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Review Article

Diagnosis and Treatment of Insomnia and Sleep Disorders in Athletes

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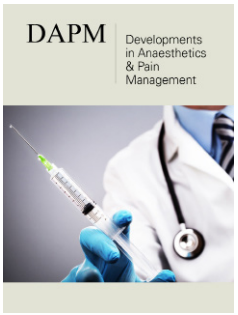
ISSN: 2640-9399



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Submission: May 18, 2026

Published: July 10, 2026

Volume 3 - Issue 2

How to cite this article: Hani Raoul Khouzam*. Diagnosis and Treatment of Insomnia and Sleep Disorders in Athletes. Dev Anesthetics Pain Manag. 3(2). DAPM. 000556. 2026.
DOI: 10.31031/DAPM.2026.03.000556

Abstract

Objective: Adequate sleep plays an important role in athletes professional success. It is considered a crucial component of muscle repair, neurocognitive function, and the integrity of the immune system. Sleep drives physical and mental recovery, by directly affecting muscles strength, reaction time, and judgement during athletic competitions. Despite its vital importance, many athletes experiencing sleep disturbances may not be identified and adequately treated. This review summarizes the specific data related to the identification and treatment, of insomnia and sleep disturbances, in athletes.

Methods: Studies evaluating clinical insomnia (DSM-5-TR criteria), objective/subjective sleep monitoring, and non-pharmacological or pharmacological interventions in athletes were selected by conducting systematic search of PubMed, MEDLINE, and PsycINFO was conducted for English-language peer-reviewed articles published between 2000 and 2026.

Results: Many athletes experience increased prevalence of inferior sleep quality and serious insomnia symptoms .Biological mechanisms such as elevated nocturnal cortisol, and autonomic nervous system imbalances interacting with sport-specific performance demands such as night time competition, hyperarousal, early morning training, and jet lag contribute to the development of sleep disturbances in athletes .The use of screening tools such as the Athlete Sleep Screening Questionnaire (ASSQ) could effectively identifies at-risk athletes .The use of actigraphy as measure of objective monitoring is noticeably underutilized. Cognitive Behavioural Therapy for Insomnia (CBT-I) consistently demonstrated superior efficacy compared to other interventions. Adherence and safety concerns present serious challenges for the available pharmacological intervention.

Conclusion: Insomnia in athletes represents complex converging concepts. of sports performance and clinical interventions. Addressing sleep disturbances in athletes would require systematic screening, objective assessment, and adherence to non-pharmacological interventions such as CBT-I as first-line treatment. Timely identification and treatment of insomnia and sleep disturbances in athletes are crucial components for athletes longevity and their overall mental health and physical well-being.

Keywords: Insomnia; Athlete; CBT-I; Actigraphy; Sports psychiatry

Introduction

Sleep is an active strategic biological process. It serves as the ultimate regenerative state of homeostasis. Sleep disturbances have significant impact on its essential restorative and longevity functions thus negatively affecting its primary physiological and neurocognitive functions [1]. In athletic competitions, where performances are time measured in fraction of milliseconds optimum sleep quality has emerged as an important factor in the interface between sports medicine and psychiatry [2]. Despite sleep vital biological necessity for cellular repair, metabolic regulation, glycogen replenishment, and memory consolidation, many athletes are paradoxically among the most sleep-deprived individuals in society [3]. It is estimated that 58% to 70% of many athletes experience sleep disturbances, with 42.2% suffering from chronic poor sleep quality [1,3]. Clinical insomnia which is characterized by persistent difficulties with sleep initiation, maintenance, or early-morning awakening accompanied by daytime impairment have been reported in up to 60% of athletes [4]. Sleep

disturbances in addition to their detrimental effects on athletic performance [1] they disrupt endocrine homeostasis, resulting in potentiating catabolic cascades characterized by elevated nocturnal cortisol levels and suppressed secretion of anabolic agents, such as testosterone and growth hormone [3]. This hormonal imbalance impairs muscle tissue regeneration, increases the ratio of muscle-mass wasting, and raises an athlete vulnerability for body injury [1,3]. Insomnia has negative consequences on neurocognitive functioning and in degrading executive functioning, leading to the prolongation response time, impairment of spatial awareness, and emotional dysregulation [2-6]. From a psychiatric perspective, in athletes the. relationship between insomnia and psychiatric conditions seems to be intensely bidirectional [5,6]. For instance untreated chronic sleep disturbances frequently precede or exacerbate major depressive episodes, generalized anxiety disorder, and substance use, thus emphasising the clinical importance for psychiatrists to promptly identify and manage insomnia to prevent its dire biological and psychological consequences [6].

