


# Teens & Sleep

LINKING DISCOVERY, PRACTICE, AND POLICY

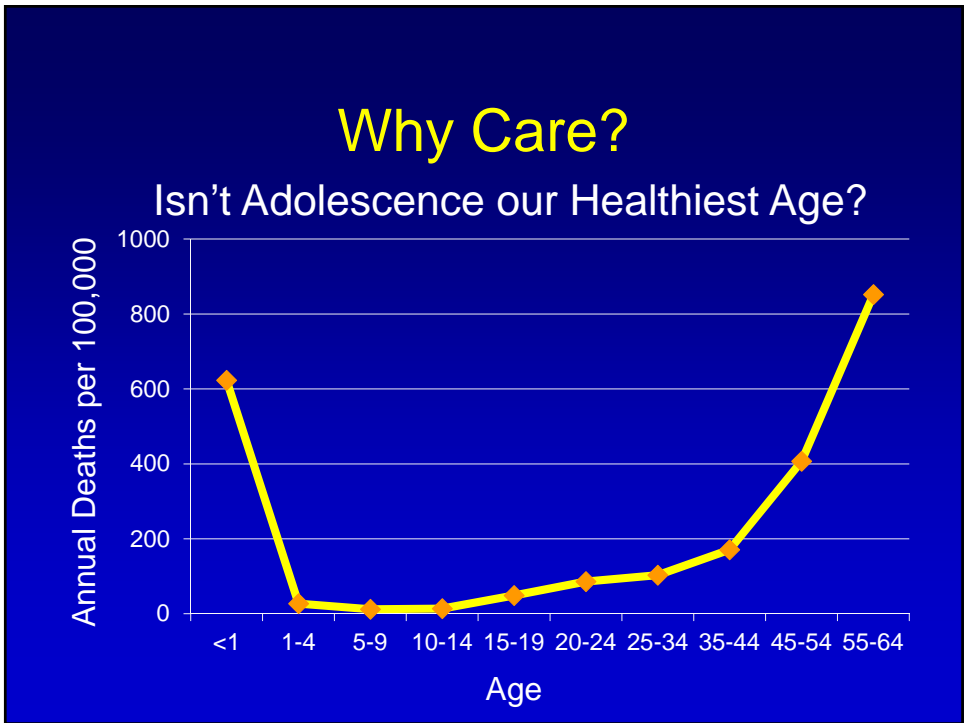
## Impact of Inadequate Sleep on Adolescent Health

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Cincinnati Children's Hospital Medical Center  
University of Cincinnati College of Medicine

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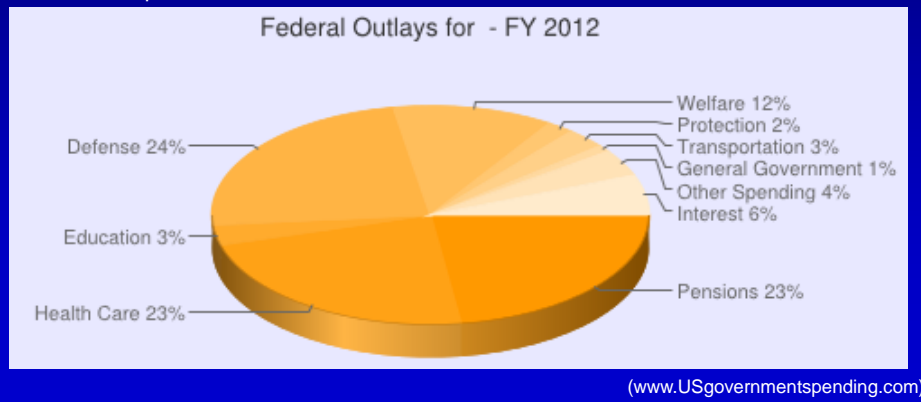


## Why Care?

- Adolescent health affects adult health
  - Adolescent onset of mental health conditions
  - High school impacts long-term finances & health
  - Lifestyle factors crystallize during adolescence
  - Adolescent obesity → adult obesity-related complications, even after weight loss  
(e.g., Must et al., 2002; Power et al. 1997)
- Prevention efforts challenging in teens
  - Overall effect of obesity prevention <0.1 BMI unit.  
(Waters et al., 2011)

