

Impact of Sleep and Sleep Deprivation

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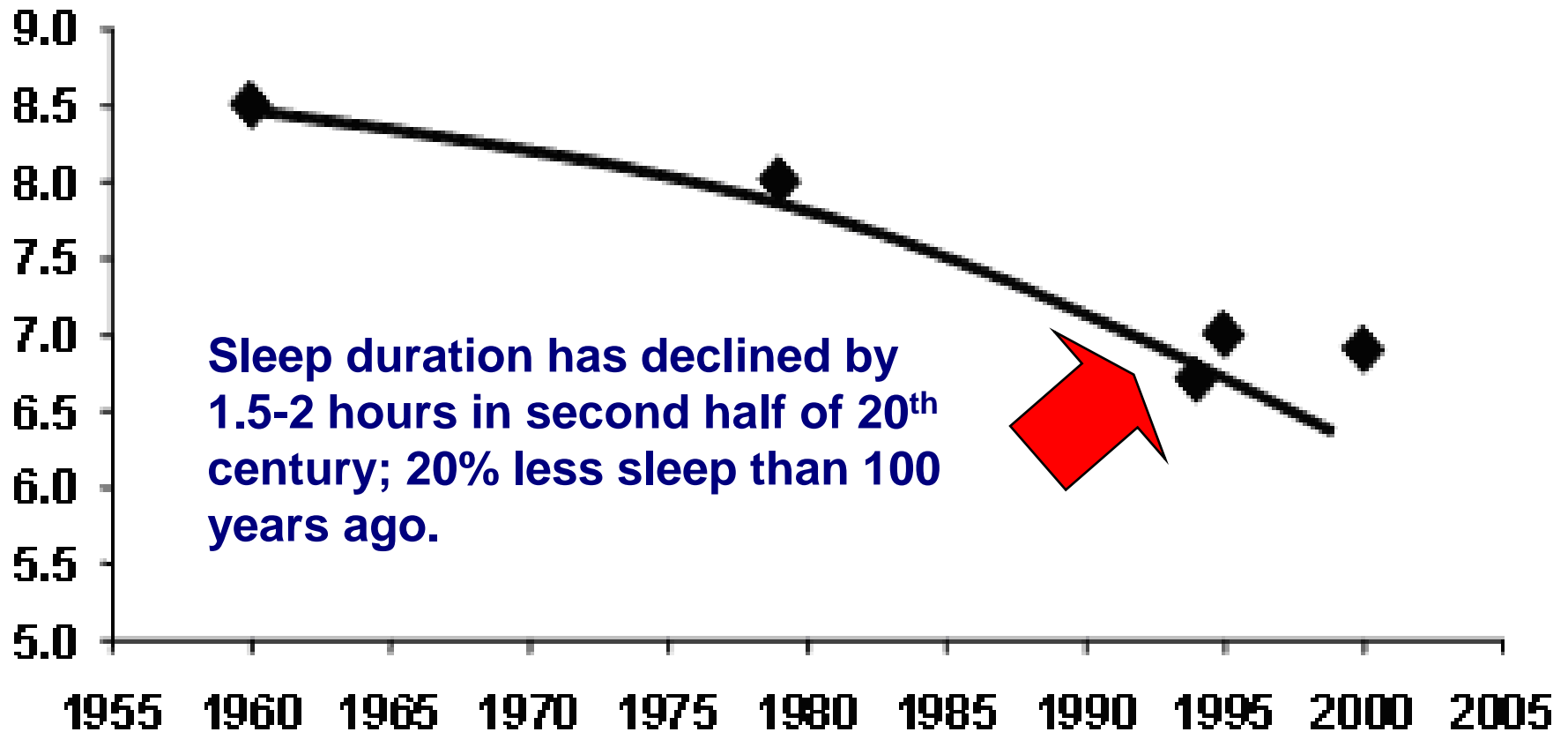
November 11, 2016

We Have Become a Nation of Sleepy People

- Average American sleeps 6.5 hours on weekdays; 7.5 hours on weekends;
- 39% sleep less than 7 hours on weekends.



National Sleep Foundation Sleep in America Poll 2002



- Many regularly sleep only 5-6 hours per night.

Why is Sleep so Important?

Why Sleep?

Possible Functions of Sleep

- Restoration and recovery:
 - Tissue repair
 - Rest body and brain
 - Brain restoration (e.g., synthesis of glycogen)
- Cognitive - Consolidate memory and daily experiences
- Energy conservation;
- Brain Growth and Development;
- Prey-Predator;
- Programming of Innate Behavior.

How Much Sleep Do We Need?

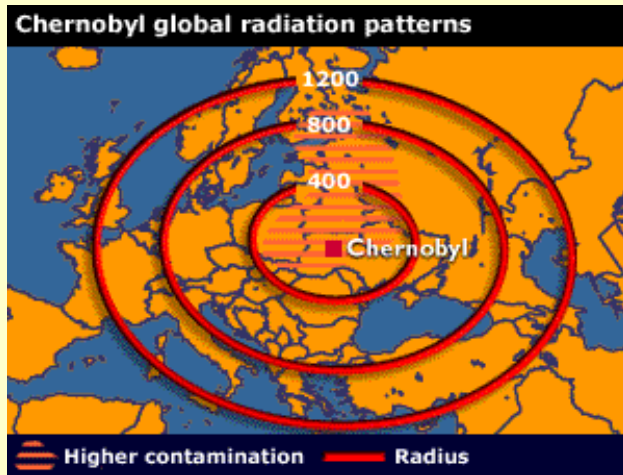
Age	Hours of sleep needed
0-3 mos	15-17
3-18 mos	13-15
18 mos – 3 yrs	11-13
4-12 yrs	10
Teens	8 ½- 9 ½
Adults	7-9

What Are the Effects of Sleep Deprivation?



