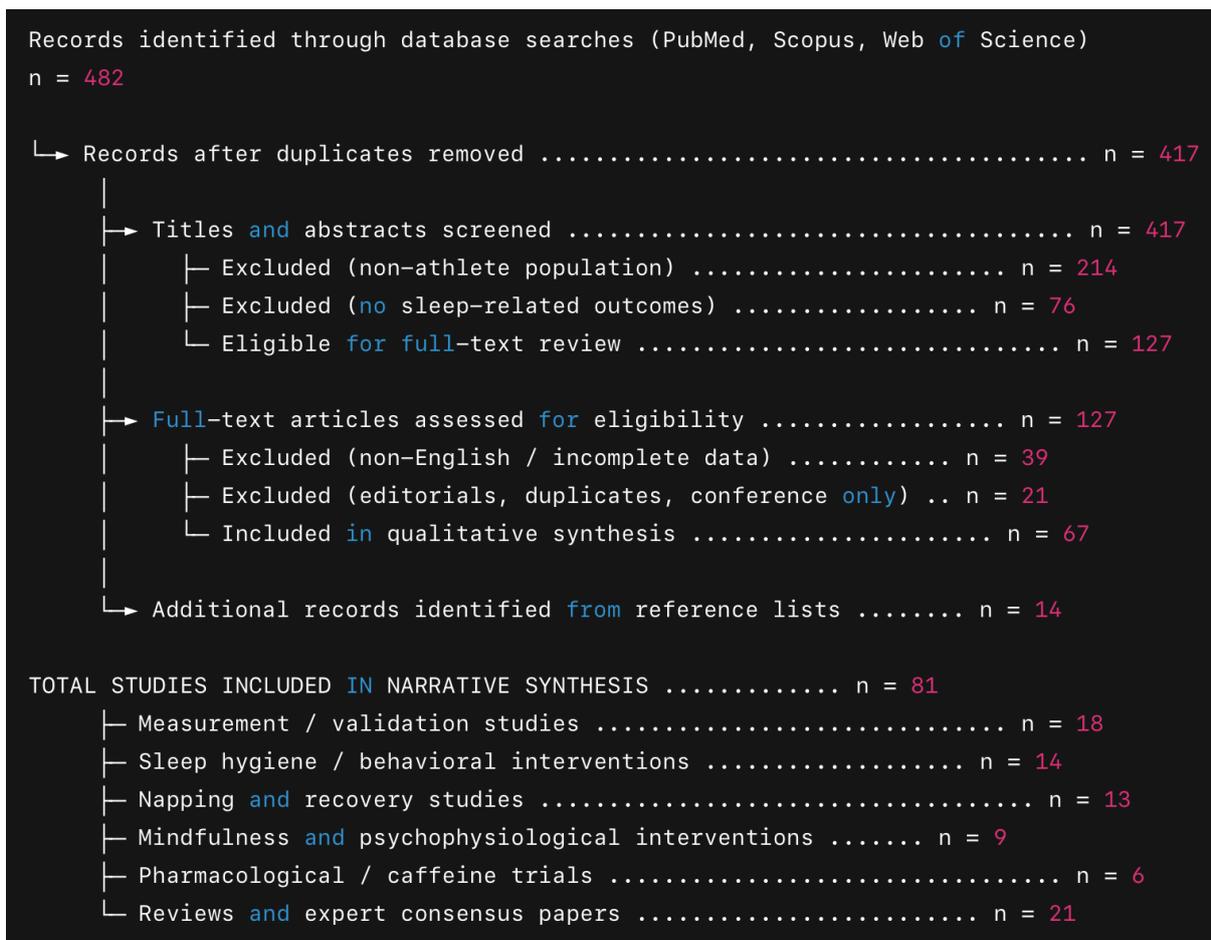


Figure 1. Literature selection process (PRISMA-style schematic)

The figure is intended to summarize database yields, duplicate removal, screening decisions, and final study inclusion in a PRISMA-inspired flow format, adapted for a narrative review.