Identifying athletes' insomnia

Athletes represent a unique population with specific sleep challenges that differ from the general population. Athletes face a constellation of risk factors that predispose them to sleep disturbances [7]. The risk and contributing factors of sleep disturbances are outlined in Table 1. Sleep disturbances that have been reported by some athletes are summarized in Table 2.

Table 1: Risk and contributing factors of sleep disturbances in athletes.

Risk Factors	Contributing Factors
Training-related	Arduous training demands, early morning/late evening sessions, travel across time zones
Competition-related	Pre-competition anxiety, evening competitions delaying sleep onset, irregular schedules
Physiological	Elevated core body temperature post-exercise, hormonal fluctuations
Environmental	Shared accommodations, noise, unfamiliar sleeping environments
Circadian disruption	Jet lag, shift-like training schedules, light exposure irregularities

Table 2: Types of sleep disturbances in athletes.

Insomnia (most common): Difficulty initiating or maintaining sleep, early awakening
Sleep-Disordered Breathing (SDB): Obstructive Sleep Apnea (OSA) — particularly in contact sport athletes with larger neck circumference and body mass
Circadian rhythm disorders: delayed sleep phase, jet lag disorder
Sleep deprivation: chronic insufficient total sleep time (<7–9 hours recommended for athletes)
Restless Legs Syndrome (RLS): may be exacerbated by iron deficiency common in endurance athletes
Parasomnia (disruptive sleep behaviors): less common but reported in high stress athletic performances

Pathophysiology of sleep disturbances

The development of sleep disturbances in athletes is a manifestation of multiple complex interactions between neurobiological, psychological, environmental, and training requirements that contribute to. The disruption of the natural sleep processes governing sleep [7]. This can be effectively framed using Spielman's 3P model: predisposing, precipitating, and perpetuating factors as illustrated in Table 3; [8].

Table 3: Spielman's 3P model.

Mechanistic Domain	Underlying Etiological Drivers	Impact on Sleep Architecture
Neuroendocrine & Autonomic	Chronic sympathetic overactivation; elevated nocturnal cortisol; reduced anabolic signalling.	Elevated Wake After Sleep Onset (WASO); suppression of slow-wave and REM sleep.
Psychological & Cognitive	Performance anxiety; selection pressure; rigid perfectionism; fear of failure.	Prolonged Sleep Onset Latency (SOL); profound cognitive pre-sleep hyperarousal.
Environmental & Structural	Late-night competitions; early morning training; exposure to bright arena lighting.	Circadian phase delay; severe restriction of Total Sleep Time (TST).
Physiological & Circadian	Frequent trans-meridian travel; chronic Delayed Onset Muscle Soreness (DOMS); excessive caffeine use.	Desynchronization of master clock; sleep fragmentation; altered melatonin rhythm.

Neuroendocrine and autonomic alteration

The biological disturbances that could precipitate insomnia in athletes could be a manifestation of a probable imbalance within the Hypothalamic-Pituitary-Adrenal (HPA) axis and the Sympathetic Nervous System (SNS). High-intensity, high-volume training without adequate recovery stimulates a state of chronic physiological stress akin to overtraining syndrome [9]. This state triggers a sustained rise in circulating catecholamines (epinephrine and norepinephrine) and nocturnal cortisol levels. The emergence of sleep would require a physiological transition where lowering

of sympathetic activity simultaneously occurs with an increase in parasympathetic activity However, athletes with overtraining-induced hyperarousal have shown elevated resting heart rates, reduced Heart Rate Variability (HRV), and elevated core body temperatures at bedtime, preventing the physiological transition into stage 1 sleep [9]. This sustained hyperarousal alters sleep architecture, significantly suppressing Slow-Wave Sleep (SWS) and Rapid Eye Movement (REM) sleep, which are critical for physical tissue repair and mental restoration.

