Objectives

How do sleep and fatigue impact mental health and performance?

How do you recognize sleep and fatigue problems?

How do you ameliorate basic sleep and fatigue problems?

How do you get help for more serious problems?
Sleep issues are surprisingly common

Insufficient Sleep

- ≤3 hours: 11.2%
- 4 hours: 3.19%
- 5 hours: 3.75%
- 6 hours: 23.55%
- 7 hours: 28.72%
- 8 hours: 27.64%
- 9 hours: 4.42%
- 10 hours: 2.35%
- ≥11 hours: 1.27%

Insomnia

- Difficulty Falling Asleep
- Difficulty Resuming Sleep
- Early Morning Awakenings
- Non-Restorative Sleep

- 1 night/week or more
- 3 nights/week or more

Sleep Apnea

- Men 30-49
- Men 50-70
- Women 30-49
- Women 50-70

- <25
- 25-29.9
- 30-39.9
- 40+

Grandner et al., 2013; 2016; Peppard et al., 2013
Sleep duration trends

Tubbs et al., submitted
Worsening disparities

Tubbs et al., submitted
Sleep and performance

The less sleep you get, the more impaired you are.

Deficits due to sleep loss are cumulative.

After 2 weeks, you don’t adjust -- you get worse.

Van Dongen et al., 2004
Sleep and performance

But you don’t realize that you are getting worse.

Van Dongen et al., 2004
Drowsy driving

**Complete Sample**

- Unadjusted
- Adjusted

**Never Insufficient**

- Unadjusted
- Adjusted

Odds Ratio of Drowsy Driving

Maia, Grandner, Findley, and Gurubhagavatula et al., 2013
Sleep loss and decision making

Sleep deprivation leads to poor decision making

- Inability to process complex data streams
- Impaired ability to weigh risks and benefits
- Impaired ability to discern “good” info from “bad”
- Decreased ability to make long-term decisions
- Not all effects fixed with stimulants
Worse performance

Those with poor sleep had worse performance

<table>
<thead>
<tr>
<th>Self</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0.0%</td>
</tr>
<tr>
<td>Rarely</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>-2.1%</td>
</tr>
<tr>
<td>Often</td>
<td>-4.2%</td>
</tr>
<tr>
<td>Always</td>
<td>-3.6%</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, race/ethnicity, education, income, and overall health

Hui and Grandner, 2015
Higher healthcare costs

Hui and Grandner, 2015
And as sleep gets worse...

After a 1-year follow up, if sleep got worse:

- More missed days
- More missed part days
- Decreased performance
- Decreased relative performance
- Additional $189 in spending per category

Hui and Grandner, 2015
Productivity loss

In 1,007 adults age 22-60, productivity loss associated with insufficient sleep, insomnia, daytime sleepiness, long sleep, and snoring:

Across domains:
- Health or physical condition
- Caring for others
- Lack of resources
- Issues with coworker
- Too much to do/Lack of time
- Issues with supervisor
- Personal problems/Worries
- Depression/Anxiety
- Financial Stress/Concerns
- Technical Issues
- Lack of training

Only slight moderation by caffeine

Yang et al., 2018
Perceived cognitive decline
Incident injuries

Baseline insomnia and/or daytime sleepiness were associated with incident sports-related concussion risk

- This relationship was stronger than that seen for prior concussion history and sport played
- Implications for baseline screening of sleep problems

Raikes et al., 2019
Sleep and mental health

The relationship between insomnia and depression is one of the most well-established findings in all sleep research. Poor sleep quality is associated with every single symptom of depression.

