Reset Your Rhythm:
How meal timing and light cycles affect health

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How the body tells time

• Circadian Rhythm
  • Internal 24-hour clock that regulates the sleep-wake cycle
  • Countless body functions are synchronized by the circadian rhythm

• Key regulators of circadian rhythm
  • Light exposure
  • Food intake
Timing is everything

Inappropriate timing of light exposure and food intake

Altered circadian rhythm

Poor sleep and negative health effects
Let’s talk about sleep

• Sleep duration has fallen over time:
  • In 1910, Americans slept an average of 9 hours per night
  • Today, the average is only 6.8 hours per night

• We aren’t getting enough sleep:
  • National Institutes of Health recommends at least 7-8 hours per night
  • About 33% of Americans sleep 6 hours or less each night
The effects of not getting enough sleep

• Impaired brain function
  • Learning, problem solving, focus, mood, etc.

• Poor physical health
  • Immunity, muscle/tissue repair, inflammation

• Increased risk of disease
  • Heart disease, diabetes, cancer, obesity
Lack of sleep and weight

- Increased energy intake
  - Total calories
  - Number of meals and snacks
  - Food preferences (high-calorie/carb)
- Decreased energy expenditure
  - Decreased metabolism
  - Decreased physical activity
Lack of sleep and disease risk

• Heart disease
  • Higher blood pressure, LDL-C, and triglycerides; lower HDL-C

• Diabetes
  • Increased blood glucose and hemoglobin A1C

• Cancer
  • Night shift work is classified by WHO as a “probable carcinogen”

• Alzheimer’s disease
  • Sleep deprivation increases amyloid-beta and tau protein levels in the brain
Why are we sleeping so much less?

• Average hours of sleep per night
  • 1910: 9 hours
  • 1942: 7.9 hours
  • 1990: 6.7 hours
  • 2013: 6.8 hours

• Why are we sleeping 25% less than we did 100 years ago?
Types of Body Clocks

• Master Clock
  • Located in the brain
  • Regulated by light exposure

• Peripheral Clocks
  • Located throughout the body
  • Regulated by timing of food intake
Melatonin

• Sleep hormone regulated by master clock in the brain
• “Hormone of darkness”
  • Produced in darkness (night)
  • Production blocked by light (day)
• Functions
  • Promotes sleep
  • Antioxidant
  • Lowers inflammation
  • Promotes immune function
  • Regulates metabolism
Melatonin & Metabolism

- Melatonin regulates the circadian rhythm of energy metabolism
  - Utilize energy from food during the day
  - Utilize energy from fat stores at night
- Alteration in melatonin rhythm contributes to metabolic dysfunction
  - Higher blood sugar $\rightarrow$ diabetes
  - Higher triglycerides $\rightarrow$ heart disease
  - Increased fat storage $\rightarrow$ obesity
Why are we sleeping so much less?

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• Why are we sleeping 25% less than we did 100 years ago?
What happened from 1910 to 1942?

• Average sleep reduced by 1.1 hours (12%)
  • 1910: 9 hours
  • 1942: 7.9 hours

• What happened during these 32 years that caused us to sleep 12% less?
What happened from 1910 to 1942?

U.S. Lightbulb Sales 1885-1945 (in millions)
Artificial light disrupts circadian rhythm

- **Natural environment:**
  - Melatonin produced only at night (between sunset and sunrise)
  - Melatonin absent during the day (between sunrise and sunset)

- **Modern environment:**
  - Use of artificial light at night tells the body it is still daytime
  - Blocks melatonin production
  - Sleep onset, duration, and quality are impaired
What happened from 1942 to 1990?

• Average sleep further reduced by 1.2 hours (15%)
  • 1942: 7.9 hours
  • 1990: 6.7 hours

• What happened during these 48 years that caused us to sleep 15% less?
What happened from 1942 to 1990?

% of US Households with Television 1950-1980
Sources of Artificial Light

- Lightbulbs
- TVs
- Computers
- Smartphones
- Tablets
E-books affect melatonin production

• Study compared reading electronic book on iPad to reading printed book for four hours prior to bedtime
• E-book reading caused:
  • Decreased evening sleepiness
  • Increased morning sleepiness
  • Longer time to fall asleep
  • Reduced melatonin production
Life without artificial light

• Study subjects spent a week camping in Colorado in the summer
• Only light was from sunlight and campfire
• Circadian rhythms shifted to follow light cycle
  • Melatonin production began at sunset and stopped at sunrise
  • Sleep patterns shifted earlier to follow the light cycle
Correcting an altered circadian rhythm

- Goal is to follow natural light cycles
- Two objectives:
  - Increase light exposure during the day (sunlight)
  - Decrease light exposure at night (artificial light)
- Day-night contrast is important:
  - Greater light exposure during the day lessens the negative effects of artificial light at night.

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Increasing light exposure during the day
Increasing light exposure during the day

• Start the day with light
  • Go outside in the morning sunlight
  • Dawn simulation alarm clock
  • Light box
  • Re-Timer glasses

• Spend time outside throughout the day
  • Exercise improves sleep
  • Exercising outside has dual benefit

• Avoid spending time in dark rooms during daytime
• Avoid excessive use of sunglasses
Sunsprite

• Wearable device that measures daily exposure to bright light.