3. Results and Evidence Synthesis

3.1 Objective and Subjective Sleep Measurement

Polysomnography (PSG) remains the gold standard for characterizing sleep architecture, including staging of non-REM and REM sleep, arousals, and sleep continuity. Despite its diagnostic precision, PSG is rarely feasible in elite sport environments because it is resource intensive, often requires laboratory conditions, and may interfere with routine training and travel schedules (1). Accordingly, actigraphy has become the most commonly used objective field method in sports science, enabling multi-night monitoring of sleep-wake patterns,

circadian timing, and responses to training or competition cycles (11). Across validation work, actigraphy shows acceptable agreement with PSG for estimating total sleep time and sleep efficiency at the group level, although it can misclassify quiet wake as sleep and is less informative about sleep stages (11,12). These strengths and limitations highlight why actigraphy is best used for longitudinal trend monitoring rather than detailed sleep physiology.

Questionnaire-based tools provide practical screening and context that objective sensors cannot capture, particularly for identifying behaviors, environments, and symptoms that contribute to sleep disruption. Common instruments in athletic settings include the Pittsburgh Sleep Quality Index (PSQI) for global sleep quality, the Athlete Sleep Screening Questionnaire (ASSQ) for sleep difficulty screening, and the Athlete Sleep Behaviour Questionnaire (ASBQ) for athlete-specific behaviors such as late-night training, technology use, and travel routines (12). The Japanese adaptation of the ASBQ (ASBQ-J) demonstrated adequate test–retest reliability and construct validity in female collegiate athletes, supporting cross-cultural application when language-appropriate tools are required (14). In practice, combining actigraphy with structured self-report (questionnaires and sleep diaries) offers a more complete picture: objective data quantify patterns over time, while subjective instruments identify modifiable drivers (e.g., schedule, stress, pain, caffeine) and support individualized intervention planning.

3.2 Sleep Quantity and Quality Among Athletes

Across multiple sports, elite athletes frequently report habitual sleep durations below 7 hours and sleep efficiency under 85%, with the most pronounced deficits occurring during intensified training blocks, competition phases, and periods of high travel demand (1,3,5). Beyond reduced duration, athletes often describe longer sleep onset latency, greater nocturnal awakenings, and poorer perceived restfulness compared with non-athletic controls, suggesting that sleep quality is an additional and independent concern. A mixed-method study by De Blasiis et al. highlighted common contextual disruptors including ambient temperature, noise, unfamiliar sleeping environments, and psychosocial load such as academic or occupational demands (8). Sex-specific patterns have also been observed: female athletes may display greater night-to-night variability in sleep latency and efficiency than males, potentially reflecting hormonal influences, injury/pain profiles, and differences in external stressors (16). Collectively, these findings support routine monitoring that accounts for both physiological demands and the lived realities of athletes' schedules.

Chronotype and habitual training time interact with sleep timing, particularly when training sessions occur late in the evening or early in the morning. Late-evening sessions may delay sleep onset through elevated arousal and delayed circadian wind-down; however, when late training is consistent and athletes are adapted, total sleep time may be preserved through later wake times (15). By contrast, early-morning sessions and travel-related early starts more commonly truncate sleep because bedtime does not shift earlier to the same extent, resulting in chronic sleep restriction across a week. These dynamics imply that the same training stimulus can have different sleep consequences depending on individual chronotype, schedule regularity, and the buffer time available between training completion and bedtime.

3.3 Sleep Optimization Interventions

a) Sleep Hygiene Education

Sleep hygiene education targets modifiable behaviors and environmental conditions that support sleep initiation and maintenance, such as consistent bed and wake times, reducing evening light and technology exposure, optimizing bedroom temperature and noise, and managing stimulant use. Importantly, education appears most effective when individualized to the athlete's baseline issues and delivered in a format that fits high-performance schedules. Recent work using individualized, media-based messaging in professional female footballers demonstrated significant improvements in objective sleep efficiency and reduced sleep latency following a brief intervention period, with additional improvements in athlete-reported sleep behaviors emerging at follow-up (16). This approach is appealing because it is low-cost, scalable, and can be delivered without extensive staff time, making it practical for team environments.

