



# SLEEP AND ATHLETES

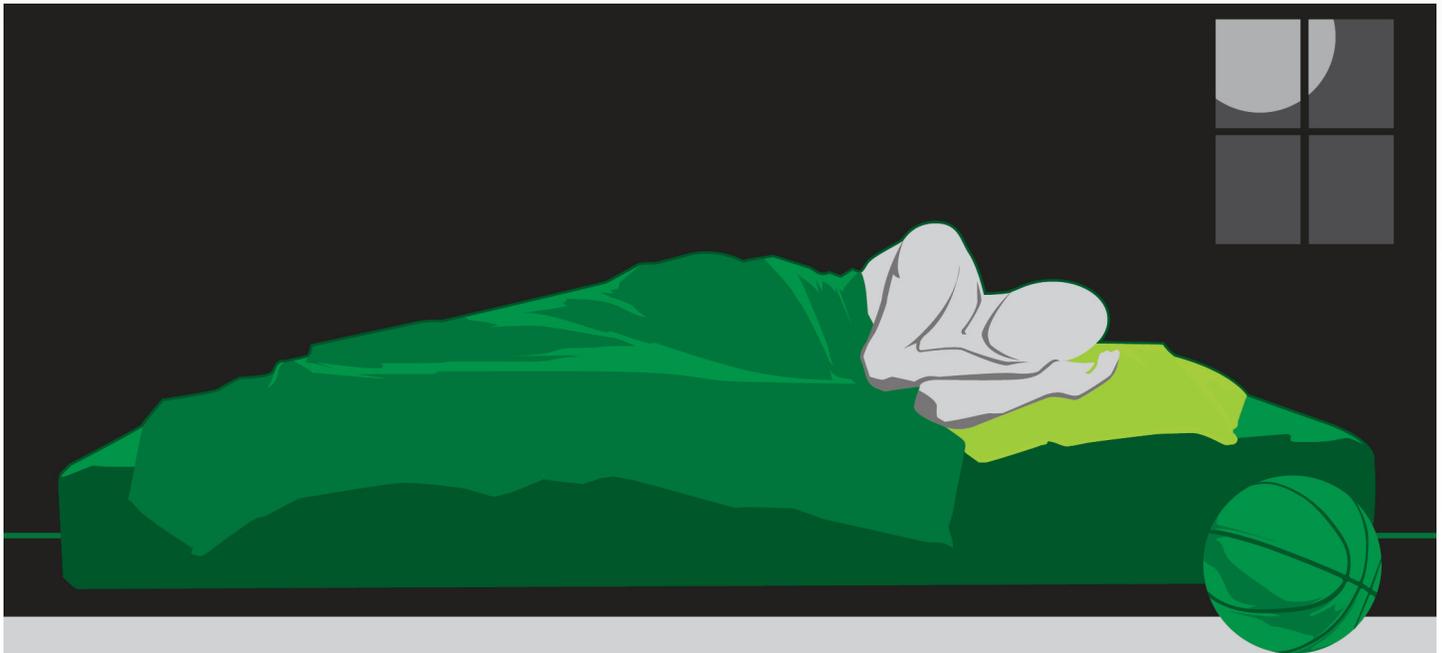
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## INTRODUCTION

Sleep is extremely important for performance, learning, development and physical and mental health.<sup>3</sup> Some of the consequences of inadequate sleep include: a reduction in academic performance, mood disturbance, increases in risk-taking behaviour and drowsy driving.<sup>11</sup> From an athletic perspective, reductions in performance, decision-making ability, learning and cognition can occur alongside reductions in immune function and an increased susceptibility to weight gain. While this chapter will outline the importance of sleep for all athletes,

additional focus will be placed on the adolescent athlete. It is becoming increasingly clear that adolescence (ages 12–18 yrs) is a period of development where sleep is particularly important. What is also becoming obvious is that many adolescents do not obtain the recommended amount of sleep.<sup>11</sup> This chapter will discuss consequences of reduced sleep, how much sleep is required, reasons for poor sleep and strategies that can be utilized to enhance sleep quality, and quantity in athletes and adolescents.