Impact on Society

SLEEPINESS CAUSES ACCIDENTS



Chernobyl nuclear reactor



(Photo: NOAA) Exxon Valdez spilling oil into the waters of Prince William Sound. This was the worst environmental disaster in the United States' history.

Exxon Valdez oil spill



Friendly fire mistakes



Space Shuttle Challenger

Consequences of Sleepiness

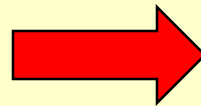
- Injuries and deaths due to attention lapses and delayed response times at critical moments;
- Drowsiness or fatigue identified as principal cause >100,000 police-reported traffic crashes in US each year, killing more than 1,500 and injuring another 71,000.



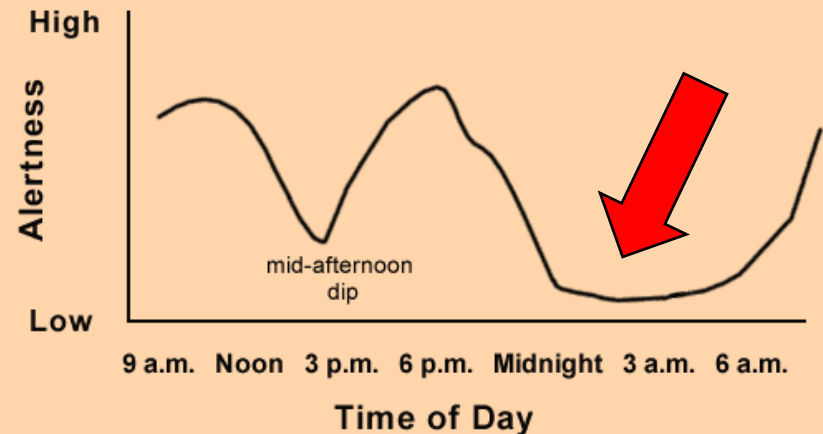
Consequences of Sleep Deprivation

- 50% of truck drivers & 25% all drivers have fallen asleep at least once while driving;
- 20% of MVAs occur between midnight and 6 AM:

- 66% showed **NO** attempt to steer = asleep.



Alertness Peaks and Dips



THE EQUIPMENT VAN for Danville-based rock group Hybrid Ice flipped over on Interstate 81 near Chambersburg during Tuesday's ice storm. The band was enroute to an engagement in Nor-

th Carolina when the accident occurred about 3 a.m. Equipment manager Russ Beiler was slightly injured but refused treatment. (Photo by Jeff Willoughby)

Danger Signs for Sleepy Drivers

- Eyes closing or going out of focus by themselves
- Trouble keeping your head up
- Yawning nonstop
- Wandering, disconnected thoughts
- Not remembering driving the last few minutes
- Drifting between lanes, tailgating, or missing traffic signs
- Jerking the car back in lane
- Drifting off the road and narrowly missing a crash

“If you don’t think fatigue wrecks havoc, take a look at some of the laws we write around here at 1 a.m.”

Rep. James Oberstar (D-MN),
quoted by *TrafficWorld* magazine, 2002

Impact on Health

Have You Also Got the Monday Morning Blues?

- Although some people are better able to vary their bedtimes than others:
 - If you sleep 2 hours later on Saturday and Sunday morning:
 - You can cause your internal clock to drift 2 hours later.



When you get up at 6 am on Monday morning, your internal clock feels it's 4 AM

Sleep Loss Can Lead to Changes in Hormones Which Regulate Appetite Control

- Recurrent partial sleep deprivation results in:
 - **↑ Ghrelin** = an orexigenic hormone secreted by the stomach *stimulates appetite* (“feed me”);
 - **↓ Leptin** = an anorexigenic hormone released by fat cells signals *satiety* to the brain (“stop eating, you are full”).



You Have the GTT of a 80 year old!

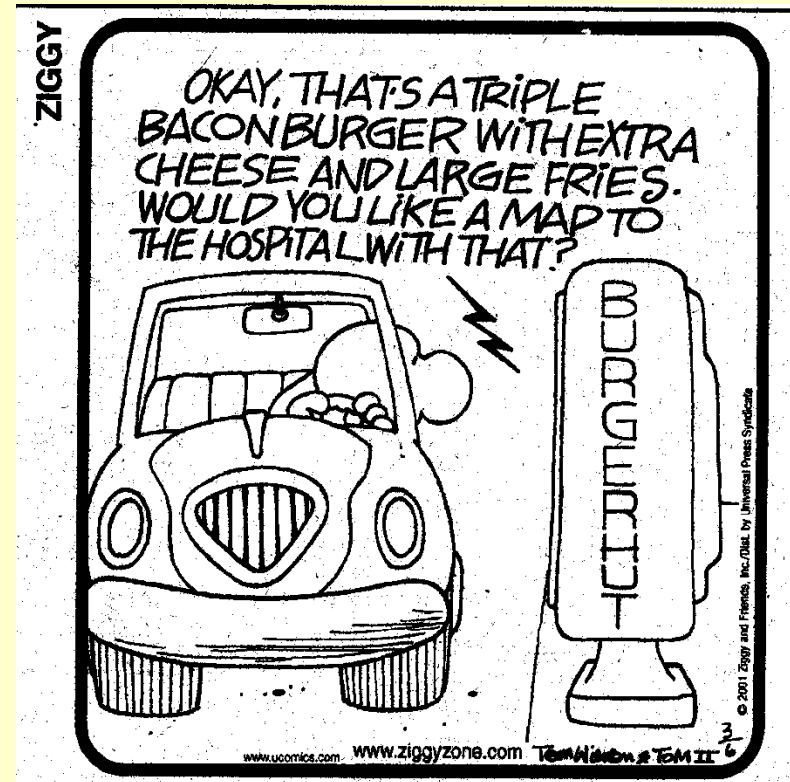
- Glucose tolerance tests in healthy young subjects restricted to 4 hours in bed for 6 nights dropped from 2.5 to 1.5 kg (% per min);
- Partial sleep deprivation resulted in an impaired glucose tolerance within the range seen in adults, ages 61 to 80.

