Sleep & Obesity Risk In Adults

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Overview

What constitutes adequate sleep in adults?
- Guidelines and recommendations

What are the consequences of inadequate sleep in adults?
- Cardiometabolic risk factors
- Neurocognitive dysfunction
- Interactive effects?

What factors influence sleep in adults?
- Social-Ecological Model
- Demographic factors
- Socioeconomic factors

How can adults improve their sleep?
- Guidelines for healthy sleep
- Sleep disorders interventions
- Making behavioral changes
- Potential impact on obesity risk

How can we implement these in adults?
- Importance of screening and referral
- Improving behavioral sleep routines
- Policy implications
What constitutes adequate sleep?

Over 50 years of studies showing that sleep habits in the general population are associated with morbidity and mortality risk.

Short and long habitual sleep duration typically associated with worse outcomes
  • Mechanisms for short sleep are better articulated

But the field lacked general guidelines for sleep because of variable definitions, lack of precision in measures, etc.
  • Recently, though several guideline documents have emerged

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![Graph showing the relationship between hours of sleep and mortality hazard ratio](image-url)

*Kripke et al., 2002*
Guidelines for adequate sleep

American Academy of Sleep Medicine and Sleep Research Society: **7 or more hours**

National Sleep Foundation: **7-9 hours**

American Thoracic Society: **7-9 hours**

American Heart Association: **7 or more hours**
Adverse consequences

• Cardiometabolic disease risk
  • Metabolic disruption
  • Energy imbalance
  • Inflammation
  • Cardiovascular disease

• Neurocognitive dysfunction
  • Impaired vigilance
  • Impaired decision making
  • Potential interactive effects on obesity
Sleep and obesity: mechanisms?

Other factors regulating hunger and appetite may also be relevant:
- Cholecystokinin: hunger suppressant, released by the intestinal L-cells after food intake, also interacts with orexin system
- Adiponectin: secreted by adipose, modulates glucose metabolism
- Peptide YY 3-36: appetite suppressant released by the intestinal L-cells after food intake
Insulin signaling

Disruptions in insulin signaling partially caused by circadian rhythm disruptions

- Driving rhythmic transcription of gene networks in exocytosis driven by glucose, cAMP, and Ca2+
- Other modifying factors include melatonin, GLP-1, and brain-derived Ach

Perelis, Ramsey, Marcheva and Bass, 2016
Energy intake and weight gain

198 sleep deprivation vs 27 controls

- 5 nights of sleep restriction to 4 hours
- Unlimited access to food in lab kitchen

![Graph showing weight change](image-url)

Spaeth, Dinges, and Goel, 2013
Energy intake and weight gain

- Days following baseline sleep (BL and EW)
- Days following sleep restriction (SR1-5)
- Days with a delayed bedtime (EW, SR1-4)

Spaeth, Dinges, and Goel, 2013
Sleep duration and inflammation

Short sleep duration is associated with a pro-inflammatory state in lab and general population

Adjusted for: age, sex, race/ethnicity, BMI, BMI², insomnia diagnosis, sleep apnea diagnosis, difficulty falling asleep, and snoring/gasping during sleep
Other inflammatory markers

Sleep restriction in the laboratory

- TNFa (Irwin et al., 2006)
- IL-6 (Haack et al., 2007; van Leeuwen et al., 2009)
- IL-1B and IL-17 (van Leeuwen et al., 2009)

Short sleep duration in the population

- TNFa (Patel et al., 2009)
- IL-6 (Taveras, 2010)
- D-dimer (von Kanel et al., 2010)
- I-CAM (Dowd et al., 2011)
- Visfatin (Hayes et al., 2011)
Incident hypertension

Meng, Zheng, and Hui, 2013
Incident diabetes

Holliday, Magee, Kritharides, Banks, and Attia, 2013
Decision making

N=23 young adults normal rested sleep and total sleep deprivation, separated by 1 week

- Provided meals, no difference in hunger ratings
- Presented with food stimuli

Greer, Goldstein, and Walker, 2013
Sleep deprivation leads to increase “wanting” of unhealthy food

Greer, Goldstein, and Walker, 2013
SLEEP

Individual Level
- Genetics, Behavior, Psychology, Health, Environment

Social Level
- Work / School
- Family / Home
- Neighborhood, Social Groups, Race/Ethnicity, Socioeconomic, Religion, Culture

Societal Level
- Public Policy, Globalization, Technology, Economics, Environment, Geography

Adverse Health Outcomes
- Cardiovascular Disease
- Metabolic Dysregulation
- Immune Dysfunction
- Performance Deficits
- Psychological Disturbance
- Obesity / Weight Gain
- Cancer
- Stress

Grandner, Hale, Moore & Patel, 2010
Access to health care

Foregoing care partially mediated the relationship between short sleep and cardiometabolic disease

- Obesity: 15.6%
- Diabetes: 18.37%
- Hypertension: 17.43%
- Hypercholesterolemia: 25.60%
- Coronary Heart Disease: 16.79%
- Myocardial Infarction: 15.80%
- Stroke: 16.98%

Grandner et al., 2015
"A lot of control" or "Complete control" over sleep time (p<0.0001)

Control over sleep

Grandner et al., In Preparation
How can adults improve sleep?