Psychological and cognitive impact

Athletic competitions require intense psychological resilience, and as a result could lead to the development of performance anxiety, obsession with perfectionism, and an intense fear of failure [10]. Several athletes would develop escalated pre-sleep cognitive hyperarousal while attempting to initiate sleep, they would often experience involuntary rumination regarding tactical errors, coaching critiques, contract insecurities, or negative media commentary. This cognitive activity stimulates the cortical arousal system, triggering a surge of beta-wave activity on Electroencephalography (EEG) that prevents the onset of coordinated alpha and delta waves required for deep sleep [11].

Diagnostic challenges

Identifying insomnia in athletes may require an individualized diagnostic approach that differentiates temporary sleep interruptions from clinical sleep disorders. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR) a diagnosis of insomnia disorder requires sleep initiation or maintenance difficulties occurring at least three nights per week for a minimum of three months, resulting in significant daytime distress or functional impairment [12]. In athletes, the clinical presentation could be difficult to elicit in the midst of rigorous training schedules, travel requirements, and cultural norms that stigmatize athletes disclosing mental health issues [13].

Clinical presentation

Athletes suffering from insomnia typically present with prolonged sleep onset latency (>30 minutes), frequent nocturnal awakenings, or an inability to return to sleep following early-morning awakenings. The psychological overlay is marked by pre-sleep cognitive hyperarousal-characterized by ruminative thoughts regarding training performance, technical execution, selection pressures, and public scrutiny. Standard subjective sleep questionnaires developed for the general public, such as the Pittsburgh Sleep Quality Index (PSQI) or the Insomnia Severity Index (ISI), may not sensitive to the unique variables of athletes training schedules, travel fatigue, and nap architecture [14]. In clinical practice the Athlete Sleep Screening Questionnaire (ASSQ) is usually used in identifying sleep disturbances in athletes [15]. The ASSQ is a validated instrument specifically calibrated to segment athletes into distinct sleep difficulty categories (none, mild, moderate, severe) based on sport-specific metrics. It accounts for factors such as travel across time zones, respiratory parameters, and training-induced sleep disruption [16-18].

Clinical assessment

An accurate diagnosis of sleep disturbances in athletes should be based on obtaining a thorough and detailed history and would include:

A. Sleep diary (2-week minimum): bedtime, wake time, naps, perceived quality.

B. Validated questionnaires (Table 3a & 3b).

Table 3a: Clinical assessment.

Tool	Purpose
STOP-BANG Questionnaire for Obstructive Sleep Apnea (OSA) [17]	OSA screening
Athlete Sleep Screening Questionnaire (ASSQ) [15]	Sport-specific tool
Athlete Sleep Behavior Questionnaire (ASBQ) [18]	Sleep hygiene behaviors in athletes

Table 3b: Given that subjective self-reports can both overestimate and underestimate the severity of sleep disturbances due to performance anxiety, objective verification is clinically recommended.

Method	Application
Actigraphy	Wrist-worn device; estimates sleep-wake cycles, total sleep time, efficiency; practical for athletes in training environments
Polysomnography (PSG)	Clinical standard for diagnosing OSA, parasomnias, periodic limb movements
Wearable technology	Consumer devices (e.g., Apple wrist band, Oura Ring, etc…) provide sleep staging data; useful for longitudinal monitoring but less validated than PSG

Polysomnography (PSG): While laboratory-based polysomnography remains the clinical standard for diagnosing sleep disorders, its clinical utility for routine athlete monitoring is restricted by high costs, low accessibility, and the potential to exacerbate sleep latency due to its unfamiliar laboratory environment [7,19].

Actigraphy: Medical-grade actigraphy worn on the wrist for a continuous period of 7 to 14 days offers a valid, non-invasive alternative. Actigraphy tracks rest-activity cycles, providing objective data on Sleep Onset Latency (SOL), Total Sleep Time (TST), Wake After Sleep Onset (WASO), and overall sleep efficiency [20].

Sleep diaries: To maximize diagnostic precision, actigraphy data must be paired concurrently with a daily sleep diary. This helps cross-reference objective parameters with the athlete's subjective perception of sleep quality and daytime fatigue levels [21].

Treatment framework

Managing insomnia and sleep disturbances in athletes requires a comprehensive and structured treatment plan that focus on long-term safety, balancing training and performance demands, while adhering with anti-doping regulations. Systemic rules and anti-doping regulations could increase the level of scrutiny of athletes who receive pharmacotherapy for sleep disturbances, thus behoving clinicians to consider non-pharmacological interventions as a first-line therapeutic approach.