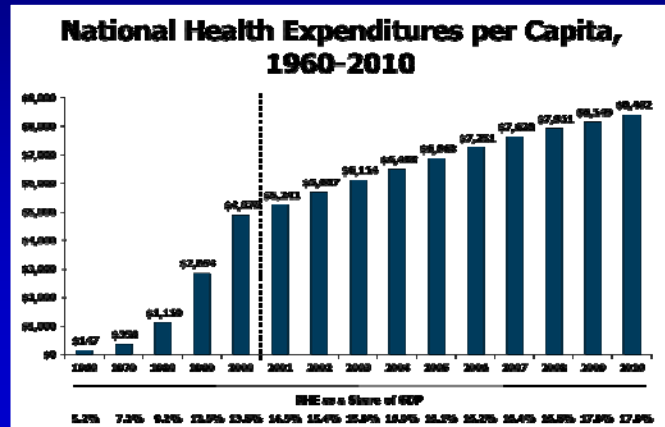
## Why Care?

- Healthcare costs are huge
  - \$2.6 *Trillion* in 2010



## Why Care?

- Healthcare costs are huge *and growing*.



## Why Care?

(Special “shout-out” to the educators)

- Health needed to learn
- Health promotion programs directly involve schools
- Objections to public policy that promotes teen sleep come from people who are interested in health

# Sleep and Health Outcomes

Inadequate sleep causes real-world problems:

## Mental Health

- Daytime sleepiness



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# Sleep and Health Outcomes

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# Sleep and Health Outcomes

Inadequate sleep causes real-world problems:

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- Attention & Learning
- Mood / Emotion



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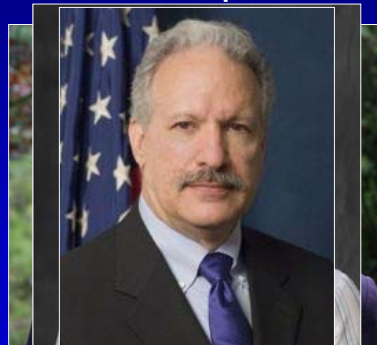
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# Sleep and Health Outcomes

Inadequate sleep causes real-world problems:

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- Mood / Emotion
- Risky Behaviors



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# Sleep and Health Outcomes

Inadequate sleep causes real-world problems:

## Mental Health

- Daytime sleepiness
- Attention & Learning
- Mood / Emotion
- Risky Behaviors

## Physical Health

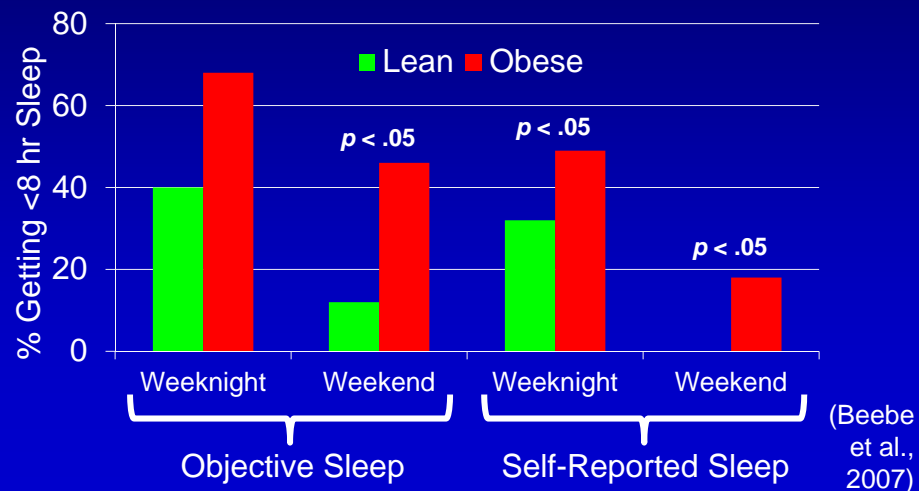
- Obesity
- Athletics
- Illness
- Special Populations

