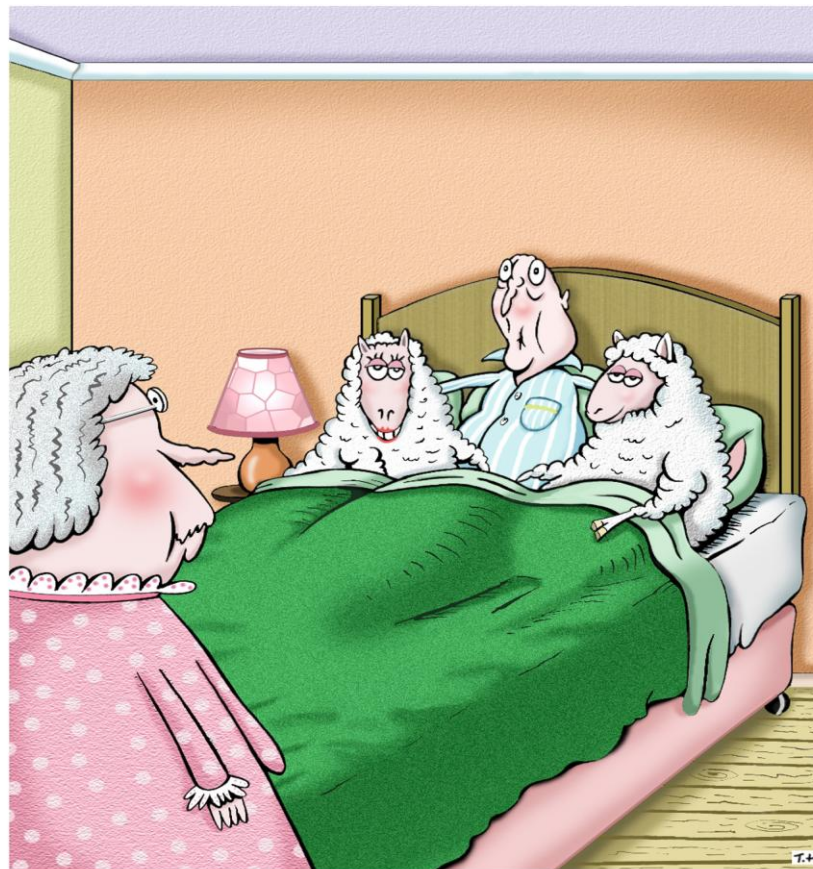


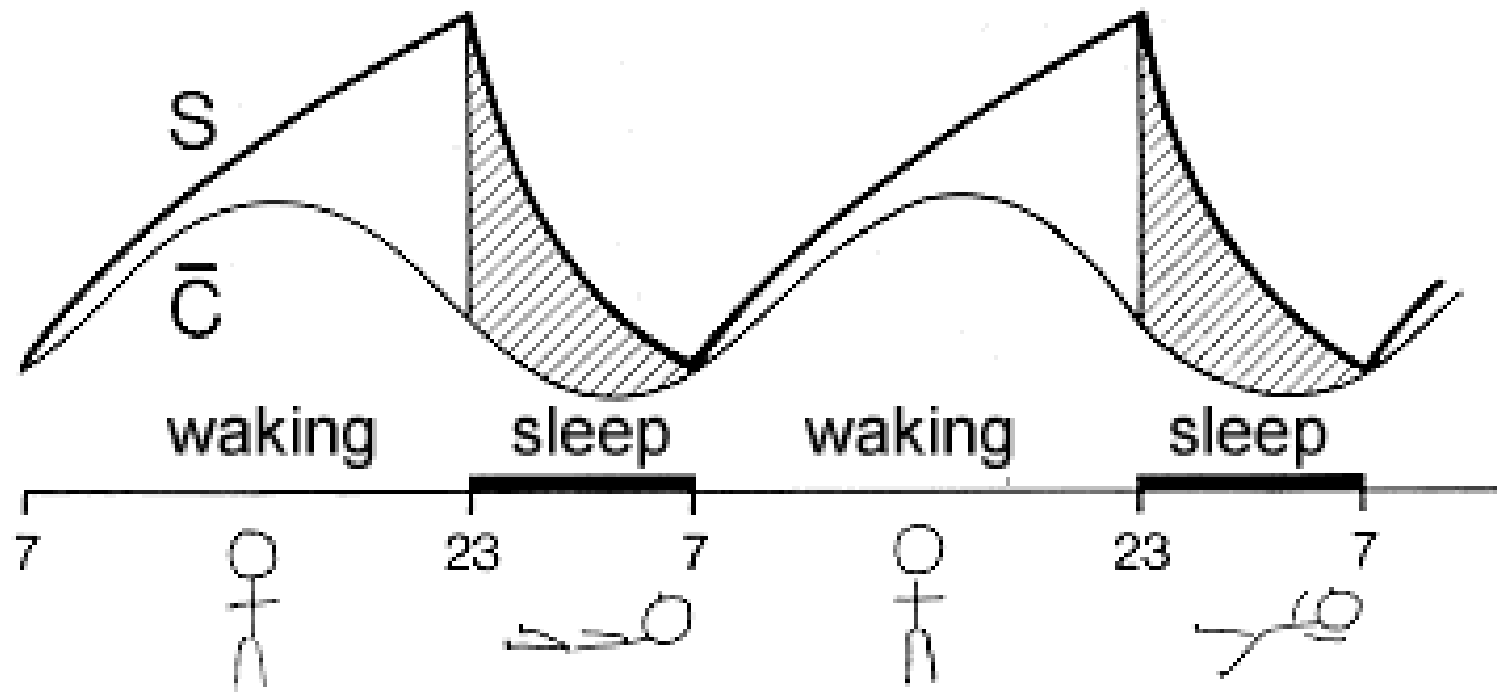
# Sleep and Obesity

Jason Ellis

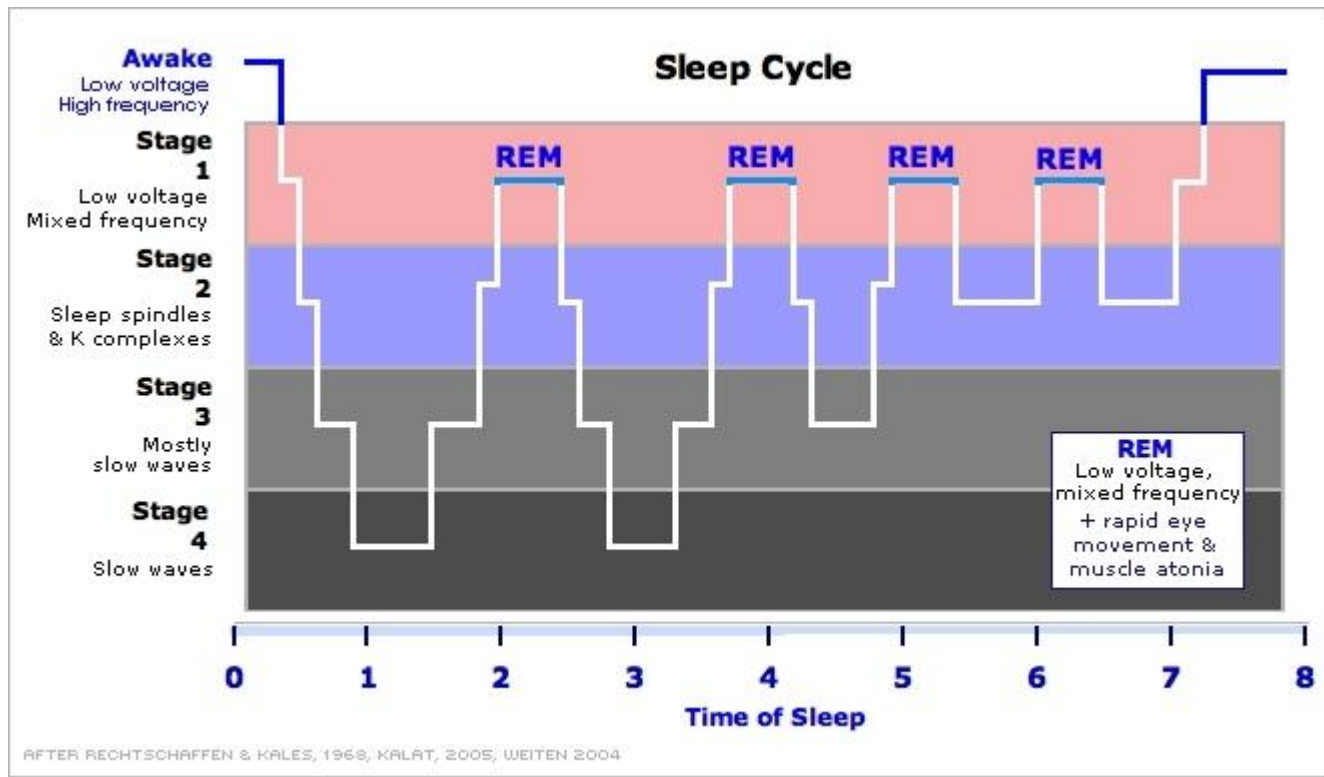


"It's not what it looks like Laura, I just couldn't sleep."

## Sleep - Waking Cycle



# What is Normal Sleep?



# The issue of short sleep

**off the mark**.com by Mark Parisi



# The source of the problem

- What does “short sleep” mean?
  - Subjective or objective?