Ji et al., 2019

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<table>
<thead>
<tr>
<th>Insomnia symptoms</th>
<th>OR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1: Anhedonia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>0.993</td>
<td>0.912–1.080</td>
<td>0.868</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.362</td>
<td>1.214–1.528</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.212</td>
<td>1.061–1.385</td>
<td>0.005</td>
</tr>
<tr>
<td>Item 2: Depressed Mood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.073</td>
<td>0.989–1.165</td>
<td>0.088</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.176</td>
<td>1.055–1.311</td>
<td>0.003</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.239</td>
<td>1.091–1.408</td>
<td>0.001</td>
</tr>
<tr>
<td>Item 3: Sleep disturbances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.296</td>
<td>1.185–1.417</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.160</td>
<td>1.030–1.305</td>
<td>0.014</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.542</td>
<td>1.345–1.767</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Item 4: Tiredness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>0.967</td>
<td>0.891–1.050</td>
<td>0.425</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.474</td>
<td>1.319–1.647</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.361</td>
<td>1.202–1.541</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Item 5: Appetite symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.124</td>
<td>1.039–1.216</td>
<td>0.004</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.109</td>
<td>0.999–1.231</td>
<td>0.052</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.260</td>
<td>1.116–1.423</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Item 6: Feeling of failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>0.994</td>
<td>0.920–1.074</td>
<td>0.889</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.159</td>
<td>1.045–1.285</td>
<td>0.005</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.294</td>
<td>1.147–1.460</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Item 7: Trouble concentrating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.052</td>
<td>0.967–1.143</td>
<td>0.236</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.299</td>
<td>1.159–1.457</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.108</td>
<td>0.971–1.264</td>
<td>0.127</td>
</tr>
<tr>
<td>Item 8: Psychomotor symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.200</td>
<td>1.082–1.331</td>
<td>0.001</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.286</td>
<td>1.119–1.478</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>0.991</td>
<td>0.842–1.167</td>
<td>0.915</td>
</tr>
<tr>
<td>Item 9: Suicidal ideation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep symptoms</td>
<td>1.153</td>
<td>1.028–1.292</td>
<td>0.015</td>
</tr>
<tr>
<td>Daytime symptoms</td>
<td>1.224</td>
<td>1.050–1.426</td>
<td>0.010</td>
</tr>
<tr>
<td>Perception symptoms</td>
<td>1.085</td>
<td>0.903–1.304</td>
<td>0.381</td>
</tr>
</tbody>
</table>

Ji et al., 2019
Insomnia and short sleep

• Insomnia is positively associated with depressed mood
• Short sleep duration is also independently associated with depressed mood
• Long sleep is also associated with depressed mood
• In short sleepers, relationship between insomnia and depression is actually weaker

Tubbs et al., In Press
Insomnia and onset of depressive episodes

Insomnia predicts the onset of depressive episodes

Perlis et al., 1997
Mental health in young adults

Odds Ratio

- Hopelessness: 1.281
- Overwhelmed: 1.235
- Exhaustion: 1.307
- Loneliness: 1.206
- Sadness: 1.21
- Functional Problems: 1.304
- Anxiety: 1.283
- Anger: 1.267
- Desire to Hurt Self: 1.208
- Suicide Ideation: 1.303
- Suicide Attempts: 1.115
Mental health

In young adults, each additional night of insufficient sleep was associated with increased risk of suicide ideation.
Insomnia and suicide

Data across 39 studies shows that insomnia in particular is associated with a 2.8-fold likelihood of suicide ideation, 3.5-fold likelihood of suicide attempts, and 2.4-fold likelihood of death by suicide.

Reasons for this are not clear, but simply being awake at night may represent a unique risk factor for suicide.

CDC data from 19 states:

Pigeon et al., 2015; Perlis et al., 2015
Incident obesity

Cappuccio et al., 2008
Incident hypertension

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Risk Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Risk Ratio IV, Random, 95% CI</th>
<th>Risk Ratio IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cappuccio (a) 2007</td>
<td>-0.11653</td>
<td>0.243753</td>
<td>8.7%</td>
<td>0.89 [0.55, 1.44]</td>
<td></td>
</tr>
<tr>
<td>Cappuccio (b) 2007</td>
<td>0.270027</td>
<td>0.356573</td>
<td>4.2%</td>
<td>1.31 [0.65, 2.64]</td>
<td></td>
</tr>
<tr>
<td>Fernandez-Mendoza 2012</td>
<td>0.24686</td>
<td>0.179642</td>
<td>15.3%</td>
<td>1.28 [0.90, 1.82]</td>
<td></td>
</tr>
<tr>
<td>Gangwisch 2010</td>
<td>0.223144</td>
<td>0.135052</td>
<td>25.1%</td>
<td>1.25 [0.96, 1.63]</td>
<td></td>
</tr>
<tr>
<td>Kim 2012</td>
<td>0.285179</td>
<td>0.141674</td>
<td>23.1%</td>
<td>1.33 [1.01, 1.76]</td>
<td></td>
</tr>
<tr>
<td>Knutson 2009</td>
<td>0.262364</td>
<td>0.153173</td>
<td>20.2%</td>
<td>1.30 [0.96, 1.76]</td>
<td></td>
</tr>
<tr>
<td>Lopez-Garcia 2009</td>
<td>-0.61619</td>
<td>0.39587</td>
<td>3.4%</td>
<td>0.54 [0.25, 1.17]</td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1.21 [1.05, 1.40]</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Heterogeneity: Tau² = 0.00; Chi² = 6.60, df = 6 (P = 0.36); I² = 9%
- Test for overall effect: Z = 2.61 (P = 0.009)