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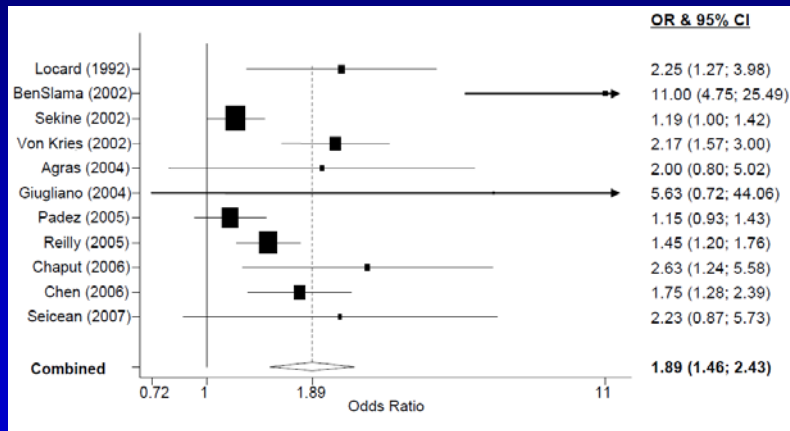


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## Short Sleep & Obesity: Real-World Evidence



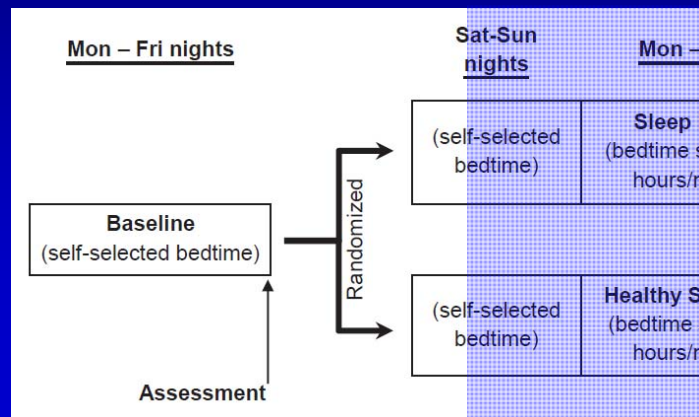
## Short Sleep & Obesity: Real-World Evidence



(Cappucio et al., 2008)

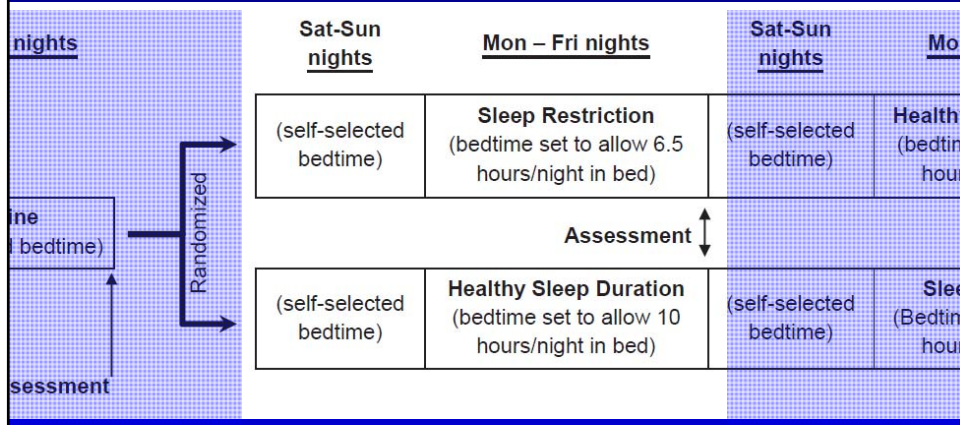
## Short Sleep & Obesity: Evidence of Causation