b) Sleep Extension

Sleep extension aims to increase total sleep time by expanding time in bed, either acutely (e.g., a single night) or over several days as a form of sleep banking. Evidence in rugby players indicates that extending sleep to approximately 10 hours after an evening training session can increase total sleep time and may accelerate recovery of certain domains, particularly cognitive performance in the next-day window (18). However, effects may vary across outcomes: some neuromuscular and autonomic recovery markers may respond similarly to, or even favor, structured active recovery depending on timing and measurement. Overall, sleep extension

remains a biologically plausible strategy, especially when athletes anticipate upcoming sleep loss due to travel, competition schedules, or congested fixtures.

c) Daytime Napping

Daytime napping is a simple, non-pharmacological strategy to supplement nocturnal sleep and manage acute sleepiness, fatigue, and cognitive load during heavy training or travel. Meta-analytic evidence indicates that naps of 30–60 minutes can meaningfully improve cognitive performance (e.g., attention and reaction time), enhance physical performance (e.g., sprinting and power-related tasks), and reduce perceived fatigue, with benefits observed after both normal sleep and partial sleep restriction (19,20). Timing appears important for practicality and physiology; early-afternoon naps align with the post-lunch dip in alertness and are less likely to impair subsequent night sleep compared with later naps. To minimize sleep inertia and ensure transfer to training or competition, athletes should allow a buffer after waking (at least ~30–60 minutes) before demanding performance tasks.

d) Mindfulness and Relaxation

Mindfulness and relaxation-based strategies target pre-sleep cognitive and physiological arousal, which is particularly relevant when athletes train or compete late and attempt to sleep shortly thereafter. In university athletes, a brief 6-minute mindfulness induction delivered immediately before bedtime after night training reduced pre-sleep arousal and improved subjective ratings of rest and overall sleep quality, although sleep duration itself did not change (21). Broader evidence from mindfulness-based intervention trials in sport suggests benefits for mindfulness skills, flow, acceptance-related processes, and performance-relevant psychological components, which may indirectly support sleep through improved stress regulation and attentional control (22). These findings support incorporating brief, feasible practices into evening routines, especially when schedule constraints limit other recovery modalities.

e) Caffeine and Nutritional Factors

Caffeine is commonly used to offset sleep restriction-related decrements in alertness and endurance, but its timing and dosing can create a trade-off between acute performance support and subsequent sleep disruption. Experimental work in sleep-restricted soccer players suggests that acute caffeine supplementation can partially attenuate reductions in aerobic endurance

performance, supporting its role as a countermeasure when sleep loss is unavoidable (23). Nevertheless, late-day caffeine intake may prolong sleep onset latency and reduce sleep quality in sensitive individuals, which can perpetuate a cycle of fatigue and stimulant reliance. Caffeine has been linked to delayed secretion of melatonin, which can be responsible for the aforementioned sleep difficulties. (24) Nutritional factors such as evening meal composition, hydration status, and timing of supplementation may also influence sleep, yet controlled sport-specific trials remain limited; these areas represent priorities for future applied research.

f) Travel Fatigue and Jet Lag

Long-haul, transmeridian travel is a common feature of elite sport and can produce circadian misalignment, sleep disruption, gastrointestinal symptoms, and daytime fatigue that collectively impair readiness. Available evidence supports multimodal countermeasures including planned light exposure or avoidance, progressive sleep scheduling before travel, and judicious use of melatonin (typically 0.5–5 mg taken near local destination bedtime) to facilitate circadian adjustment (25,26,27). Because response depends on direction of travel, number of time zones crossed, and individual chronotype, protocols should be individualized and integrated with team logistics. Tryptophan stimulates serotonin and melatonin production among other benefits, and can be used for performance enhancement. (28) These strategies are particularly relevant for athletes facing dense international calendars, where repeated travel can accumulate sleep debt and compromise recovery.

Table 1.