	18-27 yr old subjects in sleep debt	18-27 yr old subjects fully rested
Kg (% per min)	1.45 ± 0.31	2.40 ± 0.41
	61-80 yr old adults with impaired glucose tolerance (1)	21-30 yr old fit subjects (2)
Kg (% per min)	Range: 1.30 – 2.10	Range: 2.20 – 2.90
<small>(1) Garcia et al., J Am Geriatr Soc 45: 813-7, 1997. (2) Prigeon et al., Metabolism 44: 1259-63, 1995.</small>		

- Only 6 days of restricted sleep caused a reversible pre-diabetic insulin resistance state

Other Demonstrated Health Effects of Sleep Deprivation

- Immune Function
 - Antibody titers to vaccination
 - Febrile response to endotoxin
 - Natural killer T-cell activity
- Endocrine function
 - Thyroid hormone
 - Cortisol
 - Prolactin
 - Luteinizing hormone
 - Estradiol
- Mortality
- Appetite and food selection
- Insulin sensitivity (propensity to develop diabetes)



Take Away Message




- Partial sleep deprivation predisposes to:
 - Display increased hunger;
 - Select high carbohydrate candies, ice cream, pasta and bread;
 - Are less able to control their dietary urges;
 - Predisposed to obesity, insulin resistance, metabolic syndrome, diabetes mellitus type 2.



DAYTIME SLEEPINESS

Causes of Daytime Sleepiness

- Insufficient Sleep Time
- Irregular Sleep/waking Habits
- Poor sleep hygiene
- Sleep disordered breathing (Sleep Apnea)
- Shift work and other circadian disorders;
- Medical, neurological, and psychiatric illnesses
- Drugs/alcohol
- Pain
- Medications and drug effects

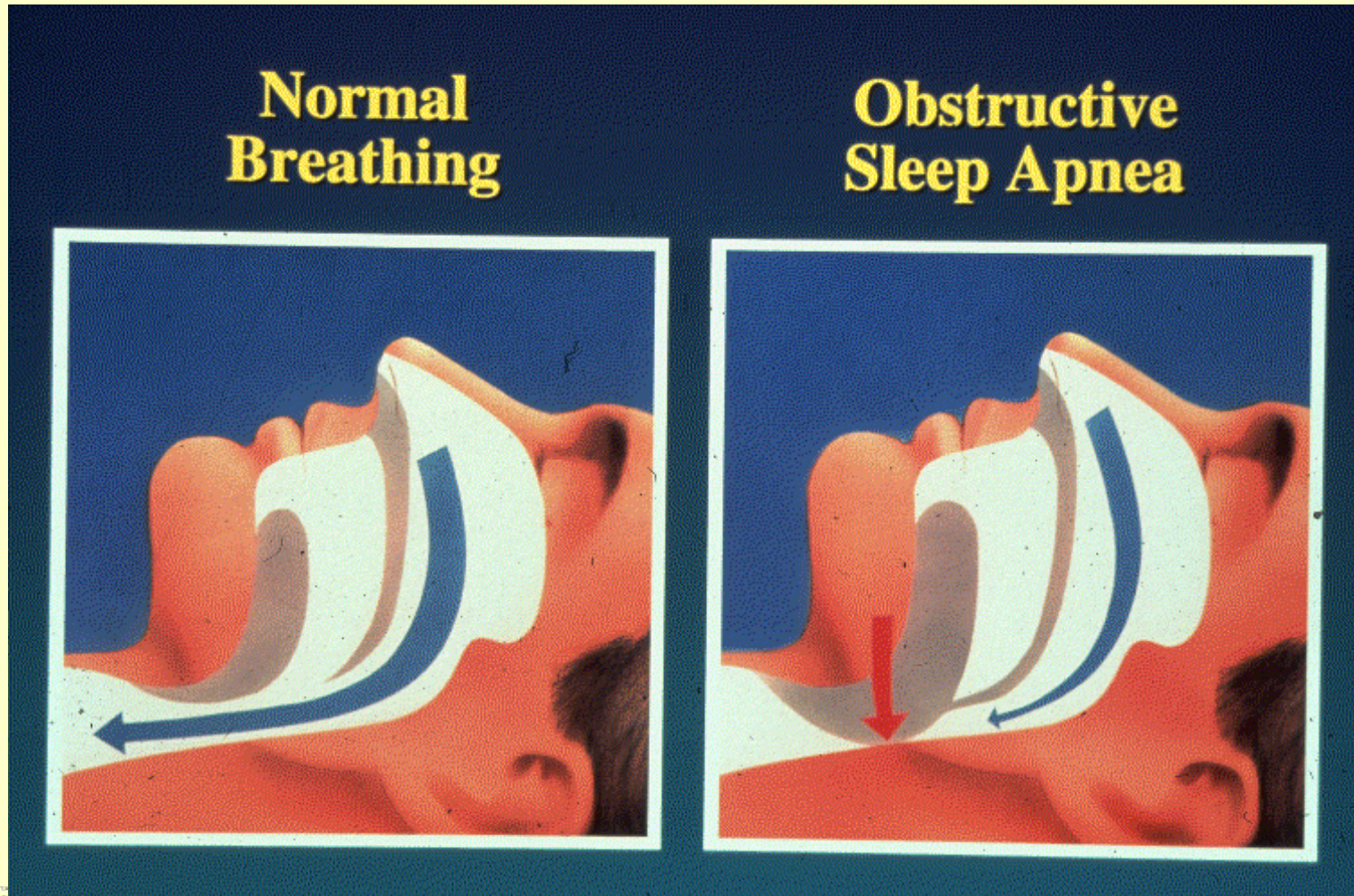


OBSTRUCTIVE SLEEP APNEA (OSA)

