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Problematic Smartphone Use, Sleep Quality, Recovery and Athletic Performance: A Narrative Review

Mikołaj Makaryczew ORCID <https://orcid.org/0000-0003-4735-8221>

E-mail: makaryczewmikołaj@gmail.com

Medical University of Lublin, 20-093 Lublin, Poland

Zuzanna Kowalczyk ORCID <https://orcid.org/0009-0005-2205-4901>

E-mail: zuzanna.kovv@gmail.com

Medical University of Lublin, 20-093 Lublin, Poland

Kacper Wrzosek ORCID <https://orcid.org/0009-0009-6215-2134>

E-mail: kacperwrzosek2003@gmail.com

Student Research Circle at the Chair and Department of Epidemiology and Clinical Research Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Paulina Gumółka ORCID <https://orcid.org/0009-0007-7571-2917>

E-mail: paulinagumolka@wp.pl

Student Research Circle at the Chair and Department of Epidemiology and Clinical Research Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Kacper Ponikowski ORCID <https://orcid.org/0009-0008-4052-0410>

E-mail: kacperponikowski2410@gmail.com

Student Research Circle at the Chair and Department of Epidemiology and Clinical Research Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Piotr Kowalewski ORCID <https://orcid.org/0009-0002-6687-2226>
E-mail: pkowalewski222@gmail.com
Student Research Circle at the Chair and Department of Epidemiology and Clinical Research
Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Natalia Kowalczyk ORCID <https://orcid.org/0009-0001-9271-4339>
E-mail: natalia.kowalczyk6@icloud.com
Student Research Circle at the Chair and Department of Epidemiology and Clinical Research
Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Agata Bukowska ORCID <https://orcid.org/0009-0009-8792-4284>
E-mail: agata.bukowska0510@wp.pl
Medical University of Warsaw, 02-091 Warsaw, Poland

Kornelia Kuchta ORCID <https://orcid.org/0009-0008-0272-5968>
E-mail: kornelia-kuchta@wp.pl
Student Research Circle at the Chair and Department of Epidemiology and Clinical Research
Methodology, Medical University of Lublin, 20-093 Lublin, Poland

Wiktor Słyś ORCID <https://orcid.org/0009-0001-0865-7790>
E-mail: wiktorslys7@gmail.com
Medical University of Lublin, 20-093 Lublin, Poland

Corresponding author: Mikołaj Makaryczew, E-mail: makaryczewmikolaj@gmail.com

Abstract

Problematic smartphone use (PSU) is becoming increasingly prevalent among young adults and athletes, with one of its principal sequelae being deterioration of sleep. The aim of the present review is to synthesise current evidence concerning the relationships among PSU, sleep quality, recovery processes and athletic performance. Experimental, cross-sectional and longitudinal studies describing physiological mechanisms—including blue-light exposure, suppression of melatonin secretion and cognitive arousal—as well as behavioural mechanisms linked to pre-sleep telephone use were examined. The accumulated data indicate that evening smartphone use prolongs sleep onset latency, shortens total sleep time and reduces sleep efficiency, whereas sleep of diminished quality impairs muscular recovery, hormonal homeostasis and cognitive function and elevates injury risk. Although investigations that directly link the continuum of PSU–sleep–recovery–athletic outcomes remain scarce, the available evidence consistently points to a negative direction of association. Physical activity may act as a protective factor against PSU, yet it does not eliminate risk entirely. Restricting smartphone use for 60–90 min before bedtime constitutes a simple, low-cost intervention that may support sleep, recovery and athletic performance, particularly during periods of intensive training loads.

Keywords: problematic smartphone use; sleep quality; recovery; athletic performance; sleep hygiene; athletes.

1. Introduction

Over the past decade the number of smartphone users and the average daily duration of mobile-device use have risen steadily, rendering the smartphone an integral component of everyday functioning among young adults [1]. Concurrent with the widespread adoption of these devices, the phenomenon of problematic smartphone use (PSU) has emerged; it is defined as a usage pattern that encompasses at least some dysfunctional features, such as anxiety in the absence of device access or neglect of other activities [2]. Intensive yet controlled smartphone use must be distinguished from addiction: high usage intensity alone need not produce adverse consequences provided it is not accompanied by loss of control and compulsive symptoms [3].

