Fencers Club London

Est 2015

Raising The Game

SLEEP AND THE ATHLETE: NARRATIVE REVIEW AND 2021 EXPERT CONSENSUS RECOMMENDATIONS

taken from:
Neil P Walsh et al.

by Pawel Osmanski

NEED FOR SLEEP

TWO TYPES:

- REM
- NON-REM (Divided into 3 stages ‘light’ sleep in stages 1 and 2, through to ‘deep’ sleep in stage 3.

The duration and composition of normal sleep changes across the life cycle. At the ages most relevant to aspiring and established athletes, a sleep **of 8–10hours for an adolescent (aged 15 years)** contains approximately 57% light sleep, 22% deep sleep and 21% REM sleep; and a sleep of **7–9 hours for a young adult (aged 30 years)** contains approximately 61% light sleep, 16% deep sleep and 23% REM sleep.

THE CICRADIAN RHYTHM

All living organisms, at least those who survive more than few days, exhibit a biological rhythm dictated by the rotation of the earth. The Circadian rhythm describes an internal biological clock follows the 24 hour day/night cycle it is independent on the passage of night and day.

The cells that control circadian rhythm are found in a structure called suprachiasmatic nucleus (SCN) and consist of 20,000 nerve cells which are responsible for the daily cycling behaviour of our body and brain.