Table 1. Summary of selected studies investigating sleep measurement and interventions in athletes (2018–2025)

No.	Author (Year)	Population / Sport	Design / Method	Sleep Assessment Tool	Intervention / Focus	Main Findings
1	Walsh NP et al. (2021) (1)	Elite athletes multi-sport	Narrative review & expert consensus	PSG, Actigraphy, ASBQ	Expert consensus on athlete sleep	Defined athlete-specific risks, provided individualized toolbox for practitioners.
2	De Blasiis K et al. (2021) (8)	15 elite athletes, France (INSEP)	Mixed-methods (actigraphy + interviews)	Actigraphy, Sleep diaries	Sleep-wake behaviour analysis	Sleep efficiency impaired by environment & study load; individualized feedback recommended.
3	Gooderick J et al. (2025) (15)	16 female professional footballers	Repeated-measures time-series	Actigraphy + ASBQ	Individualised media-based hygiene education	Sleep efficiency ↑ (p<0.001), latency ↓ (p<0.001); demonstrates

No.	Author (Year)	Population / Sport	Design / Method	Sleep Assessment Tool	Intervention / Focus	Main Findings
						effective mid-season improvement.
4	Leduc C et al. (2022) (17)	10 male rugby players	Randomised crossover trial	Actigraphy	Sleep extension vs active recovery	10 h sleep improved cognitive recovery ↑; no benefit to neuromuscular function next-day.
5	Mesas AE et al. (2023) (18)	291 male athletes (18–35 y)	Systematic review & meta-analysis	Various objective & subjective	Daytime napping (30–60 min)	Moderate-to-high improvements in physical (SMD = 0.99) and cognitive (SMD = 0.69) performance.
6	Li C et al. (2018) (20)	63 university athletes (HK)	Randomised controlled trial	Sleep diaries, questionnaires	6-min mindfulness induction before sleep	Reduced pre-sleep arousal ↓ (p<0.01) and improved subjective sleep quality ↑.
7	Wang Y et al. (2023) (21)	32 RCTs (all sports)	Systematic review & meta-analysis	Mixed tools	Mindfulness-based interventions	Improved mindfulness (SMD = 0.50) & flow (SMD = 0.81); limited effect on overall mental health.
8	Cheng R et al. (2025) (22)	10 college soccer players	Randomised crossover trial	Performance & fatigue indices	Caffeine 3 mg/kg under sleep restriction	Restored aerobic performance ↑ (VO ₂ max, p<0.05) but no anaerobic gain; caution for later sleep.
9	Janse van Rensburg DC et al. (2020) (23)	Various elite teams / travelling athletes	Systematic review	Mixed methods	Jet-lag management (light, melatonin, sleep)	Combined light exposure + melatonin 0.5–5 mg most effective; limited athlete-specific RCTs.
10	Herxheimer A & Petrie KJ (2002) (24)	Airline travellers (healthy adults)	Cochrane systematic review (10 trials)	Subjective rating scales	Melatonin for jet-lag	8/10 trials positive; NNT = 2; 5 mg most effective at destination bedtime.
11	Schyvens A et al. (2025) (10)	62 healthy adults (46 ± 12 y)	Laboratory validation	PSG vs wearables	6 Wearable sleep tracking devices	Fitbit Sense κ = 0.42, Apple Watch κ = 0.53; sufficient for long-term trend tracking.
12	Martin T et al. (2018) (16)	636 ultramarathon runners	Cross-sectional survey	Questionnaires	Sleep habits and race strategies	74% used sleep extension pre-race; napping common; sleep correlated with race time (r = 0.48).

Abbreviations: PSG = polysomnography; ASBQ = Athlete Sleep Behaviour Questionnaire; RCT = randomized controlled trial; SMD = standardized mean difference; NNT = number needed to treat; ↑ = increase; ↓ = decrease.

This table is intended to summarize study design, population, sport, sleep assessment methods, intervention characteristics, and key outcomes to allow rapid comparison across evidence clusters.

4. Discussion

The evidence demonstrates that sleep quality and duration are integral components of athletic performance and recovery, functioning as a biological substrate for adaptation to training stress. Adequate sleep supports muscle repair and protein synthesis, cognitive focus and skill consolidation, immune regulation, and endocrine balance, all of which contribute to training consistency and competition readiness. Conversely, even short periods of sleep restriction can impair neuromuscular output, slow reaction time, and degrade decision-making under fatigue, increasing the likelihood of suboptimal performance and potentially elevating injury risk (1,2,5). These effects are especially relevant in sports that require repeated high-intensity efforts and rapid perceptual-cognitive processing.