Sleep occupies a fundamental role in health, recovery and athletic performance. In athletes it constitutes one of the most important processes responsible for restoration of energetic resources, muscular recovery and maintenance of cognitive efficiency [4,5]. Sleep also influences hormonal regulation and post-exercise repair processes; consequently, its deficiency can diminish training capacity, recovery and competitive outcomes [6].

Athletes may be particularly susceptible to the deleterious effects of evening smartphone use. High training loads, competitive pressure and intensive engagement with social media encourage telephone use in the peri-sleep period, thereby potentially disrupting sleep and recovery [7,8]. At the same time, the number of studies that directly examine the influence of PSU on recovery and athletic performance remains limited; the majority of available work addresses either sleep or smartphone addiction in isolation and seldom integrates these themes within a sporting context [9,10].

The objective of the present review is to summarise current evidence regarding the associations among problematic smartphone use, sleep quality, recovery processes and athletic performance.

2. Problematic smartphone use among athletes and young adults

Problematic smartphone use is frequently characterised as a behavioural pattern akin to other behavioural addictions, in which loss of control over use co-occurs with negative consequences for functioning [2,11].

Severity of PSU is most commonly assessed by means of self-report questionnaires, including the Smartphone Addiction Scale (SAS) and its short form (SAS-SV), which permit quantitative appraisal of symptoms and inter-group comparisons [2,12].

Development and maintenance of PSU are driven by psychological mechanisms such as compulsivity, fear of missing out (FOMO) and reward-related reinforcement involving the dopaminergic system and application designs optimised for maximising engagement [11]. Notifications, personalised content and social media generate frequent, brief episodes of telephone use that readily transition into habitual patterns [7].

Prevalence of PSU is especially high among students and young adults, in whom excessive screen time is associated with poorer sleep quality and greater daytime sleepiness [12,13]. The problem is likewise present in athletic populations; use of social-media applications and evening telephone use are linked in athletes to poorer well-being, reduced recovery and sleep disturbance [7,10,11].

Individual activities performed via smartphone differ in their potential to disrupt sleep. Social media, gaming, streaming and messaging engage attention and arousal to varying degrees, so that their impact on sleep may be heterogeneous [7,13]. Interactive and emotionally charged content tends to prolong usage at the expense of time allocated to sleep.

Risk factors for PSU include stress, loneliness, sporting pressure, as well as boredom during training camps and prolonged travel, during which the telephone functions as an emotion regulator and a tool for social contact [3,8,11].

3. Smartphone use and sleep quality

3.1. Physiological mechanisms

The adverse effect of evening smartphone use on sleep is explained primarily by exposure to short wavelength (blue) light, which suppresses melatonin secretion and phase-delays the circadian rhythm, thereby postponing sleep onset [14]. Experimental studies demonstrate that evening exposure to screen emitted light can alter sleep architecture and sleep-dependent processes such as declarative-memory consolidation [14].

Beyond photic effects, physiological and cognitive arousal play an important role. Telephone use in bed is associated with prolonged sleep-onset latency, increased nocturnal awakenings and changes in autonomic parameters, including elevated heart rate and reduced heart-rate variability (HRV), indicating heightened sympathetic activity [15]. Engaging content and social interactions before sleep sustain cognitive arousal and impede down-regulation [16].

Figure 1. Two parallel mechanisms linking evening smartphone use to impaired sleep: a photic pathway (blue-light exposure → melatonin suppression → altered sleep architecture) and a cognitive-behavioral pathway (engaging content → cognitive/sympathetic arousal → prolonged sleep-onset latency) [14–16].

