

Sleep hygiene for athletes

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OVERVIEW

The practice of sport at all levels is accompanied by varying levels of time commitment, which can negatively impact on sleep. Sleep deprivation among athletes of all ages and levels is common, with a recent review stating that 50-78% of elite athletes regularly experience sleep disturbance.⁴⁷ Sleep is often pushed back to fit in socialising, education, competition or training, reducing both sleep duration and quality: sleep quality is defined as short sleep onset-latency, no more than one waking per night, waking of less than five minutes per night and waking feeling refreshed.^{3,39} Failing to meet sleep requirements may be putting some athletes at greater risk of injury, impairing sports performance and negatively affecting both physical and mental well-being. Identifying current sleep habits, alongside education around optimal sleep hygiene practices, may be one strategy to improve athletes' recovery, performance and overall well-being.

Introduction

The most obvious cycle in the human 24-hour circadian cycle is the cycle of activity and sleep. Sleep is arguably the ultimate recovery strategy, significantly affecting performance and disease risk, as well as both physical and mental well-being.^{2,6,47} Sleep has been suggested to be the single best psychological and physiological recovery strategy available to elite athletes.¹² The internally driven circadian rhythm, entrained to external cues, allows the body to oscillate between sleep and wake in a 24-hour cycle.¹⁰

Falling asleep is a complex process, which requires a number of physiological processes to co-align; the sleep homeostasis drive – or 'sleep pressure' – accumulates over a period of wakefulness, leading to tiredness. Sleep does not begin 'in a moment', but is rather an end process of a series of interwoven physiological changes, beginning with relaxed drowsiness.³⁷ This

starting point demonstrates the importance of sleep hygiene and the need for relaxation, unwinding and low stimulation prior to bedtimes. Just before to falling asleep, core body temperature drops;¹⁴ this temperature drop continues into the first two sleep stages, known as non-rapid eye movement (NREM) sleep stages 1 and 2. These are both light stages of sleep, and by the end of stage 2, body temperature will have dropped around 2°C. The third stage of sleep, NREM stage 3, marks the beginning of deep sleep, when recovery and regeneration are at their highest.³⁶ The fourth sleep stage is rapid eye movement sleep (REM), another deep sleep stage. These cycles repeat throughout the night every 90-120 minutes.

Sleep requirements

Sleep requirements change throughout life stages, and Table 1 highlights the suggested durations at each stage, for individuals with no health concerns.¹⁷

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Table 1: Optimal sleep durations throughout life stages

STAGE OF LIFE	AMOUNT OF SLEEP NEEDED WITHIN 24 HOURS
Newborn	14–17 hours
Babies	12–15 hours
Toddlers	11–14 hours
Pre school	10–13 hours
School age (up to teenage)	9–11 hours
Teenagers	8–10 hours
Young adulthood	7–9 hours
Older adulthood	7–8 hours

The sleep needs of athletes have been suggested to be greater than the non-athletic population due to greater recovery needs,⁴⁷ so it could be sensible to assume athletes should aim for the upper end of these recommendations; yet a recent review found average sleep durations among over 1000 professional athletes was only 7.2 hours.⁴⁷ More worrying, perhaps, are the findings that adolescent athletes report even lower sleep durations than senior athletes, despite adolescents having greater sleep needs than adults.⁴ Sleep deprivation not only has the potential to hamper performance both in the short and long term,⁵ but on a broader level, the long-term well-being of these athletes may be at risk. In 2021, Duffield et al⁷ reported a high incidence of poor sleep among collegiate athletes and noted that this may be related to depressive symptoms. Regular short sleep durations have been associated with increased risk of diabetes, cardiovascular disease and certain cancers in later life; it is also well established that short sleep duration lowers cognitive functioning and negatively affects memory consolidation.^{20,38}

Sleep deprivation is associated with increasing injury risk in adolescent populations,^{31,48} with one study concluding that meeting sleep needs may serve as effective injury prevention.³¹ In this study, 112 adolescent athletes carried out sleep surveys, the data from which was correlated retrospectively with injury data. Multivariate analysis demonstrated that athletes who slept less than 8 hours per night were 1.7 times more likely to have had an injury compared to those sleeping

more than 8 hours (95% confidence interval). In terms of performance, Mah et al³⁰ found that increasing sleep durations of collegiate basketball players resulted in improved sprint times (16.2 ± 0.61 sec at baseline vs 15.5 ± 0.54 sec at end of sleep extension, $P < 0.001$), shooting accuracy (free throw percentage increasing by 9%), reaction time (decreased psychomotor vigilance task scores, $P < 0.01$); and improved self-perceived mental well-being as recorded from questionnaires. Supporting this finding, a study carried out in collegiate tennis indicated that increasing sleep durations improved serving accuracy by 17%.⁴⁵ All these data suggest that optimal sleep assists in improving objective markers of sports performance, and thus education around methods of optimising sleep should be of value for all coaches.