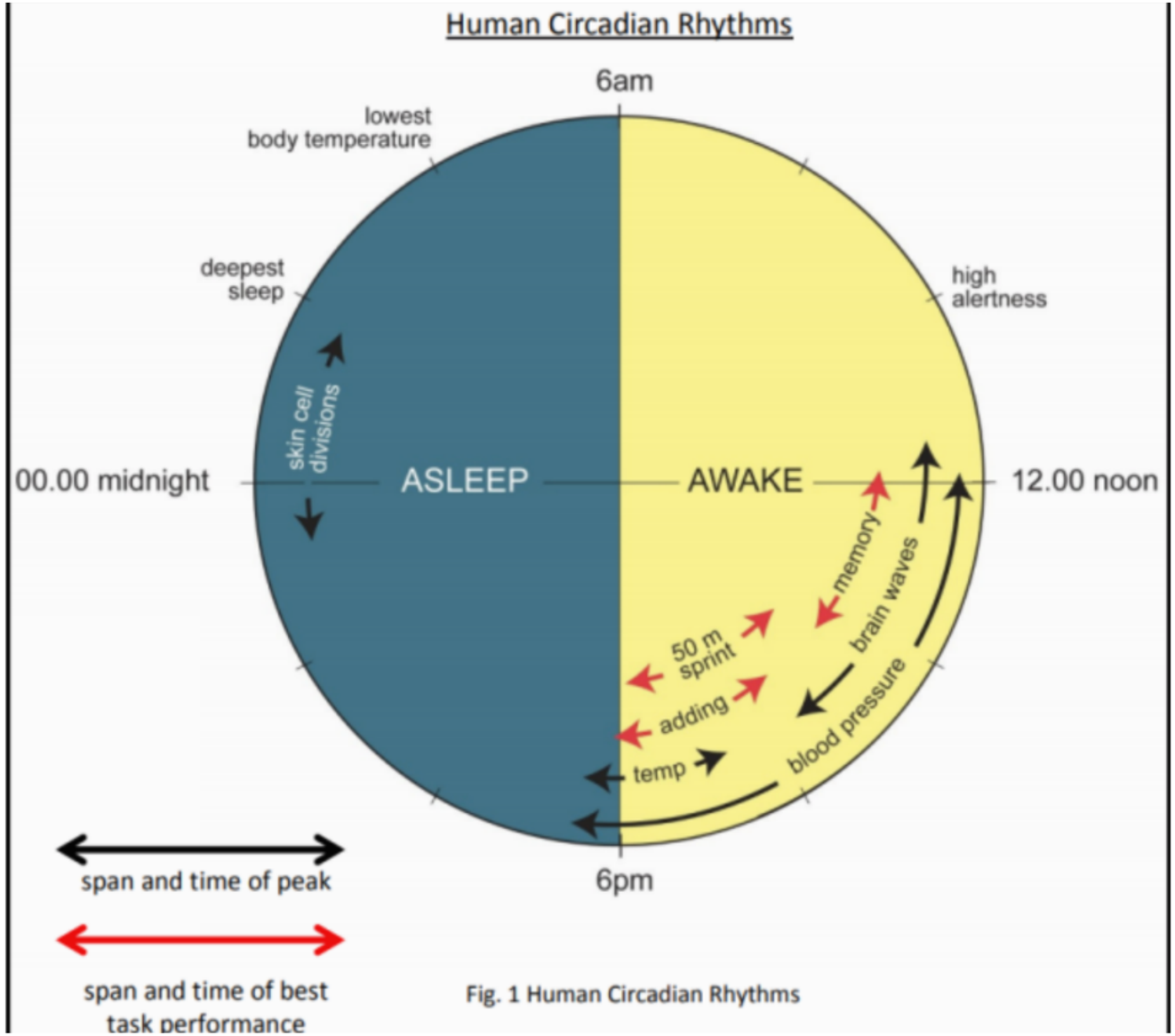


Fig. 1 Human Circadian Rhythms

Source -https://www.lenscience.auckland.ac.nz/en/about/teaching-and-learning-resources/senior-biology-learning-resources/circadian-rhythms-keeping-time/what-are-circadian-rhythms.html

CYCLING OF BODY FUNCTIONS (LEFT) AND HORMONES (RIGHT) OVER A 24-HOUR PERIOD

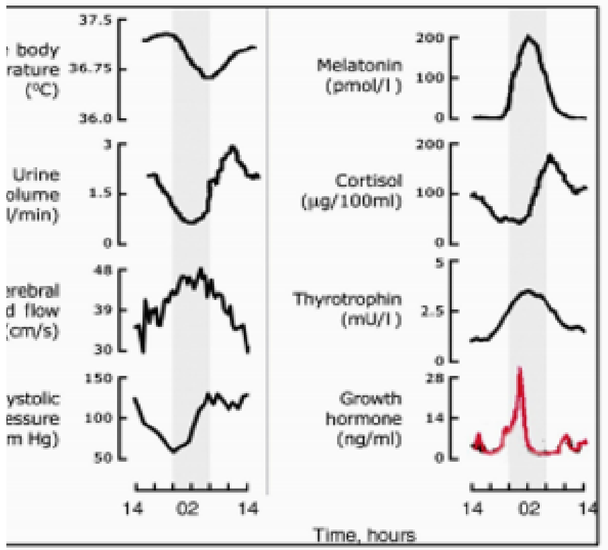


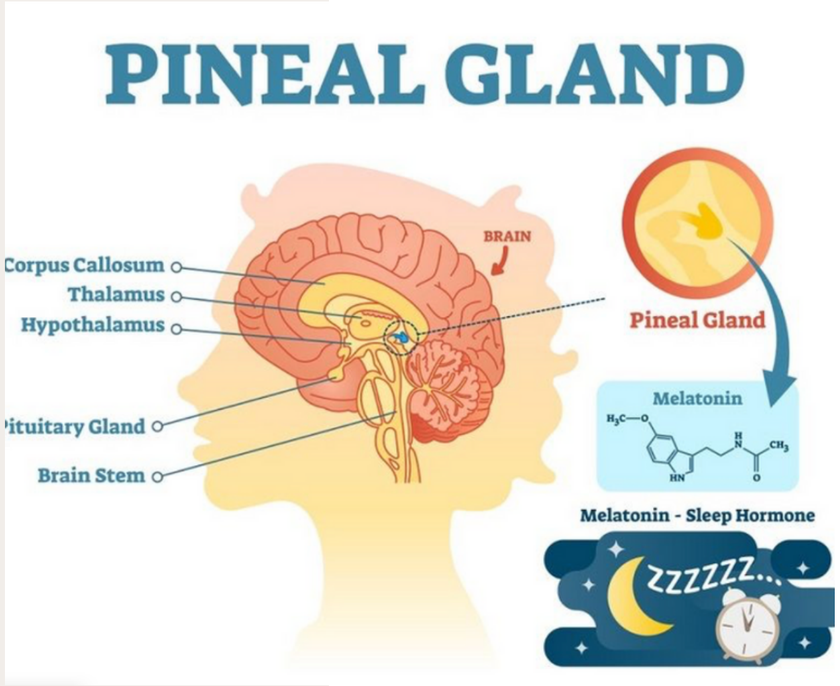
Figure 1 Cycling of various bodily functions (left) and hormones (right) over a 24-hour period.