3.2. Sleep quality

Meta-analyses and systematic reviews consistently demonstrate an association between electronic-media use, including smartphones, and impaired sleep quality; the effect is particularly pronounced for problematic use [13,17]. PSU is linked to longer sleep-onset latency, shorter total sleep time, lower sleep efficiency, more frequent nocturnal awakenings and poorer subjective sleep quality as measured by the Pittsburgh Sleep Quality Index (PSQI) [2,13].

These conclusions rest on diverse study designs. Cross-sectional investigations typically reveal strong positive associations between PSU severity and sleep deterioration [1,2]. Longitudinal studies and those employing objective measurements based on intensive daily monitoring tend to be more nuanced and occasionally attenuate the strength of the relationships, underscoring the particular importance of nocturnal relative to daytime use [18,19]. Notwithstanding this heterogeneity, the overall direction of association remains consistent: greater intensity of device use, especially when problematic, is associated with poorer sleep indices [1,13,17].

3.3. Pre-sleep smartphone use

Particular significance attaches to smartphone use immediately before sleep and after retiring to bed. Scrolling, social-media browsing, video viewing, messaging and gaming differ in their impact on sleep; critical determinants appear to be timing of use and degree of engagement [14,15,16]. Analyses comparing daytime, pre-sleep and post-bedtime use indicate that use after retiring is most strongly associated with reduced sleep quality, and that applications requiring active engagement ("lean-forward") may exert effects distinct from those of passive content ("lean-back") [20].

The heterogeneity of effects across activities suggests that it is not the mere fact of telephone use but rather the nature of the content, its emotional valence and the timing of use that determine the magnitude of sleep disturbance [7,20].

4. Sleep, Recovery, and Athletic Performance

4.1. The Importance of Sleep in Athletes

Sleep is a fundamental component of athletic recovery, playing a critical role in muscle repair, protein synthesis, hormonal regulation, cognitive function, immune competence, and injury prevention [4,6,21]. In professional athletes, adequate sleep duration and quality support training capacity, recovery processes, and overall athletic performance, whereas insufficient sleep is associated with impairments in these physiological functions and performance outcomes [5].

At the physiological and molecular levels, sleep deprivation disrupts hormonal homeostasis by increasing concentration of cortisol while reducing anabolic hormone levels. It also promotes pro-inflammatory and pro-apoptotic processes, thereby adversely affecting exercise induced adaptations and tissue regeneration [22].

4.2. Sleep and Recovery

Sleep duration and quality influence key indicators of recovery, including delayed onset muscle soreness (DOMS), fatigue, heart rate variability (HRV), physiological recovery processes, and inflammatory responses [23,24]. Sleep monitoring is increasingly being utilized as a tool for assessing readiness for exercise, thereby supporting the reduction of injury risk and the prevention of overtraining [25].

Poor sleep quality has been associated with increased fatigue, greater muscle soreness, and a higher risk of burnout among young athletes [26]. Sleep patterns and their effects on recovery may differ between endurance and strength-based sports, as well as between sexes, highlighting the need for individualized recovery strategies [27].

4.3. Sleep and Athletic Performance

Sleep quality and duration have a significant impact on performance-related parameters, including strength, power, speed, reaction time, decision-making accuracy, and injury risk [28,29]. Both experimental studies involving sleep deprivation or sleep restriction and observational studies consistently demonstrate that insufficient sleep impairs physical and cognitive performance while

increasing the subjective perception of exertion [28].

Chronic insufficient sleep is associated with an increased risk of musculoskeletal injuries and reduced physical performance, making sleep an important—yet often underestimated—factor in the optimization of athletic performance [4,21,29].

5. How Smartphone Use May Influence Recovery and Athletic Performance

Integrating the evidence presented above allows for the proposal of a coherent mechanism linking problematic smartphone use (PSU) with impaired athletic performance. The proposed pathway involves a sequential relationship in which problematic smartphone use leads to impaired sleep, followed by compromised recovery, ultimately resulting in reduced physical performance and diminished athletic outcomes [4,13,28].

Figure 2. Proposed sequential pathway linking problematic smartphone use to reduced athletic performance, via impaired sleep and compromised recovery, supported by direct evidence from athletic populations [4,8,10,13,28,30].