Meng, Zheng, and Hui, 2013
Incident diabetes

<table>
<thead>
<tr>
<th>Study ID</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayas et al</td>
<td>1.29 (1.05, 1.58)</td>
</tr>
<tr>
<td>Beihl et al</td>
<td>2.07 (1.20, 3.57)</td>
</tr>
<tr>
<td>Gangwisch et al</td>
<td>1.57 (1.11, 2.22)</td>
</tr>
<tr>
<td>Hayashino et al</td>
<td>1.15 (0.76, 1.74)</td>
</tr>
<tr>
<td>Holliday et al (this study)</td>
<td>1.29 (1.03, 1.62)</td>
</tr>
<tr>
<td>Kita et al (no FHD)</td>
<td>5.37 (1.38, 20.91)</td>
</tr>
<tr>
<td>Kita et al (with FHD)</td>
<td>0.25 (0.03, 2.42)</td>
</tr>
<tr>
<td>Mallon et al (men)</td>
<td>2.80 (1.07, 7.30)</td>
</tr>
<tr>
<td>Mallon et al (women)</td>
<td>1.80 (0.48, 6.80)</td>
</tr>
<tr>
<td>von Ruesen et al</td>
<td>1.06 (0.80, 1.40)</td>
</tr>
<tr>
<td>Xu et al</td>
<td>1.37 (0.97, 1.93)</td>
</tr>
<tr>
<td>Yaggi et al</td>
<td>1.95 (0.95, 4.01)</td>
</tr>
<tr>
<td>Overall (I-squared = 32.8%, p = 0.128)</td>
<td>1.33 (1.20, 1.48)</td>
</tr>
</tbody>
</table>

\[ p = 4 \times 10^{-5} \]
Sleep protects the immune system

• Sleep health is related to foundational immunologic functions
  • Sleep health impacts likelihood of contracting illness
  • Sleep health impacts recovery from illness
• Exposures during the day are processed and consolidated during sleep

Prather et al., 2015
Sleep changes during COVID
Changes to sleep patterns

- Difficulty detaching at night
- Difficulty with awakenings at night
- Altered daily activity rhythms and light exposure
- Vivid dreams and nightmares
Sleep during lockdown

Ong et al., 2020
Sleep and mental health during COVID

Killgore et al., 2020
Fitbit data: 2020 is different
Changes to sleep duration and bedtime

Rezaei and Grandner
Sleep duration increasing
Staying up later

Rezaei and Grandner
Fitbit data: Sleep is changing

Rezaei and Grandner
Intersecting problems

Sleep loss is related to both poor health and impaired brain function.
It is possible that these effects overlap.
Many health conditions are made worse by increased stress and greater difficulty making healthy decisions.
Grandner, Hale, Moore, and Patel, 2010; Grandner, 2019
How to recognize sleep problems

- Insomnia disorder
- Sleep apnea
- Circadian rhythm disorders
- Other sleep disorders
- Insufficient sleep
- Daytime sleepiness
Insomnia Disorder

• Persistent difficulty initiating and/or maintaining sleep
  • 30 / 30 / 3 rule
  • Includes daytime dysfunction

• Screen with Insomnia Severity Index and/or Sleep Diary

• Significant daytime impairments
  • Impairments in cognitive function, quality of life, physical performance, mental health, and inflammation
  • Associated with occupational injuries

• Issue of comorbid vs secondary insomnia

• Implications for treatment: CBTI, sleep hygiene, sedatives, other meds
Sleep Apnea

• Difficulty maintaining airway patency during the night, leading to frequent respiratory events
  • Categorized based on AHI (events per hour)

• Risk factors for athletes include neck circumference, snoring, and daytime tiredness
  • Screen with STOP-BANG questionnaire but validity is limited

• Significant impairments
  • Cardiometabolic disease, inflammation, injuries/accidents, physical and performance, fatigue, depression

• Treatment with CPAP but other options exist
Circadian rhythm disorders

• Delayed sleep-wake phase is common, especially among young adults
  • Associated with depression, insomnia, and cardiometabolic risk

• Advanced sleep-wake phase is less common
  • Associated with anxiety and mood symptoms

• Irregular circadian rhythm and shift work sleep disorder may also exist in athletes who are constantly shifting schedules

• Important roles of regularity, light and activity rhythms, and travel

• Treatment usually with light and melatonin

• Implications for metabolism and energy balance
Other sleep disorders

• Restless legs syndrome
• Hypersomnia disorders
  • Narcolepsy
  • Idiopathic hypersomnia
• Parasomnias
  • NREM: Sleepwalking, night terrors
  • REM: Nightmares, REM behavior disorder
Insufficient sleep

• Amount of sleep for a typical health adult is about 7 hours
• But athletes may need more
When is sleep insufficient?