### Sleepy Teens Study



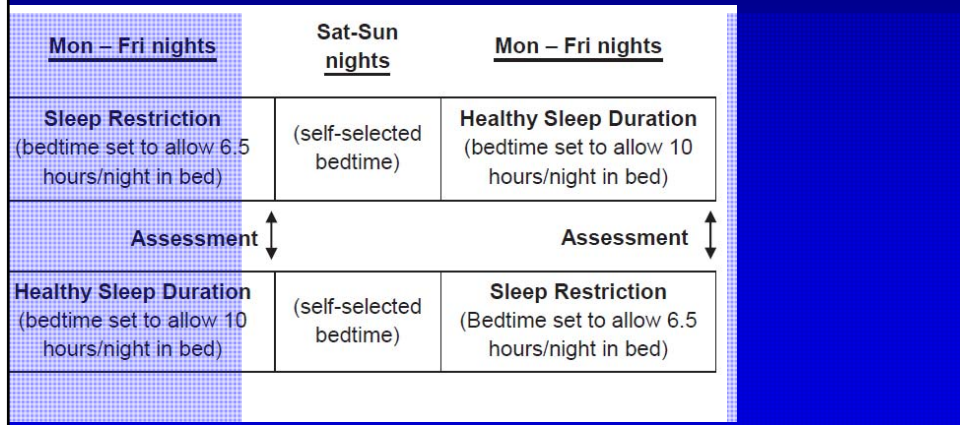
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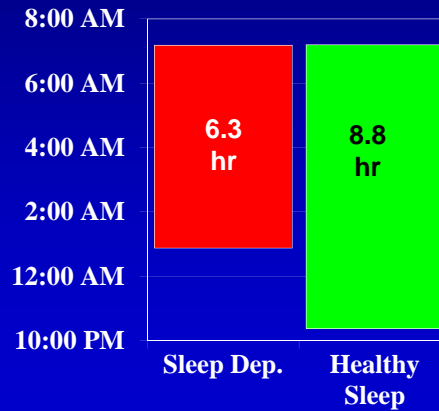




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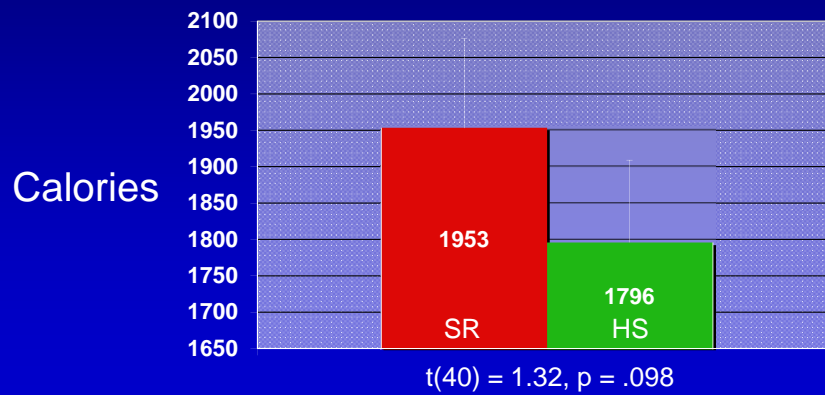
## Sleepy Teens Study

**Average  
Sleep Schedules**



# Short Sleep & Obesity: Evidence of Causation

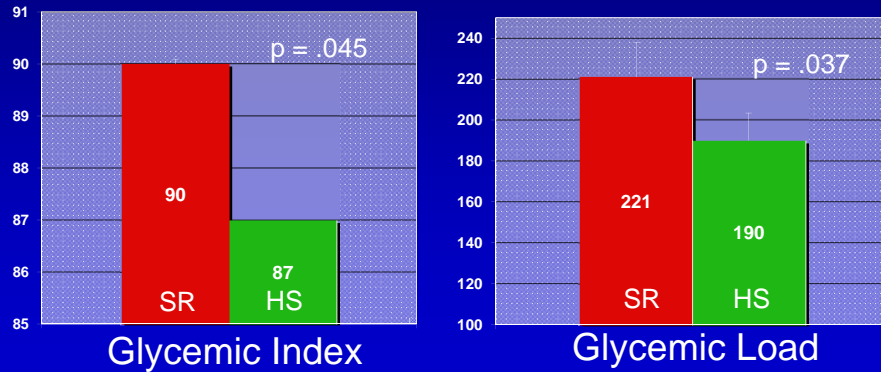
## 24-hour Dietary Recall, Sleepy Teens Study