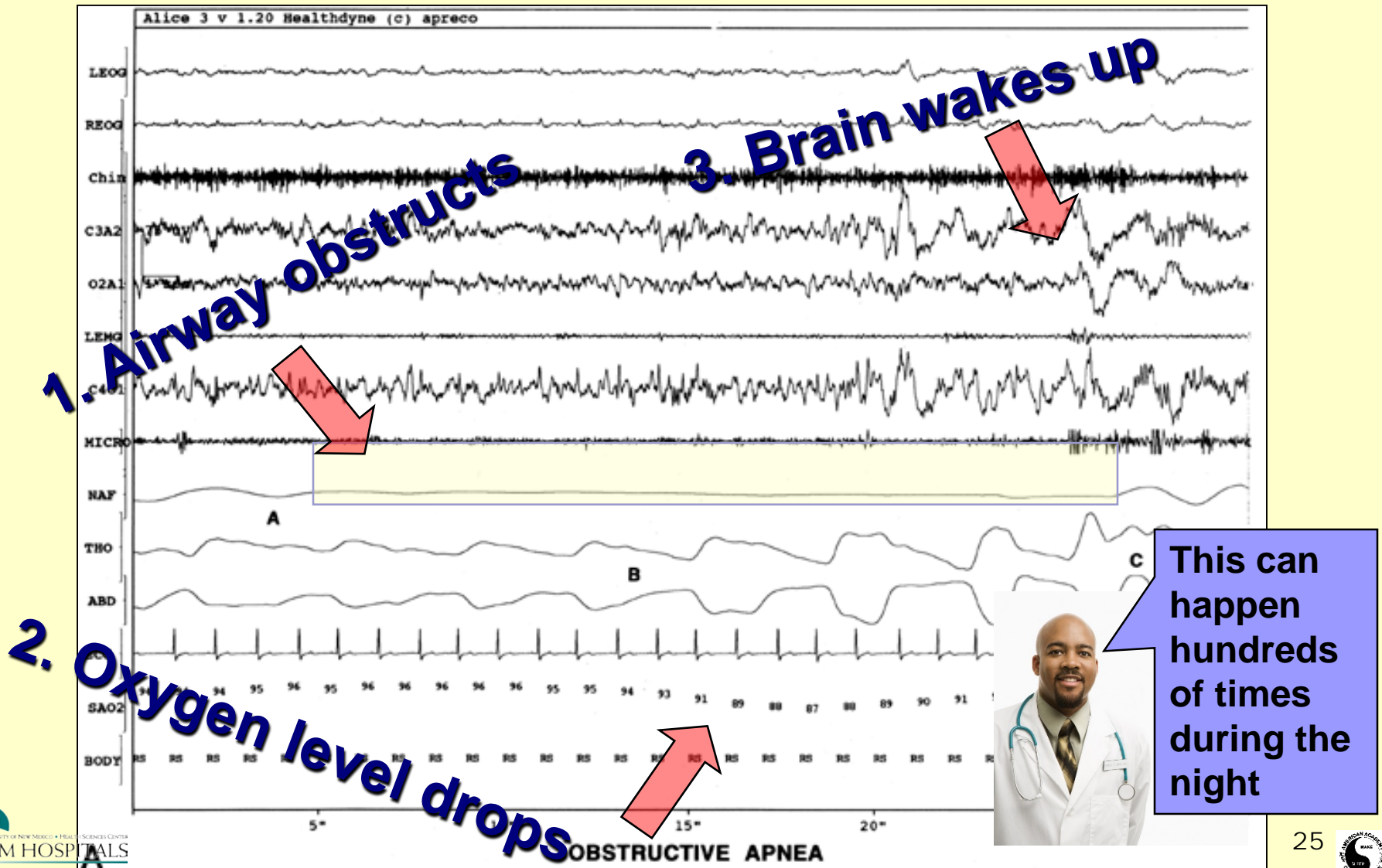
Sleep Apnea: What is it?

- Apnea: cessation of breathing lasting 10 seconds or longer
- Hypopnea: decrease in breathing causing either an awakening or reduced oxygen in blood
- Sleep Apnea: more than 5 apneas or hypopneas for every hour asleep

Why Does Obstructive Apnea Occur?



Obstructive Sleep Apnea on PSG



Oropharynx in OSAS (Extreme Example)



Symptoms of Obstructive Sleep Apnea

- Snoring or noisy breathing
- Moving around in bed; sleepwalking, sleep talking, sitting up, enuresis
- Awakenings with shortness of breath
- Heavy nocturnal sweating
- Frequent urination
- Daytime sleepiness
- Night-time or morning headaches or nausea
- Intellectual Impairment
- Depression
- Decreased libido or impotence

Sleep Quiz

One out of three Americans has a sleep disorder, which can make sleeping or waking hours miserable. Many of these people suffer needlessly because they are unaware that a problem exists.

SCORE YOURSELF!

Insomnia

- | | | |
|-----|----|--|
| Yes | No | I have difficulty falling asleep. |
| Yes | No | Thoughts race through my mind and this prevents me from sleeping |
| Yes | No | I wake up during the night and cannot go back to sleep |
| Yes | No | I worry about things and have trouble relaxing |
| Yes | No | I wake up earlier in the morning than I would like to |
| Yes | No | I lie awake for half an hour or more before I fall asleep |
| Yes | No | I feel sad and depressed |

Sleep Apnea

- | | | |
|-----|----|---|
| Yes | No | I've been told that I snore |
| Yes | No | I've been told that I stop breathing while I sleep, although I don't remember this when I wake up |
| Yes | No | I have high blood pressure |
| Yes | No | I sweat excessively during the night |
| Yes | No | I get morning headaches |
| Yes | No | I suddenly wake up gasping for breath during the night |
| Yes | No | I am overweight |
| Yes | No | I experience aching or "crawling" sensations in my legs |
| Yes | No | Sometimes I can't keep my legs still at night |

If you answered "YES" to two or more questions in one of the above categories, you may have a sleep disorder, and we suggest you consult your medical provider about referral to a sleep specialist. For information on sleep disorders, you may go to the UNMH Sleep Disorders Center Website at <http://hospitals.unm.edu/SDC>



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SLEEP DISORDERS CENTER

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The *Experts* in Sleep Medicine

If you think your child may have a sleep problem, ask yourself these five simple questions. Remember:

Bedtime

Does my child have problems going to bed or falling asleep?