## KEY FINDINGS



- Decreased sleep quality and quantity can impair performance in basketball players.
- Athletes may take longer to fall asleep and have lower sleep efficiency than non-athletes.
- Social demands, technology and caffeine can interfere with total sleep time.
- Recent evidence suggests that enhancing sleep may also enhance performance in basketball players.
- Adolescents require greater than 9 hours per night of sleep, yet many adolescents sleep significantly less than 9 hours per night.
- To create optimum sleep quality and quantity, maintain a regular sleep routine to ensure an appropriate sleep environment.
- To assess sleep, begin with a detailed sleep diary.

## CONSEQUENCES OF REDUCED SLEEP ATHLETIC PERFORMANCE

While there is limited research on exercise performance and sleep, a small number of studies have examined the effect of partial sleep deprivation on athletic performance in adults. Reilly and Deykin<sup>13</sup> reported decrements in a range of psychomotor functions after only one night of restricted sleep; however, muscle strength, lung power and endurance running were unaffected.<sup>13</sup> Reilly and Hayles<sup>14</sup> reported similar effects in females following partial sleep deprivation, with gross motor functions being less affected by sleep loss than tasks requiring fast reaction times.<sup>14</sup> Reilly and Percy<sup>15</sup> found a significant effect of sleep loss on maximal bench press, leg press and dead lifts, but not maximal bicep curl. Submaximal performance, however, was significantly affected on all four tasks and to a greater degree than maximal efforts. The greatest impairments were found later in the protocol, suggesting an accumulative effect of fatigue from sleep loss.<sup>15</sup>

From the available research it appears that submaximal prolonged tasks may be more affected than maximal efforts, particularly after the first two nights of partial sleep deprivation.<sup>15</sup>

### OTHER CONSEQUENCES

There are a number of other biological functions that can be altered following sleep deprivation. Changes in glucose metabolism and neuroendocrine function as a result of chronic, partial sleep deprivation may result in alterations in carbohydrate metabolism, appetite, food intake, and protein synthesis. Ultimately these factors can all negatively influence an athlete's nutritional, metabolic and endocrine status and hence potentially reduce athletic performance.

### EFFECTS OF SLEEP EXTENSION

Another means of examining the effect of sleep on performance is to extend the amount of sleep an athlete receives and determine the effects on subsequent performance. Mah et al,<sup>9</sup> instructed six basketball players to obtain as much extra sleep as possible following two weeks of normal sleep habits. Faster sprint times and increased free-throw accuracy was observed at the end of the sleep extension period. Mood was also significantly improved, with increased vigour and decreased fatigue.<sup>9</sup> While limited, this data suggests that increasing the amount of sleep an athlete receives may significantly enhance performance.

### EFFECTS OF NAPPING

Athletes suffering from some degree of sleep loss may benefit from a brief nap, particularly if a training session is to be completed in the afternoon or evening. Waterhouse et al<sup>16</sup> are one of the only groups to investigate the effects of a lunchtime nap on sprint performance following partial sleep deprivation (4 h of sleep). Following a 30-min nap, 20-m sprint performance was increased (compared to no nap), alertness was increased, and sleepiness was decreased. In terms of cognitive performance, sleep supplementation in the form of napping has been shown to have a positive influence on cognitive tasks following a night of sleep deprivation (2 h).<sup>12</sup> Naps can markedly reduce sleepiness and can be beneficial when learning skills, strategy or tactics.<sup>12</sup> Napping

may be beneficial for athletes who have to routinely wake early for training or competition and for athletes who are experiencing sleep deprivation.<sup>16</sup>

### HOW MUCH SLEEP ARE ATHLETES GETTING?

According to a 2005 Gallup Poll in the USA, the average self-reported sleep duration of healthy individuals is 6.8 h on weekdays and 7.4 h on weekends.<sup>7</sup> However, the sleep habits of elite athletes have only recently been investigated. Leeder et al<sup>8</sup> compared the sleep habits of 26 elite athletes from Olympic Sports (Canoeing, n=11; Diving, n=14; Rowing, n=10; Short-track speed skating, n=11) using actigraphy over a four-day period to that of age- and sex-matched non-sporting controls. The athlete group had a total time in bed of 8:36 ± 0:53 hr:min, compared to 8:07 ± 0:20 in the control group. Despite the longer time in bed, the athlete group had a longer sleep latency (time taken to fall asleep) (18.2 ± 16.5 min vs. 5.0 ± 2.5 min), a lower sleep efficiency (estimate of sleep quality) than controls (80.6 ± 6.4% vs. 88.7 ± 3.6%), resulting in a similar time asleep (6:55 ± 0:43 vs. 7:11 ± 0:25 hr:min). The results demonstrated that while athletes had a comparable quantity of sleep to controls, significant differences were observed in quality of sleep between the two groups.<sup>8</sup>

