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SLEEP RECOMMENDATIONS FOR COMPETITIVE ATHLETES

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LEARNING OUTCOMES

After this course participants will be able to:

- Identify the two main electrical states of the sleep cycle.
- Describe at least three effects of sleep deprivation on exercise and athletic performance.
- List at least three barriers within their own practice setting that may interfere with sleep performance.
- Outline at least three solutions to minimize barriers to optimal sleep patterns in elite athletes.

OBJECTIVES

WHAT is the Problem?

WHY should you care?

HOW to make a change?

SLEEP DURATION RECOMMENDATIONS

Reference: National Sleep Foundation

Type	Age	Hours Recommended	Lowest Appropriate	Highest Appropriate
Newborn	0-3 months	14-17	11-13	18-19
Infant	4-11 months	12-15	10-11	16-18
Toddler	1-2 years	11-14	9-10	15-16
Pre-School	3-5 years	10-13	8-9	14
School Age	6-13 years	9-11	7-8	12
Teen	14-17 years	8-10	7	11
Young Adult	18-25 years	7-9	6	10-11
Adult	26-64 years	7-9	6	10
Older Adult	65+ years	7-9	5-6	9

HOW MUCH SLEEP DID YOU GET

Hours per week	Hours per night	Level of Preparedness	6 AM Wake Up	7 AM Wake Up
61-66 Hours	9 Hours	Elite	9 PM - 6 AM	10 PM – 7 AM
55-60 Hours	8 Hours	Great	10 PM – 6 AM	11 PM – 7 AM
49-54 Hours	7 Hours	Good	11 PM – 6 AM	12 AM – 7 AM
44-48 Hours	6.5 Hours	Not Enough	11:30 PM – 6 AM	12:30 AM – 7 AM
38-43 Hours	6 Hours	Bad	12 AM – 6 AM	1 AM – 7 AM
32-37 Hours	5 Hours	Awful	1 AM – 6 AM	2 AM – 7 AM

BACKGROUND ON SLEEP

- Definition: Reversible behavioral state in which an individual is perceptually disengaged from and unresponsive to the environment (Carskadon and Dement, as cited in Halson, 2014)
- Permits recovery and prepares for next cycle of wakefulness
  - 8 hours of sleep are needed per night to prevent neurobehavioral deficits. (Halson, 2014)
- Athletes need more sleep than sedentary people. (Davenne, 2009)
  - Anecdotally the single best recovery strategy in elite athletes (Halson, 2008)

THEORIES ON SLEEP FUNCTION

(Halson, 2008)

- Somatic
  - Restorative relationship between sleep and immune/endocrine systems
- Neuro-metabolic
  - Metabolic cost paid by sleep (Used for detoxification)
- Cognitive
  - Learning, memory, and synaptic plasticity
  - Primary for brain rather than body (Frank, as cited in Halson, 2008)

MEASUREMENT OF SLEEP

- Polysomnography
  - Can measure brain activity, eye movements, muscle activity, and cardiac activity
  - Expensive and time consuming
- Actigraphy
  - Recording body movements through use of wrist device
  - Non-invasive and easy to collect data
  - Can be matched with sleep diaries for increased effectiveness
- Sleep Scales
  - Athlete Sleep Behavior Questionnaire (ASBQ)
  - Pittsburgh Sleep Quality Index
  - Epworth Sleepiness Scale (ESS)

SPIRIT OF INQUIRY

- Sleep has many physiological and cognitive functions that may be important to elite athletes. (Halson, 2014)
- Human performances are highly dependent on the sleep-wake rhythm, including quantity and quality of sleep prior to competition. (Davenne, 2009)
- Sleep deprivation can have significant effects on athletic performance. (Halson, 2014)
- Detrimental effects due to sleep deprivation can lead to decline in aerobic and anaerobic processes as well as affecting fatigue and recovery. (Davenne, 2009)

SPIRIT OF INQUIRY

- Many obstacles to normal sleeping patterns (Davenne, 2009)
  - Travel
    - Effect of west coast teams in NFL on sleeping patterns (Smith et al.)
  - Irregular schedules
  - Foreign environments
  - High levels of anxiety
    - 66% of German athletes slept worse than normal at least once prior to competition. (Erlacher et al., as cited in Halson, 2014)
    - 64% elite Australian athletes reported worse sleep than normal before important competition (Juliff et al., as cited in as cited in Marshall & Turner, 2016)