Source: WHY WE SLEEP – prof. Matthew Walker

M E L A T O N I N

Behind the SCN lies a very small structure called the pineal gland, which secretes a hormone called melatonin.
(Helps set sleep cycles based on the light received in the eyes.)

The SCN signals the brain to release melatonin and this signals the body it is time to sleep.



Source - Source: https://biologydictionary.net/pineal-gland/

ADENOSINE AND SLEEP PRESSURE

All the cells in the body require energy and that come in shape of the adenosine triphosphate (ATP). As the ATP is broken down producing energy to power the body, it loses it’s phosphate and becomes adenosine.

Therefore, after a busy day there is a build-up of adenosine in the body, and in particular in the brain. The increase of adenosine creates a “sleep pressure”, signalling a brain to sleep.

THE SLEEP-WAKE CIRCADIAN RHYTHM ALONGSIDE THE SLEEP PRESSURE CAUSED BY ADENOSINE

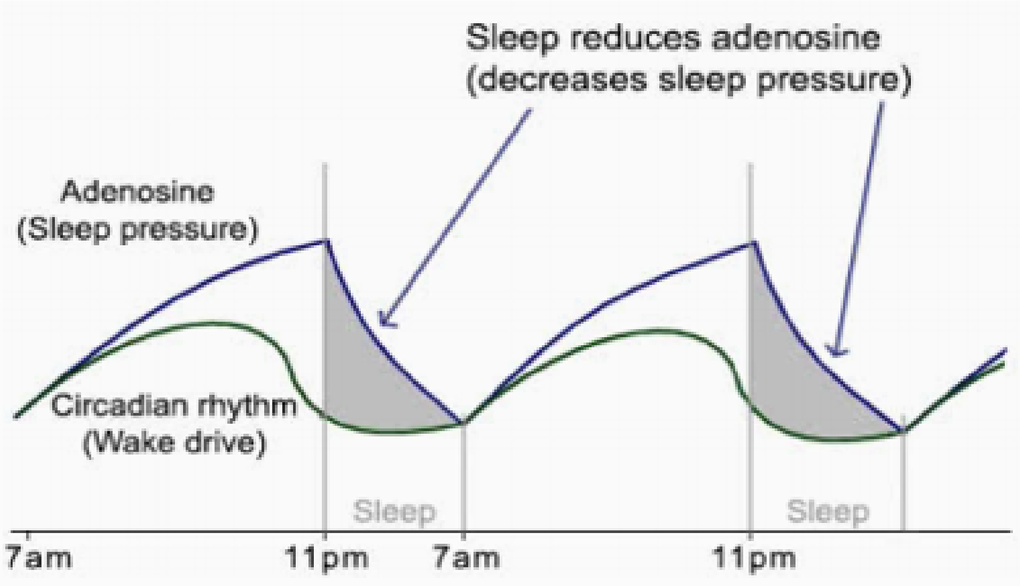


Figure 2 The sleep-wake circadian rhythm alongside the sleep pressure caused by adenosine.

CHRONOTYPES

Chronotype is a genetically determined predisposition that modifies each individual’s preference to be most active in the morning (‘morningness’), the middle of the day (neither type) or in the evening (‘eveningness’).57 113 In relation to chronotype distribution, as defined by the ‘morningness–eveningness’ preference continuum,114 a skew towards ‘morningness’ has been reported in elite athletes.*5*

DAILY VARIATIONS IN COMPONENTS OF SPORTS PERFORMANCE BEFORE TRAVEL

Before considering the consequences of jet lag for sporting performance, it is essential to note that there are specific times of day when rhythms associate with peak sporting performance.

