



Shift Work/Sleep Cycles & Safety

Andrew W. McHill, PhD & Nicole Bowles, PhD MPH

Oregon Health & Science University

Oregon Infrastructure Construction Safety Symposium

February 15th 2024

Outline

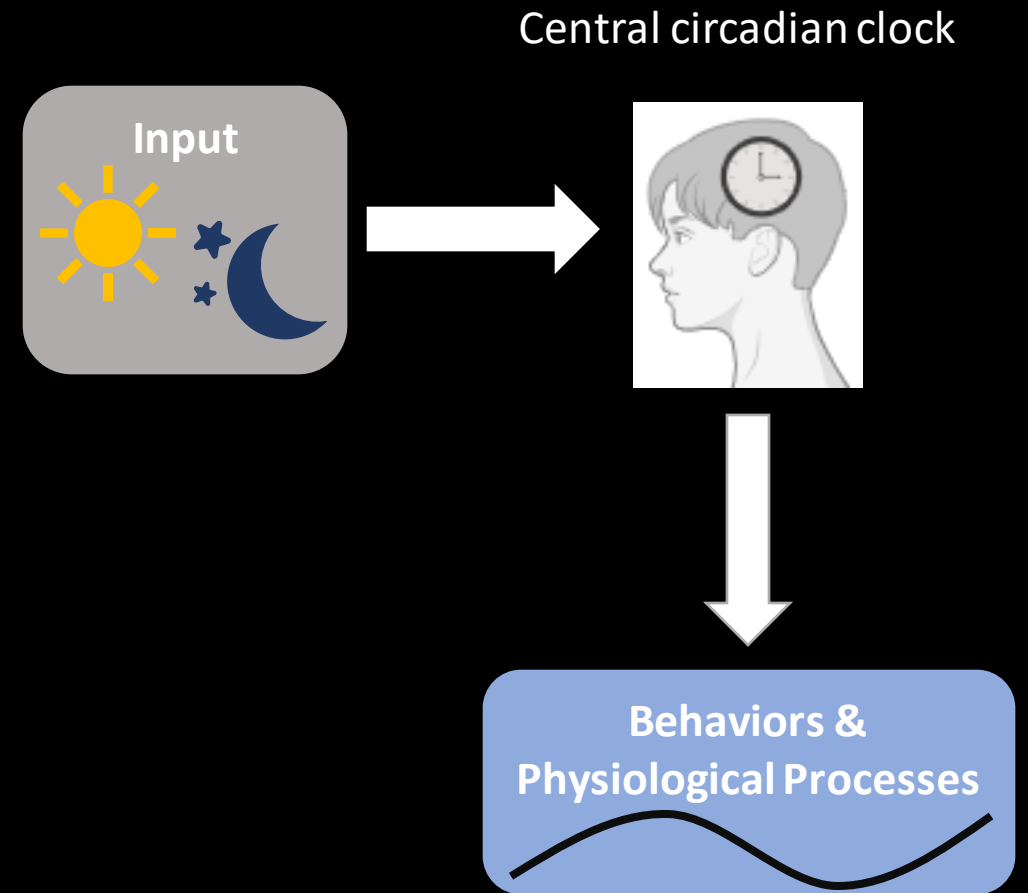
1. Basics of the internal biological clock (circadian system) and how shiftwork disrupts this clock.
2. Shiftwork and health consequences.
3. Shift Work Strain: Navigating Stress, Family, and Health
4. What can we do about this?