COMMON AREAS TO STUDY EFFECTS OF SLEEP ON PERFORMANCE

- Full sleep deprivation
  - Full night without sleeping
- Partial sleep deprivation
  - Multiple nights not receiving adequate amount of sleep
- Sleep extension
  - Prolonging sleep cycle
- Napping
  - Supplementing night time sleeping throughout the day

PERFORMANCE EFFECTS OF SLEEP DEPRIVATION (Halson, 2014)

- Anaerobic powers are not affected at 24 hours but impaired at 36 hours. (Souissi et al.)
- Significant decrease in knee extension and flexion peak torque (Bulbulian et al.)
- No change in performance tasks but mood changes with 24 hour deprivation in US college weight lifters. (Blumert et al.)
- Significant decrease in mean and total sprint time following 30 hour of sleep deprivation (Skein et al.)
- Less distance was covered after the sleep deprivation trial during the 30-min self-selected pace treadmill run (Oliver et al., as cited in as cited in Marshall & Turner, 2016)

DETRIMENTAL EFFECTS OF SLEEP DEPRIVATION (Davenne, 2009)

- Increased lapsing
- Cognitive slowing
- Memory impairment
- Decreased vigilance and attention
- Shift in response capability
- Decline in ability to perform maximum exercise
  - Aerobic and anaerobic
- **Mood, psychomotor, and cognitive functions decline more quickly than physical capabilities**

DETRIMENTAL EFFECTS OF SLEEP DEPRIVATION

- Less effect on gross motor functions (Reilly & Deykin, as cited in Halson, 2014)
- More effect on sub-maximal exercise (Reilly & Pierce, as cited in Halson, 2014)
  - Cumulative effect of fatigue from sleep loss may lead to decline in maximal efforts.
- Cognition
  - Learning and memory deficits
  - Decreased efficiency and productivity
  - Increased accident risks
  - Important for consolidation of memory and preparation for new ideas

DETRIMENTAL EFFECTS OF SLEEP DEPRIVATION (Halson, 2014)

- Pain Perception and Recovery
  - Deprivation may enhance pain
  - Insufficient sleep can result in onset and amplification of pain. (Halson, 2008)
  - Decreased optimism and sociability (Haack & Mullington, as cited in Halson, 2008)
- Immunity and Inflammation
  - Peak pro-inflammatory activity at night for immune cells
  - May lead to increased risks of illness
  - Markers of acute inflammation are influenced by manipulation of sleep
- Metabolism and Endocrine function
  - Increased hunger and appetite, especially in carbohydrate-rich foods
  - Increased release of cortisol (catabolic) and decreased secretion of anabolic hormones (Insulin-like growth factor and testosterone)

SLEEP FOR THE ATHLETE

(Davenne, 2009)

- Two main phases of sleep cycle
  - Slow wave sleep
  - Rapid eye movement (REM) sleep
- Alternate back and forth to allow body to recover from various effects throughout the day
- The total structure of sleep constitutes 75% NREM and 25% REM (Carskadon & Dement, as cited in Marshall & Turner, 2016)

SLOW WAVE SLEEP

(Davenne, 2009)

- High-amplitude, low-frequency waves
- Brain reduces activity and neuronal activity becomes synchronized
- Importance due to the need for release of growth hormone at beginning of night (Davenne, 2009 and Halson, 2014)
  - Many effects to allow proper recover from strenuous workouts and competitions.
- As energy expenditure increases during day, blood levels of growth hormone rises the following night. (Kanaley et al., as cited in Davenne, 2009)

RAPID EYE MOVEMENT (REM) SLEEP

(Davenne, 2009)

- Low-amplitude, high-frequency waves
- Similar brain waves as during wakefulness
- Memory consolidation and dreaming
- Disconnect between brain and body allowing for total relaxation
  - Activated brain in paralyzed body (Halson, 2014)
  - Through cortical-spinal tract
  - Allows for effective restoration of myofibrils

CIRCADIAN RHYTHM AND PERFORMANCE

(Davenne, 2009)

- Basic components of performance follow circadian rhythm
  - Temperature, strength, flexibility, metabolic and psychomotor functions
  - Explains peak performance in afternoon and early evening
- Reduced ability during night and early morning
  - Increased frequency in injuries at these times (Winget et al., as cited in Davenne, 2009)
- Decreased vigilance and increased sleepiness at beginning of afternoon

EXERCISE AND CIRCADIAN RHYTHM

(Davenne, 2009)

- Brain activity is driven by body clock, which is highly dependent on body activity.
- Internal body clock matches light and dark phases of environment.
  - Environmental light synchronizes with internal clock.
  - Partly regulated by feedback loops including physical activity and melatonin release
- Physical activity can counteract desynchronization due to jet lag.
- Athletes may be more sensitive to disruptive changes.

