SLEEP: Cycles, Rhythms, Health & Weight

How the Foods We (and our residents/patients) Eat Effects Sleep

Rest v. Sleep

Rest is a condition in which the body is in a decreased state of activity without physical emotional stress and freedom from anxiety.

Sleep is a state of rest accompanied by an altered level of consciousness and relative activity and perception to environment are decreased

Sleep Background

- By 2025 62 million Americans will be over the age of 65
- Annual direct costs associated with insomnia $15.4 billion
Sleep Disorders: Insomnia

- Difficulty initiating sleep, maintaining sleep and/or unrestorative sleep leading to daytime impairments
- Affects 20-50% in western countries adult population
- Reported more in elderly women than men
- Up to 57% of noninstitutionalized elderly have problems with chronic insomnia

PHYSIOLOGY OF SLEEP

The cyclic nature of sleep is thought to be controlled by Centers located in the brain and by Circadian Rhythms.

- Reticular activating system (RAS) located at the brain stem and Cerebral Cortex plays an important role in sleep wake cycle.

PHYSIOLOGY OF SLEEP

- Sleep begins with the activation of the preoptic area of the anterior hypothalamus.

- Sleep promoting neurons act over wake promoting neurons by releasing Gamma Amino Butyric Acid (GABA).
The inhibition of wake promoting neurons results in intensifying sleep process.

Another key factor to sleep is exposure to darkness. Darkness and preparing for sleep (e.g., lying down, decreasing noise) cause a decrease in stimulation of the RAS. During this time, the Pineal gland in the brain begins to actively secrete the natural hormone Melatonin, and the person feels less alert.

With the beginning of daylight, Melatonin is at its lowest level in the body and the stimulating hormone, Cortisol, is at its highest causing wakefulness.
Circadian Rhythms

- It is a sort of 24-hour internal biological clock. The term circadian is from the Latin “circa dies”, meaning “about a day.”
- Biological rhythms exist in plants, animals, and humans.
- In humans, these are controlled from within the body and synchronized with environmental factors, such as light and darkness.

Types/ Stages/ Phases Of Sleep

- Electroencephalogram (EEG) patterns, eye movements and muscle activity are used to identify stages of sleep. The stages of sleep are classified into two stages:
  - Non Rapid Eye Movement (NREM) Sleep
    - Stage 1
    - Stage 2
    - Stage 3
    - Stage 4
  - Rapid Eye Movement Stage(rem) Sleep. During sleep, NREM and REM sleep alternate in cycles.

NREM Sleep

- Stage 1: NREM
  - Stage lasts a few minutes-lightest level of sleep.
  - Gradual fall in vital signs and metabolism.
  - General slowing of EEG frequency
  - Eyes tend to roll slowly from side to side
  - Sensory stimuli such as noise easily arouses person.
  - Sleeper may deny he is sleeping.
NREM Sleep

Stage 2: NREM
- Stage lasts 10 to 20 minutes.
- It is a period of sound sleep.
- Relaxation progresses.
- Further slowing of EEG
- Absent eye ball movements
- Body functions continue to slow.
- Arousal remains relatively easy

Stage 3: NREM
- Stage lasts 15 to 30 minutes.
- It involves initial stages of deep sleep.
- Muscles are completely relaxed.
- Large slow waves in EEG
- Vital signs decline but remain regular.
- Sleeper is difficult to arouse and rarely moves

Stage 4: NREM
- Stage lasts approximately 15 to 30 minutes.
- It is the deepest stage of sleep.
- If sleep loss has occurred, sleeper spends considerable portion of night in this stage.
- Vital signs are significantly lower than during waking hours.
- It is very difficult to arouse sleeper
REM Sleep

- Stage usually begins about 90 minutes after sleep has begun.
- Dreaming occurs in this stage.
- Stage is typified by rapidly moving eyes, fluctuating heart and respiratory rates, increased or fluctuating blood pressure, loss of skeletal muscle tone, and increase of gastric secretions.
- EEG pattern resembles that of awake state.
- It is very difficult to arouse sleeper.

FUNCTIONS OF SLEEP

- Conservation of energy
- Restoration of tissues and growth
- Thermoregulation
- Regulation of emotions- sleep deprivation causes emotional disorders like irritability, anxiety, depression etc.
- Memory and learning- there will be information transfer between cerebral cortex and hippocampus during sleep

Normal Sleep Requirements

- Newborn: 16-18 hours /day
- Infants: 12-14 hours
- Toddlers: 10-12 hours
- Preschool: 11-12 hours
- School-Age: 8-12 hours
- Adolescents: 8-10 hours
- Adult: 6-8 hours
- Elders: 6 hours
Sleep and Aging

- Nocturnal secretion of endogenous melatonin gradually decreases with age.
- In every decade except for ages 30-39 the prevalence of insomnia is increased in women with prevalence of insomnia being 40% in women.
- Insomnia stable in middle years and abruptly jumps in decades 70-79 and 80-89.