Studies conducted directly in athletic populations provide empirical support for this model. In a randomized study involving elite soccer players, two hours of smartphone use before bedtime over consecutive evenings significantly impaired sleep quality and reduced both cognitive and physical performance on the following day, with more pronounced effects observed during afternoon testing sessions [30]. Among collegiate student-athletes, social media use was associated with poorer sleep quality and lower performance-related outcomes [8], while in talented adolescent volleyball players, intensive smartphone use, particularly during the late evening, was associated with poorer indicators of mental health [10].

Evidence regarding smartphone addiction and athletic performance further suggests that excessive mobile device use may adversely affect athletes' functioning by impairing sleep quality and recovery processes [9,11]. To date, the greatest attention has been directed toward soccer players, volleyball players, collegiate athletes, and elite-level competitors [7,8,10,30].

6. Can Physical Activity Protect Against Problematic Smartphone Use?

The relationship between smartphone use and physical activity appears to be bidirectional. A growing body of evidence suggests that regular physical activity may serve as a protective factor, reducing the risk of problematic smartphone use and smartphone addiction [31,32]. Systematic reviews and their recent updates have reported moderate to large effect sizes for exercise-based interventions in reducing the severity of PSU, although they also emphasize considerable methodological heterogeneity across studies [32,33].

The protective effects of physical activity have been attributed to improvements in psychological resilience, self-control, and overall well-being, as well as reductions in perceived stress, all of which have been identified as mediators of the association between exercise and the severity of problematic smartphone use [34–37]. The type of physical activity may also influence this relationship, with aerobic endurance exercise appearing to confer the greatest protective effects [35].

Physical activity may additionally improve sleep quality indirectly, with smartphone use acting as

a mediating factor, thereby further linking physical activity, smartphone use, and sleep within a common conceptual framework [38]. Consequently, participation in sport has been proposed as a potential neuroprotective factor that may mitigate some of the adverse effects associated with excessive digital device use [11].

Figure 3. Bidirectional relationship between physical activity and problematic smartphone use: protective mediators reduce PSU risk, while PSU may in turn limit physical activity; risk is reduced but not eliminated, even among elite athletes [31–37].

Nevertheless, participation in sport does not completely eliminate the risk of problematic smartphone use. Athletes themselves, including elite competitors, frequently engage in intensive smartphone use, and evening use of social media may negatively affect their sleep quality and recovery, thereby compromising optimal athletic performance [7,10,11].

7. Practical Implications

The available evidence provides practical recommendations for coaches, physiotherapists, sport psychologists, dietitians, and athletes themselves. Their shared objective is to minimize the negative impact of evening smartphone use on sleep and recovery.

The most important recommendations include limiting smartphone use during the 60–90 minutes before bedtime, using night mode to reduce blue-light exposure, adhering to good sleep hygiene practices—including removing the smartphone from the bedroom—as well as providing education on digital hygiene and monitoring sleep quality [15,25]. Simple behavioral interventions, such as disabling unnecessary notifications or switching the screen to grayscale mode, have been shown to effectively reduce problematic smartphone use (PSU) and improve sleep quality [39].

Figure 4. Recommended digital and sleep hygiene interventions across the pre-sleep window (60–90 minutes before bedtime through to sleep onset) [15,25,39].

These recommendations are supported by intervention studies. Randomized controlled trials indicate that reducing screen time improves sleep quality and overall well-being, although these effects may be temporary and require ongoing support [40]. Interventions based on active nudging aimed at reducing screen time have also been associated with potential improvements in sleep quality [41]. In athletic populations, structured sleep strategies and recovery-focused interventions are of particular importance [23,29].

8. Limitations of the Available Evidence

The interpretation of these findings should take into account several methodological limitations. Among the most common are the predominance of cross-sectional studies, which preclude causal inference, and the reliance of many studies on self-reported sleep measures, which are subject to reporting bias [1,17]. The number of experimental studies, particularly randomized controlled trials, remains limited, and studies involving elite athletes typically include relatively small sample sizes [18,28].