Internal Circadian Timing System



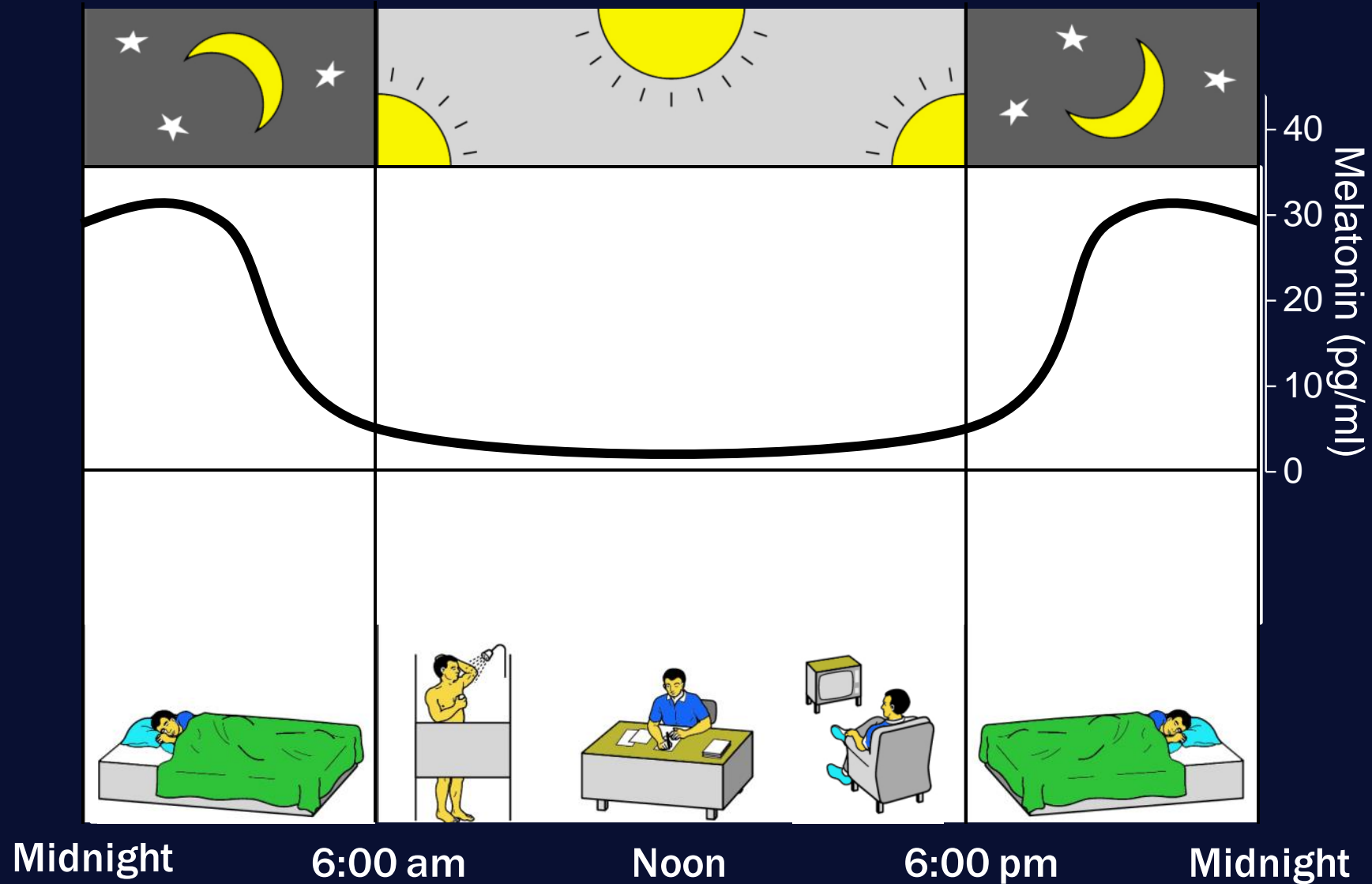
Circadian Rhythms

Derived from Latin with “circa” meaning