  - Chosen or forced?
  - How short is short?
  - Short compared to what?



Cats. All they do is eat and sleep.  
Truth is, they don't even do that well.

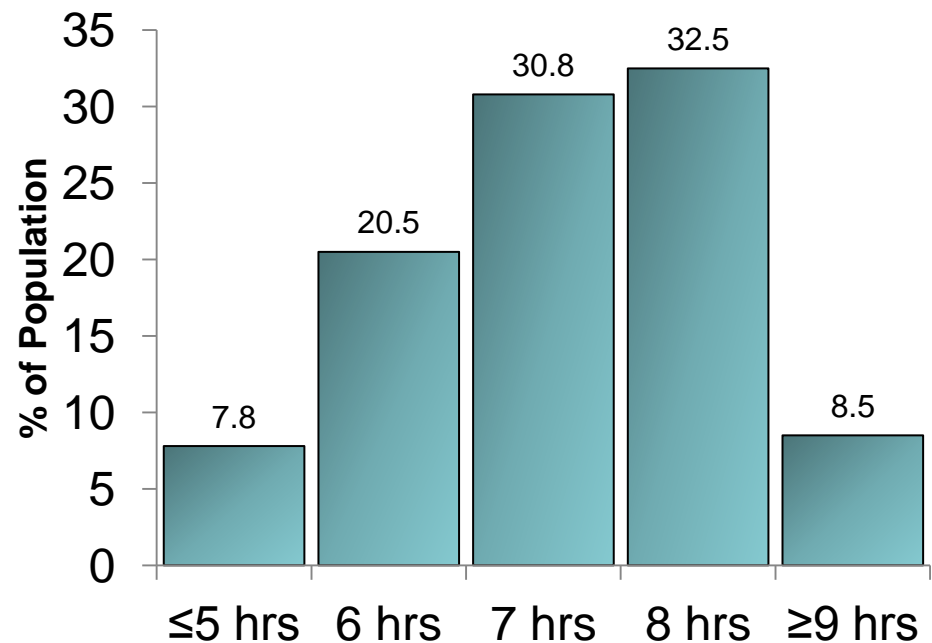
- For the purposes of this talk, “short sleep” means:
  - Habitual sleep duration of  $\leq 6$  hours

# Clinical significance of short sleep

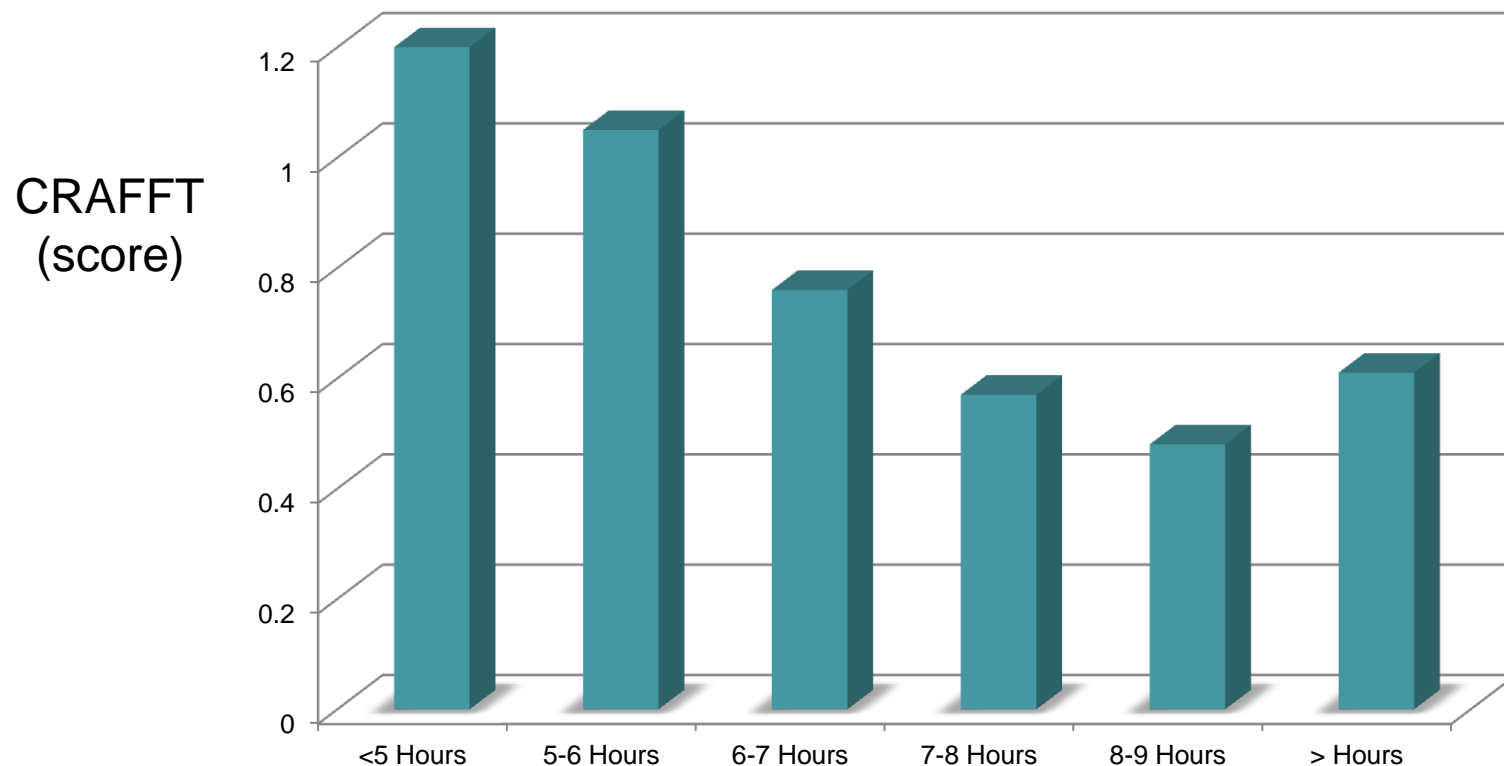
Short sleep duration is a worldwide issue

