Dying to get some Sleep

MUD

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Sleep deprivation

• One of most pervasive health problems in U.S.
• 1.5 hours less/night than a century ago
• 2002 “Sleep in America” poll - 35% “need 8 hours but don’t get”
• Studies: < 6-7 hours sleep - ↑ mortality risk (HD, smoking, BP)
• Can affect: health
  safety
  performance
  pocketbook
• Experts say – brainpower ↓
Sleep hours trending down – National Health Summary

Adults reporting an average of <6 hours of sleep
Percent

Men

Women

Age group

18-29 30-44 45-64 65-74 75+

1985 2006

Age group

18-29 30-44 45-64 65-74 75+
Outline

• Sleep - why we need it
• Reasons we don’t sleep
• Consequences of sleep deprivation
• Studies & statistics
• Success for sleep
IT'S 02.30 HOURS AND I'M STILL LYING AWAKE AND WONDERING WHY I BOUGHT A WATER-BED!
Sleep

• Naturally recurring state; reduced or absent consciousness, suspended sensory activity; inactivity of nearly all voluntary muscles

• Heightened anabolic state; accentuating growth, rejuvenation of immune, nervous, skeletal and muscular systems (most animals)

• Melatonin triggers functions - cells detox, slows respiratory system

• Stages assessed by polysomnography: EEG, EOG, EMG

• 2007 American Academy of Sleep Medicine (AASM) stages: REM & Non-REM (N1, N2, N3)
Sleep stages

NREM sleep

• N1: drowsy sleep; twitching; lost muscle tone (falling!) 4 - 5%

• N2: muscle activity/conscious awareness disappears; eye movement stops; brain waves slow; 45 - 55% adult sleep

• N3 (deep sleep): no eye or muscle activity; children - night terrors, sleepwalking, bedwetting; 6 - 15%

REM sleep

• Brain waves - waking levels; most memorable dreams; HR & BP ↑ male erection; body temperature fluctuates; muscles relax; paralysis; 20 - 25% adult sleep; infants 90%

• N1 → N2 → N3 → REM 90 - 110 minutes x 5 per 8 hour night
Sleep cycles

- **Stage 1**: 4-5% Light sleep. Muscle activity slows down. Occasional muscle twitching.
- **Stage 2**: 45-55% Breathing pattern and heart rate slows. Slight decrease in body temperature.
- **Stage 3**: 4-6% Deep sleep begins. Brain begins to generate slow delta waves.
- **Stage 4**: 12-15% Very deep sleep. Rhythmic breathing. Limited muscle activity. Brain produces delta waves.
- **Stage 5**: 20-25% Rapid eye movement. Brainwaves speed up and dreaming occurs. Muscles relax and heart rate increases. Breathing is rapid and shallow.
Sleep – why do we need it?

- William Dement: "As far as I know, the only reason we need to sleep that is really, really solid is because we get sleepy."

- Evolution: Animals are proof – even Jaws!

- Proposed functions:
  1. **Restoration**: wound healing; study 2004
     immune system; study 2007
     somatic growth; study 2007
  2. **Ontogenesis**: REM - brain development
  3. **Memory processing**: cognitive function; working memory test: 26 min/night/4 days - 38%
  4. **Preservation and Protective**: adaptive function: maximize safety

Drummond, Salamat, and Brown, Working Memory 2006
Allison & Cicchetti, 1976; Webb, 1982
Optimum amount of sleep

- Varies - age and individual; genetics; size and shape; *adequate if no daytime sleepiness or dysfunction*

- Basal sleep need – hours necessary (regularly) for optimal performance

- Controlled by:
  - *Circadian clock* – inner timekeeping; works with adenosine; decrease in body temperature
  - *Homeostasis* – need for sleep as function since time of last sleep cycle

- DEC2 gene – 3% of population
Optimal sleep not meaningful unless timed with circadian rhythms
# How much is enough?