An additional challenge is the heterogeneity in definitions of problematic smartphone use (PSU)

and the diversity of assessment tools employed, which limits the comparability of findings across studies [13,32]. Furthermore, there is a lack of standardization regarding the timing and nature of smartphone exposure, making it difficult to establish evidence based exposure thresholds [33]. These limitations highlight the need for well-designed longitudinal and experimental studies employing objective measures of both sleep and smartphone use, conducted specifically in athletic populations [18,30].

Figure 5. Evidence map summarising the populations, study designs and main findings of the key studies discussed in this review, alongside the principal methodological gaps identified in Section 8 [1,2,8,10,13,17,18,19,30].

Figure 6. Evidence synthesis table with data individually verified against the original publications (sample, design and finding confirmed source-by-source) for 10 of the 41 references most directly relevant to sport, sleep and problematic smartphone use. The Dridi et al. randomized crossover trial corresponds to reference [30] cited in Section 5; two further reviews in this table (Cunha et al.; Kong et al.) used PRISMA-registered protocols.

9. Conclusions

The accumulated evidence supports several consistent conclusions. First, there is strong evidence that problematic smartphone use (PSU) adversely affects sleep quality [1,13,17]. Second, impaired sleep quality negatively affects recovery as well as physical and cognitive performance, which are essential for athletic success [4,5,21,22,23]. Third, studies directly examining the full pathway linking PSU, recovery, and athletic performance remain limited; however, the available evidence consistently suggests a negative association throughout this pathway [9,10,11,30]. Fourth, reducing evening smartphone use represents a simple, low-cost intervention with the potential to enhance recovery and athletic performance [30,39,40,41].

Integrating education on digital hygiene and routine sleep monitoring into athletic training programs may provide measurable benefits for athletes' health and performance while requiring minimal resources.

Author contributions

Conceptualization: Mikołaj Makaryczew, Zuzanna Kowalczyk, Kacper Wrzosek, Kacper Ponikowski, Kornelia Kuchta, Paulina Gumółka, Piotr Kowalewski, Natalia Kowalczyk, Wiktor Słyś

Methodology: Mikołaj Makaryczew, Wiktor Słyś, Kacper Wrzosek, Kacper Ponikowski, Zuzanna Kowalczyk

Software: Mikołaj Makaryczew, Kacper Wrzosek, Zuzanna Kowalczyk, Paulina Gumółka

Check: Mikołaj Makaryczew, Kornelia Kuchta

Formal Analysis: Kacper Wrzosek, Kacper Ponikowski, Piotr Kowalewski

Investigation: Mikołaj Makaryczew, Kacper Wrzosek, Kacper Ponikowski, Agata Bukowska

Resources: Zuzanna Kowalczyk, Kacper Ponikowski, Paulina Gumółka, Wiktor Słyś, Agata Bukowska

Data Curation: Mikołaj Makaryczew, Kacper Wrzosek, Natalia Kowalczyk

Writing – Original Draft: Mikołaj Makaryczew, Zuzanna Kowalczyk, Piotr Kowalewski

Writing – Review & Editing: Mikołaj Makaryczew, Kacper Ponikowski, Piotr Kowalewski, Natalia Kowalczyk, Kornelia Kuchta

Visualization: Mikołaj Makaryczew, Kacper Wrzosek, Zuzanna Kowalczyk, Paulina Gumółka, Natalia Kowalczyk, Wiktor Słyś