Short sleep duration is associated with a number of adverse health outcomes

- Obesity
- Hypertension
- Hyperlipidemia
- Diabetes
- Mortality



# Sleep Duration and Substance Use

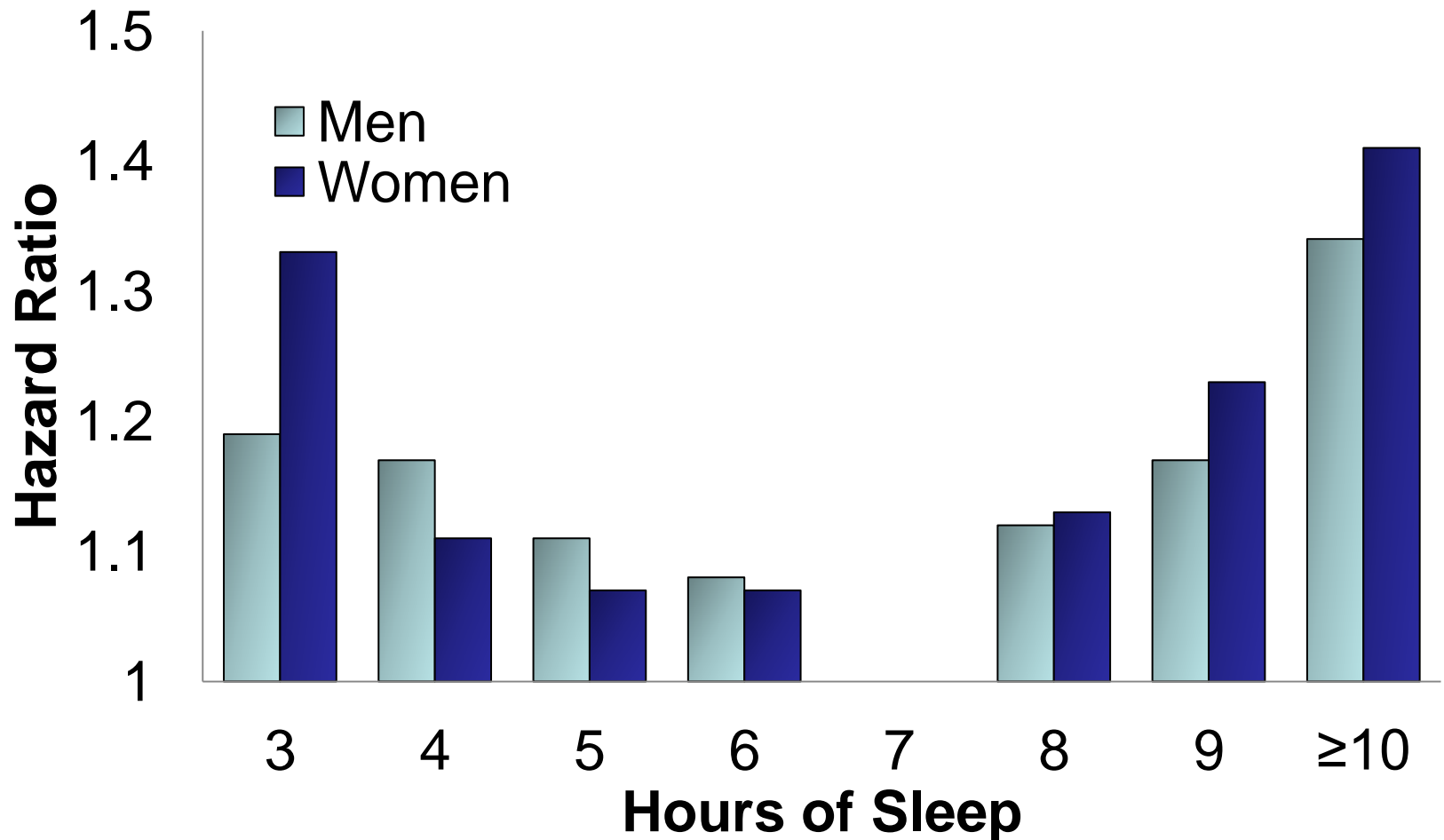


Adapted from Siversten et al (2015)