Non-pharmacological interventions

Cognitive Behavioural Therapy for Insomnia (CBT-I)

CBT-I is recognized globally as the standard clinical intervention for chronic insomnia, demonstrating a 70% to 80% success rate within athletic populations without compromising performance [22]. It is a structured, 6-to-8-week multimodal therapeutic regimen addressing the behavioural and cognitive factors that sustain sleep disturbances.

Stimulus control therapy: This component breaks the psychological association between the bed and hyperarousal or frustration. Athletes are strictly instructed to use the bed exclusively for sleep and sexual activity. If sleep onset is not achieved within 20 minutes, the athlete must exit the bed, move to a dimly lit room, engage in a low-arousal activity (e.g., reading a physical book), and return to bed only when sleepiness returns.

Sleep Restriction Therapy (SRT): SRT curbs excess time spent awake in bed, which often fragments sleep architecture. Based on a 2-week sleep diary, the athlete's allowed time in bed is restricted to match their actual average total sleep time (ensuring it does not drop below a safe minimum of 5.5 to 6 hours for recovery). This temporary restriction builds homeostatic sleep pressure, decreasing sleep onset latency and increasing overall sleep efficiency. As efficiency rises above 85–90%, the time-in-bed window is gradually lengthened by 15-to-30-minute increments.

Cognitive restructuring: This phase identifies and challenges catastrophic thoughts regarding sleep loss. Athletes often develop distorted cognitions, such as *"If I don't sleep 8 hours tonight, I will fail in tomorrow's competition."* Cognitive restructuring reframes these beliefs to lower pre-sleep anxiety and somatic hyperarousal. The various components of CBT-I are summarized in Table 4.

Table 4: Cognitive Behavioral Therapy for Insomnia (CBT-I).

Sleep restriction therapy: Consolidates sleep by limiting time in bed to actual sleep time, then gradually extending
Stimulus control: Reassociates bed with sleep only
Cognitive restructuring: Addresses maladaptive beliefs about sleep and performance
Relaxation techniques: Progressive muscle relaxation, diaphragmatic breathing
Sleep hygiene education

Sleep Hygiene Strategies

While sleep hygiene alone is not usually effective for the management of chronic insomnia, its strategies could provide vital supportive components to CBT-I program [21].

Microclimate architecture: The sleep environment must be carefully managed, keeping ambient temperatures between 15°C and 19°C to facilitate the drop in core body temperature necessary for deep sleep stages. Complete light elimination should be achieved using black-out curtains or eye masks.

Photic and digital engineering: Blue-wavelength light from electronic screens should be restricted for a minimum of 60 minutes before bedtime. Alternatively, blue-light-filtering glasses can be utilized to prevent the suppression of endogenous melatonin synthesis.

Nutritional and ergogenic timing: High-intensity caffeine intake must be restricted within 6 hours of sleep onset. Furthermore, athletes should avoid consuming high-fat, high-protein meals within 2 hours of sleep, as the elevated metabolic activity required for digestion can disrupt sleep maintenance. The various sleep hygiene strategies are outlined in Table 5.

Table5: Sleep hygiene strategies.

Strategy	Recommendation
Consistent sleep schedule	Fixed bed/wake times, even on rest days
Sleep extension	Target ≥8–10 hours for elite athletes
Napping	Strategic 20–30 min naps; avoid >90 min or late afternoon
Pre-sleep routine	Dim lights, avoid screens 60 min before bed
Temperature regulation	Cool sleeping environment (18–20°C)
Nutrition timing	Avoid heavy meals, caffeine within 6 hours of sleep
Training schedule optimization	Avoid high-intensity training within 2–3 hours of bedtime

Mindfulness and biofeedback modalities

Mindfulness-Based Stress Reduction (MBSR) and biofeedback procedures target the physical components of hyperarousal [23]. Modalities such as Progressive Muscle Relaxation (PMR), diaphragmatic breathing exercises, and Heart Rate Variability (HRV) biofeedback train athletes to voluntarily suppress sympathetic nervous activity and stimulate parasympathetic pathways. These approaches lower resting heart rate and somatic tension, facilitating a smoother transition into sleep.

Sleep banking strategy

For athletes facing unavoidable sleep loss related to extensive travel or short interval consecutive competitions, "sleep banking" strategies could be implemented. It is an approach that consistently extend sleep duration by 1 to 2 hours per night for one to two weeks prior to a period of sleep restriction could biologically preserve motor skills, reaction times, and emotional stability during subsequent sleep disruptions [24].