Supervision: Mikołaj Makaryczew, Agata Bukowska

Project Administration: Mikołaj Makaryczew, Kornelia Kuchta, Agata Bukowska

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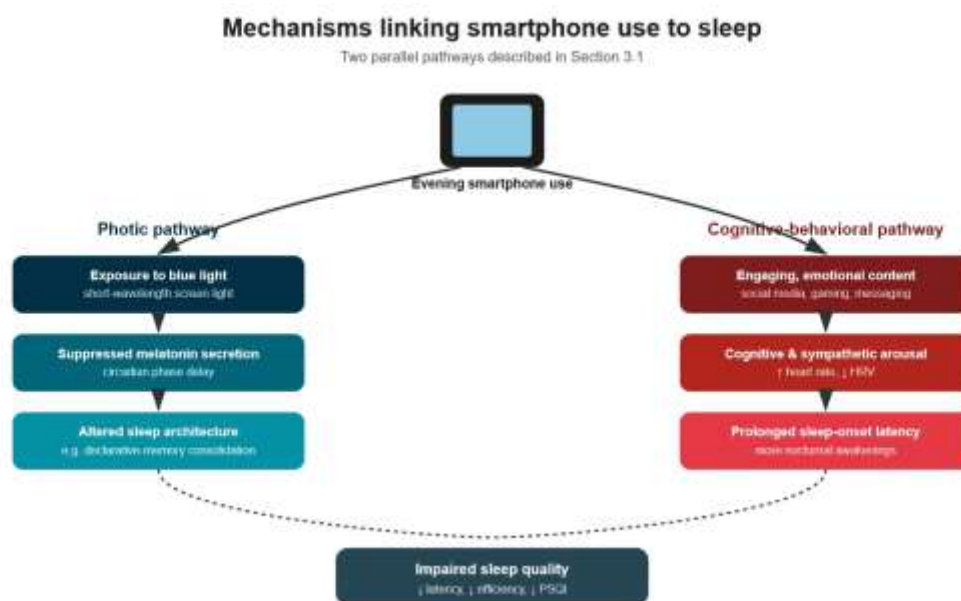


Figure 1. Two parallel mechanisms linking evening smartphone use to impaired sleep: a photic pathway (blue-light exposure → melatonin suppression → altered sleep architecture) and a cognitive-behavioral pathway (engaging content → cognitive/sympathetic arousal → prolonged sleep-onset latency) [14–16].

Pathway model: problematic smartphone use and athletic performance

Sequential chain of associations based on the review (Section 5)



Figure 2. Proposed sequential pathway linking problematic smartphone use to reduced athletic performance, via impaired sleep and compromised recovery, supported by direct evidence from athletic populations [4,8,10,13,28,30].

Physical activity and problematic smartphone use

A bidirectional relationship — protective, but not fully protective (Section 6)

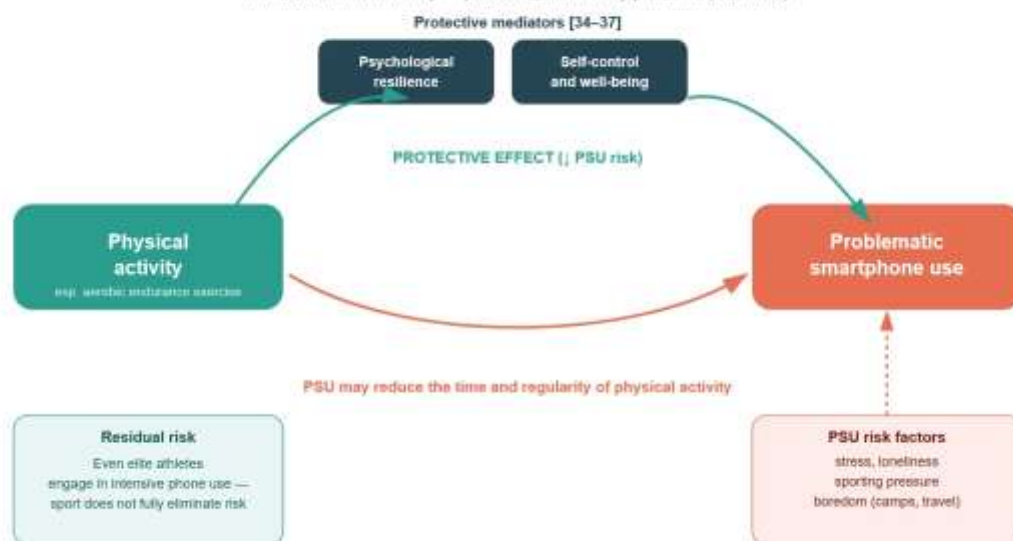


Figure 3. Bidirectional relationship between physical activity and problematic smartphone use: protective mediators reduce PSU risk, while PSU may in turn limit physical activity; risk is reduced but not eliminated, even among elite athletes [31–37].