## Sleep Duration and Mortality

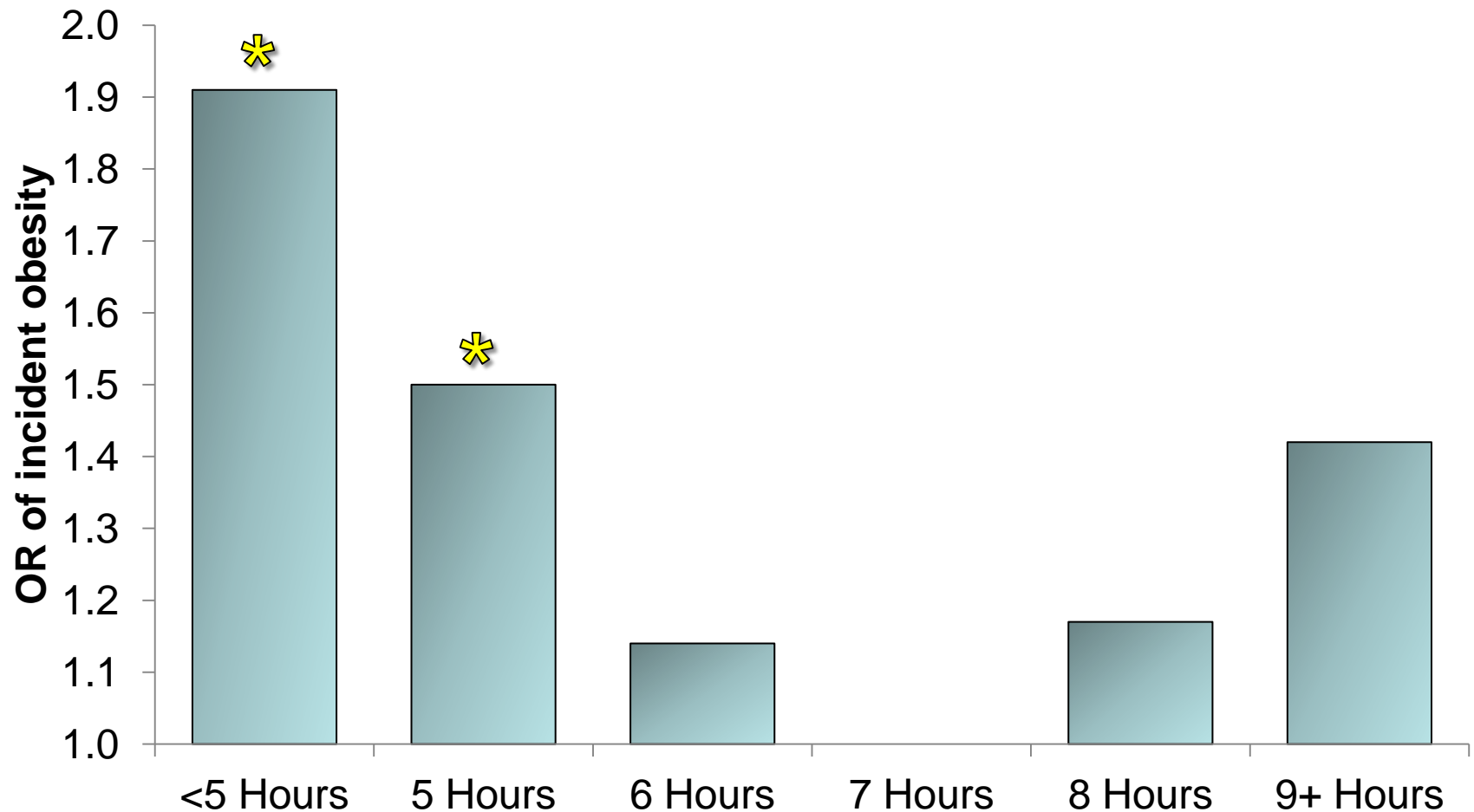


# Obesity and weight gain

- At least 65 studies have shown an association between short sleep duration and obesity
- Several studies have shown that short sleep duration is associated with obesity
  - In the Nurses' Health Study, those sleeping 6 hours or less are more likely to become obese and more likely to gain >15kg over 16 years

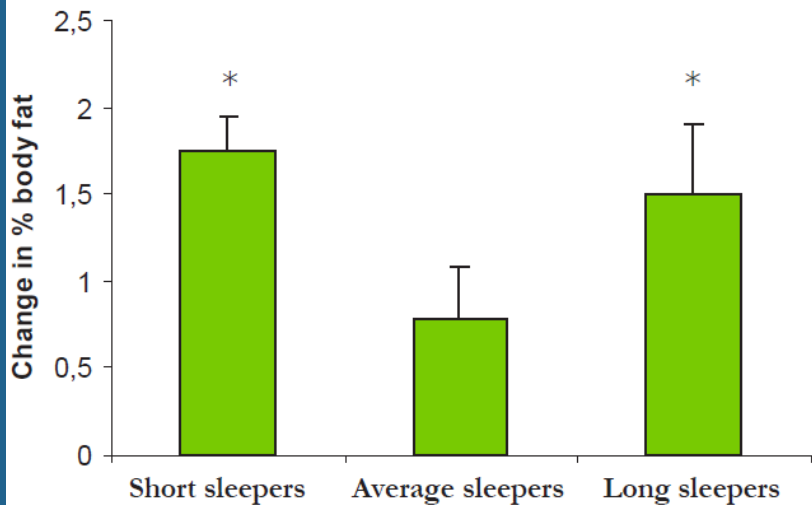
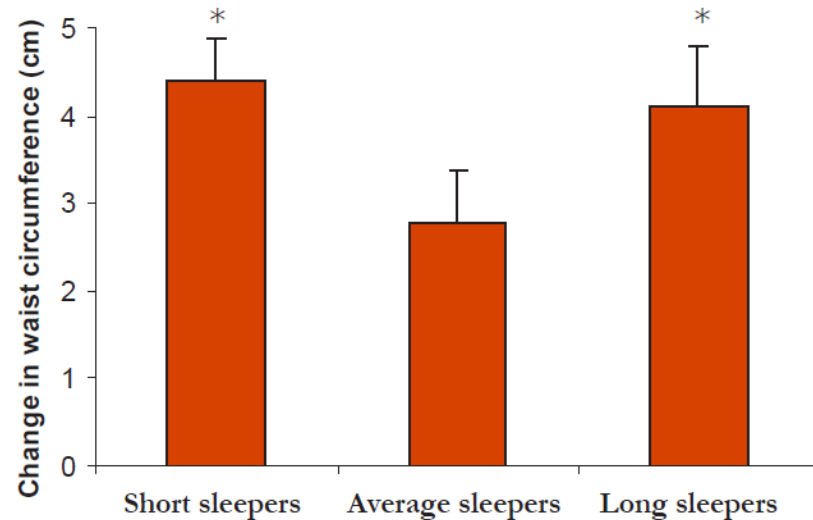
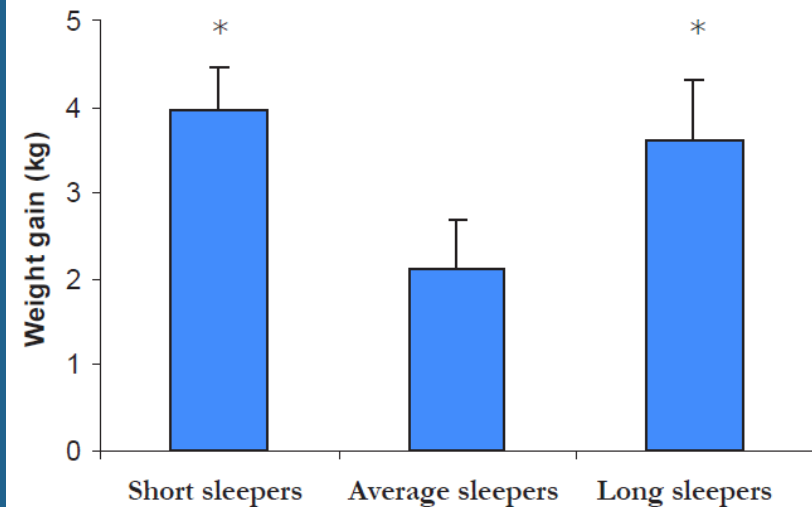


# Incident obesity among men



*Adjusted for: age, work shift, smoking, alcohol, physical activity, and depressive symptoms*