approximate and “dian” meaning a day





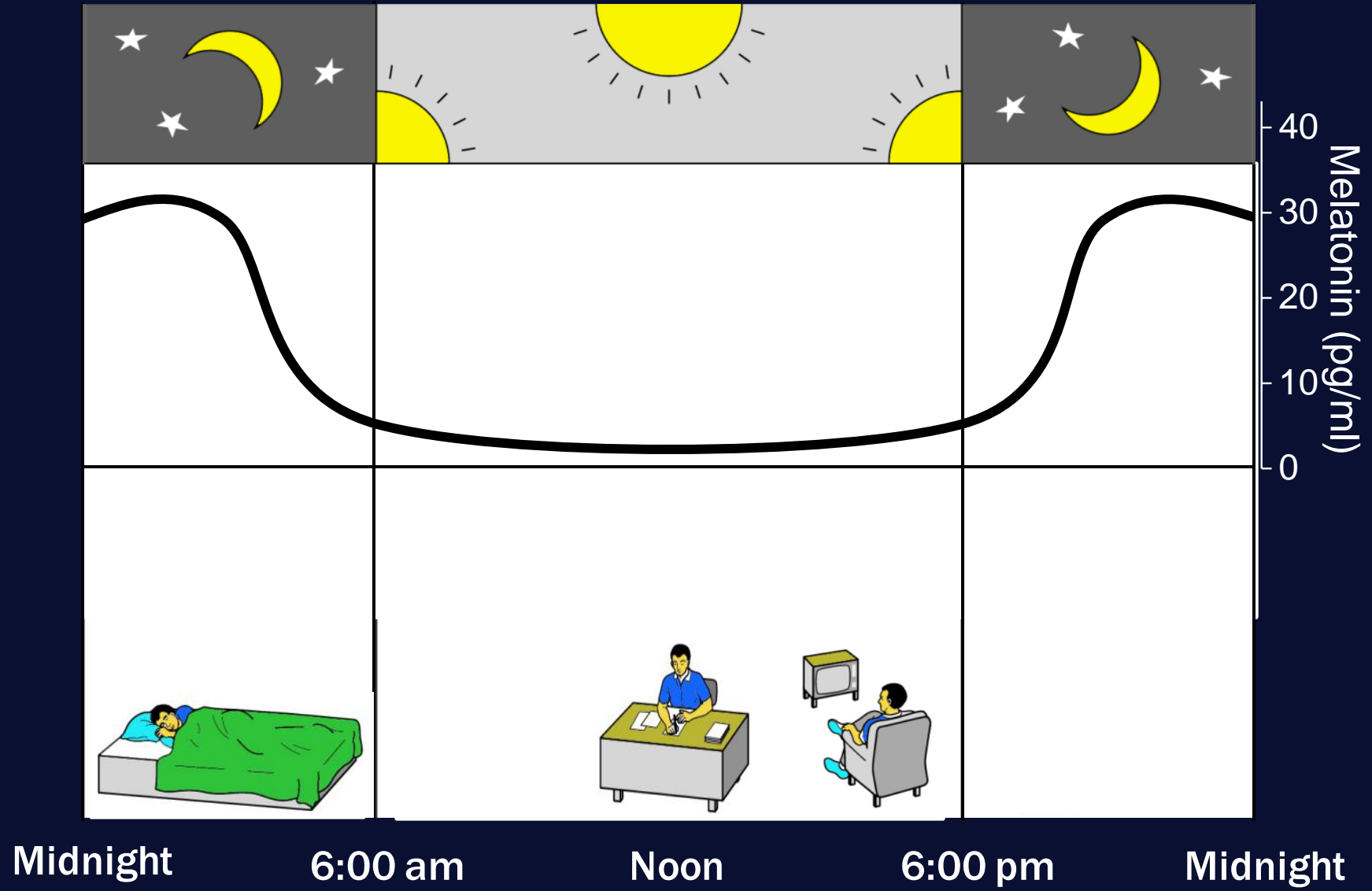
Alignment between our biology and behavior