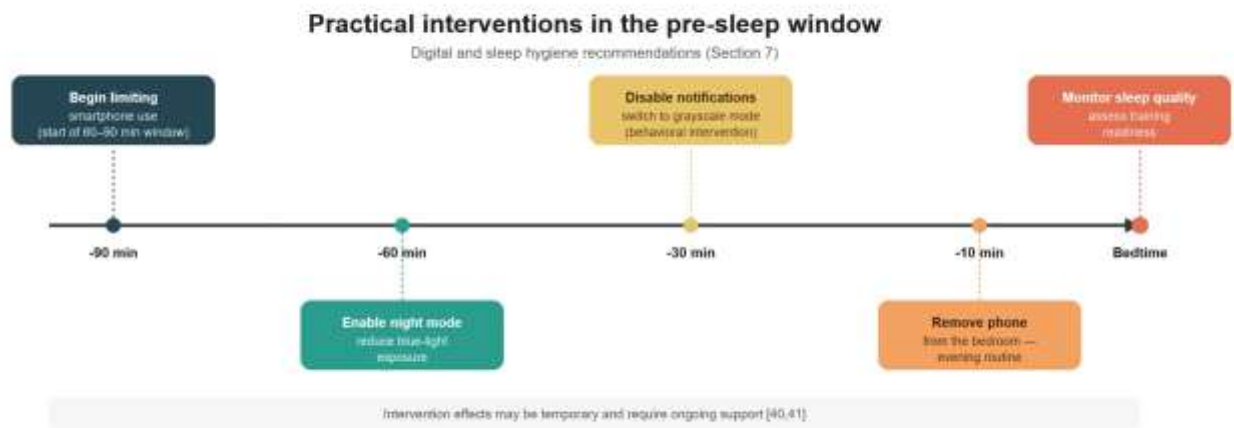


Figure 4. Recommended digital and sleep hygiene interventions across the pre-sleep window (60–90 minutes before bedtime through to sleep onset) [15,25,39].

Evidence map: PSU, sleep and athletic performance
Overview of key studies cited in the review

Population	Study design	Main finding	Ref.
Elite soccer players	Experimental (RCT)	2 h of pre-bedtime phone use on consecutive nights → significantly worse sleep and cognitive/physical performance	[30]
Collegiate student-athletes	Observational	Social media use associated with poorer sleep and lower performance-related outcomes	[0]
Adolescent volleyball players	Observational	Intensive late-evening use → poorer mental-health indicators	[10]
Students / young adults	Cross-sectional (strong associations)	Higher PSU → longer latency, shorter sleep, lower efficiency, poorer PSQI scores	[1,2,13]
General populations	Longitudinal / objective monitoring	More moderate effects; nocturnal use matters more than daytime use	[18,19]
Meta-analyses / reviews	Systematic	Consistent association between electronic-media use and impaired sleep	[13,17]

Research gap (Section 8):
Predominance of cross-sectional studies, self-reported sleep measures, few RCTs, small elite-athlete samples, and inconsistent PSU definitions/tools — limiting comparability across studies.

Figure 5. Evidence map summarising the populations, study designs and main findings of the key studies discussed in this review, alongside the principal methodological gaps identified in Section 8 [1,2,8,10,13,17,18,19,30].

Evidence synthesis table

Verified data extracted directly from 10 key sources in the bibliography.