Tasks **requiring complex hand-eye-coordination skill,** such as the accuracy of tennis or badminton serves, **peak around 13:00– 15:00**. They have two components to the rhythm, a circadian influence parallel to core body temperature, but also a time-awake effect where performance decreases with time awake and mental fatigue (synchronous with the sleep-wake cycle).

JET LAG

There have been several investigations on chronobiotics, agents that can cause phase adjustment of the body clock:

Employed with various levels of success.*138*

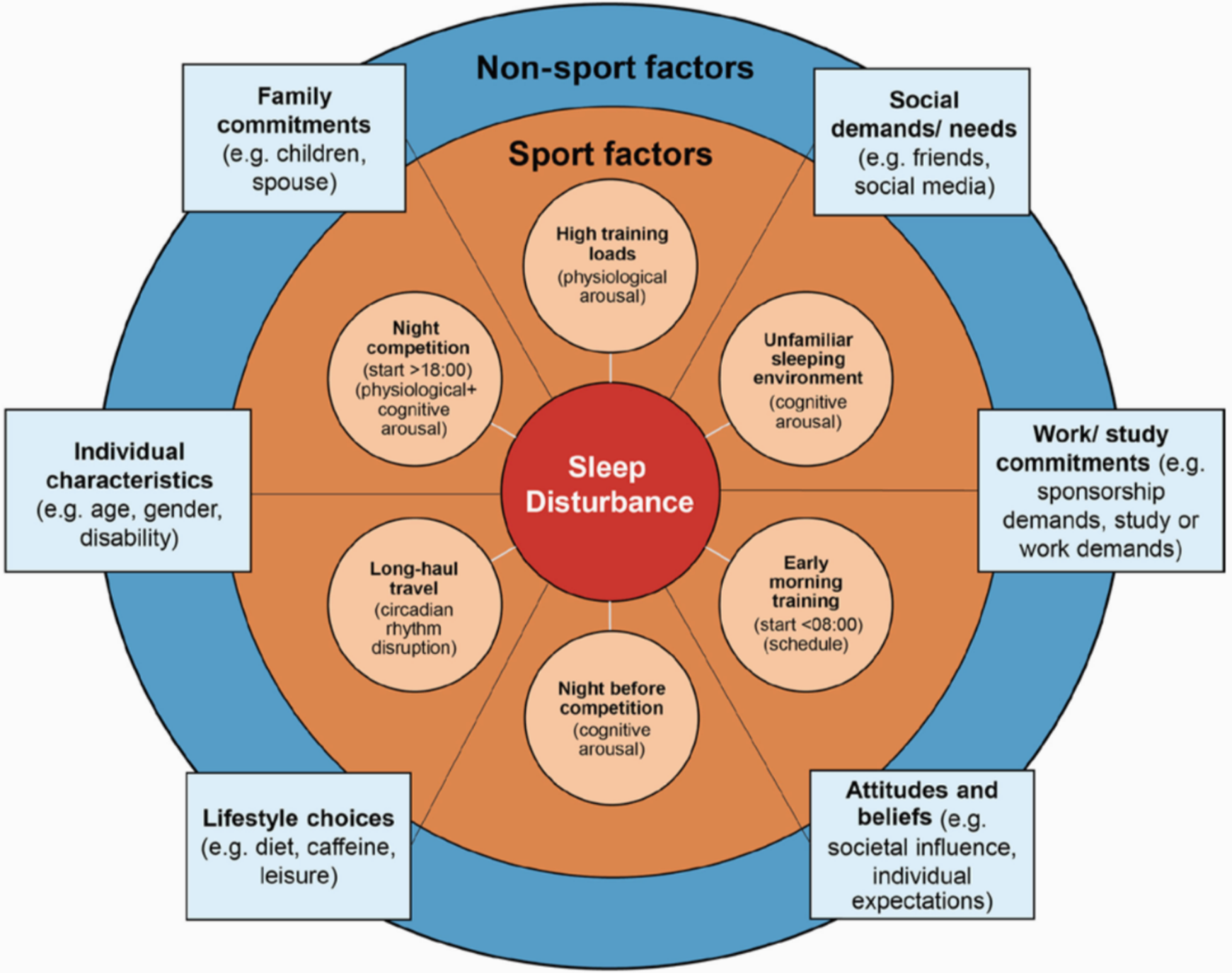
- Either preflight,139 after arrival using melatonin,*140 141*
- Bright light,*142 143* (250–10 000 lux)
- Exercise*14*
- Combination of prearrival and postarrival melatonin.*140 141 145*