(Beebe et al., 2013)

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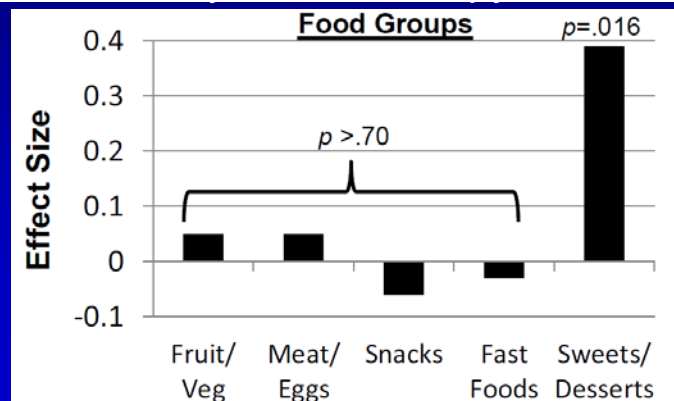
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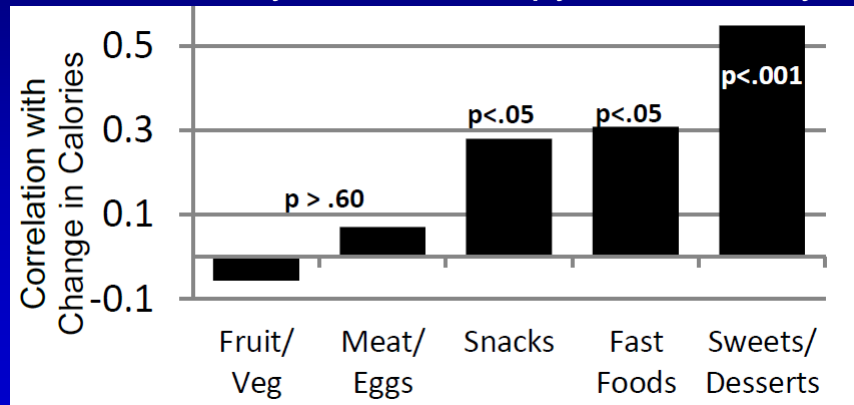
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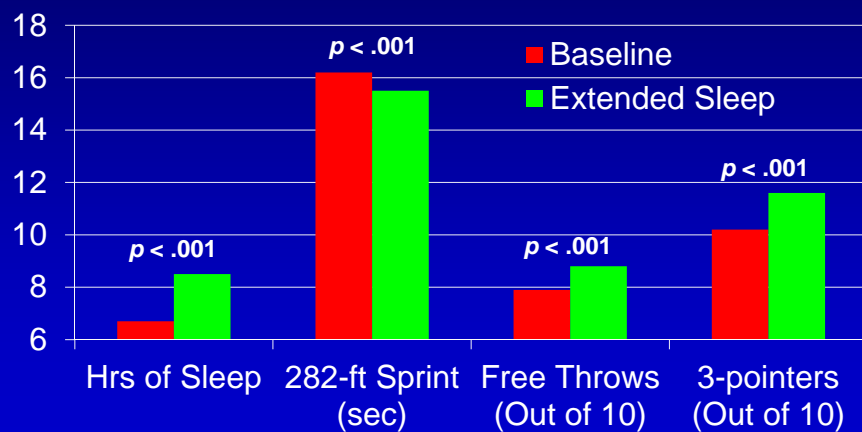
### Ratings of Appeal, Sleepy Teens Study