Study	Design / N	Verified key finding
Dridi et al. 2025(6) - <i>Biology of Sport</i> <i>Referenced as [30]</i>	RCT, crossover N = 10 male elite soccer players	2 h of pre-bedtime smartphone use vs. reading (control), 1-week washout. Evening smartphone exposure significantly impaired sleep quality and next-day cognitive/physical performance; effects were pronounced in afternoon testing sessions. DOI: 10.1186/s12937-025-00040-0
Watkins et al. 2021 - <i>Orthop J Sports Med</i>	Observational Collegiate athletes	Social media use linked to poorer sleep quality and lower competition performance among collegiate athletes; limited prior research on SM's effect on performance noted. DOI: 10.1177/1941738121100007
Cunha et al. 2023 - <i>Sports Med - Open</i>	PRISMA / PICOS systematic review Athletes (individual & team sports)	Synthesised recent literature on sleep interventions in athletes; included studies required at least one performance/ recovery outcome. Sleep interventions generally improved subsequent athletic performance and recovery. DOI: 10.1186/s12937-023-00389-z
Kong et al. 2025 - <i>Frontiers in Physiology</i>	PRISMA systematic review + meta-analysis (PROSPERO reg.)	Athletes vs. non-athletes: Sleep deprivation significantly impairs sports performance and increases perceived exertion (RPE); effects vary by type/duration of deprivation and group. DOI: 10.3389/fphys.2025.1544388
Charrel & Grandjean 2022 - <i>Sleep Med Clinics</i>	Narrative/critical review (update) Elite athletes	Updated synthesis: poor sleep is prevalent among athletes and affects physical performance, mental performance, injury recovery, and mental health. DOI: 10.1016/j.smcl.2022.01.006
Strassburg et al. 2022(23) - <i>Sleep Med Reviews</i>	Systematic review 60 screened, 42 included (mod/high Q) Ages 18-25	Searched Medline, Web of Science & CINAHL for observational studies on digital media use and sleep in late adolescents/young adults. Consistent evidence of a negative association. DOI: 10.1016/j.smrv.2022.101742
Andersen et al. 2023 - <i>Sleep (CUP)</i>	Cross-sectional + causal discovery N = 5,789 parents; 4,236 w/ tracking data	Danish SmartSleep Study (ages 15-58): Nighttime smartphone use affects mental health via two distinct pathways: problematic smartphone use AND poor sleep quality — a potential leverage point for public health interventions. DOI: 10.1093/sleep/zsac026
Yang et al. 2021 - <i>J Behav Addict</i>	Cross-sectional Chinese undergraduate	Physical activity is negatively associated with mobile phone addiction; the strength of this protective relationship is moderated by exercise type. DOI: 10.1556/0048.2021.00058
Pirwani & Szabo 2024 - <i>Pres Med Reports</i>	Systematic literature review 31 studies	University students: Synthesised evidence suggests regular physical activity is a plausible preventive measure against smartphone addiction (moderate strength of evidence). DOI: 10.1016/j.pmedr.2024.102744
Pirwani & Szabo 2025 - <i>Pres Med Reports</i>	One-year update, systematic review 18 new studies (2024-2025)	14 of 18 new studies confirm the inverse PH-smartphone addiction relationship. Average effect size across the update: Cohen's d = -0.82 (slightly weaker than original 2024 review), consistent with the earlier synthesis. DOI: 10.1016/j.pmedr.2025.103179

Methodological note:

All data above were individually verified against the original publications (i.e. sample, design, and finding confirmed source-by-source) for 10 of the 41 references most directly relevant to sport, sleep and problematic smartphone use. The Dridi et al. study corresponds directly to the RCT cited as [30] in Section 5 of the review. Two further systematic reviews in this table (Cunha 2023; Kong 2025) used PRISMA-registered protocols, strengthening the methodological weight this table adds to the review. Table covers 10 of 41 bibliography entries, prioritised for direct relevance to sport, sleep and problematic smartphone use.

Figure 6. Evidence synthesis table with data individually verified against the original publications (sample, design and finding confirmed source-by-source) for 10 of the 41 references most directly relevant to sport, sleep and problematic smartphone use. The Dridi et al. randomized crossover trial corresponds to reference [30] cited in Section 5; two further reviews in this table (Cunha et al.; Kong et al.) used PRISMA-registered protocols.