Short Sleep Duration: Associations with Childhood Obesity & Weight Gain

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Goals of this Presentation

- Describe patterns of childhood sleep duration in the US
- Describe the state of the science and research gaps relating insufficient sleep to overweight and obesity in infancy and early childhood
- Describe mechanisms relating sleep to obesity
- Summarize interventions to improve sleep for obesity prevention
Secular trends in childhood sleep

- The rising prevalence of childhood obesity has been paralleled by secular trends of shorter sleep durations in children;
- Meta-analysis of almost 700,000 children from 20 countries, going back over 100 years found that, on average, children today sleep about **20-25 minutes less** each day than their parents did when they were their age. (Matricciani, Olds & Petkov, 2012)
- Across childhood, evidence suggests a decrease in sleep duration over the last 20 years, due largely in part to **later bedtimes**.
Patterns of Sleep Duration

- Infants/Toddlers in the lower 25% of sleep:
  - More likely to be put to bed asleep v. drowsy/awake
  - Poor self-regulation of sleep

- Children in the lower 25% of sleep:
  - More likely to share a room or bed; More likely to drink ≥ 1 caffeinated beverage during the day; More likely to have a TV in the room where they sleep
Patterns of Sleep Duration - Adolescents

- Only one in five adolescents get an optimal nine hours of sleep on school nights.
- Over 50% of adolescents say they know they get less sleep than they need to feel their best.
- Nearly all adolescents (97%) have at least one electronic item – such as a TV, computer, phone or music device – in their room.
Sleep & Obesity in Infants and Children

• **Systematic review**: 29 studies conducted in 16 countries suggest that short sleep is associated with an increased risk for being or becoming overweight/obese. Later bedtimes also found to be a risk factor for overweight/obesity. (Hart et al. 2011)

• **Some debate about sleep & obesity in infancy**: Some studies have reported inverse associations between sleep duration and adiposity in infancy, others have had null findings, and at least one RCT of an infant sleep intervention did not have an effect on future overweight. (Lumeng et al. 2015)
Infant Sleep Duration & Childhood Obesity

• Cross-sectional studies have found an inverse association between sleep duration and weight in children (Patel et al. 2008; Hart et al 2011)

• In multivariable analyses, infants who slept <12 h/d:
  – higher BMI z-score
    (β 0.16; 95% CI: 0.02, 0.29)
  – increased odds of obesity
    (OR 2.04; 95% CI: 1.07, 3.91).

Taveras et al. Archives of Pediatric and Adolescent Medicine, 2008
Chronic Insufficient Sleep is Associated with Higher BMI z-score in Mid-Childhood

Sleep score ranges from 0 (maximal curtailment) to 13 (no curtailed sleep). Adjusted for maternal age, education BMI, parity; household income; child race/ethnicity & mid-childhood TV.
Potential Mechanisms (older children)

Hart et al 2011
Potential Mechanisms (older children)

SLEEP RESTRICTION
- Amount (no. of hours)
- Duration (no. of days)
- Relationship to individual sleep needs

SLEEPINESS/FATIGUE

ALTERATIONS METABOLIC PROFILE
(leptin, ghrelin, insulin, glucose, orexin, serotonin)

Increased opportunity to eat

APPETITE DYSREGULATION
Alterations in hunger/satiety

INCREASED ENERGY INTAKE

INCREASED BMI

REDUCED ENERGY EXPENDITURE

REDUCED PHYSICAL ACTIVITY/INCREASE SEDENTARY BEHAVIOR

SLEEPINESS-RELATED IMPAIRMENTS
- Mood
- Attention
- Impulse control
- Int/Ext behavior
- Motivation
- Judgment

CHANGES IN EATING BEHAVIOR (PARENTAL/CHILD)
- Food amounts
- Food types/preferences
- Timing

Hart et al 2011
Worse combination?
Too much TV, too little sleep

Predicted probability of overweight at age 3 years

Daily Sleep (hours/day)

Daily TV viewing (hours/day)
Potential Mechanisms (older children)

- Sleep Restriction
  - Amount (no. of hours)
  - Duration (no. of days)
  - Relationship to individual sleep needs
- Alterations Metabolic Profile
  - Leptin, ghrelin, insulin, glucose, orexin, serotonin
- Appetite Dysregulation
  - Alterations in hunger/satiety
- Increased opportunity to eat
- Increased Energy Intake
- Reduced Energy Expenditure
- Reduced Physical Activity/Increase Sedentary Behavior
- Increased BMI

Sleepiness/Fatigue

Sleepiness-Related Impairments
- Mood
- Attention
- Impulse control
- Int/Ext behavior
- Motivation
- Judgment

Changes in Eating Behavior (Parental/Child)
- Food amounts
- Food types/preferences
- Timing

Hart et al 2011
Interventions to improve sleep quality and quantity

Can we increase sleep duration (or improve sleep quality) in children? ....and if so, does it lead to improved weight status?
Systematic review of sleep interventions
(Falvey et al, 2014)

1. Health education
   - Teaching parents about developmental sleep needs and behaviors to avoid.

2. Bedtime routines and the home environment
   - strict bedtime routine for infants and toddlers that involve a bath, a massage or application of lotion, and a quiet activity each night;
   - language-based bedtime routines, such as reading, singing, praying, or talking.
Children ages 3-4 should sleep 11-12 hours per night.