While the above data was obtained during a period of normal training without competition, athletes may experience disturbed sleep prior to important competition or games. Erlacher et al<sup>4</sup> administered a questionnaire to 632 German athletes to assess possible sleep disturbances prior to competition. Of these athletes, 66% (416) reported that they slept worse than normal at least once prior to an important competition. Of these 416 athletes, 70% reported problems falling asleep, 43 reported waking up early in the morning and 32% reported waking up at night. Factors such as thoughts about competition (77%), nervousness about competition (60%), unusual surroundings (29%) and noise in the room (17%) were identified as reasons for poor sleep.<sup>4</sup>

In a study from the Australian Institute of Sport, athletes and coaches ranked sleep as the most prominent problem when they were asked about the causes of fatigue/tiredness.<sup>5</sup> Sleep characteristics ranked first when athletes were asked about the aspects of the clinical history that they thought were important.

Therefore, it appears that sleep disturbances in athletes can occur at two time points: 1) prior to important competitions and 2) during normal training. This sleep disruption during normal training may be due to poor routine as a consequence of early training sessions, poor sleep habits (i.e., watching television in bed), nocturnal waking to use the bathroom, caffeine use, and excessive thinking/worrying/planning. While not documented in the literature, anecdotal evidence also suggests that athletes such as soccer players who compete at night also have significant difficulties falling asleep post competition.

### HOW MUCH SLEEP DO ADOLESCENTS NEED?

Research suggests that the sleep needs of adolescents do not differ from that of younger children.<sup>10</sup> Evidence suggests that when adolescents are allowed to sleep as much as they want, they sleep for an average of 9.25 hrs per night.<sup>2</sup> Further, during mid-puberty, there is an increased desire to sleep during the day even when sufficient sleep occurred at nighttime.<sup>2</sup> From the literature available, it appears that adolescents require a minimum of 9 hrs per night of sleep.

### HOW MUCH SLEEP ARE ADOLESCENTS GETTING?

Despite the recommendation that 12–18 year olds obtain a minimum of 9 hrs of sleep per night, research shows that adolescents sleep between 7.5 and 8.5 hrs per night.<sup>11</sup> While there is certainly going to be individual differences, it is clear that many adolescents are not meeting the minimum requirements for the recommended hours of sleep.

### CAUSE OF POOR SLEEP IN ADOLESCENTS

There are a number of factors that may explain the poor sleep observed in adolescents, and these can be broken down to internal and external factors.

#### INTERNAL FACTORS

A shift in circadian rhythm occurs during puberty as a result of changes in the timing of melatonin release.<sup>11</sup> Melatonin is a hormone that when released precipitates sleepiness. The delay in release of melatonin in adolescents results in the later feelings of sleepiness, the later subsequent bedtime, and the later wake-up time.

#### EXTERNAL FACTORS

As mentioned above, adolescents have a propensity to go to bed later and wake up later the following morning based on biological factors. However, due to school and extracurricular activities, most adolescents do not have the opportunity to wake later in the morning on school nights and potentially weekends, depending on their sporting schedule. This significantly reduces their sleep opportunity.

Adolescence is usually associated with increased social demands. This can include time spent “in person” or electronically. There is an increasing trend for adolescents to communicate via telephone, SMS, email, Facebook and Twitter into the late evening. As many adolescents experience sleep deprivation, they have increased levels of daytime sleepiness, which may result in caffeine and/or energy drink intake to feel alert and more awake. Caffeinated beverages can have a significant impact on the time taken to fall asleep.

### WHEN DO ADOLESCENTS SLEEP?

The changes that occur with development result in adolescents feeling sleepy later in the evening when compared to children.<sup>11</sup> Specifically, sleep onset time (time at which a person falls asleep) occurs later in the evening, and wake-up time is later in the morning.<sup>6</sup> The reasons for this delay will be discussed below; however, the result of the delay is most often reduced total sleep time due to the requirement to attend school or training the following morning.