Management of specific sleep disorders

Athletes with specific sleep disturbances [25] would require individualized treatment interventions as illustrated in Table 6.

Table 6: Management of specific sleep disorders.

I. Obstructive Sleep Apnea
Continuous Positive Airway Pressure (CPAP) therapy: First-line for moderate-to-severe OSA; improves daytime alertness and cardiovascular function.
Weight management (where applicable)
Positional therapy for positional OSA
Mandibular advancement devices for mild-moderate OSA
Referral to sleep medicine specialist
II. Circadian Rhythm Disorders / Jet Lag
Light therapy: Morning bright light exposure to advance circadian phase
Melatonin (0.5–5mg): Taken at destination bedtime to facilitate phase shifting
Strategic napping and gradual schedule adjustment pre-travel
Eastward travel is generally more disruptive than westward
III. Restless Legs Syndrome
Iron supplementation if serum ferritin <50–75ng/mL (common in endurance athletes)
Dopamine agonists (pramipexole, ropinirole) for refractory cases
Magnesium supplementation suggested despite limited evidence

Obstructive sleep apnea

A. Continuous positive airway pressure (CPAP) therapy: First-line for moderate-to-severe OSA; improves daytime alertness and cardiovascular function.

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Circadian rhythm disorders / jet lag

A. Light therapy: Morning bright light exposure to advance circadian phase.

B. Melatonin (0.5-5mg): Taken at destination bedtime to facilitate phase shifting.

C. Strategic napping and gradual schedule adjustment pre-travel.

D. Eastward travel is generally more disruptive than westward.

Restless legs syndrome

A. Iron supplementation if serum ferritin <50–75 ng/mL (common in endurance athletes).

B. Dopamine agonists (pramipexole, ropinirole) for refractory cases.

C. Magnesium supplementation suggested despite limited evidence.

Pharmacological interventions

Pharmacotherapy for insomnia in athletes is an intervention that need to be considered when non-pharmacological therapies could not completely resolve the ongoing sleep disturbances. In view of the anti-doping regulations this intervention should be cautiously, implemented, and supervised by psychiatric experts and, or sleep medicine specialists [26]. The use of pharmacological agents with athletes requires careful consideration of potential side effects, including residual day time sedation, impaired psychomotor speed, altered coordination, and the risk of developing dependency or addiction.

Anti-Doping regulations compliance

Every pharmacological agent prescribed must be cross-referenced with the current World Anti-Doping Agency (WADA) Prohibited List [27]. While standard hypnotics are not explicitly banned in most non-precision sports, certain classes-such as beta-blockers or specific stimulants used to counter daytime sleepiness-are heavily restricted or banned in-competition. Additionally, the risk of supplement contamination with prohibited substances requires that any over-the-counter sleep aid carry a third-party verification for instance Certified for Sport (NSF).

Pharmacological treatment

Exogenous melatonin: For circadian rhythm sleep-wake disorders and jet lag, low-dose exogenous melatonin (0.5 mg to 3.0 mg) administered 2 to 3 hours prior to the desired local sleep time is highly effective [28]. It acts primarily as a chronobiotic agent to shift the internal clock, rather than a direct sedative hypnotic.

Dual Orexin Receptor Antagonists (DORAs): Newer agents like suvorexant and lemborexant represent a promising option in sports psychiatry. Unlike traditional GABA-A receptor agonists (benzodiazepines and Z-drugs), which sedate the brain by widespread central nervous system depression, DORAs specifically target and turn down the orexin-driven wakefulness pathways [29]. This targeted mechanism reduces the risk of next-day psychomotor slowness, muscle relaxation, or cognitive deficits, making it a safer option for athletes requiring peak coordination [30].

Sedating antidepressants: Low-dose tricyclic antidepressants such as doxepin, or other antidepressants such as mirtazapine or trazodone [31] may be considered when insomnia is comorbid with depressive or anxiety disorders. These agents can improve sleep maintenance without the high addiction potential associated with traditional benzodiazepines.