Sleep Patterns and Aging

- It is not clear whether the need to sleep decreases with age although this is a common belief.
- During the late decades of life sleep evolves even further.
- Ability to sleep decreases with age.*
- Older adults report waking up earlier, increased sleep onset latency, increased time spent in bed, increased night time awakening, increased napping and decreased total sleep.
- *Some elderly report sleeping more than younger adults and report a more consistent sleep pattern (subjective).

Dementia and Sleep

- Longer sleep duration may be an early sign of dementia.
- AD patients suffer from sleep disturbances - sleep fragmentation, longer periods on intra sleep wakefulness.
- As dementia progresses the symptoms of poor sleep become more severe.
- Patients become sleepier during the daytime.
- Increases in neurocognitive impairment, end organ dysfunction, chronic health condition and increased mortality.
Sleep Patterns and Aging

- Sleep disturbances have been shown to double the risk of death for healthy older adults - University of Pittsburgh School of Medicine.
- 8 studies between 1981 and 1997
- EEG monitors observed sleep patterns in 185 healthy adults 60 to 90 years old

- 66 adults had died in the sleep study
- Laid awake for long periods
- Slept less “efficiently” through the night
- Had abnormally high or low amounts of REM sleep

FACTORS AFFECTING SLEEP

- Both the quality and the quantity of sleep are affected by a number of factors.
- Sleep quality is a subjective characteristic
- Quantity of sleep is the total time the individual sleeps.
- 1. AGE
- 2. Illness
- Illness that causes pain or physical distress (e.g., arthritis, backpain) can result in sleep problems
Elderly Spend More Time in Lighter Stages of Sleep

- Increased fragmentations of entire sleep cycle
- REM sleep may decrease overall
- Take longer to initiate sleep
- Decreased total sleep time
- Have early morning awakening
- Increased need to nap during the day
- Tend to fall asleep during the daytime faster
- Elderly women maintain sleep better with aging but with menopause have increased subjective complaints of insomnia

FACTORS AFFECTING SLEEP

- Respiratory conditions
- Pain
- Need to urinate during the night
- Environment—noise in the environment—can inhibit sleep
- Lifestyle
- Stress

FACTORS AFFECTING SLEEP

- Stimulants and Alcohol
- Caffeine-containing beverages act as stimulants of the central nervous system (CNS).
- Drinking beverages containing Caffeine in the afternoon or evening may interfere with sleep.
- Even though alcohol induces sleep, it disturbs REM sleep causing irritability
FACTORS AFFECTING SLEEP

• Medications:
  • Beta-blockers have been known to cause insomnia.
  • Narcotics, such as morphine, are known to suppress REM sleep and to cause frequent awakenings and drowsiness.
  • Most Hypnotics suppress REM sleep

Standards of Care to Manage Insomnia

• Melatonin is a hormone that is associated with circadian rhythms and some research has demonstrated sedative/hypnotic effects of this compound
• Melatonin is effective in the management of chronic insomnia in subsets of the chronic insomnia population and there is no evidence that melatonin poses a risk of harm (based on a small number of studies

Standard of Care to Manage Insomnia - Foods Affecting Sleep

• Diet • Certain foods induces sleep. As some nutritional interventions may exert effects on neurotransmitters that are involved in the sleep-wake cycle, it is possible that these interventions may enhance sleep.
  • Ex: the L-tryptophan present in the milk induces sleep- precursor for serotonin
Foods Affecting Sleep

- Synthesis of 5-HT is dependent on the availability of its precursor in the brain, the amino acid L-tryptophan (Trp).
- Large neutral amino acids (LNAA) travel across the blood-brain barrier along with Trp.
- The ratio of Trp/LNAA in the blood is crucial to the transport of Trp into the brain and an increase in this ratio can be achieved by the intake of pure tryptophan or tryptophan-rich proteins.

Factors Affecting Sleep

- Neurotransmitters in the brain involved in the sleep-wake cycle.
- Serotonin, gamma-aminobutyric acid (GABA), orexin, melanin-concentrating hormone, cholinergic, galanin, noradrenaline and histamine.
- Nutritional interventions may influence sleep via neurotransmitters.

Foods Affecting Sleep...

- The food protein with the highest Trp content and most favorable Trp:LNAA ratio is a-lactalbumin, a whey-derived protein.
- Carbohydrate, however, increases brain Trp via insulin stimulation of LNAA into skeletal muscle, which results in an increase in free-Trp
Foods Affecting Sleep
- High glycemic index foods improves sleep
- Consume more than 1 h prior to bedtime
- Consuming solid meals better than liquid meals at enhancing sleep
- High in protein diets improved sleep quality
- High in fat diets negatively influence total sleep time.
- American Journal of Clinical Nutrition - jasmine rice consumed four hours before bed fell asleep almost twice as fast as normal.