One study found that in a group of 20 healthy adolescents, average sleep onset time was 12:44 a.m. with a rise time of 8:18 a.m., resulting in 7.7 hrs of sleep.<sup>1</sup> In addition, adolescents tend to have more variable sleep patterns across the week when compared to children and adults.<sup>6</sup> This is evidenced by significant differences between school-night and weekend sleep onset time, wake-up time and total sleep times. Reports suggest that adolescents delay their bedtime by 1–2 hrs on weekends, and they may sleep in 3–4 hrs later on weekends compared to school nights.<sup>10</sup> This typically results in more sleep obtained on weekends, as the adolescent is able to fit his or her sleep pattern to their more favoured bedtime and wake-up time due to no influence of school schedules. However, this also results in significantly altered routines across a 7-day week.

### HOW TO ASSESS SLEEP

A simple sleep diary in which information on bedtime, wake-up time, total sleep time, caffeine consumed prior to sleep, activities performed before going to bed, perceptions of sleep quality, and daytime functioning is recorded can be very useful. The National Sleep Foundation (<http://www.thensf.org/>) has excellent resources including diaries for adults and teens, which can be helpful to gain insight into sleep habits. A sleep clinician can conduct a detailed sleep history and assessment to determine if the athlete has a clinical sleep disorder. Psychiatric and medical conditions may need to be considered due to their interaction with sleep. A sleep clinician may conduct sleep assessments using actigraphy (wearing of a wristwatch to detect movement during sleep) or polysomnography (overnight stay in a sleep laboratory to measure brain activity and other physiological functions).

### SOLUTIONS TO SLEEP PROBLEMS

Many of the strategies suggested for optimising sleep in adults also apply to the adolescent. However, there are some specific tips and tricks that may be useful for this age group. Table 1 includes some of the guidelines from The National Sleep Foundation (<http://www.thensf.org/>).

**TABLE 1. SLEEP SOLUTIONS FROM THE NATIONAL SLEEP FOUNDATION  
[HTTP://WWW.THENSF.ORG/]**

- Naps can help pick you up and make you work more efficiently, if you plan them right. Naps that are too long or too close to bedtime can interfere with your regular sleep.
- Make your room a sleep haven. Keep it cool, quiet and dark. If you need to, get eyeshades or blackout curtains. Let in bright light in the morning to signal your body to wake up.
- No pills, vitamins or drinks can replace good sleep. Consuming caffeine close to bedtime can hurt your sleep, so avoid coffee, tea, soda/pop and chocolate late in the day so you can get to sleep at night. Nicotine and alcohol will also interfere with your sleep.
- When you are sleep deprived, you are as impaired as when driving with a blood alcohol content of .08%, which is illegal for drivers in many states. Drowsy driving causes over 100,000 crashes each year. Recognize sleep deprivation and call someone else for a ride. Only sleep can save you!
- Establish a bed-and-wake-time and stick to it, coming as close as you can on the weekends. A consistent sleep schedule will help you feel less tired since it allows your body to get in sync with its natural patterns. You will find that it's easier to fall asleep at bedtime with this type of routine.
- Don't eat, drink, or exercise within a few hours of your bedtime. Try to avoid the TV, computer and telephone in the hour before you go to bed. Stick to quiet, calm activities, and you'll fall asleep much more easily.
- If you do the same things every night before you go to sleep, you teach your body the signals that it's time for bed. Try taking a bath or shower (this will leave you extra time in the morning), or reading a book.
- Try keeping a diary or to-do lists. If you jot notes down before you go to sleep, you'll be less likely to stay awake worrying or stressing.
- Most teens experience changes in their sleep schedules. Your internal body clocks can cause you to fall asleep and wake up later. You can't change this, but you can participate in interactive activities and classes to help counteract your sleepiness. Make sure your activities at night are calming to counteract your already heightened alertness.
- Sleep, you'll be less likely to stay awake worrying or stressing.

## SUMMARY

Sleep is one of the body's most important biological functions with roles in performance, cognition, learning, development and mental and physical health. While there are numerous consequences as a result of inadequate sleep, identifying sleep problems and following the recommended sleep guidelines can help ensure sporting performance is maximized.

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