Excessive sleepiness

Does my child seem sleepy, or overtired during the day? Is he/she difficult to get up in the morning?

Awakenings

Does my child awaken frequently during the night or have trouble getting back to sleep?

Regularity of sleep

What time does my child go to bed and get up on week-days? Weekends? How much sleep does he/she get? Need?

Snororing

Does my child snore loudly? Does he/she seem to have breathing problems at night?

If the answer to any of these questions is "yes," don't just live with the problem or hope your child will outgrow it. Speak to your child's health care provider, who can help and treat the problem appropriately.

Source: National Sleep Foundation



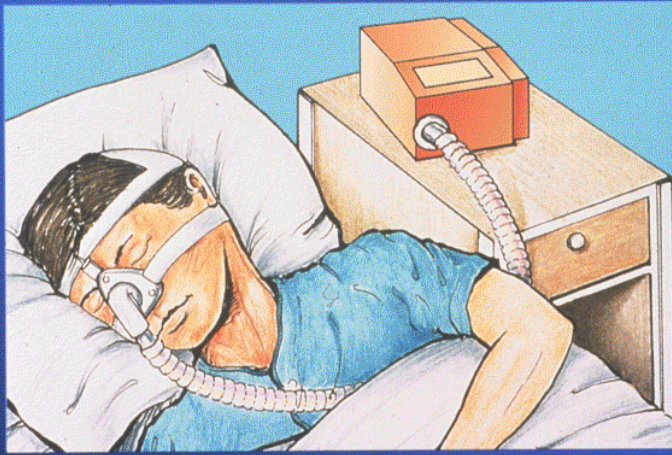
Is Obstructive Sleep Apnea Dangerous?

- Higher mortality rate in patients with moderate or severe obstructive sleep apnea
 - High blood pressure
 - Heart attacks
 - Strokes
 - Kidney Failure
 - Abnormal heart rhythms
 - Automobile and work accidents

Medical Complications of Obstructive Sleep Apnea

- Hypoxia
- Hypertension
- Pulmonary HTN
- Polycythemia
- Cardiac arrhythmias
- Gastroesophageal reflux
- Depression
- Diabetes
- Sudden nocturnal death
- Hypercapnia
- Pedal edema
- Impotence
- Seizures

Positive Airway Pressure



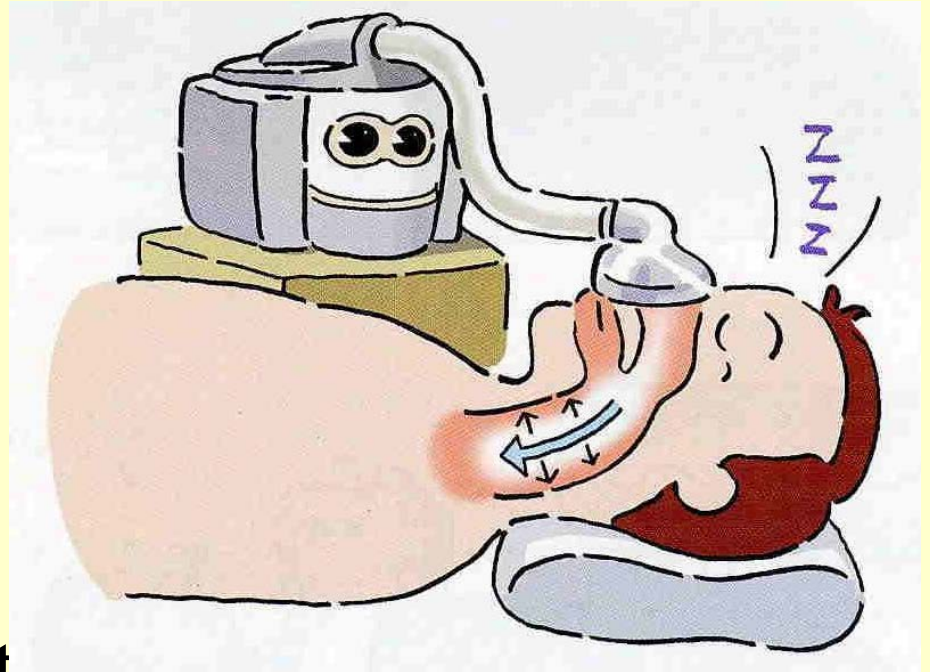
Effective PAP therapy results in daytime alertness, improved health and happier patients (and friends and family.)

The “Gold Standard” for treating OSA is through PAP therapy.



PAP Reduces Ghrelin Levels

- Studies recently published show PAP treatment:
 - Reduced Ghrelin levels in patients with OSA
 - Reduced visceral fat accumulation and fatty liver.



Harsch et al., 2003; Sanner et al. 2004.

What About Children?

Our Children Suffer The Same Chronic Sleep Debt

60% of children < age 18 complained of being tired during the day in the past year;
15% of school-aged children reported falling asleep at school during the past year;
Teens more likely to complain (23% adolescents vs. 11% younger kids).



Consequences of Sleepiness

- Injuries and deaths due to attention lapses and delayed response times at critical moments;
- Drowsiness or fatigue identified as principal cause >100,000 police-reported traffic crashes in US each year, killing more than 1,500 and injuring another 71,000.



Consequences of Poor Sleep in Adolescents

- Poor sleep → increased risk of unintentional injuries and death;
- 55% of fall-asleep crashes were drivers < age 25;¹
- Young males (ages 16-25) are 3-5 times more likely to be involved in drowsy driving crashes than females.