A systematic review carried out in 2020⁴⁷ assessed 81 studies of athletes' sleep habits (from a variety of both team and individual sports) and discovered that more than half the athletes within this research reported poor sleep on multiple occasions, as determined by more than one waking in the night, regular sleep duration of less than 7 hours and waking unrefreshed. Similarly, a review of 283 athletes found that over half also reported regular sleep disturbances, particularly following late night training or matches.²³ Not only was sleep duration affected, but athletes also showed poorer sleep quality than age and sex-matched controls,²⁶ demonstrating more disturbances within the night.

What exacerbates this problem is the scheduling of many professional games now in the evening, which are often to satisfy commercial screenings, but clearly negatively affect the sleep needs of the athletes. Nedelec et al³⁴ noted that sleep behaviours among athletes



were significantly affected by specificity of training and competition schedules. Following evening games, sleep initiation among athletes has been reported to be later than non-game days, and overall sleep duration has been found to be, on average, around 2.4 hours less.⁴³ Eagles et al⁸ found a significant decrease in the sleep quality of professional rugby players following game nights as compared to non-game nights. The sleep disruption following evening training or matches has been suggested to be attributable to both behavioural and psychological changes.⁴⁴ Following exercise, core temperature increases, potentially slowing the core temperature drop required for sleep initiation.¹³ Increases in muscle tension, pain and psychological arousal are also contributing factors in negatively affecting athletes' sleep.^{12,36} For those engaging in high intensity sport, it is suggested that a minimum of three hours is needed post-activity for arousal levels to lower;¹⁶ this highlights the need for appropriate interventions to down-regulate arousal levels, in order to optimise sleep duration. Coaches should be mindful of scheduling to allow for potential later sleep times following evening training or competition, with start times the following day potentially beginning later to account for this.

Coaches have a duty of care to educate athletes about the importance of sleep to recovery, performance, cognition and overall well-being, both for the short and long term. Many adolescent athletes resort to repaying their sleep debt at weekends, resulting in a reduced psychomotor vigilance time on Mondays as compared to later in the week.⁴ Napping is a common strategy used by athletes to supplement insufficient night time sleep.⁴⁶ When dealing with unfavourable schedules, such as late night or early training, daytime napping can be an easy strategy to repay sleep debt, and has been shown not to affect subsequent night time sleep durations or quality.⁴⁶ Napping has been shown to enhance alertness and boost mood;^{18,24,32} it is a sleep strategy used by as many as 72% of collegiate athletes.⁴⁶ However, it is advisable to keep nap durations to less than 30 minutes in order to prevent getting into the deeper stages of sleep; keeping the nap short is likely to prevent grogginess upon waking.⁴⁸

It is time for a return to prioritising sleep, and education around sleep hygiene could be one way to address the sleep deficit that many athletes are suffering regularly.²³ Performance lifestyle coaching

and support is key, and education around time management and sleep hygiene are strategies that can help. Sleep hygiene is the term used to refer to the habits or routines performed leading up to sleep, the environment of sleep and the general preparation for sleep.¹⁹ Research by O'Donnell and Driller³⁶ found a single one-hour sleep hygiene education session during pre-season resulted in significant improvements to total sleep time for elite female athletes (mean $\pm$ SD; 22.3 $\pm$ 39.9 minutes, $p=0.01$); this is a promising find given the ease of application of this strategy for most coaches. Supporting this conclusion, the work of Otsuka et al⁴¹ concluded that sleep hygiene education is a low-cost, highly valid strategy to address sleep issues. However, Jenkins et al²¹ found that sleep hygiene education did not significantly improve sleep habits of elite rugby players during the competition season. The researchers attributed their findings to the fact that the competitive season has potentially greater stress and distraction than pre-season, and subsequently suggested that sleep hygiene education should be carried out in off-season or pre-season, to maximise the potential for changing sleep behaviours. Sleep hygiene adherence can be challenging for some athletes due to unfavourable schedules; therefore, having a complete picture of the athletes' schedule and current sleep practices prior to interventions is advised.²³

The following is intended as a list of starting action points for athletes to improve their sleep hygiene. Coaches are suggested to educate their athletes regarding these points in pre- or off-seasons. All the points are easy to implement without radical lifestyle changes, and require no additional equipment or cost.

Reduce technology use in the evening

Bedrooms are supposed to be a place of rest, but they have increasingly become filled with technology. The use of any screen not only increases the temptation to stay up later, thus reducing sleep duration, but it could also be disrupting sleep quality. Melatonin is a neurohormone which rises as darkness increases, raising sleep pressure.⁴⁰ This is controlled by a photopigment, called melanopsin: melanopsin is activated by light,

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specifically blue light, and suppresses melatonin synthesis, thus reducing sleep pressure.⁴⁰ Although many devices do now contain a blue light filter to avoid negatively impacting sleep, the use of such devices can still lead to over-arousal and give the brain too much stimulation at a time when it should be aiming to move towards relaxed drowsiness. In a study of 1,225 participants, 42% reported using their phones while they were in bed after they had turned the lights out.²⁵ The researchers went on to conclude that the use of electronic devices in bed reduced both sleep duration and quality. He et al¹⁵ conducted a study in which participants were asked to refrain from phone use for 30 minutes before bedtime. This simple strategy was continued for four weeks, at the end of which the researchers concluded that this was an effective intervention to reduce the time taken to fall asleep, sleep quality, sleep duration and memory. As such, athletes should be advised to refrain from phone use, or even turn them off, a minimum of 30 minutes before bedtime.