SLEEP TOOLBOX

Encouragingly, sleep education presentations ranging in duration from **30 to 60min have been shown to increase sleep duration by an average of 20–90min.*158–160***

Improvements in sleep were not maintained at follow-up 1 month later.*159*

More frequent sleep education sessions throughout the season, along with frequent check-ins with the athlete about their sleep, may be required to maintain the benefit.


Non-sport factors
Sport factors
Family commitments (e.g. children, spouse)
Social demands/ needs (e.g. friends, social media)
High training loads (physiological arousal)
Night competition (start >18:00) (physiological+ cognitive arousal)
Unfamiliar sleeping environment (cognitive arousal)
Individual characteristics (e.g. age, gender, disability)
Sleep Disturbance
Work/ study commitments (e.g. sponsorship demands, study or work demands)
Long-haul travel (circadian rhythm disruption)
Early morning training (start <08:00) (schedule)
Night before competition (cognitive arousal)
Lifestyle choices (e.g. diet, caffeine, leisure)
Attitudes and beliefs (e.g. societal influence, individual expectations)

CAUTION WHEN USING SLEEP MONITORS

Table 1 for strengths and weaknesses of sleep monitors. Caution must be taken to understand the impact of the feedback from
the device to the individual athlete.

Some athletes may become preoccupied with their sleep monitor data, which may increase anxiety around sleep and result in worse sleep.*169*

Another important consideration is privacy, as sleep monitoring device apps may contain personal and sensitive information; it is important to consider who has access to this information. *170*

Practitioners must weigh both the pros and cons of using sleep monitoring technology for the athletes they are working with.