Consumed even small amounts of alcohol ↑↑↑ risk for injury in sleep-deprived teens;²

REFs: 1) National Sleep Foundation;

2) Roehrs 1994;

REFs: 1) National Sleep Foundation; 2) Roehrs 1994; 3) Wolfson and Carskadon 1998.

Causes of Excessive Daytime Sleepiness (EDS) in Children and Adolescents

- Insufficient sleep from:
 - Chronic sleep debt;
 - Poor sleep hygiene;
 - Delayed sleep phase syndrome;
 - Limit-setting or sleep-onset association disorders;
- Poor quality fragmented sleep due to:
 - Obstructive sleep apnea;
 - Restless legs or periodic limb movements (PLMD);
 - Other medical conditions (epilepsy, chronic pain, chemotherapy);
- Primary EDS disorders;
 - Narcolepsy, idiopathic hypersomnia, Kleine-Levin syndrome, myotonic dystrophy;
- Medications, alcohol, stimulants, nicotine, caffeine or street drugs.



Does Sleepiness Impair Mood in Children and Adolescents?

- Decreased **positive** mood following sleep restriction;^{1,2}
- Sleep deprivation **↑** depressive symptoms for depressed in remission and non-depressed adolescents.³



Higher levels of depressed mood among short sleepers (6.5 hours) versus long sleepers (8.25 hrs) on school nights.⁴

Insufficient Sleep Increases Problem Behaviors

- **LOWER** rates of problem behavior (aggression, bullying, self-injury) among intellectually-disabled children when they slept well.



- Poor sleep in childhood associated with poor behavior regulation and increased risk for psychopathology.

REFs: 1) J Appl Behav Anal 1997;30:601; 2) J Appl Behav Anal 1996;29:133; 3) Res Dev Disabil 2000;21:125.

Behavior of Overtired Children with Sleep Apnea

- Hyperactivity and/or attention deficits;
- Bizarre and/or aggressive behavior;
- Learning, developmental, discipline, and/or behavioral problems;
- Poor school performance;
- Developmental delay;
- May briefly improve following nap;
- Poor appetite, decreased intake, slow eating, difficulty swallowing and growth retardation.

Do children Snore?

Answer: Yes and No

A Common mistake pediatricians or general practitioners make is assuming that just because a child does not audibly snore that they do not suffer from sleep disordered breathing.

- * Mouth breathing
- * Loud or labored breathing
- * Shallow breathing or no breathing