• Still difficult to tell, but often based on subjective reports of daytime symptoms (though this is likely insufficient)
  • More objective measures are still in development and have not been validated

• Insufficient sleep vs sleep deprivation
  • Importance of accumulated sleep debt
Excessive daytime sleepiness

• Distinct from fatigue and tiredness
• Sleepiness reflects a propensity to fall asleep
• Does not always co-occur with tiredness or even fatigue
• Associated with depression symptoms
• Treatment usually just sleep improvement
  • Or caffeine, light, or other countermeasures
  • Sometimes becomes a disorder that requires medical treatment
How to turn your mind off

• Many people with insomnia have trouble “turning their mind off” and don’t know why
  • But most of the time, this is a result of accidentally programming your brain to do this in bed!

• What happens is, for one reason or another, something causes us to spend time awake in bed
  • But even when that original cause is gone, the insomnia takes on a life of its own because you “trained” your brain to be awake in bed

• You need to give yourself time to wind down
  • Plan for 30-60 minutes at least of less intense activity
  • Both mental and physical
  • Allow time for your mind to go over whatever it needs to
Mobile technology

Snyder and Chang, 2019
Stimulus Control

Sleep
Sex
Television
Movie
Radio
Reading
Eating
Working
Arguing
Worrying

Talking
Doing bills
Smoking
Thinking
Ruminating
Planning
Clockwatching
Rehearsing
Replaying
Texting
10 sleep hygiene commandments

Thou shalt keep a regular schedule
Thou shalt exercise regularly but not too late at night
Thou shalt get light during the day and avoid it at night
Thou shalt keep your bedroom cool, dark and comfortable
Thou shalt not consume excessive foods or liquids in the evening
Thou shalt put down screens before getting ready for bed
Thou shalt not ingest caffeine, nicotine and alcohol at night
Thou shalt not go to bed angry or worried or upset
Thou shalt get rid of the clock
Thou shalt not nap too long or too late during the day
Other recommendations and guidance

The Society of Behavioral Sleep Medicine (SBSM) COVID-19 Task Force: Objectives and Summary Recommendations for Managing Sleep during a Pandemic

Earl Charles Crew, Kelly Glazer Baron, Michael A. Grandner, Carolyn E. Ievers-Landis, Christina S. McCrae, Michael R. Nadorff, Sara Nowakowski, Skye Ochsner Margolies & Kathryn Hansen
Recommendations in this document

• Managing new-onset (acute) insomnia
  • Remember stimulus control
  • Adopt behavioral and environmental controls: detect, detach, distract
  • Assess for maladaptive coping strategies
  • Enhance resources for coping with daytime stressors

• Managing delayed / irregular schedules
  • Encourage developing consistency where possible
  • Go outside for bright light in the morning
  • Establish social, dietary, and exercise routines
  • Avoid screens at night

Crew et al., 2020
Recommendations in this document

• Managing nightmares
  • Recognize and address causes (such as stress)
  • Limit exposure to triggers
  • Physical relaxation upon awakening

• Telehealth
  • Sleep interventions via telehealth can be effective and should be utilized
  • Even if delivered to groups

Crew et al., 2020
Recommendations in this document

• Dealing with children / teenagers
  • Prioritize parent-child relationships
  • Manage expectations
  • Encourage activities that build sleep need (like time outside)
  • Discourage activities that lead to sleep disruption (like screens and naps)

• Dealing with older adults
  • Recognize impact of home confinement, inactivity, and social isolation
  • Establish activity and light exposure routines in early part of the day
  • Encourage communication and social interaction
  • Avoid excessive napping

Crew et al., 2020
For stressed healthcare workers

• Be as well-rested as possible because getting good sleep is important
• Set yourself up for optimal sleep
• If your schedule is disrupted by long shifts and sleepless nights, get sleep where you can
• When you are able to sleep, try to protect it
• Do what you can to protect the sleep of others as well
• If you cannot sleep, get out of bed
• When you have to stay awake, set yourself up for alertness

Crew et al., 2020; Grandner, 2020
Other options

These sleep “tips” may not be enough, especially if you have an untreated sleep disorder!

Help is available:

Sleep Disorders Center (Medicine)

Behavioral Sleep Medicine Clinic (Psychiatry)
University of Arizona College of Medicine
Sleep & Health Research Program
Department of Psychiatry

http://www.sleephealthresearch.com
Thank you!

Michael A. Grandner PhD MTR
Director, Sleep and Health Research Program
Director, Behavioral Sleep Medicine Clinic
Associate Professor of Psychiatry, Psychology, Medicine, and Nutritional Sciences
University of Arizona College of Medicine

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