# Incident adiposity



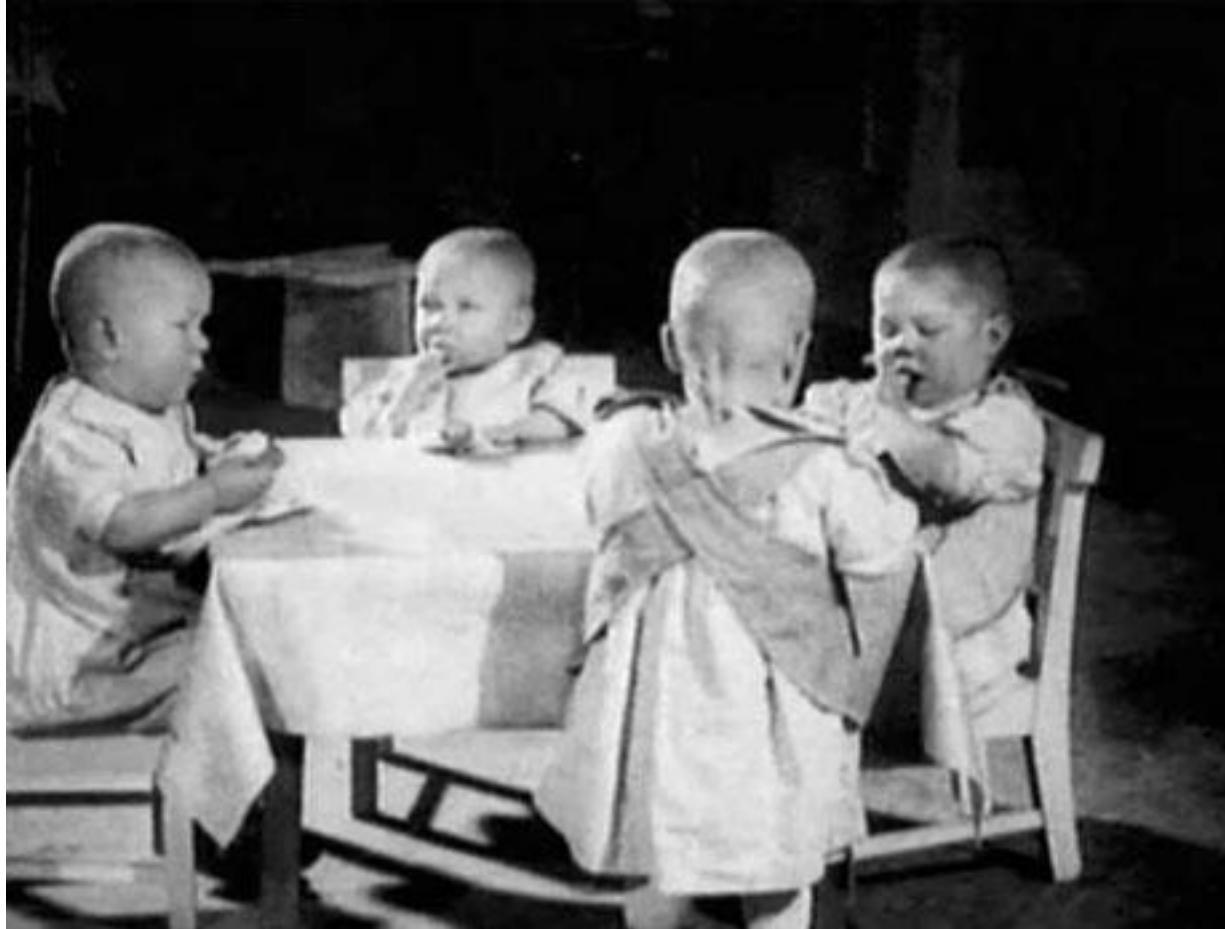
**Figure 1**—Mean (a) weight gain, (b) change in waist circumference, and (c) change in percentage of body fat by sleep-duration group. The model was adjusted for age, sex, baseline body mass index, study phase, length of follow-up, resting metabolic rate, smoking habits, employment status, education level, total annual family income, menopause status, shift-working history, alcohol intake, coffee intake, total caloric intake, and participation in vigorous physical activity. \*Significantly different from the 7-8 hours sleeping group (average sleepers),  $P < 0.05$ .

# Sleep and BMI across the lifespan



Adjusted for:

- Sex
- Race/Ethnicity
- Marital Status
- Exercise
- Income-Poverty Ratio
- Income
- Education
- Alcohol
- Smoking
- Total Caloric Intake
- Food Variety