## Sleep & Athletics: Real-World Evidence

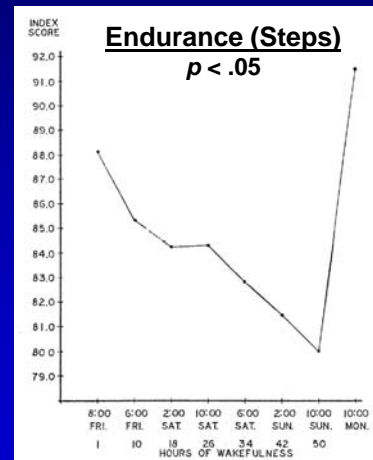
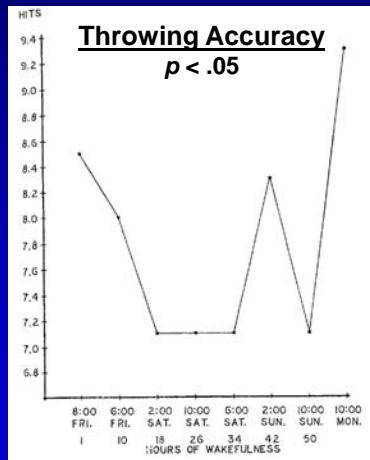
- Short sleep is associated with certain types of sports injuries in youth.  
(Luke et al., 2011)
- Even among elite teen athletes, less sleep is associated with less willingness to train hard.  
(Engle-Friedman et al, 2010)

## Sleep & Athletics: Evidence of Causation



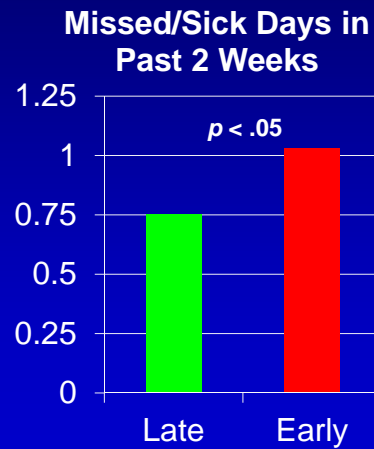
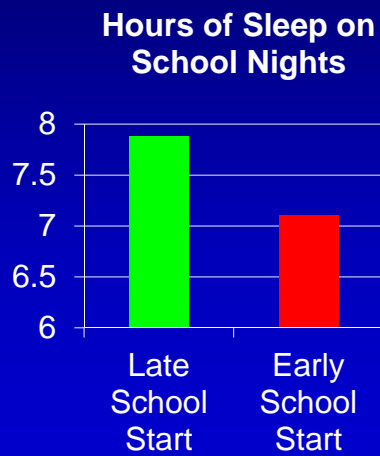
(Mah et al., 2011)

## Sleep & Athletics: Evidence of Causation



(Copes & Rosentswieg, 1972)

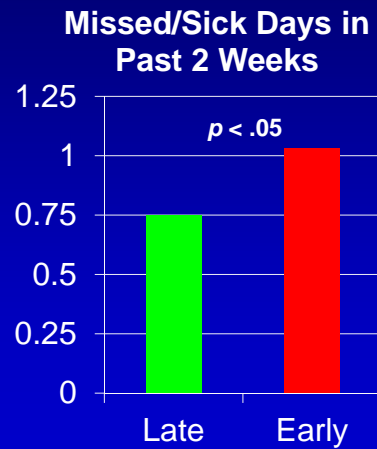
## Sleep & Illness: Real-World Evidence



(Wahlstrom, 2002)