<table>
<thead>
<tr>
<th>Age</th>
<th>Sleep Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns (0-2 months)</td>
<td>12-18 hours</td>
</tr>
<tr>
<td>Infants (3 to 11 months)</td>
<td>14 to 15 hours</td>
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<tr>
<td>Toddlers (1-3 years)</td>
<td>12 to 14 hours</td>
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<tr>
<td>Preschoolers (3-5 years)</td>
<td>11 to 13 hours</td>
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<tr>
<td>School-age children (5-10 years)</td>
<td>10 to 11 hours</td>
</tr>
<tr>
<td>Teens (10-17)</td>
<td>8.5-9.25 hours</td>
</tr>
<tr>
<td>Adults</td>
<td>7-9 hours</td>
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</tbody>
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*Source: National Sleep Foundation*
Reasons we don’t sleep – 100M of us

- Insomnia - 70M
- Sleep apnea or other disorders – 18M
- Eating/drinking habits
- Restless leg syndrome – 12 M
- Depression – 90%
- Noisy bedtime setting
- Shift working – 22M
- Frequent flyers
- Medical illness causing pain

National Sleep Foundation 2010
Insomnia

• Acute - 1 night to a few weeks

• Chronic – 3 nights a week for a month or longer (only 10% diagnosed)

• National Sleep Foundation (NSF):
  Americans overall – 58%
  Elderly – 68%
  Males – 31%
  Females – 67%

• Primary - stress, anxiety, coffee, alcohol

• Secondary – physical condition (depression, asthma, cancer)

• Treatment: Nothing, change in sleep habits, pills, treat health conditions, behavioral therapy

*Gayle Greene - Insomniac

2007 National Sleep Foundation (NSF) poll
Insomnia

"No wonder you have insomnia... lying there awake all night."
Sleep Apnea

Prevalence:

• 20 million in the U.S.
• Children 1-2%
• Male: 24%
• Female: 9%
• Elderly: 20%
• 40% of Americans go undiagnosed (9M)

Risks if untreated:

• Stroke – 4x more likely
• Heart disease – 4x more likely
• 3% risk of heart attack and stroke
• 50% have hypertension
• 38,000 deaths/yr
Consequences of sleep deprivation

• 2 hours sleep loss = two or three 12-ounce beers

• Miss: 1 night - irritable and clumsy; easily tired
  2 nights - concentration ↓; mistakes on normal tasks
  3 nights - hallucinate; lose grasp on reality

• 85 sleep disorders recognized by American Sleep Disorders Association (ASDA)
The problem with not sleeping...
Effects of sleep deprivation

- Irritability
- Cognitive impairment
- Memory lapses or loss
- Impaired moral judgement
- Severe yawning
- Hallucinations
- Symptoms similar to ADHD
- Impaired immune system
- Risk of diabetes Type 2
- Increased heart rate variability
- Risk of heart disease
- Decreased reaction time and accuracy
- Tremors
- Aches
- Growth suppression
- Risk of obesity
- Decreased temperature

Other:
Sleep deprivation consequences: short term

• Decreased performance & alertness (1.5 hrs/32%)
• Memory & cognitive awareness
• Physical appearance
• Wound healing

• Stress relationships
• Immune system
• Poor quality of life
• Occupational injury
• Automobile injury
Occupational injury: Excessive Daytime Sleepiness

• > 10 people die/day - injuries on the job (sleepiness, drugs, alcohol)

• Fatal & non-fatal accidents - $100 billion/year lost wages and productivity

• 2009 (NSF): 85% police officers, 80% regional pilots, 48% air traffic controllers - nodded off on the job in past year; 41% medical workers - fatigue related errors (19% worsened patient condition)

‘99 AA crash in Little Rock
'03 Staten Island Ferry crash
‘09 regional jet crash-Buffalo NY
Exxon Valdez, 3 Mile Island & Chernobyl nuclear accident