Direct

Pro-inflammatory  
State

Insulin Dysregulation



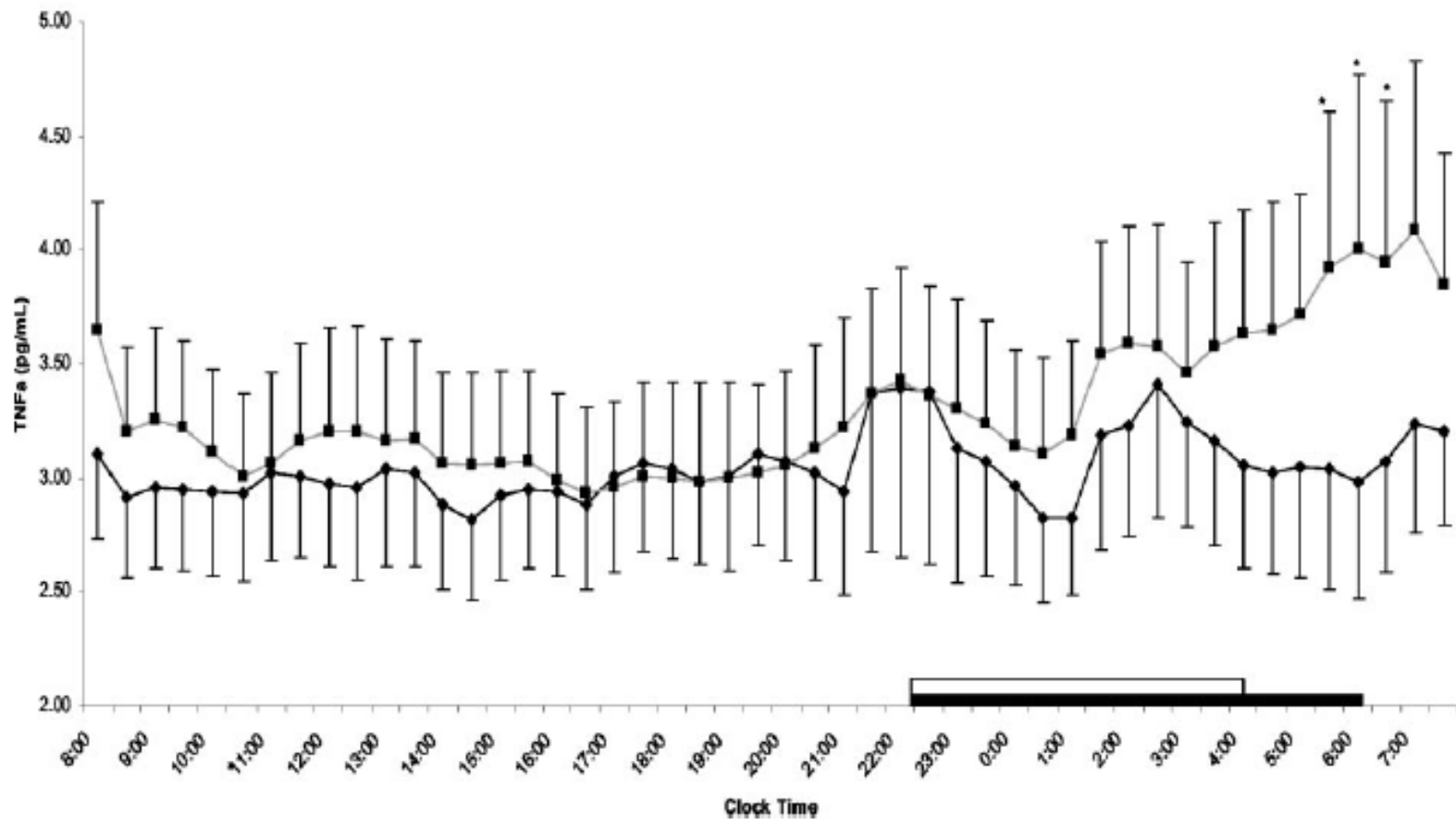
Indirect

Mood Dysregulation

Impaired Decision  
Making

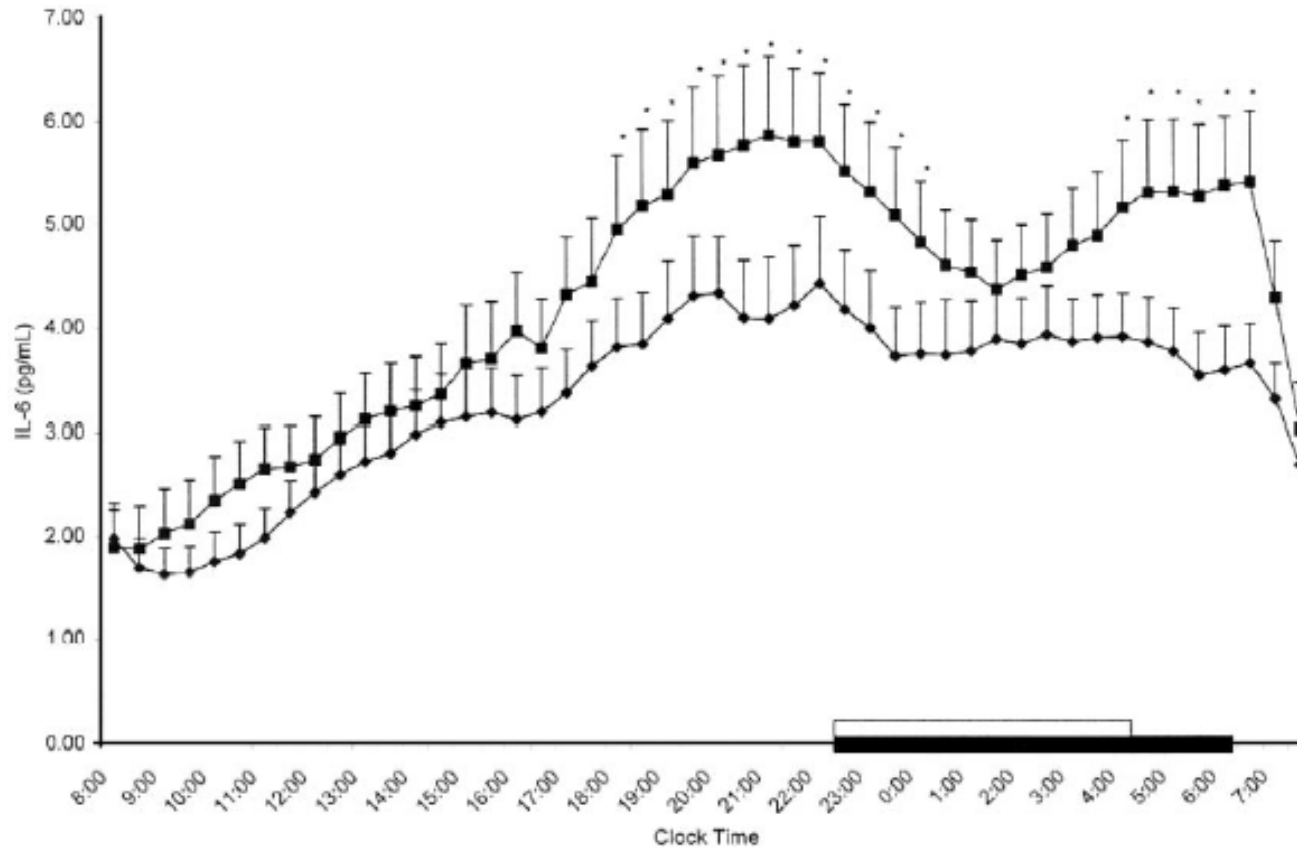


# Sleep deprivation and TNF $\alpha$

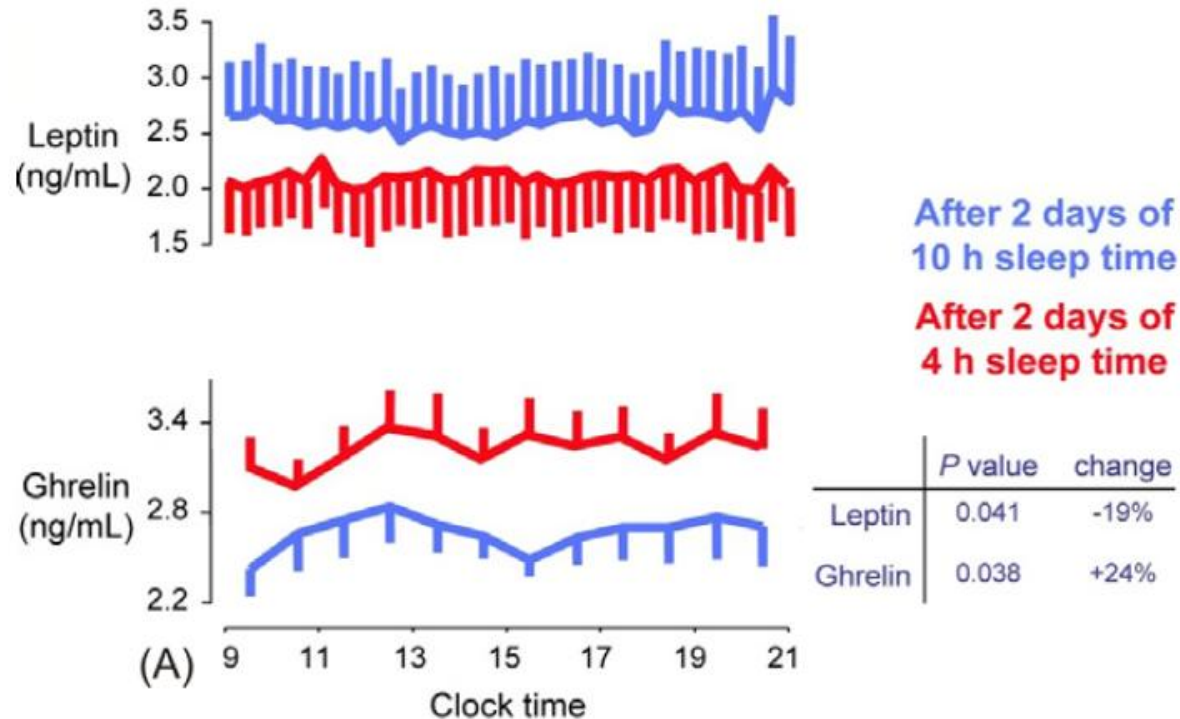