Objective and subjective approaches offer complementary insights that are most useful when combined. Actigraphy and other wearable-derived measures provide longitudinal pattern data across training weeks, travel periods, and competition phases, helping practitioners identify chronic sleep restriction, irregular timing, or increased fragmentation. Validated questionnaires and diaries, in contrast, capture context and perceived sleep quality, as well as athlete-specific behaviors (e.g., late-night technology use, pain, stress, and rumination) that may not be evident in sensor outputs. Integrating these streams enables individualized assessment, shared decision-making with athletes, and targeted selection of interventions rather than one-size-fits-all advice.

Interventions such as sleep hygiene education, structured napping, mindfulness-based techniques, and sleep extension show consistent benefits across athletic levels, largely because they are feasible, low risk, and address common mechanisms (sleep opportunity, arousal, and recovery time). However, the evidence base remains heterogeneous, with many studies limited by small samples, short intervention windows, and male-dominant cohorts, alongside variability in both sleep metrics and performance outcomes. Technological advances in consumer wearables and smartphone applications may facilitate continuous monitoring and behavior change support at scale, but measurement properties and algorithms vary widely, and many devices still require validation against PSG and well-characterized actigraphy protocols (11,12). Future work should also prioritize consistency in reporting (e.g., time-in-bed, sleep efficiency definitions, and compliance) to improve comparability.

A critical gap persists in understanding sex-based differences, developmental considerations, and long-term adherence to behavioral interventions. Female athletes face unique physiological

and contextual challenges, including menstrual-cycle related symptom fluctuations, different injury profiles, and persistent underrepresentation in sleep and sport science research (16,18). Adolescent, collegiate, and student-athlete populations often operate under dual academic and athletic demands, which can normalize chronic sleep restriction and irregular schedules that undermine recovery (10). Accordingly, interventions may need to be embedded within broader support systems, including education for coaches and staff, schedule optimization, and individualized load management.

Travel fatigue and circadian disruption are major yet manageable stressors in international sport, with risks amplified by dense fixture calendars and repeated time-zone crossings. Implementing light-based strategies, structured sleep scheduling, and carefully timed pharmacological support, particularly melatonin taken close to destination bedtime, can accelerate circadian alignment and reduce jet lag symptoms (25,26,27). To be effective, travel protocols should be planned in advance, individualized where possible, and coordinated with training load, meal timing, and recovery priorities at the destination. Even modest improvements in sleep timing and quality during travel periods may translate into meaningful gains in readiness and perceived wellness.

Table 2.

Table 2. Comparative efficacy and evidence level of sleep interventions in athletic populations

Intervention Type	Representative Studies	Population / Context	Primary Outcomes	Effect Direction	Evidence Level (CEBM 2011)	Implementation / Practical Notes
Sleep hygiene education	Gooderick et al. 2025 (16); Driller et al. 2018 (13)	Professional footballers, rugby, cricket	↑ Sleep efficiency (+5–10%), ↓ latency, improved ASBQ scores	Positive (large effect sizes)	2 (Individual RCT / time-series)	Cost-effective; scalable via media; requires individualization and coach support.
Sleep extension	Leduc et al. 2022 (18); Mah et al. 2011 (4)	Rugby, basketball, swimmers	↑ Cognitive performance and mood; minor effect on physical recovery	Positive (moderate)	2	Feasible during training camps; challenging in competition phases.
Daytime napping	Mesas et al. 2023 (19); Lastella et al. 2021 (12); Leong et al. 2022 (20)	Multi-sport athletes 18–35 y	↑ Reaction time and vigilance and memory retention	Positive (small → moderate)	1 (Meta-analysis)	20–60 min nap between 13:00–16:00; ≥ 30 min wake-buffer to avoid sleep inertia.