CIRCADIAN RHYTHM AND ATHLETICS

- 7:30 AM: Cortisol Increases and Melatonin Production Stops
- 10:00 AM: Highest Alertness
- 2:30 PM: Best Coordination
- 3:00 PM: Dip in Circadian Rhythm
- 3:30 PM: Fastest reaction Time
- 5:00 PM: Greatest Muscle Strength and Cardiovascular Endurance
- 9:00 PM: Melatonin Secretion Starts
- 3:30 PM-10:30 PM: Peak Performance

RECOVERY AND MID-DAY NAPPING

(Davenne, 2009)

- Humans are programmed to recover in middle of day. (Lavie, as cited in Davenne, 2009)
- Numerous benefits to physical and cognitive performances
  - Positive influence on cognitive task with decreased sleepiness and improved learning (Halson, 2014)
  - Improved alertness, short term memory and reaction time; however, grip strength was not affected (Waterhouse et al., as cited in as cited in Marshall & Turner, 2016)
- Prevent sleep restriction due to family and work schedules
- Athletes may be encouraged to have short (less than 30 minutes) and regular period of sleep in early afternoon.
  - May be beneficial for afternoon and evening training sessions (Halson, 2014)

HOW LONG TO NAP

- 10-20 minutes: ideal for boost in energy and alertness; Lighter stages of non-REM sleep
- 30 minutes: May cause sleep inertia (hangover like grogginess)
- 60 minutes: best for remembering facts, faces, and names but will have some sleep inertia
- 90 minutes: Full sleep cycle; Improved emotions, procedural memory, and creativity; Avoids sleep inertia

PARTIAL SLEEP DEPRIVATION FOR ATHLETES

- Partial sleep deprivation can have more profound effects. (Pilcher & Huffcutt, as cited in Davenne, 2009)
- Repetitive partial sleep deprivation impair hormonal and immune system functions.
  - May slow glucose metabolism by 30-40 % (Spiegel et al., as cited in Davenne, 2009)
- Sleep may be single most important factor when reaching peak level of performance.
  - Significant improvement in performance and mood while decreasing fatigue (Dement, as cited in Davenne, 2009)

EFFECTS OF EXERCISE ON SLEEP

(Davenne, 2009)

- Quality of sleep improves considerably with physical activities
- Increased physical activity leads to improved sleep habits
- Decreased physical activity leads to fractioned and shorter sleep periods
- Controversies still exist regarding the effects of evening exercise on sleep
  - May stimulate alertness and vigilance
  - Desire for sleeping may increase after prolonged activity

EFFECTS OF SLEEP EXTENSION

(Mah et al., 2011)

- Minimal research on sleep extension over long periods of time
- Purpose: To extend the nocturnal sleep duration of collegiate basketball players for a number of weeks and to examine the effects on specific measures of athletic performance as well as traditional measures of reaction time, daytime sleepiness, and mood
- Conducted over 2 NCAA seasons at Stanford University

EFFECTS OF SLEEP EXTENSION VARIABLES

(Mah et al., 2011)

- Sleep duration
  - Subjects maintained daily sleep logs and journals
  - Sleep-wake activity measured through actigraphy worn on dominant wrist
- Athletic performance
  - Timed sprint (282 feet)
  - Shooting accuracy (10 free throws and 15 three point shots)
- Reaction time
  - Psychomotor Vigilance Test (PVT)
  - Use of dominant thumb to respond to stimuli
  - Mean reaction time

EFFECTS OF SLEEP EXTENSION VARIABLES

(Mah et al., 2011)

- Daytime sleepiness
  - Daytime sleepiness and mood states measured with Epworth Sleepiness Scale (ESS)
    - Measures sleep propensity from 0-3 during 8 standardized daily situations
    - Higher scores reflect greater sleepiness
- Mood measures
  - Profile of Mood States (POMS)
    - Tension, depression, anger, vigor, fatigue, and confusion