• Screening and treatment for sleep disorders
• Maintaining healthy sleep habits
• Making healthful behavioral changes
• Potential impact on obesity risk
Screening and treatment

• Sleep disorders remain largely undiagnosed
  • Screening tools are readily available and specialists are available

• Insomnia: Significant symptoms experienced by ~30% of the population and Insomnia Disorder likely present in ~10%
  • Associated with obesity risk
  • First-line treatment: Cognitive Behavioral Therapy for Insomnia
  • Efficacious, effective across populations, lasting effects
  • Hypnotic medications are also an option

• Sleep apnea: Clinically significant disease likely present in 10-20% of men >30 (and 5-10% of women over 30)
  • Significant overlap with obesity (>75% of patients are obese)
  • First-line treatment: Continuous Positive Airway Pressure (CPAP)
  • Efficacious, effective across populations, but has adherence issues
  • Other options include oral appliances and other devices (and weight loss)
Healthy sleep habits

Sleep hygiene recommendations are often insufficient to fix a sleep problem, but they can help prevent sleep problems and remove obvious barriers to sleep

**Recommendations include:**

- Regular sleep schedule and bedtime routine (even on weekends)
- Bright light during the day and avoid light at night
- Keep bedroom cool, dark, and comfortable
- Avoid caffeine, nicotine, alcohol, and stimulating medications at night
- Avoid excessive food and liquids at night
- Avoid naps (if you are having difficulty with insomnia)
- Avoid obsessive clock watching
- Practice good stimulus control
  - The bed is for sleep (and sex) only
  - No other activities in bed, especially light-emitting electronic devices
  - When you cannot sleep, get out of bed

Perlis, Aloia, and Kuhn, 2010
Making healthful changes

- Health belief model
- Integrated behavior model
- Transtheoretical model
Health belief model

Rosenstock, 1966; Champion & Skinner, 2008; Grandner, 2017
Integrated behavior model

Montano & Kasprzyk, 2008; Grandner, 2017
Transtheoretical model

- Precontemplation
- Contemplation
- Preparation
- Action
- Maintenance

Prochaska & DiClemente, 1982; Prochaska, DiClemente, & Norcross, 1992
Impact on obesity risk

• Increased sleep duration associated with
  • Decreased 24-hour blood pressure (Haack et al., 2013)
  • Improved insulin sensitivity (Leproult et al., 2015)
  • Decreased overall appetite for unhealthy foods (Tasali et al., 2014)
  • Improved sustained attention and decreased sleep pressure (Arnal et al., 2015)
  • Improved cognitive function (Lucassen et al., 2014)

• But there is a potential risk of too much sleep extension
Implementation

• Importance of screening and referral
• Improving behavioral sleep routines
• Critical unanswered research questions
• Policy implications
Screening and referral

• Insufficient sleep is highly prevalent and not addressed in clinical settings

• Sleep disorders are highly undiagnosed
  • Rates of sleep apnea in diabetes clinics are estimated to be 70-86%
  • Insomnia is rarely treated like an independent disorder and suboptimally treated

• Screening tools exist for most sleep disorders
  • Referrals can be made off of a few simple questions, especially insomnia (difficulty falling or staying asleep at least 30 mins, at least 3 nights per week) and sleep apnea (loud snoring, sleepiness)

• Clinicians specializing in sleep disorders exist
  • American Academy of Sleep Medicine
  • Society of Behavioral Sleep Medicine
Improving sleep behavior

Behavioral sleep interventions

• Insomnia: Stimulus control and sleep restriction therapy
• Interventions for other sleep disorders

Currently, no empirically-supported interventions for increasing sleep time in insufficient sleepers

• Currently, just recommendations
• Problems with this approach
  • Unknown sleep needs, risk of insomnia, difficulty of change
• Using behavioral principles
  • Increasing readiness / motivation
  • Changing attitudes / intentions / social norms
  • Removing barriers
  • Small, manageable changes
Unanswered research questions

• Mechanisms linking insufficient sleep and obesity risk
  • Overlap with separate risks associated with insomnia

• Interventions for insufficient sleep
  • What is the effect of sleep interventions on obesity risk
  • What is the effect on other cardiometabolic risk factors
  • How can such an intervention be implemented

• Sleep and obesity risk across populations
  • Influence of sleep in obesity and cardiovascular disease disparities
  • Role of sleep as a modifiable risk factor across populations
  • Role of sleep disparities in health and disease
  • Development of tailored sleep interventions that take context into account
Policy implications

• Sleep, health equity, and healthcare access
  • Example: Access to healthcare among disadvantaged populations

• Sleep and public safety
  • Example: Obesity and sleep apnea in commercial drivers and police

• Workplace reforms
  • Example: Sleep difficulties associated with economic output

• Healthcare initiatives
  • Example: Role of sleep in preventive care

• Telehealth implications
  • Example: Sleep medicine across state lines (compacts)
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