Intervention Type	Representative Studies	Population / Context	Primary Outcomes	Effect Direction	Evidence Level (CEBM 2011)	Implementation / Practical Notes
Mindfulness relaxation	/ Li et al. 2018 (21); Wang et al. 2023 (22)	University and elite athletes	↓ Pre-sleep arousal (p < 0.01); ↑ subjective sleep quality; improved flow	Positive (moderate to large)	1–2 (Meta-analysis to RCTs)	Brief (5–10 min) interventions effective; best performed pre-sleep.
Caffeine supplementation	Cheng et al. 2025 (23)	Male soccer players under sleep restriction	Restored aerobic performance (V̇O ₂ max ↑ p < 0.05); potential sleep delay	Mixed (short-term positive / sleep disruptive later)	2	Use ≤ 3 mg·kg ⁻¹ ≥ 6 h before sleep; monitor tolerance.
Jet-lag management (light / melatonin)	Janse van Rensburg et al. 2020 (25); Herxheimer & Petrie 2002 (26); Tokarski et al. 2024 (27)	Travelling elite teams, general travelers	Faster circadian realignment; improved alertness post-flight	↓ Positive (moderate)	1 (Systematic review / Cochrane)	Combine timed light exposure + melatonin 0.5–5 mg at destination bedtime.
Technology-based monitoring	Schuyvens et al. 2025 (11)	Healthy adults / athletes	Consumer wearables valid vs PSG (κ 0.4–0.5)	Neutral (valid tracking only)	3	Suitable for longitudinal self-monitoring but not diagnosis.
Comprehensive sleep programs (multi-component)	Walsh et al. 2021 (1)	Elite multi-sport athletes	Integrative approach across education, environment & screening	Positive (consensus)	4	Serves as framework for sport organizations and medical staff.

Legend: ↑ = improvement; ↓ = reduction; PSG = polysomnography; ASBQ = Athlete Sleep Behaviour Questionnaire; CEBM = Oxford Centre for Evidence-Based Medicine.

This table is intended to classify interventions by evidence strength, feasibility, resource requirements, and typical effect direction on sleep and performance outcomes.

5. Conclusions

Sleep should be recognized as a key performance determinant and a foundational recovery tool in both professional and amateur sports, with relevance comparable to training load management and nutrition. Objective monitoring (e.g., actigraphy) combined with validated questionnaires enables personalized identification of sleep deficits, irregular timing, and modifiable behaviors that contribute to poor recovery. Across the included evidence, sleep hygiene education, sleep extension or banking, controlled daytime napping, and brief mindfulness or relaxation strategies emerge as practical, low-cost interventions with measurable benefits for sleep quality and selected performance-related outcomes. Where

schedules are constrained, these strategies can be tailored and layered to create realistic, sustainable improvements in total sleep obtained across a 24-hour period.

Future research should prioritize standardized sleep and outcome reporting, improved representation of female and youth athletes, and longer-term evaluation of adherence and real-world effectiveness of behavioral strategies. Methodologically, combining objective sleep monitoring with sport-specific performance and recovery markers will help clarify which interventions work best for which contexts (e.g., late training, travel, congestion). From an applied perspective, integrating individualized sleep programs into routine training cycles, rather than delivering them only in response to problems, may enhance recovery, optimize adaptation, and safeguard athlete health across a season. Such integration will likely require collaboration between coaches, medical staff, and athletes to align education, scheduling, and monitoring practices.

Disclosure

Author Contributions

Conceptualization: Alicja Pyzik; Methodology: Alicja Pyzik, Anna Polakowska and Karolina Borkowska; Check: Kamil Swoboda, Kamil Tomasz Pielusiński and Anna Dziegciarczyk; Formal analysis: Alicja Pyzik, Wiktoria Laura Sobczak and Anna Polakowska; Investigation: Alicja Pyzik, Anna Dziegciarczyk, Karolina Borkowska; Writing – rough preparation and plan: Alicja Pyzik; Writing – review and editing: Wiktoria Laura Sobczak, Kamil Tomasz Pielusiński, Anna Polakowska and Kamil Swoboda; Visualisation: Alicja Pyzik, Michał Olejnik; Supervision: Alicja Pyzik.

All authors have read and agreed with the published version of the manuscript.

Funding

This study received no external funding.

Institutional Review Board Statement

Not applicable

Informed Consent Statement

Not applicable

Data Availability Statement

Not applicable, as no new data was synthesised. All analysed sources are included in the reference list.

Conflict of Interest

The authors declare no conflict of interest – there are no financial or personal relationships with people or organisations which could influence the work presented in this review.

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