# Sleep deprivation and IL-6



# A Common Pathway

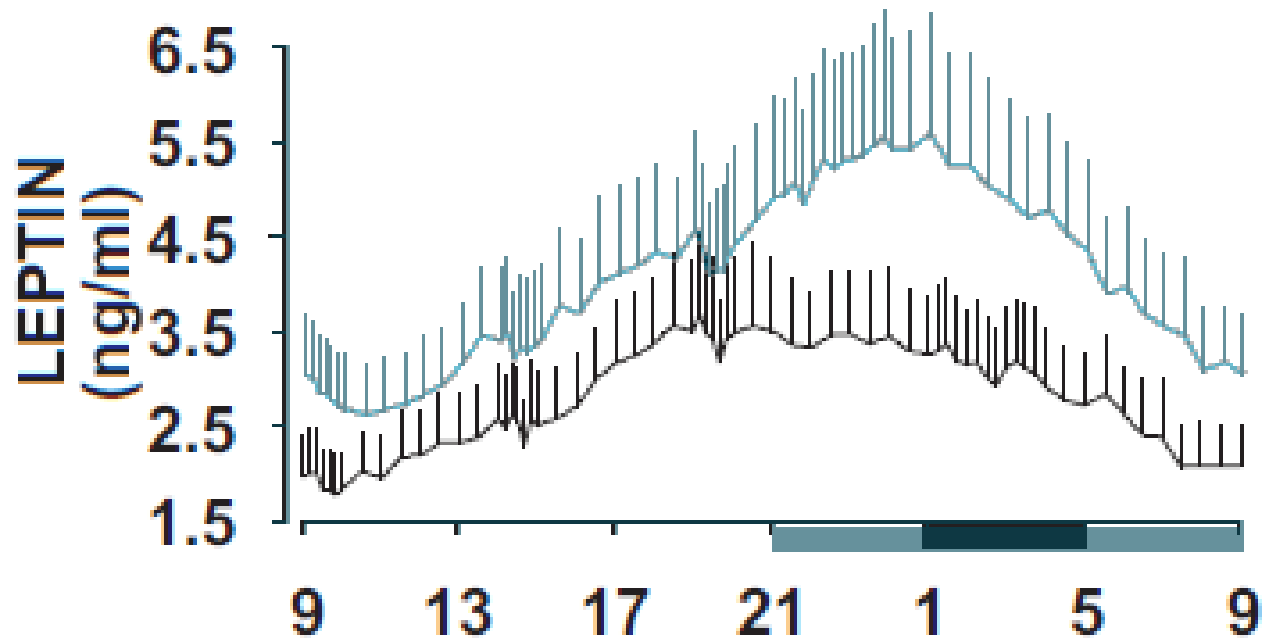


Found decreases in leptin and increases in ghrelin

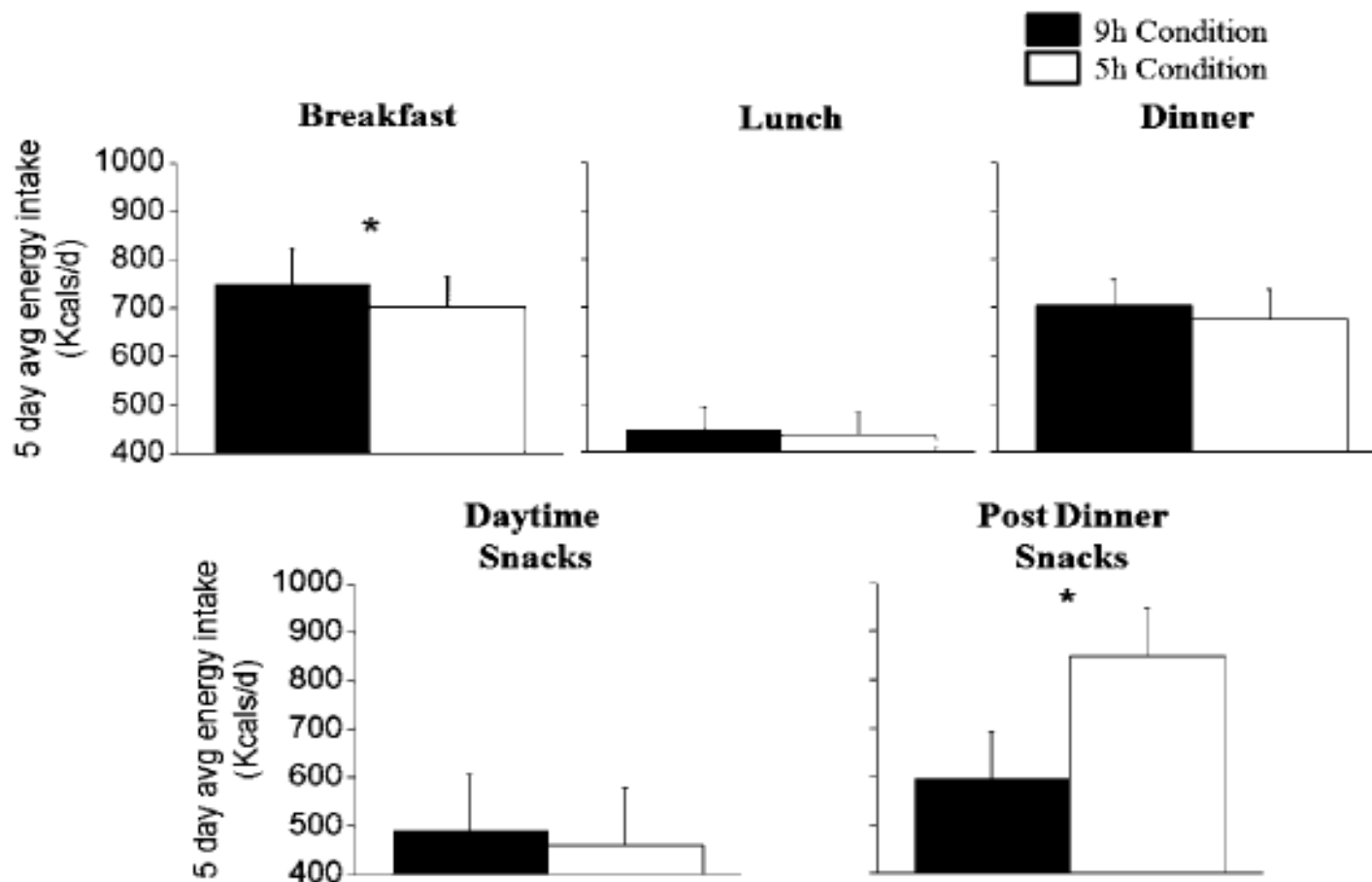
Change in leptin was stronger predictor of changes in hunger than the increase in ghrelin