Keep bedtimes and wake times consistent

In 2017, Phillips et al⁴² created the 'sleep regularity index', defined as the percentage probability of an individual being asleep at two points apart within 24 hours. They found positive correlations between sleep regularity and academic performance, and stated that sleep regularity was as important as the number of hours an individual sleeps. Irregular sleep patterns, specifically inconsistencies with bedtime and wake times, are associated with later sleep onset time and shorter overall sleep duration.³³ The practice of regularity of bedtime and wake times is therefore advised wherever possible;²⁴ although travel and late competition times may affect this practice among the elite populations, it is likely to be easier for adolescent and recreational athletes to carry out consistently. Coaches should advise athletes, where possible, to have a regular bedtime and wake time, which should be prioritised as a regular commitment ahead of socialising or work

demands. For athletes travelling long-distance, sleep and wake times should be consistent, where possible, throughout the duration of the trip, and napping can be used to supplement sleep losses during time adjustments.

Wind down with yoga or mindfulness

Allowing at least 30 minutes to wind down before going to bed is key to relax the mind and body and prepare for sleep.³⁷ Practising gentle yoga – such as restorative yoga, Yin yoga, or Hatha yoga – before going to bed has been associated with increased sleep quality and duration, as well as reducing the time taken to fall asleep.¹¹ As previously mentioned, avoidance of screens for the final 30 minutes before bed is important and therefore activities such as yoga or gentle stretching could replace screen time.¹¹ Mindfulness, such as focused breathing, is advocated to down-regulate arousal levels, increasing parasympathetic nervous drive and reducing sympathetic activity^{28,29} and could be a useful strategy in successfully reducing the time taken to initiate sleep post-match. Li et al²⁷ assessed the use of mindfulness – specifically focusing on breath work – to reduce arousal following evening exercise and to improve sleep quality. They concluded that practising mindfulness was effective in reducing arousal levels and improved overall sleep quality. The researchers used only a brief



six-minute induction to the breathing techniques, which was sufficient to elicit positive results. This serves to highlight the ease of administration of such interventions for coaches, and is potentially a useful tool for coaches to add into athletes' education.

Reduce caffeine and alcohol intake

Caffeine is frequently consumed in the form of coffee and tea, as well as being a common feature of energy drinks marketed at a sporting population. Consuming caffeine in the evening may disturb circadian timing, negatively affecting sleep quality and duration, and hamper the sleep-wake physiology interplay.⁴³ Caffeine levels sufficient to prevent tiredness are likely to remain in the blood some 3-4 hours post ingestion;¹ however, the rate at which caffeine is metabolised is dose-dependent and affected by factors including age, gender and body mass.³⁵ Caffeine has been shown to reduce the time spent in deep sleep,⁴³ reducing the recovery potential of the sleep process. It is therefore recommended for athletes to keep caffeine consumption to the morning, in order to allow the substance to be metabolised and to prevent any negative impact on subsequent sleep.

The consumption of alcohol results in sleep being more consolidated in the first half of the night and more disturbed in the second half of the night, and less time is usually spent in deep sleep.⁹ At all doses, the onset of deep sleep is significantly delayed,⁹ potentially impacting the physiological and psychological recovery potential of sleep. For this reason, the avoidance of alcohol in the evening should be advised.

Conclusion

The above four strategies are easy for coaches to advise and should be relatively easy for athletes to implement. Although travel and competition schedules may prevent some athletes achieving unbroken consistency with sleep hygiene strategies, particularly in terms of achieving sleep regularity, sleep hygiene strategies can still be utilised in order to improve overall sleep duration. Improving sleep hygiene may positively impact the sleep quality and duration of athletes and may be one strategy that could reduce the sleep debt that many athletes are facing daily: it may also result in ultimately improving performance, reducing injury risk and supporting overall well-being.

AUTHORS' BIOGRAPHIES



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Julie runs a consultancy from her own private studio, working with adolescent and senior athletes from a range of sports. Julie previously led the strength and conditioning programme at a prestigious private school, a role which she did for over 10 years.



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Edward is a lecturer in strength and conditioning at the University of Gloucestershire, currently undertaking a PhD into the biomechanics of striking in combat sports. He graduated from Middlesex University with an MSc in strength and conditioning in 2010 and went on to work for Performance Hertfordshire, followed by the English Institute of Sport, where he led first the GB Wheelchair Rugby and later the England Netball programmes. Between 2017-2020 he managed a neurorehabilitation centre specialising in spinal injuries.

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