Table 1 Evaluation of tools for sleep assessment in athletes

Tool	Strengths	Weaknesses	Practicality of use
Objective tools			
Polysomnography	Gold standard for sleep assessment. Determination of sleep stages and spectral power. Diagnosis for sleep disorders.	Expensive, intrusive and typically one-time assessment. Typically performed in laboratory in an unnatural sleep environment. Expertise required for interpretation.	Laboratory or home-based systems. Mainly used for sleep disorders diagnosis and research.
Research-grade actigraphy devices	Current standard for sleep assessment in the athletic field setting. Non-intrusive and less expensive than polysomnography. Provides long-term monitoring, provides data on routine. Validated against polysomnography.	Does not measure sleep stages accurately. Not suitable for diagnosis of sleep apnoea. Device is easily removed. Requires expertise for analysis. More expensive than commercial devices. Difficulties with assessing insomnia. Typically overestimate total sleep time and sleep efficiency relative to polysomnography. Some devices do not disclose algorithms.	Affords long-term monitoring in a realistic setting but requires some sleep expertise.
Commercial wearable devices	Non-intrusive and less expensive than polysomnography and research-grade Actigraphs. Provides long-term monitoring and data on routine. Increases sleep awareness, promotes athlete-staff interaction and provides immediate feedback. May prompt further evaluation.	Does not measure sleep stages accurately, unless validation supports this function. Not suitable for diagnosis of most sleep disorders under normal conditions. Device is easily removed. May cause increase in anxiety/worry around sleep. Immediate feedback could influence/be detrimental to performance. Typically overestimate total sleep time and sleep efficiency relative to polysomnography. Most devices do not disclose algorithms or provide access to raw data. Many devices have limited validation.	Affords long-term monitoring in a realistic setting but device must be validated. Ability to adjust feedback important, when required.
Nearables	Non-intrusive, placed on or near the bed, accessible, generally low cost and affords long-term monitoring. May increase sleep awareness, promote athlete-staff interaction and provide immediate feedback. May prompt further evaluation.	Lack of sufficient validation, device not worn by individual, may increase screen time, may increase anxiety/worry around sleep. Immediate feedback could influence/ be detrimental to performance. Little information on algorithms used and most devices do not provide access to raw data.	Lack of validation; therefore, questionable utility.
Subjective tools			
Sleep diaries	Non-intrusive and cost effective. Affords long-term monitoring and provides information on routine, subjective information.	Burdensome and may be influenced by recall bias. Overestimates sleep duration and efficiency relative to polysomnography.	Affords long-term monitoring in a realistic setting but takes effort from the athlete and the practitioner to collect the data. For example, Consensus Sleep Diary.
Sleep questionnaires	Cost and time effective, can provide behaviour information.	May be influenced by response bias, lack of standardised data for athletes.	Questionable utility without validation in athletes. For example, PSQI, ISI, KSS, SSS, ESS, SHI, LSEQ, VAS, MEQ, subjective ratings.
Athlete-specific sleep questionnaires	Cost and time effective, can identify athletes who need further sleep assessment, can provide behaviour information, validated in athletes.	May be influenced by response bias, lack of validation with polysomnography.	Can be used as an initial clinical tool (ASSQ), and a way to identify maladaptive sleep behaviours (ASBQ). See figure 2 for specifics. Additional questionnaires needed to be developed for athlete specific assessment.

GOOD SLEEP HYGIENE

Sleep hygiene includes the habits necessary to have good sleep quality and daytime alertness. Research has shown that having good sleep hygiene can improve sleep quality.*168*

Common sleep hygiene habits include avoiding **stimulants (eg, caffeine), alcohol,** and **heavy meals too close to bedtime,** adequate exposure to **natural light in the morning**, not lying in bed awake for long periods of time, having a **relaxing bedtime routine** and having a sleep environment conducive to sleep which is **cool, dark and quiet.**

PROTECT YOURSELF FROM BLUE LIGHT AT NIGHT

Use dim red lights for night lights. Red light is less likely to shift circadian rhythm and suppress melatonin.

Avoid looking at bright screens beginning two to three hours before bed. If you use a lot of electronic devices at night, consider wearing blue-blocking glasses or installing an app that filters the blue/green wavelength at night.

Expose yourself to lots of bright light during the day, which will boost your ability to sleep at night, as well as your mood and alertness during daylight.

DAYTIME SLEEP QUANTITY (NAPS)

Improvements in **alertness, concentration, motor performance and mood.*161***
(For those athletes who may have rigid early morning training times and cannot get enough night-time sleep, a nap during the day can supplement limited night-time sleep.*1*)

1. A shorter window to nap, durations of <30 min are recommended so athletes do not have sleep inertia (ie, grogginess) from getting into the deeper stages of sleep.

2. Athletes should consider the benefits of taking a 15–20 min ‘coffee-nap’ in the mid-afternoon. **(Caffeine consumed in doses of 150–200mg just prior to a mid-afternoon nap (hence ‘coffee-nap’) has been shown to be an effective countermeasure to mid-afternoon sleepiness (the ‘postlunch dip’).*163 164***

3. On wakening, exposure to bright light and face washing are also recommended additions to the nap routine.*164*
Athletes can set an alarm about 10 min longer than the duration of the nap in order to factor in the amount of time to fall asleep. Relaxation and breathing techniques can help the athlete to fall asleep. Athletes should avoid naps altogether if they have problems falling asleep at night.

SLEEP BANK

Sleep extension has a potential to improve athlete performance and mood and reduce stress level.

This tool may be a good way to **ease anxiety leading into an important competition**. By getting more sleep prior to an important competition, athletes can have confidence knowing that a poor night's sleep the night before the competition should not affect their performance. The period of banking sleep does not have to be months, even **just 1 week shown to improve performance**.