EFFECTS OF SLEEP EXTENSION RESULTS

(Mah et al., 2011)

- 11 men's basketball players were enrolled
  - No statistical significance between participants and non-participants except for weight.
- Total Sleep Time
  - Increased by 110.9 minutes during sleep extension
  - Subjective reports were significantly higher than actigraphy readings.
- Reaction Time
  - Improved PVT performance during daily and weekly testing
  - Significant decrease in daily and weekly mean reaction time
  - Many other significant improvements including decreased lapses as well as minimum reaction time

EFFECTS OF SLEEP EXTENSION RESULTS

(Mah et al., 2011)

- Athletic Performance
  - Decreased sprint time from 16.2 to 15.5 sec
  - Improvement in shooting accuracy
    - Free throws (7.9 vs. 8.8); 9% improvement
    - 3-point shots (10.2 vs. 11.6); 9.2% improvement
- Daytime Sleepiness and Mood
  - Substantial reduction in daytime sleepiness
  - Marked improvement in fatigue, vigor, and total mood disturbances on POMS
- Also demonstrated improved performance in collegiate swimmers in similar methods (Mah et al., as cited in Halson, 2014)
  - Improvement in 15 meter sprint, reaction time, turn time, and mood

LIMITATIONS OF SLEEP EXTENSION STUDY

(Mah et al., 2011)

- Small sample size
- Lack of control group
- Difficulty adhering to sleep extension due to travel requirements
- Athletic performance measures were not new to participants.
  - Accounted for through mean days within study
- Lack of measurement of in-game performances

SLEEP DEPRIVATION ON REACTION TIME AND ANAEROBIC POWER

(Taheri & Arabameri, 2012)

- Purpose: To investigate one night sleep deprivation on anaerobic performance as well as reaction time
- Participants: Random selection of 18 physical education students who exercise regularly
- Study Design
  - Self-administered questionnaire to demographics, sports participation, and training per week
  - Participants kept 3 day schedule for sleep-wake cycle prior to study
  - Non-smokers and no medication
  - No naps during day of testing
  - Participants were not allowed to sleep for one full night and day

SLEEP DEPRIVATION STUDY RESULTS

(Taheri & Arabameri, 2012)

- Mean peak power was not significantly changed compared to baseline.
  - Measured by Anaerobic test (Wingate test): 30 second supra-maximal cycling against resistance load
  - One night sleep deprivation may not be significant enough to affect processes
- Mean choice reaction time was significantly slower in sleep deprivation group. (37 ms average)
  - Measured by reaction time test
    - Two choice reaction tasks performed on computer with joysticks
  - Frontal lobe highly responsive to sleep loss

NUTRITIONAL INTERVENTIONS
(Halson, 2014)

- Carbohydrates
  - High glycemic index (GI) foods may be beneficial more than 1 hour prior to sleep.
    - Approximately 4 hours prior to bedtime (Halson, 2008)
    - Solid is better than liquid consumption
  - Lack of consistency and control
  - Increased carbohydrate intake may result in shorter sleep latencies
- Limited evidence supports decreased caloric intake may result in poor sleep.
  - Weight-restricted sports, such as wrestling and gymnastics
- Altering protein intake may affect sleep architecture and improve sleep quality.
- Increase in fat intake negatively influences total sleep.

HORMONAL INFLUENCES
(Halson, 2014)

- Tryptophan: Doses as low as 1 gram can improve sleep latency and quality
  - More research needed for timing and dosage (Halson, 2008)
  - Common foods: Milk, meat, poultry, eggs, beans, peanuts, cheese, leafy green vegetables
- Serotonin: Converts to melatonin
- Melatonin: Safe for short term use with no effect on primary sleep disorders (Buscemi et al.)
  - Common in tart cherries (Halson, 2008)
  - May help reduce core temperature
  - Be cautious of side effects
- Valerian: Herb used to treat insomnia and anxiety
  - Cautious of positive drug test

NEGATIVE INFLUENCES

(Halson, 2008)

- Alcohol
  - Positive and negative effects on sleep
  - Overall detriment to sleep quantity and quality
  - Can change throughout the night due to fast metabolism
- Caffeine
  - Mild CNS stimulant (As little as 100 mg)
  - Negative effects on sleep latency, quality, and quantity
  - May be dose-related
- Hyper-hydration
  - May lead to increase awakening and decrease sleep quality

OTHER INFLUENCES ON SLEEP

(Halson, 2008)