Results from the Center for Disease Control and Prevention 2008 Behavioral Risk Factor Surveillance System (BRFSS) survey
Drowsy driving

• National Center for Sleep Disorder Research (NCSDR) & National Highway Traffic Safety Administration (NHTSA) report that:

  Most car crashes do not involve alcohol
  Sleep deprivation like driving drunk (0.10% vs 0.08%)
  Fall asleep crashes more serious: higher speed, delayed response
  Drowsy driving crashes - more injury than other non-alcohol related crashes: Mortality 1.4% vs. 0.5%

• NSF: 51% say “sleepy,” 17% have “fallen asleep”

British Medical Journal 2000
Automobile injury

• According to National Highway Traffic Safety Administration (NHTSA) drowsy driving causes:
  approximately 250,000 crashes a year
  approximately 71,000 people injured; 1500 fatalities
  $12.5 billion in property losses & lost productivity

• "Healthy People" initiative - reduce rate of car crashes due to sleepiness per from 2.7 to 2.1/100 million miles traveled by 2020

• Rumble strips:
  Stop immediately
  2 cups of coffee
  20 minute nap

 12am – 6am risky times

National Journal of Sleep; May 2010
NHTSA 2000
Sleep deprivation consequences: long term

• Obesity
• Cardiovascular disease
• Stroke
• High blood pressure
• Cancer
  • Psychiatric problems, including depression and other mood disorders

• Attention Deficit Disorder (ADD)
• Mental impairment
• Fetal and childhood growth retardation
• Injury from accidents
• Disruption of bed partner's sleep quality
• Poor quality of life
Sleep Deprivation and Obesity

• More than 35% Americans obese

• Research: (2001) Awake past midnight and < 6 hrs sleep ↑ obesity
  (2002) 1.1 million people - ↑ BMI with < 7 hrs sleep
  (2004) Wisconsin study - sleeping < 8 hrs; the ↑ in
  BMI proportional to amount of decreased sleep
  (2005) Virginia study - overweight and obese individuals
  slept less than subjects of normal weight
  (2005) Short sleep duration at 30 mos predicts obesity at 7 yrs

• Since 1992: 13 studies of > 45,000 children support inverse
  relationship between hrs sleep and obesity

• Messing with the hypothalamus? (appetite, energy expenditure)

Taheri, S. Sleep and metabolism: Bringing pieces of the jigsaw together.
Sleep Medicine Reviews. 2007. 11:159-162  Brandon Peters, M.D., About.com Guide
Updated May 23, 2011
Sleep Deprivation and Obesity

Spiegel, University of Chicago; Laboratory studies:

- 1999 - sleep restriction/effect on metabolism; 4 hrs/night/1 week; impaired glucose tolerance and changes in hormones related to weight gain and hypertension; changes reversible with normal sleep

- 2004 - sleep restriction/effect on hormones related to hunger and appetite; reduction in leptin by 18%; increase in ghrelin by 28%; subjects showed subjectively increased appetite for calorie-dense foods with high carbohydrate content

Sleep Deprivation and Obesity

University of Warwick Medical School (2006)

• Capuccio studied 28,000 children, 15,000 adults

• Sleep deprivation associated with 2-fold risk of becoming obese

• Greater in BMI & waist circumference over time

• Theory - increase in appetite due to hormonal changes from sleep deprivation; Lack of sleep produces more ghrelin and less leptin
Figure 3. Age-adjusted percentage of adults aged 18 years and over who were physically inactive and age-adjusted percentage who were obese, by usual hours of sleep in a 24-hour period: United States, 2004–2006

NOTE: Estimates are age adjusted using the projected 2000 U.S. population as the standard population and using three age groups: 18–44 years, 45–64 years, and 65 years and over. Estimates are based on household interviews of a sample of the civilian noninstitutionalized population.

