2. What is Sleep?

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I. What is Sleep?

A. “Sleep is an active neurobehavioral state that is maintained through a highly organized interaction of neurons and neural circuits in the central nervous system.” (Markov & Goldman, 2006, p. 841)

II. Normative Data

A. Krueger & Friedman, 2009

i. National Health Interview Survey
ii. n = 110,441
iii. 18 and older
iv. 28.3% sleep six or fewer hours
v. 63.3% sleep 7 or 8 hours
vi. 8.5% sleep 9 or more hours

vii. variables associated with shorter sleep

a) living with young children
b) being unmarried
c) working long hours
d) more frequent binge drinking

viii. variables associated with longer sleep

a) being younger
b) Mexican American
c) pregnant
d) low levels of physical activity

ix. variables associated with long or short duration sleep

a) being older
d) cardiovascular disease
e) low levels of education, income, or few income sources
f) diabetes
h) underweight
i) consuming few or numerous drinks in a week

B. National Sleep Foundation, 2010: Sleep Habits

Typical Workday and Non-Workday
(Average Wake Time; Average Bed Time; Average Hours Slept – Self Reported)
C. NSF 2010: Good Night’s Sleep

<table>
<thead>
<tr>
<th>Race</th>
<th>Number of Nights Can Say “I had a Good Night’s Sleep”</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (B)</td>
<td><img src="white_sleep_distribution.png" alt="White Sleep Distribution" /></td>
</tr>
<tr>
<td>Black (C)</td>
<td><img src="black_sleep_distribution.png" alt="Black Sleep Distribution" /></td>
</tr>
<tr>
<td>Asian (D)</td>
<td><img src="asian_sleep_distribution.png" alt="Asian Sleep Distribution" /></td>
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<tr>
<td>Hispanic (F)</td>
<td><img src="hispanic_sleep_distribution.png" alt="Hispanic Sleep Distribution" /></td>
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</tbody>
</table>

### III. Neuro-Biologic Mechanisms

**A. Sleep Stages (Saey, 2009)**

i. NREM Sleep
   a) stage 1
   b) stage 2
   c) stages 3 and 4 (slow wave sleep)

ii. REM Sleep

**B. Sleep Architecture (Carskadon & Dement, 2005)**

**C. Sleep in Adulthood (Ohayon, Carskadon, Guilleminault, & Vitiello, 2004)**

i. sleep latency increases with age
ii. percentage of stage 1 and stage 2 sleep increases with age
iii. percentage of REM sleep decreases with age
D. Nau, et al., 2005 review of literature as a person’s age advances past 50 years, there is increasing likelihood of the following sleep changes:

i. Sleep will show more awakenings and sleep efficiency will decrease.
   a) an average of 8 awakenings during the night, 4 times the middle-aged average
   b) the length of awakenings will increase
   c) there will be a corresponding increase in awake time after sleep onset.

ii. Total nocturnal sleep time will become more variable
   a) average decline from 7 hr per night in middle age samples to 6 – 6.5 hr among seniors
   b) male seniors will show greater decline

iii. Sleep will become lighter and show frequent brief arousals
   a) duration of 15 sec or less
   b) restorative benefits of sleep tend to decrease as frequency of arousals increases
   c) stage 1 sleep increases from 2 – 6% in middle age to 4 – 13 % in seniors
   d) shifts between sleep stages are more frequent

iv. Deep sleep shows a possible sharp decrease with age
   a) EEG delta wave amplitude decreases with age – significance is a subject of debate
   b) dropping amplitude from scoring criteria for stage 3 and 4 eliminates the age-related decrease in deep sleep

v. About one third of older adult hypnotic users will continue use at least 5 years, a persistence rate about double that found in younger hypnotic users

vi. older adults are more vulnerable to hazards associated with hypnotic use
   a) there is a 60% increased risk among older adults using benzodiazepines of femur fracture from accidental falls

E. Physiologic Functions (Markov & Goldman, 2006)

F. Neuronal Assemblies (Krueger, et al., 2008)

i. local process
ii. cortical columns
iii. if a localized area of the brain is disproportionately stimulated during waking, delta wave activity is increased in the stimulated area during subsequent sleep

IV. Functions of sleep (Siegal, 2009)

A. Rebound sleep (homeostat)

i. 30% or less of the duration of lost sleep is recovered
ii. effects are completely reversed
iii. fur seals * do not recover REM sleep lost during extended stays in the water
iv. dolphins can maintain continuous vigilance for 5 days