All signs of OSA or SDB

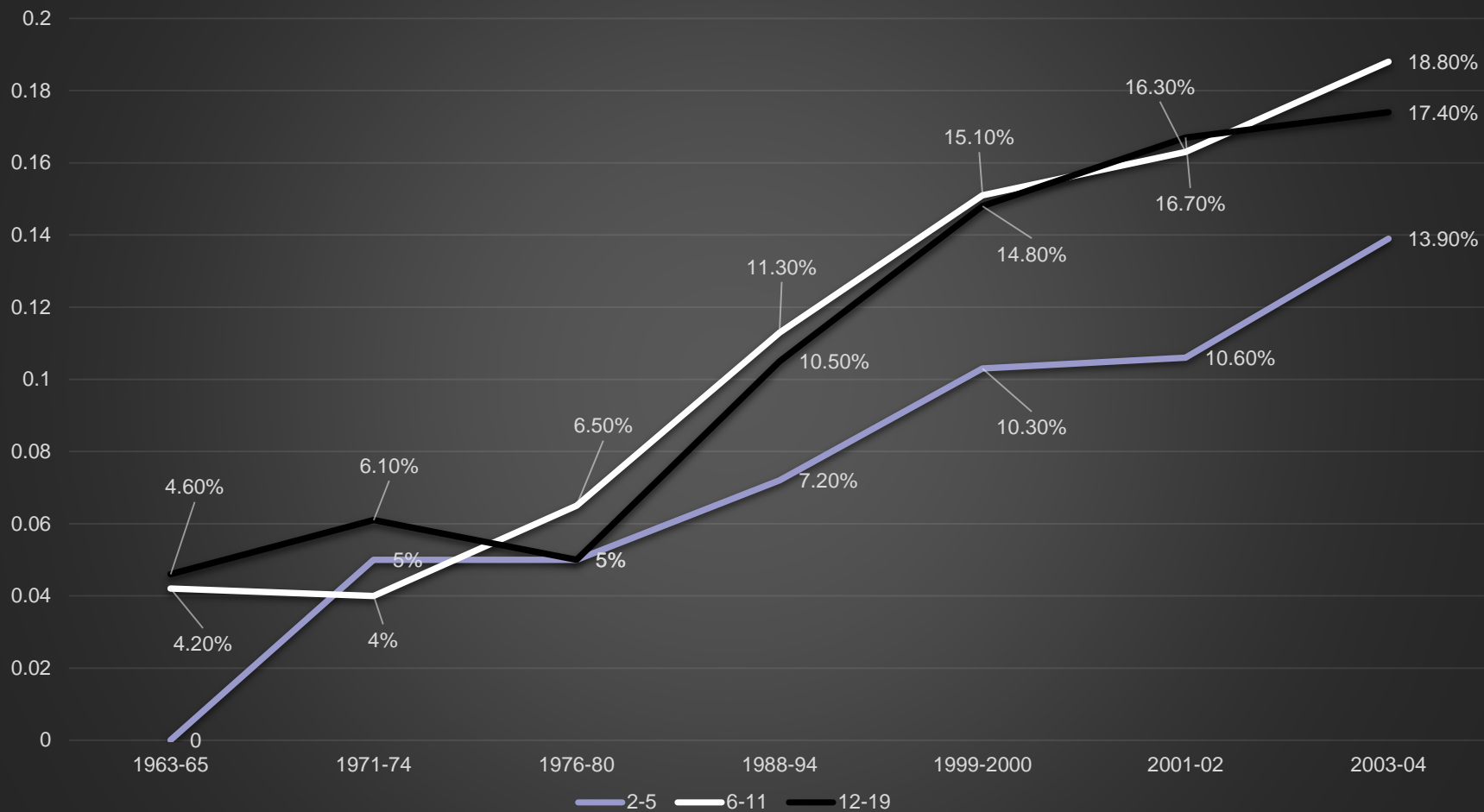


The Impact of Breathing Problems During Sleep



- It is estimated that 20-30% of children under the age of five suffer from some type of sleep disorder; 1-3 % of children suffer from sleep disordered breathing.
- Breathing Problems During Sleep May Affect Mental Development in Infants.
- Sleep Apnea Linked to Bed-Wetting in Kids. Journal of Pediatrics 2003- 66
- Studies indicate that children who snore do worse in school. 8 out of 10 people are unaware that attention deficit hyperactivity disorder and obesity can be a result of sleep disorders in children.
- “Substantial associations” between symptoms of sleep disordered breathing and inattentive and hyperactive behavior.
- The prevalence of obesity in the United States has grown significantly.

Prevalance of Overweight in Children Ages 2-19 years



It is important for parents/caregivers to talk with a physician about the possibility of a sleep disorder if any of the following signs and symptoms are observed:

Common signs and symptoms during sleep:

- Snoring
- Witnessed apnea
- Choking noises
- Increased work of breathing
- Paradoxical breathing
- Frequent leg movements
- Enuresis (bed wetting)
- Bruxism (teeth grinding)
- Restless sleep
- Diaphoresis (night sweats)
- Hyperextended neck
- Frequent awakenings
- Dry mouth
- A newborn who is extremely and consistently fussy.
- Bizarre sleeping positions



Common signs and symptoms during wakefulness:

- Poor school performance
- Aggressive behavior
- Hyperactivity
- Attention deficit disorder
- Excessive daytime sleepiness
- Morning headaches
- Morning crankiness, irritability, grogginess, disorientation, confusion

CAVEAT: Only 9-13% exhibit excessive daytime sleepiness (EDS).

Pointers for Parents

- Provide a home environment conducive to sleep:
- Establish a quiet time in evening:
 - Dim lights;
 - No loud music;
 - No TV, computer, video games, or telephone one hour before bedtime.



- Parents to be good role models for their children.
- Listen to your body: if sleepy in day, go to bed earlier, take a nap, sleep longer. Consult sleep specialist. Don't drive if drowsy or sleep-deprived.

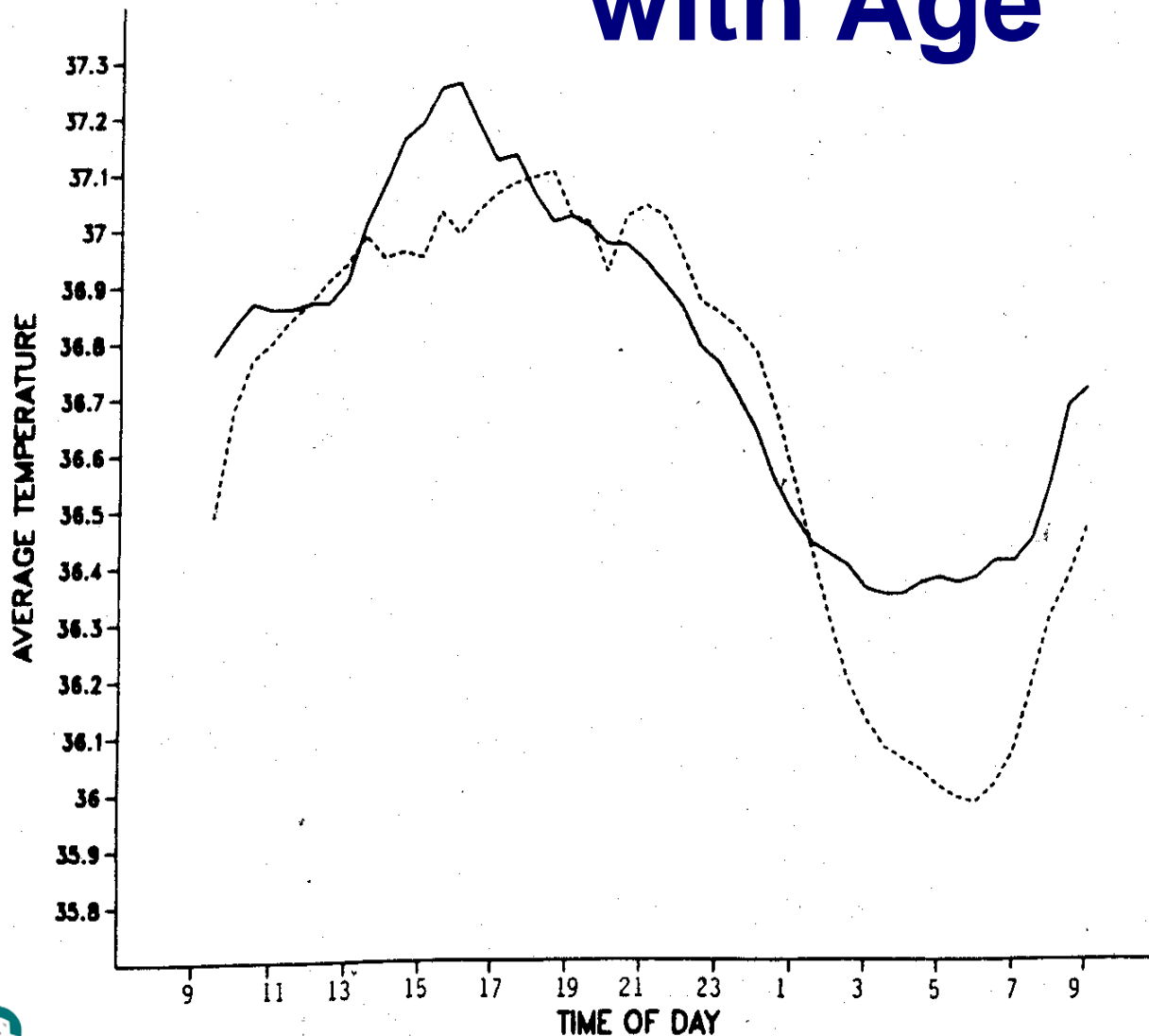
Sleep and the Elderly

Compare Polysomnographic Findings in Healthy Non-complaining Older and Younger Adults