Obesity and Mortality

- Atherosclerosis
- Heart failure
- Kidney failure
- Type 2 diabetes
- Sleep Apnea
- Cancer
- Osteoarthritis
Cardiac risk

- Physiological studies (Harvard, Mayo Clinic and Univ. of PA): sleep deficit→body into state of high alert; increasing production of stress hormones; driving up BP  *No time out for system!*

- Sleep influences functioning of lining inside blood vessels

- Sleep-deprived - elevated levels of hsCRP

- "Based on our findings, we believe that if you lose sleep that your body needs, then you produce these inflammatory markers that on a chronic basis can create low-grade inflammation and predispose you to cardiovascular events and a shorter life span"  Alexandros N. Vgontzas, Univ of PA

- Harvard study; 82K nurses increased cardiac risk with < 6 hours sleep/night
Cardiovascular risk & Psychosis

• **2001** Chicago Medical Institute: sleep deprivation linked to heart disease and mental illnesses including psychosis and bipolar disorder

• **2007** Mayo Clinic: getting < 5 hours of sleep a night increases risk of death from cardiovascular disease

• **2007** Harvard & University of California at Berkeley: MRI scans - link between sleep deprivation and psychosis; sleep - brain incapable of putting emotional event in proper perspective and incapable of making a controlled, suitable response to the event

• **2008** University College London/University of Warwick UK: 4,600 men and women; age 35 to 55; women who slept < 8 hrs/night - higher risk of dying from CV disease than men; differences in hormone levels

• **2010** Australian researchers: 20K between age 17 – 24; habitually slept <5 hours/night were 3-5 times more likely to develop psychiatric disorders than those that got 8-9 hours of sleep
Increased risk of Stroke

- 26th Annual Associated Professional Sleep Societies
- 3 year study – 5,666 adults with normal BMI; low risk sleep apnea
- Stroke risk 3-4x higher with < 6 hours sleep vs. 7-8 hours sleep

Megan Ruiter, Univ of Alabama 2012
Teams of Harvard researchers:

- 78,000 females working rotating night shifts over 10 yr period; significant increased risk of breast cancer

- Same group females (rotating night shift at least 3 nights/month for 15 years or more) had increased risk of colorectal cancer

- 53,000 women working rotating shifts; increased risk of endometrial cancer by 47%; doubled the risk of endometrial cancer in obese workers

World Health Organization (2007): classified shift work as a “probable” cause of cancer; ACS will continue to research
"Can you reset this rooster somehow? — They transferred me to the night shift."
Mortality associated with sleep duration and insomnia

- **Objective:** Evaluate large population survey; determine if sleep duration, report of insomnia/sleeping pill use associated with ↑ mortality risk

- **Method:** 1982 Cancer Prevention Study II; Participants - sleep duration and frequency of insomnia; Cox proportional hazards survival models

- **Results:** 1.1 M men and women; 30-102 yrs of age; followed to 1988
  Best survival – 7 hrs per night; Reports of “insomnia” no excess mortality; 8 hrs or > and 6 hrs or < experienced some ↑ mortality hazard
  *Increased risk > 15% for some groups* (sleeping > 8.5 hrs or < than 3.5-4.5 hrs)
  *Rx sleeping pill use - significantly ↑ mortality after control for insomnia*

- **Conclusion:** Short sleep and insomnia seem associated with little risk distinct from co morbidities   **More research needed** *
Sleep duration and mortality

[Bar chart showing the relationship between hours of sleep and hazard ratio for men and women.]