# Sleep deprivation decreases leptin

12 Hours in bed (blue) versus 4 hours in bed (black)

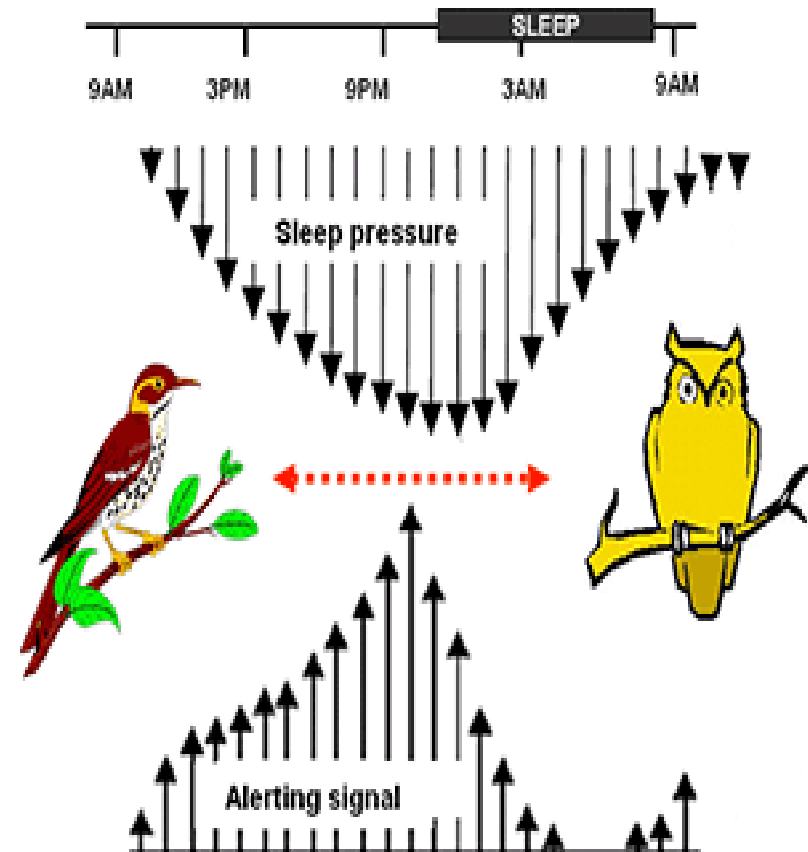


# Energy Intake (5hrs vs. 9hrs)

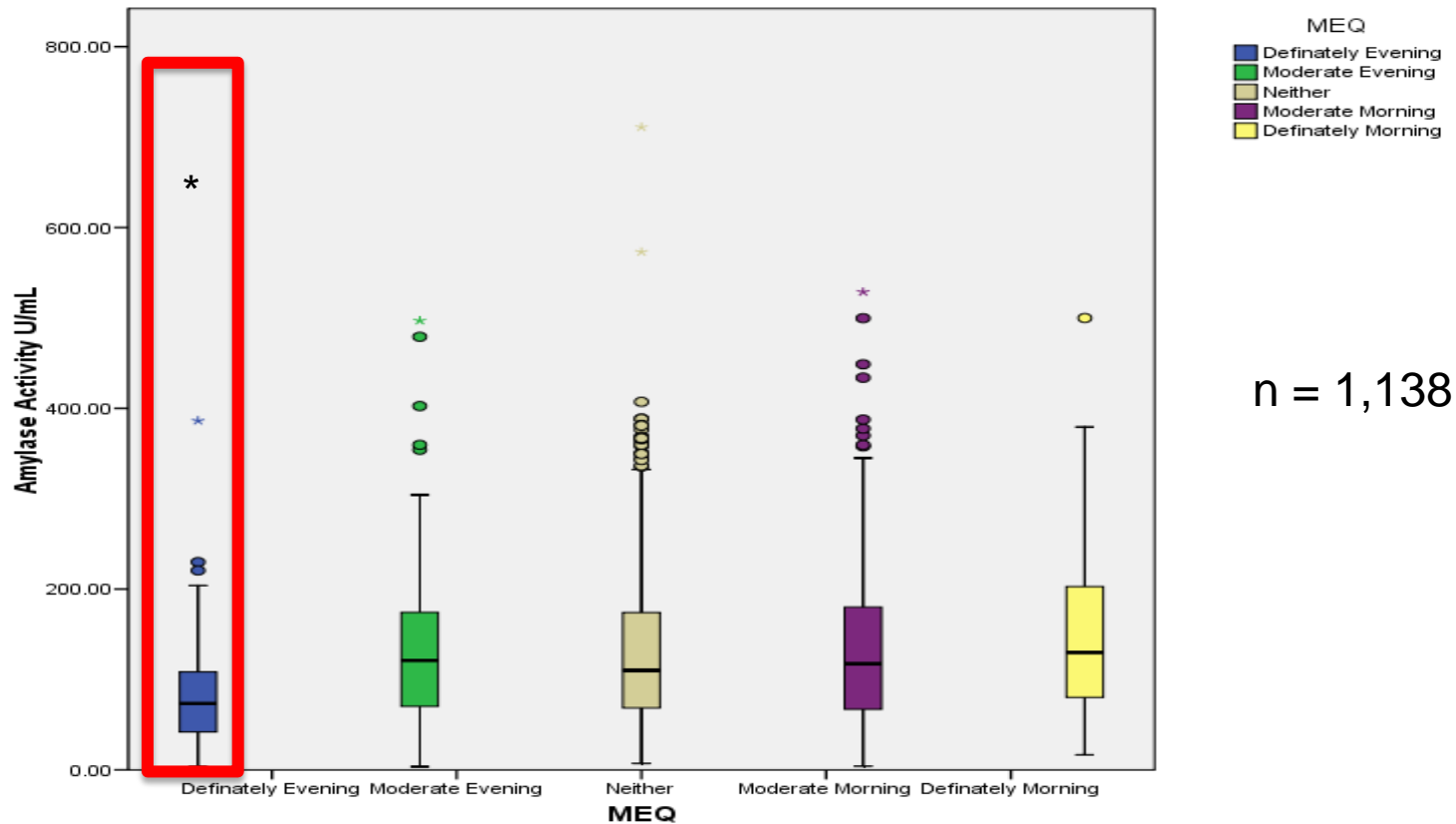


# Is Chronotype an Issue?

- Evening types more likely to have variable sleep schedules
- Evening types more likely to eat more at mealtimes
- Evening types more likely to have weight problems
- Evening types more likely to have sleep apnoea



# The Relationship between Chronotype and Amylase (Enzyme)



# SO WHAT IS THE ANSWER?

## About a Nurse



*"I'm the casting director for the show, *The Walking Dead*. I've noticed the way your nurses look after a shift, and I'd like to hire them as extras."*





## The Team

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## And the people who fund this programme of work