- Skin warming
  - Decreased skin temperature enhances sleep onset in warm environments
  - Accelerate falling asleep through warming of proximal skin and distal extremities in cold environments
- Hydrotherapy
  - Limited evidence to enhance sleep with warm water
  - Increased feeling of recovery from cold immersion may be from enhanced sleep
- Lack rigorous scientific explanations, but has underlying physiological rationale
  - Stretching and muscle relaxation
  - Sensory withdrawal (Decrease light, noise, and touch)
  - Breathing techniques

Athlete Sleep Behavior Questionnaire (ASBQ)

(Driller, Mah, Halson, 2018)

- 18 items
- Scale of 1-5
- Total Score out of 90
- Validated with 3 previous questionnaires
- Valid and reliable tool that can differentiate the sleep practices between athletes and non-athletes
- May provide information on areas where improvements to individual athletes' sleep habits could be made.

INTEGRATION INTO PRACTICE

- Aim for 7-9 hours of sleep/night
- Increasing sleep knowledge of individual athletes can be valuable.
- Optimize environment
  - Quiet, dark, cool (65-68° F)
- Standardize bedtime and establish regular sleep schedule
- Minimize alcohol and caffeine intake
  - Avoid hyper-hydration
- Avoid/minimize use of electronics
  - Especially “blue-light”
- Possibility of day time nap

INTEGRATION INTO PRACTICE

- Diet
  - High carbohydrate diet leads to shorter sleep latency ✚
  - High protein leads to improve sleep quality ✚
  - Small doses of tryptophan and melatonin ✚
  - High fat diet negatively effects total sleep ▭
  - Sleep quality is disturbed with decrease in caloric intake ▭
- Greater sleep during training periods
- Allow for spontaneous awakening (Eliminate clock in bedroom)

PRELIMINARY CONCLUSIONS

- Two main cycles: Slow wave sleep and REM sleep
- Sleep can have many significant physiological and cognitive functions that affect athletic performance.
- Athletic performance may be dependent on both quality and quantity of sleep prior to competition.
- Detrimental effects due to sleep deprivation can lead to decline in aerobic and anaerobic processes as well as affecting fatigue and recovery.
- Athletes at various levels may encounter many obstacles to normal sleeping patterns.

CLINICAL BOTTOM LINE

- Health care professionals, such as certified athletic trainers, should develop a strong foundation regarding sleep habits to educate elite athletes.
- As travel and anxiety associated with competition become more prevalent at earlier stages of participation, athletic trainers may find a niche' as the most accessible health care provider and appropriate resource for many elite athletes to seek advice.

REFERENCES

- Davenne, D. (2009). Sleep of athletes-problems and possible solutions. *Biological Rhythm Research, 40(1),* 45-52.
- Driller, M.W., Mah, C.D., & Halson, S.L. (2018). Development of the athlete sleep behavior questionnaire: A tool for identifying maladaptive sleep practices in elite athletes. *Sleep Science, 11(1),* 37-44.
- Halson, S.L. (2014). Sleep in elite athletes and nutritional interventions to enhance sleep. *Sports Med, 44(Suppl I),* S13-S23.
- Halson, S.L. (2008). Nutrition, sleep, and recovery. *European Journal of Sport Science, 8(2),* 119-126.
- Mah, C.D., Mah, K.E., Kezirian, E.J., & Dement, W.C. (2011). The effects of sleep extension on the athletic performance of collegiate basketball players. *Sleep, 34(7),* 943-950.
- Marshall, G.J.G. &Turner, A.N. (2016). The importance for sleep on athletic performance. *Strength and Conditioning Journal*, *38(1),* 61-67.
- Milewski, M.D., Skaggs, D.L., Bishop, G.A., Pace, J.L., Ibrahim, D.A., Wren, T.A.L., & Barzdukas, A. (2014). Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. *J Pediatr Orthop*, 34 (2), 129–133.
- Sargent, C., Lastella, M., Halson, S.L., & Roach, G.D. (2014). The impact of training schedules on the sleep and fatigue of elite athletes. *Chronobiology International*, *31(10)*, 1160–1168. doi 10.3109/07420528.2014.957306
- Taheri, M. & Arabameri, E. (2012). The effect of sleep deprivation on choice reaction time and anaerobic power of college student athletes. *Asian Journal of Sports Medicine, 3(1),* 15-20.

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