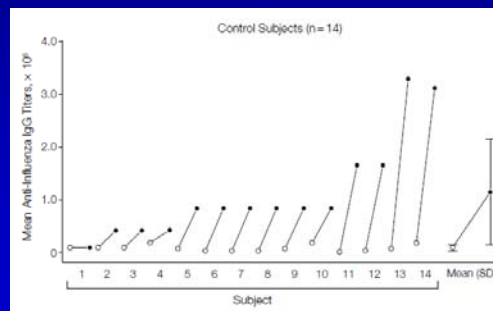
## Sleep & Illness: Real-World Evidence

~1/4 day every 2 weeks  
= 5 days every year



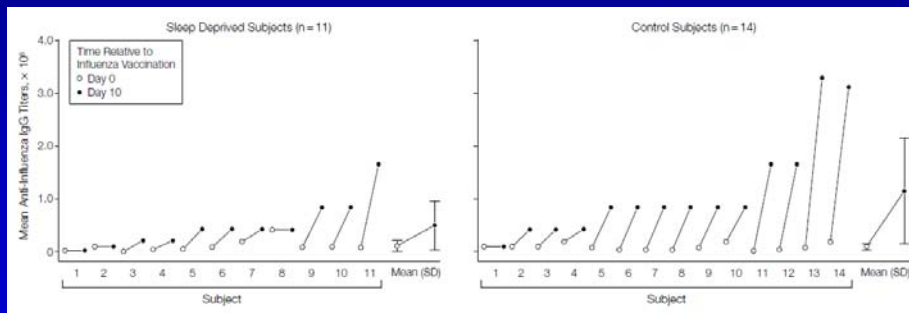
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## Sleep & Illness: Evidence of Causation



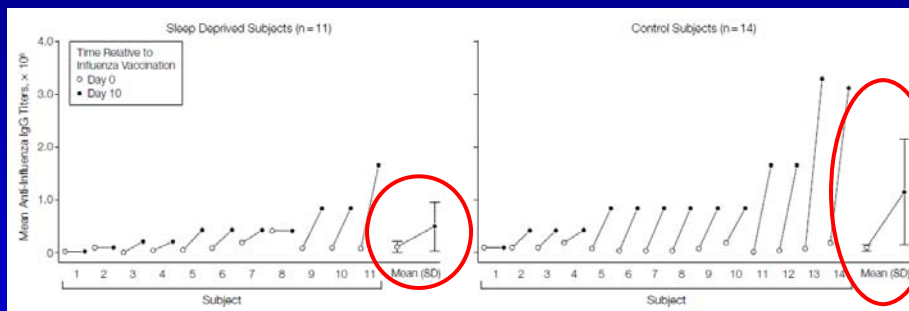
(Spiegel et al., 2002)

# Sleep & Illness: Evidence of Causation



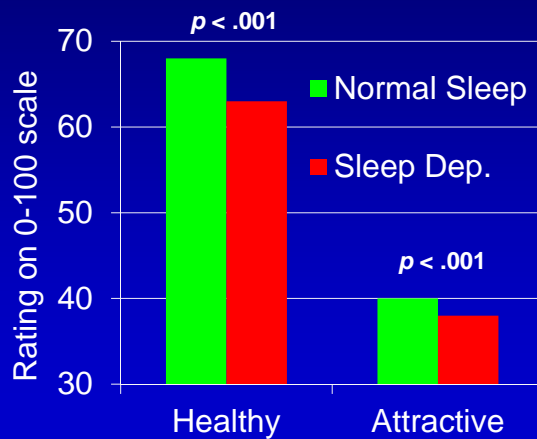
(Spiegel et al., 2002)

# Sleep & Illness: Evidence of Causation



(Spiegel et al., 2002)

## Sleep & Looking Unwell: Evidence of Causation



(Axelsson et al., 2010)

## Sleep & Special Populations: Active Investigations

- **Asthma** (L Meltzer): Sleep dep induces inflammation; does it make asthma worse?
- **Chronic Pain** (T Palermo, T Ward): does sleep dep worsen pain via inflammation or impairment via reduced pain threshold?
- **Diabetes:** (M Perfect): Sleep dep alters glucose regulation and may alter medical adherence; does it make diabetes worse?



# Sleep and Health Outcomes

It's time for some real-world solutions.



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## Many Thanks

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### Co-Investigators, Consultants

- Raouf Amin, MD
- Ron Dahl, MD
- Steven Daniels, MD, PhD
- Mark DiFrancesco, PhD
- Sean Drummond, PhD
- Jeff Epstein, PhD
- David Gozal, MD
- Dennis Molfese, PhD
- M. Douglas Ris, PhD
- Douglas Rose, MD

### Recent Co-Conspirators:

- >12 graduate students & fellows
- 2 year-round research assistants
- >40 summer research assistants
- 6 fMRI technicians
- 9 EEG technicians
- 2 study physicians

**Special thanks to the families who have lent their time and efforts to this work.**



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