Other agents: The use of Z-drugs agents like zolpidem, eszopiclone, or Benzodiazepines such as temazepam should be highly restricted. They should only be used for acute, short-term situational insomnia (e.g., severe travel fatigue immediately following trans-continental flights) for a duration not exceeding 3 to 5 consecutive days. Long-term use is discouraged due to risks of performance degradation, altered sleep architecture, tolerance development, and withdrawal rebound insomnia [32]. The pharmacological Interventions are summarized in Table 7.

Table 7: Pharmacological interventions.

Agent	Notes
Melatonin	Safe, non-habit forming; useful for jet lag and circadian adjustment; WADA-permitted
Benzodiazepines	Effective short-term but impair sleep architecture, carry dependence risk; generally avoided in athletes 3
Non-benzodiazepine hypnotics (zolpidem, eszopiclone)	Short-term use only; residual sedation may impair next-day performance
Low-dose doxepin	FDA-approved for sleep maintenance insomnia; limited athlete data
Ramelteon	Melatonin receptor agonist; useful for sleep onset; minimal abuse potential
Trazodone	Off-label; commonly used; limited high-quality evidence

Sirtuin-1 (SIRT1) role

- Nicotinamide Adenine Dinucleotide (NAD+) is a vital coenzyme found in all living cells. It acts as a primary energy source for several proteins including Sirtuin-1 (SIRT1) which is a critical NAD+-dependent enzyme that regulates metabolism, inflammation, and cellular aging [33]. One of its function is to regulate the molecular circadian clock and to counteract the physiological stress of sleep deprivation [34]. Targeting SIRT1 could be another intervention for sleep management in athletes. This intervention is clinically challenging because athletes experience unique physiological tasks, for instance during a single bout of high-intensity, exhausting exercise an acute increase in skeletal muscle SIRT1 will emerge [35]. However, when athletic performances lead to an overtrain, the resulting massive surge in oxidative stress can deplete cellular NAD + This depletion temporarily represses SIRT1 activity, which can paradoxically worsen insomnia. Carefully balancing training load, maintaining sleep hygiene, and supporting NAD +levels through nutrition are essential for athletes to benefit from SIRT1 sleep-regulating effects [36]. Nutritional interventions such as Sirtuin 1 activators versus Sirtuin 1 inhibitors could play an important role for the treatment of insomnia in athletes [37].

Anti-doping consideration: Athletes need to verify all medications and supplements with the World Anti-Doping Agency (WADA) Prohibited List. For instance certain stimulants used to counter daytime sleepiness may be prohibited.

Conclusion

Sleep disturbances in athletes are prevalent, and multifactorial. They could have significant consequences for performance, recovery, immune function, injury risk, and mental health. The schedule of training and competition that determine the daily living of athletes is abound with ample intense physical stress, psychological pressure, travel across time zones, and inconsistent sleep-wake cycles These multiple factors could lead to persistent sleep disruption. Left untreated, the unresolved insomnia and prolonged sleep disturbances would negatively impact athletic performances and increases the risk for physical injury and could precipitate the development of emotional and psychiatric disorders, such as depression and anxiety. Treating athletes with sleep disturbances should follow a clear care pathway, establishing non-pharmacological interventions such as CBT-I as first-line therapy. Pharmacological agents should be reserved for short-term,

symptoms relief, with careful adherence to the anti-doping rules. It is hoped that more large-scale, randomized controlled trials studies will be conducted with a focus on CBT-I specifically tailored to athletic schedules. There is also a need for objective studies examining the safety and performance impacts of pharmacological agents, such as Dual Orexin Receptor Antagonists, in the athletic environments.

Acknowledgment

The author wishes to express his sincere appreciation to Dr, Terry Johnson Dr, Joanne Stephen- Dr, Gargi Bandyopadhyay, Dr, Alex Rollo and Dr, Avak A. Housepian for their clinical input and his gratitude for his family, friends and colleagues for their support and encouragement.

Disclaimers

The views described in this article are those of the author and do not reflect the official policy of the Palo Alto VA Medical Center or The Department of Veterans Affairs or Community Mental Health, Whanganui Hospital Health New Zealand or Fresno Department of Psychiatry University of California San Francisco (UCSF).

Post-Script

This article summarized available medical and psychiatric literature on the diagnosis and treatment of insomnia and sleep disorders in athletes. It is intended as an educational and scholarly material for healthcare professionals and researchers. It does not recommend the adoption or the implementation of any of the described interventions which are ultimately pursued by the specialists who hold the needed clinical privileges and qualifications to manage insomnia in the athletes.

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