BANKING SLEEP AND SLEEP EXTENSION

Getting more sleep (‘banking sleep’) before a period of anticipated sleep loss may benefit performance. The sleep extension approach involves scheduling a longer sleep opportunity than normal, usually a window of **9–10hours where there is a protected time for sleep.**

One study in collegiate basketball players showed that sleep extension, comprising a 10-hour time in bed each night over a time frame of 5–7weeks, improved reaction time, sprint times, mood and free-throw shooting accuracy.*38*

Research is required to determine whether the purported benefits of sleep extension can be realised with shorter additional nightly sleep and/or over a shorter time frame, particularly in athletes identified with sleep insufficiency.

	Age Range	Recommended Hours of Sleep
Newborn	0-3 months old	14-17 hours
Infant	4-11 months old	12-15 hours
Toddler	1-2 years old	11-14 hours
Preschool	3-5 years old	10-13 hours
School-age	6-13 years old	9-11 hours
Teen	14-17 years old	8-10 hours
Young Adult	18-25 years old	7-9 hours
Adult	26-64 years old	7-9 hours
Older Adult	65 or more years old	7-8 hours

NIGHT-TIME SLEEP QUANTITY

A range of 7–9 hours is appropriate for healthy adults and 8–10 hours for teenagers166; however, experts speculate that athletes need more to recover from the physical and psychological demands of the sport.*167*

The amount of sleep athletes get may need to increase depending on the training load of the sport and the age of the athlete.

SOURCE - https://www.sleepfoundation.org/how-sleep-works/how-much-sleep-do-we-really-need

WIND DOWN FOR AT LEAST 30 MINUTES

Examples of ways to get into the right frame of mind for sleep:

1. Quiet reading
2. Low-impact stretching,
3. Listening to relaxing music
4. Relaxation exercises

Same fundamental tips for getting better rest:
CDC*1*, the National Institutes of Health*2*, the National Institute on Aging*3*, and the American Academy of Family Physicians*4*

SOURCE - https://www.sleepfoundation.org/sleep-hygiene/healthy-sleep-tips

THE BENEFITS OF SLEEP FOR THE BRAIN

SLEEP BEFORE LEARNING:
Sleep transfers memories from the Hippocampus (short term storage) to the Cortex (long term), so the hippocampus is free to store new information.

Study – two groups (nap and non- nap group), both had a session of learning designed to be taxing on the hippocampus, one group then had a 90-min nap, whilst the other stayed awake. Later both groups had another session of learning new facts. Results: those who stayed awake had significantly worse results at learning, but their concentration remained the same, whereas the nap group performed better and improved their capacity for facts. 20% increase over non nap group.

Sleep for Other Types of Memory:
Skill memory (or muscle memory, i.e. riding a bike)
Stage 2 NREM sleep (especially during the last 2 hours of sleep) is linked with skill-related memory boost.
Taking naps before training or competing can improve motor memory and reduce risk of injury – Usain Bolt takes naps before breaking world records.

Graph that links number of hours of sleep to risk of injury (negative correlation).

SLEEP DEPRIVATION AND THE BRAIN

Maintaining stable 8-hour sleep = better performance

Study shows that after 1 night of no sleep, lapses of concentration increased by 400% (microsleeps) and continued to escalate after 2nd and 3rd nights of study. After 4 hours of sleep for 6 nights, results as bad as no sleep for one night. **6 hours sleep for 10 days = 1 night no sleep.**

Operating on less than 5 hours of sleep increases risk of crash 3x.

3 nights of full recovery sleep is needed to restore brain functions (more than just a weekend).
More than 56 million Americans admit to struggling to stay awake at the wheel each month, 1.2 million accidents caused by sleepiness each year in the US.
Driving whilst drowsy kills more people each year than alcohol or drugs combined. Drugs and alcohol slow your reaction times and brain function, while microsleeps stop motor functions completely, so rather than braking late, there is no braking at all.

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