Arch Gen Psychiatry 2002 Feb;59(2):131-6
Insomnia, short sleep duration and mortality

Penn State: random 1,741 women and men studied in sleep lab; followed 10 and 14 yrs

• Insomnia - complaint for year; Short sleep - < 6 hrs

• Adjusted for: age, race, education, body mass index, smoking, alcohol, depression, sleep disordered breathing, and sampling weight

• Results: insomniac men with short sleep 4x more likely to die compared to normal sleep/non-insomniacs when adjusted for diabetes, high BP; 7x higher when high BP/diabetes;
Women – no extra mortality

• Conclusion: Insomnia/short sleep in males is associated with ↑ mortality

• Vgontzas AN; Liao D; Pejovic S; Calhoun S; Karataraki M; Basta M; Fernández-Mendoza J; Bixler EO. Insomnia with short sleep duration and mortality: the Penn State Cohort. SLEEP 2010;33(9):1159-1164
Sleep Debt – can we pay back?

1. Partial sleep deprivation: person sleeps too little for many days or weeks

2. Total sleep deprivation: person kept awake for days or weeks

Debate - is sleep debt a measurable phenomenon?

– 1997 Univ of PA: Cumulative sleep debt affects daytime sleepiness on days 1, 2, 6 and 7 of sleep restriction

– 2003 Stanford study: Groups tested using PVT (psychomotor vigilance task); variable sleep times (8, 6, 4 hrs & total deprivation*) for 2 weeks; groups* worsened as time progressed (6hr/10 day – results similar to 1 day deprivation); Negative effects accumulate over time

How to measure - Multiple sleep latency test (MSLT)
Epworth Sleepiness Scale (ESS)

• 2009 Univ of Washington – Alzheimer’s association (levels of protein orexin)?
Sleep Aides - hypnotics

• 25% of Americans use sleeping aide

• Age 20 - 44; use doubled from 2000 - 2004 (biggest increase age 10 – 19)

• Used to be addictive: benzodiazepine (Valium, Dalmane) barbiturates (Seconal, Halcion and Quaalude)

• $2 billion on zolpidem (Ambien) in 2004; Global for all Rx - $5 billion

• New: Lunesta (for longer term use), Ambien CR (prevents waking after 4 hours)

• Most recommended for short term use but “abused”

• Risk ↑ for nightly use – like smoking?
Sleep Aides

- Non-benzos - Lunesta, Sonata, Ambien
- Benzos - decrease REM sleep
- Antihistamines - Benadryl and NyQuil
- Alcohol - sedative, but disruptive sleep; reduces REM sleep
- Barbiturates - Same as alcohol; not long term sleep aide
- Melatonin - naturally occurring hormone; regulates sleepiness
- Siesta - “post lunch dip”
- Tryptophan - precursor of neurotransmitter serotonin; no solid data
- Marijuana - relaxation and drowsiness
“The sleeping pills take time to work. Don’t expect results overnight.”
Good news about sleep deprivation

• One night loss - BUZZ! Increase in dopamine - “euphoria”

• Sleep deprivation short term fix for depression

• Loss of 1 night sleep improves symptoms in 40-60% depressed patients

• Not viable for treatment on outpatient basis
Are you sleep deprived?

You don’t need a sleep clinic!

• Do you need an alarm clock to wake up?
• Falling asleep within 5 minutes of head hitting pillow
• Napping
"Take this. It’ll help you sleep."
Successful Sleep

• Create sleep chamber
• Maintain regular bedtime/wakeup time
• Don’t drink fluids before bed
• Don’t work on computer, watch TV or read in bed (the 2 S’s only!)
• Comfortable bed, pillows
• Exercise regularly

• Avoid alcohol
• Avoid caffeine
• Establish bedtime ritual
• Don’t use tobacco products
• Don’t go to bed until you’re sleepy
• Wake up? Leave bed
• Spend time outdoors
everything I need to know
I learned in preschool:

sleep is important

chibird.tumblr.com
References

- Timmer, John. US tossing and turning into a sleepless nation; 2008
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- National Sleep Foundation 2003 Lancet 2002; 359; 204-210
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- Recognizing the Dangers of Sleep DeprivationBY MAX HIRSHKOWITZ, PH.D., A.B.S.M. AND PATRICIA B. SMITH
Sleep Deprivation

Thanks for your time and attention

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