Foods Affecting Sleep
- There have been numerous studies investigating the effects of tryptophan supplementation on sleep
- It appears that doses of Trp as low as 1 g can improve sleep latency and subjective sleep quality. This can be achieved by consuming ~300 g of turkey or ~200 g of pumpkin seeds.

Foods That Helps You Sleep Better
- The Tryptophan containing in Almonds induces sleep also magnesium contains in it helps in muscle relaxation too. So tight sleep
- Almonds
Foods That Helps You Sleep Better

- Bananas are a rich source of magnesium & Potassium which helps to relax muscles and tryptophan in it convert to serotonin & melatonin. These hormones help in better sleeping.

Foods That Helps You Sleep Better

- Cherries

  - Cherries are the natural, rich source of melatonin, which aids in sleep

More Foods Affecting Sleep

- Another recently investigated intervention is tart cherry juice.
- Tart cherries contain high concentrations of melatonin and when consumed over a 2 wk period improved subjective insomnia symptoms when compared to placebo
Foods That Helps You Sleep Better

- Dairy Products like milk, cheese and yogurt are the richest source of calcium, which helps in alleviating stress and also it contains the sleep inducing agent tryptophan.

- Salmon & Tuna richly contains in salmon & tuna Vitamin B6, which is needed for the production of melatonin.

- This green leafy vegetable loaded with calcium, which helps the brain to produce melatonin, the sleep inducing hormone. Kale
Foods That Helps You Sleep Better

• Oatmeal is the fertile source of sleep inducing agents like potassium, calcium, magnesium and vitamin B6, etc.
• Walnuts: Tryptophan contains in walnuts induces the production of serotonin & melatonin

Nutritional Interventions To Promote Sleep

• Diet: • Limit alcohol and caffeine in late afternoon and evening
• Consume carbohydrates or milk as a light snack before bedtime.
• Avoid heavy and spicy foods. Heavy or spicy foods can cause gastrointestinal upsets that disturb sleep
• Decrease fluids 2 to 4 hours before sleep
• Meals and snacks- timed enhance circadian rhythms that regulate sleep and vice versa.

Foods that Inhibit Sleep

• Most common is caffeine.
• Certain foods can be associated with reflux events--foods include citrus fruits, chocolate, fatty and fried foods, garlic, onions, min flavorings, spicy foods, and tomato-based foods.
• Alcohol – wine, beer, etc. interferes with REM sleep
Foods that Inhibit Sleep

- Fluids - 2 a.m. restroom runs interrupt your sleep cycle
- Interferes with REM sleep.
- Avoid drinking fluids 60-90 minutes before bed.
- Tyramine containing foods (aged and fermented foods) stimulates the brain.
- Avoid aged cheese, smoked fish, soy, and cured meats before bedtime.

Foods that Inhibit Sleep

- Avoid tomato-based foods and spicy dishes 3 hours before bedtime (heartburn).
- Celery – a natural diuretic
- Citrus fruits/juices – acid/heartburn
- Milk chocolate – dopamine – restless/energy

And There’s Weight Gain…

- Research on sleep and appetite
- Consistent link between lack of sleep and a higher body mass index (BMI)
- Wisconsin Sleep Cohort Study
- Less than eight hours of sleep produced overweight subjects.
Sleep and Weight Gain

- Sleep lack alters leptin and ghrelin
- Appetite and fat hormones
- Leptin, released by fat cells, signals the brain to feel satiety
- Ghrelin produced in the stomach, signals hunger
- Wisconsin cohort study: persons having five hours vs. eight hours a night had lower leptin as well as higher ghrelin levels

Sleep Affecting Weight Gain

- Subjects here - craved sweet and fatty foods.
- Stress hormone cortisol
- Elevated with sleep deprivation
- Contributes to hunger
- Longitudinal study in 276 adults
- Short sleep duration vs long sleep duration increased weight gain/waist circumference -6yrs

Sleep/Eating Plan

- Eat foods lower in calories
- Regular breaks to relax
- Small snack, small fluids
- Treat Chronic conditions
- Sleep apnea, anxiety, and bipolar disorder
Sleep/Eating Plan

- Food availability
- Personal food choices
- Individual activity patterns
- Important role in weight maintenance
- Discuss with clinical, activity, therapy and dietary staff

Conclusion

- Research continues to investigate the effects of nutritional interventions on sleep.
- Importance of nutritional and dietary interventions to enhance sleep on both the general population and in the elderly.
- Timing of food ingestion and the use of different interventions would prove invaluable for optimizing sleep quality and quantity, and with weight management.

References

- University Of Pittsburgh Medical Center. "Deterioration Of Sleep During Middle Age Related To Changes In The Biological Clock." ScienceDaily 25 June 1998.
References