• Bright light sources:
  • Outdoor sunlight
  • Sunlight through window
  • Bright lamps or light box
SunFriend

• Wearable device that measures UV light exposure
  • Helps assess vitamin D production from UV-B light
  • Helps prevent sunburn

• Factors that influence vitamin D production from sunlight
  • Time of year/day
  • Duration of exposure
  • Amount of skin exposed
  • Skin tone
  • Age
Sun exposure considerations

• Balance is important
  • Excessive sun exposure can increase risk of cancer
  • Inadequate sun exposure can also increase risk of cancer

• Beyond the visible spectrum
  • UV-B light promotes vitamin D production
  • UV-A light promotes nitric oxide release
  • IR light promotes healing and repair mechanisms
Timing of light/food impacts sun exposure effects

• Timing of light
  • Morning/late afternoon infrared light may prevent/repair skin damage
  • Melatonin at night protects against oxidative effects from UV light

• Timing of food intake
  • Eating late at night alters skin circadian rhythm
  • Altered skin rhythm $\rightarrow$ altered DNA repair $\rightarrow$ sun damage/skin aging/skin cancer
Avoiding artificial light at night
Avoiding artificial light at night

- Limit artificial light exposure after sunset or 1-2 hours before going to sleep
  - Use dim lighting
  - Limit use of electronic devices
  - Reduce brightness of computers, TVs, smartphones, tablets
- Keep bedroom as dark as possible, or wear a sleep mask
- Avoid sudden increases in artificial light exposure at night
Blue light

- Melatonin production is blocked specifically by blue light
- Most light sources contain all colors of the visible spectrum, including blue
Strategies to reduce exposure to blue light

• Use orange/amber tinted lightbulbs at night in place of conventional bulbs
Strategies to reduce exposure to blue light

• Use candlelight/firelight in place of lightbulbs
Strategies to reduce exposure to blue light

• Use orange/red nightlights for navigating in the dark
Reduce blue light on computers

- Install f.lux on computers
  - justgetflux.com
Reduce blue light on mobile devices

- Twilight on Android devices
- Night Shift on Apple devices
Better than Night Shift: Color Tint on iOS Devices

- Settings → General → Accessibility → Display Accommodations → Color Filters → Color Tint

Reduce blue light on TVs

• driftTV
Reduce blue light from alarm clocks

• Use orange/red LED alarm clock in place of blue/green versions
Strategies to reduce exposure to blue light

• Wear orange-tinted glasses that block blue light
  • Wear glasses during evening hours when exposed to artificial light
  • Take them off after all the lights are shut off when going to bed
Orange lenses block blue light (455-492 nm)
Testing blue light exposure with spectroscope

- Test light sources
- Test blue-blocking glasses
Timing of food intake
How food intake affects your circadian rhythm

- Food intake should follow light cycle
  - Eat during the day
  - Stop eating at night (within 3-4 hours of bedtime)
- When you eat is as important as what you eat
- Eating at night
  - Impaired metabolic effect (glucose, triglycerides, fat storage)
  - Alters synchronization with master clock (impairs overall health and metabolism)
  - Altered gut microbiome (bacteria have circadian rhythms too!)
American Heart Association Statement

• January 2017 Scientific Statement from the American Heart Association
  • Meal timing may affect cardiovascular disease risk
  • Recommendations: Eat breakfast and avoid eating at night to reduce your risk of heart disease and diabetes
The importance of breakfast

- Breakfast synchronizes the circadian rhythm, telling the body it is daytime
  - Similar to light exposure in the morning, but acts on peripheral body clocks
- Breakfast guidelines
  - Moderate to large in size
  - Eat first thing in the morning
  - Include good source of protein (yogurt, eggs, cheese, nuts/nut butters)
Time-Restricted Eating

• Time-restricted eating
  • Restricting your daily eating period to a smaller window of time.

• Early time-restricted eating
  • Eat breakfast every day within 1 hour of waking
  • Finish eating within a 12 hour window (12 hour overnight fast)
  • Example: Breakfast at 7am. Finish eating by 7pm.

• Benefits
  • Improved circadian rhythm
  • May help promote weight loss

• If you have diabetes, talk to your doctor before implementing
Caffeine & Alcohol

• Caffeine
  • The rate of caffeine metabolism varies from person to person
  • Avoid consuming caffeine within 6 hours of sleep

• Alcohol
  • Alcohol can make it easier to fall asleep but impairs sleep quality
  • Avoid consuming alcohol within 3 hours of sleep
Consistency is key!

• Social Jet Lag
  • Staying up later and sleeping in later on the weekend
  • Waking up earlier and going to bed earlier on the weekdays

• Increased social jet lag may have similar health risks as inadequate sleep:
  • Obesity
  • Cancer
  • Diabetes
  • Heart disease

• Maintain day-to-day consistency of:
  • Sleep schedule
  • Light exposure
  • Food intake
Sleep Trackers

• Oura Ring
  • Sleep duration and stages
  • Heart rate and heart rate variability
  • Body temperature
  • Respiration rate

• Beddr
  • Blood oxygen level
  • Stopped breathing events
  • Sleep position
  • Heart rate
  • Sleep duration
Reset your Rhythm Tips

• Morning
  • Wake up at the same time every day
  • Eat a healthy breakfast upon waking
  • Spend time outside in the morning sunlight

• Day
  • Spend time outside throughout the day
  • Exercise outdoors
  • Avoid spending time in darkness
Reset your Rhythm Tips

• Evening
  • Finish eating at least 3-4 hours before going to sleep
  • Limit exposure to blue light after sunset

• Night
  • Keep bedtime consistent
  • Allot at least 7-8 hours for sleep
  • Keep your bedroom dark, quiet, and comfortable
References


• Centers for Disease Control and Prevention. Insufficient Sleep is a Public Health Epidemic. Available at: http://www.cdc.gov/features/dssleep/.

• Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. Proc Natl Acad Sci USA. 2014;


References


Questions?

For additional questions, or to schedule a one-on-one nutrition counseling appointment, email: askanrd@indiana.edu