Sleep Parameter in Non-complaining older and young adults	Aged (68 ± 0.5 y) Mean value	Young (23 ± 3 y) Mean value	Comment
Time in Bed (TIB)	465 min	411 min	
Sleep latency	14 min	6 min	2-fold increase in sleep latency
Total Sleep Time (TST)	381 min	390 min	
Wake After Sleep Onset (WASO)	64 min	15 min	3- to 4-fold increases in WASO
Total Wake Time	84 min	21 min	4-fold increase in wake
Sleep Efficiency	82%	95%	13% reduction in sleep efficiency
%SWS of TIB	5%	19%	74% reduction in SWS
%REM of TIB	17%	24%	30% reduction in REM

Vitiello et al. J Psychosomatic Res 2004;5:503-10.

Changes in Circadian Rhythm with Age



Old males
(solid line)

Young males
(dotted line)

From Monk, Exper
Gerontol 1991.

Causes of Decreased Sleep Efficiency with Age:

Physical Illness

- Nocturia (BPH; diabetes)
- Pain (arthritis; immobility with inability to change position)
- Orthopnea/PND (CHF)
- Dyspnea (COPD)
- G-E Reflux
- Diabetes
- Parkinson disease, Dementia
- Sleep Disorders (sleep apnea, PLMD)

Causes of Decreased Sleep Efficiency with Age: Psychological Factors

- Depression
 - Bereavement
 - Retirement
- PTSD
- Fear of dying
- Anxiety

Causes of Decreased Sleep Efficiency in the Elderly: Medication

- Diuretics (nocturia)
- Beta adrenergic antagonists (e.g., propranolol)
- Bronchodilators (e.g., theophylline)
- Corticosteroids
- Decongestants (e.g., pseudoephedrine)
- CNS stimulants
- Stimulating antidepressants
- Calcium channel blockers
- Herbal preparations (e.g., those containing ginkgo, caffeine, ginseng)

Sleep Hygiene

“The most effective countermeasure for sleepiness is sleep.”

Veasey et al, 2002

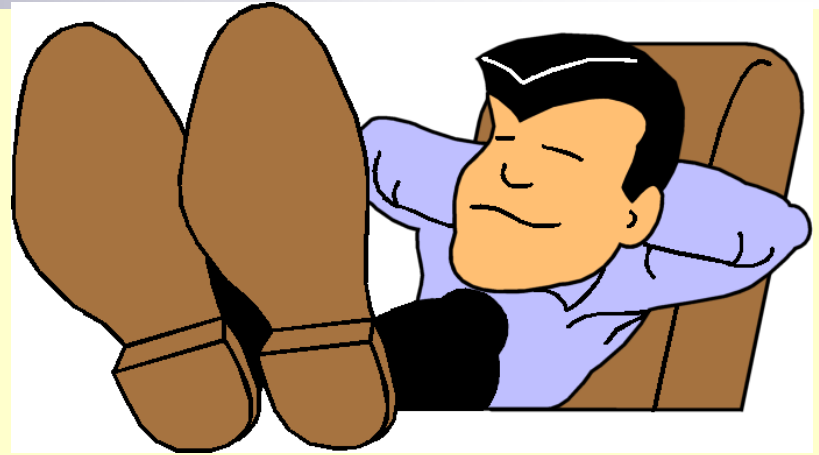
- Limit work hours
- Education
 - Chronic partial vs. acute severe sleep deprivation
 - Moonlighting and other activities
 - Optimal sleep environments
 - Optimal sleep hygiene
 - Recovery sleep
- Sleep Medicine Consultation
 - Identify and treat sleep disorders
 - Judicious use of hypnotics

Countermeasures: Napping

Nature had not intended mankind to work from eight in the morning until mid-night without that refreshment of blessed oblivion which, even if it only lasts twenty minutes, is sufficient to renew all the vital forces. This routine I observed throughout the war, and I commend it to others if and when they find it necessary for a long spell to get the last scrap out of the human structure.

Sir Winston Churchill

What is A Nap?



- A period of sleep that is
 - shorter in duration than usual
(typically, <50% of normal sleep period)
 - taken at a time other than the normal sleep period
 - may be replacement or prophylactic in nature

The key to the perfect siesta

Find a safe, quiet, comfortable place, preferably one where you can lie down. (It takes about 50% longer to fall asleep sitting upright)

Calm your body by breathing slowly and deeply. Concentrate on relaxing your muscles one group at a time

If noise is an issue, put in earplugs or turn on some white noise



Set an alarm

Darken the room or use eye shades

Have a light blanket handy in case you get chilly, but nothing too heavy (excess warmth can make you oversleep)

Quiet your mind by repeating a mantra, taking a mental walk at a relaxing place like the beach, or counting sheep or floating reds

Good Sleep Habits for All

- Consume less or no caffeine
- Avoid alcohol and nicotine
- Avoid heavy meals and less fluids close to bedtime.
- Exercise regularly, in the daytime, preferably after noon.
- Try a relaxing routine, like soaking in hot water (a hot tub or bath) before bedtime.
- Keep a dark, quiet and cool environment
- Use the bed and bedroom for sleep and sex only (no reading or watching TV in bed)
- Keep regular bed and wake time

QUESTIONS?

UNMH Sleep Disorders Center Website:

<http://hsc.unm.edu/health/patient-care/sleepmedicine>