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Physiologic changes with stages of sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>NREM</td>
</tr>
<tr>
<td>Heart</td>
<td>Increases</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Unchanged and stable</td>
</tr>
<tr>
<td>Respiration</td>
<td>Decreased rate</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Decreased tidal volume; decreased hypoxic response</td>
</tr>
<tr>
<td>Upper airway muscle tone</td>
<td>Decreased</td>
</tr>
<tr>
<td>Temperature</td>
<td>Preserved thermoregulation</td>
</tr>
<tr>
<td>Pupils</td>
<td>Constricted</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Failure of inhibition of acid secretion; prolonged acid clearance</td>
</tr>
<tr>
<td>Nocturnal penile tumescence/erectile enlargement</td>
<td>Infrequent</td>
</tr>
</tbody>
</table>
B. Circadian Rhythm

i. Signals alertness

ii. "... sleep propensity at a particular time of day is determined by the sum of the accumulated homeostatic drive for sleep and the SCN drive for wakefulness (Lavie, 2001, p. 293)."

iii. "... the paradoxical positioning of the peak of alertness just before habitual sleep time, and peak sleep propensity just before habitual waking up, help to consolidate sleep time during the night and wakefulness during the day (Lavie, 2001, p. 293)."

iv. "Light plays the primary role in the entrainment of the human circadian pacemaker to the environment (Lavie, 2001, p. 294)."

C. Siegel, 2009

i. information processing

ii. development and brain development

iii. reverse damage

iv. a) oxidative stress
   b) depletion of energy stores
   c) death of neurons
   d) downregulation of receptors
   e) cooling

v. recuperation

V. Pittsburgh Sleep Quality Index (Buysse, et al., 1989)

A. PSQI Scoring

i. component 1 (Subjective Sleep Quality): #8 Score (VG = 0, FG = 1; FB = 2; VB = 3)

ii. Component 2 (Sleep Latency): #2 + #5a

   a) #2 score (0-15 min = 0; 16-30 min = 1; 31-60 min = 2; 61+ = 3)
   b) #5a score (not = 0; Less = 1; once = 2; three = 3)

   • if sum is 0. score is 0
   • if sum is 1 - 2. score is 1
   • if sum is 3 - 4. score is 2
   • if sum is 5 - 6. score is 3

iii. Component 3 (Sleep Duration): #4 score (more than 7 = 0; 6 - 7 = 1; 5 - 6 = 2; 5+ = 3)

iv. Component 4 (Sleep Efficiency): TST / TIB (85% + = 0; 75% - 84% = 1; 65% - 74% = 2; 65% - = 3)

v. Component 5 (Sleep Disturbances): sum of scores #5b to #5j (0 = 0; 1 - 9 = 1; 10 - 18 = 2; 19 - 27 = 3)

vi. Component 6 (Sleep Medication): #6 Score

vii. Component 7 (Daytime Dysfunction): #7 score + #9 score (0 = 0; 1 - 2 = 1; 3 - 4 = 2; 5 - 6 = 3)

viii. sum of 7 components = Global PSQI score

ix. Global Score ≥ 5 indicates poor sleep quality

B. Factors (Cole, et al., 2006)

i. sample = adults older than 60

ii. Sleep Efficiency = C3 * C4

iii. Perceived Sleep Quality = C1 + C2 + C6

iv. Daily Disturbances = C5 + C7
C. PSQI.caseA
   i. range of scores $>$ midpoint
   ii. $5/8 = 63\%$

D. PSQI.caseB: same global score, different factor scores

E. PSQI.caseC: global score $= 17$

VI. Psycho-Biological Model (Espie, 2002)

VII. Competency Demonstrations
   i. explain sleep architecture and the 5 stages of sleep to a client
   ii. “Sleep in Seniors” talk $+$ identify 3 changes that occur in sleep as we age

VIII. Key Concepts
   A. Sleep Architecture: The pattern of REM and NREM sleep through the night
   B. Sleep Latency: The time it takes to get to sleep
   C. Slow Wave Sleep: A distinct type of NREM sleep characterized by slow brain waves interspersed with smaller, faster waves.
   D. Variability between individuals and from night to night
   E. Wake After Sleep Onset: The amount of time awake after the initial sleep episode

REFERENCES