The amount and quality of sleep affects a child’s mood, behavior, and learning.

- Better quality and longer sleep is associated with better school performance.

Recent studies link not getting enough sleep to a higher risk of obesity.

- When we get the right amount of sleep, the brain helps us to control hunger and achieve a healthy weight.

Children need sleep for optimal brain functioning.

- Sleep allows the brain to recharge and process information learned during the day. Sleep is especially important for children’s memory, ability to pay attention, and learning.

Connect 4 Health kids need sleep!

Children ages 5-12 should sleep 10-11 hours per night.

How can I help my child get the sleep s/he needs?

Set and maintain bedtime routines.

- A bedtime routine prepares your child for sleep.
- Try to have bedtime be the same time each night.
- Turn the TV off an hour before bedtime to make for an easier transition to sleep.

Make the room where your child sleeps comfortable.

- Use dark curtains or shades to keep light out.
- Put in a nightlight if your child needs a little light.
- Keep it cool and quiet. Soft music or a fan can offer background noise, if needed.
- Cozy blankets and pillows can make for better sleep.

Avoid caffeine and sugar.

- Drinking caffeinated and sugary drinks can make it difficult to sleep.

Keep TV and other screen media out of the room where your child sleeps.

- Screen time is stimulating and can disrupt sleep, making it harder to fall asleep.
Limit juice to 4 ounces per day, and no soda
Drink more water!

Limit fast food to less than once per week

Eat more meals together as a family (with TV off)

Remove the TV from the room where your child sleeps

Set a bedtime routine and get 11 hours of sleep

Limit TV time to less than 2 hours per day
Systematic review of sleep interventions
(Falvey et al, 2014)

3. Graduated extinction and parental presence

- In infants, toddlers, and children, parental presence while falling asleep was associated with later bedtimes, longer sleep onset latency, less total sleep time, and more frequent night awakenings;

- Graduated extinction is a behavioral technique that can be taught to parents to be utilized in the home environment. The technique involves ignoring tantrums or difficulties at bedtime for a preset time interval, which is increased weekly.
First Steps for Mommy & Me
Improving Infant Sleep Quality & Quantity

• Behavioral program to prevent infant sleep problems (0-3 weeks of age): **Goal – avoid sleep associations**
  – Accentuate differences between day and night
  – Try not to rock, hold, or nurse infant to sleep
  – Focal feed between 10pm and midnight
  – Put infant down in crib sleepy but awake

• > 1 month: Begin to lengthen the time between feeds at night by slowly breaking the association between awakening and being fed; Establish a calming bedtime routine early
Practice Recommendations

Table 2  Recommendations for practice.

Key Elements for **Effective Sleep Hygiene** During Childhood

1. Consistent sleep schedule
   - Set a consistent, age-appropriate bedtime
   - Enforce bedtime 7 nights per week
2. Consistent bedtime routine
   - Provide cues or warnings to child before transitioning to bedtime routine
   - Create a standardized bedtime routine, 20 to 30 min in duration with 2–3 activities
   - Can include, taking a bath, massage or application of lotion, or a quiet activity
   - Use language-based activities as part of the routine (e.g., singing, reading, playing a game
   - Have routine end in child’s sleeping environment
3. Teach child to fall asleep independently
   - Graduated extinction
4. Monitoring daytime nap and rest times
5. Activity extinction in preparation for sleep
   - Encourage daytime physical activity with quieter activities as bedtime approaches
   - Avoid strenuous activities for approximately 1 h before bedtime
   - Avoid TV and computers in the bedroom
   - Engage in quiet activities such as reading before sleep
6. Dietary recommendations
   - Avoid caffeine beverages within 3 h of sleep
Research Gaps in Sleep-Obesity Literature

• Few studies providing evidence of underlying biological mechanisms in infancy/early childhood;

• Most studies have focused on sleep duration and have not examined other features of sleep, e.g. Quality, Timing, Consolidation, Regularity, Ecology, Circadian Alignment

• Measurement challenges – Validated, objective measures of sleep characteristics are needed;

• Good evidence of the efficacy of behavioral interventions in improving features of sleep in infancy but RCTs testing the effects of these interventions on future adiposity are lacking.
Sleep-Obesity: Clinical Implications

• Insufficient sleep is associated with several adverse health outcomes in children and adults

• Little risk to promoting good sleep hygiene to increase sleep quality and quantity and possibly prevent obesity

“...when the exposure is both common and modifiable and the outcome is costly in terms of morbidity, mortality, and economics, even a small relative risk is of great public health relevance”

Oddy et al. 2003