Modified from Nelson, 2000



Misalignment between circadian biology and behavior



Modified from Nelson, 2000

Shift work and health consequences



**Up to 45%
increased risk in
obesity**

**3-fold increase in
accidents; 25 to
40% higher risk of
depression and
anxiety**

**Up to 40%
increased risk in
heart disease**

Credit: Katherine Streeter for NPR

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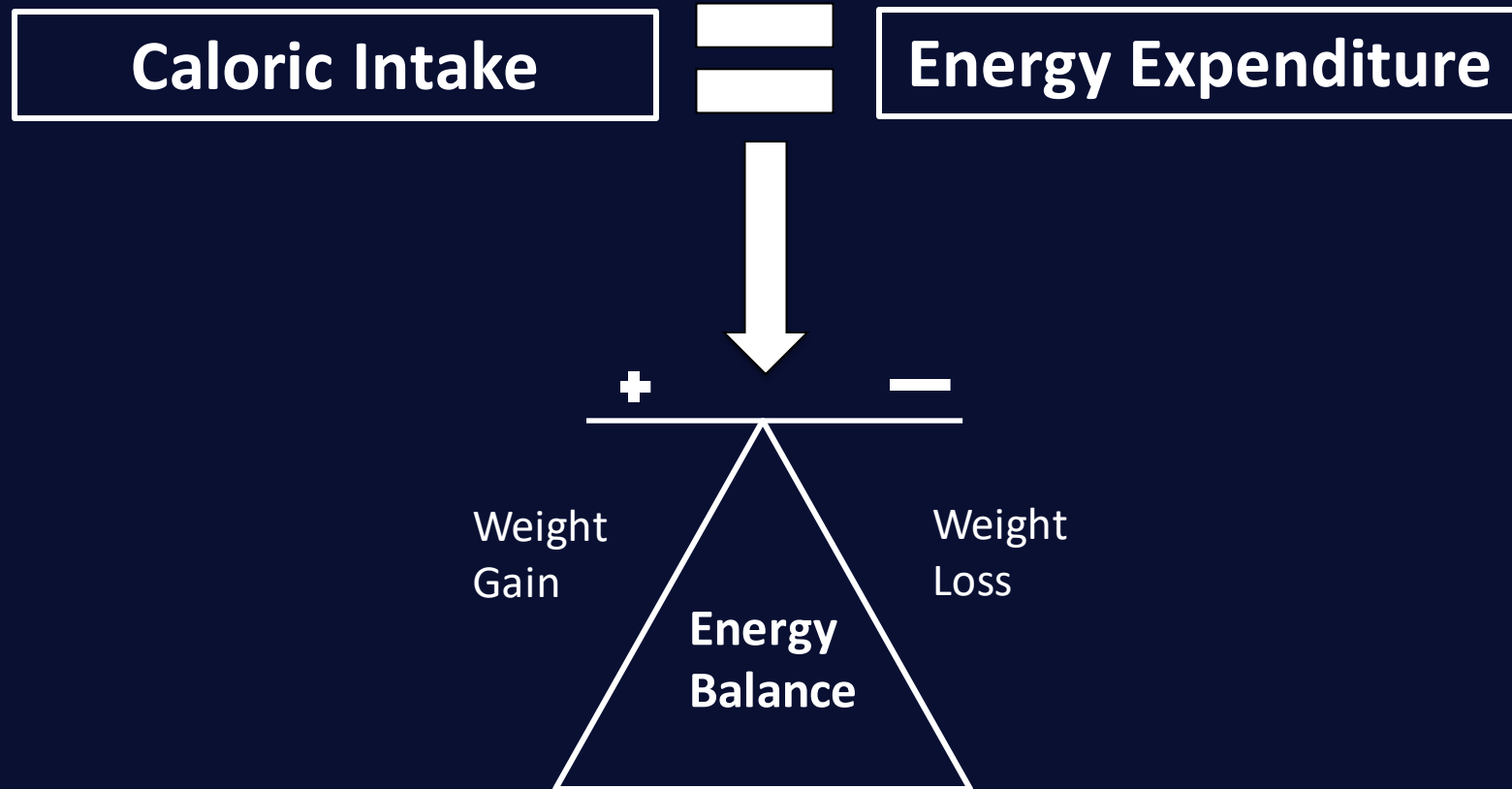
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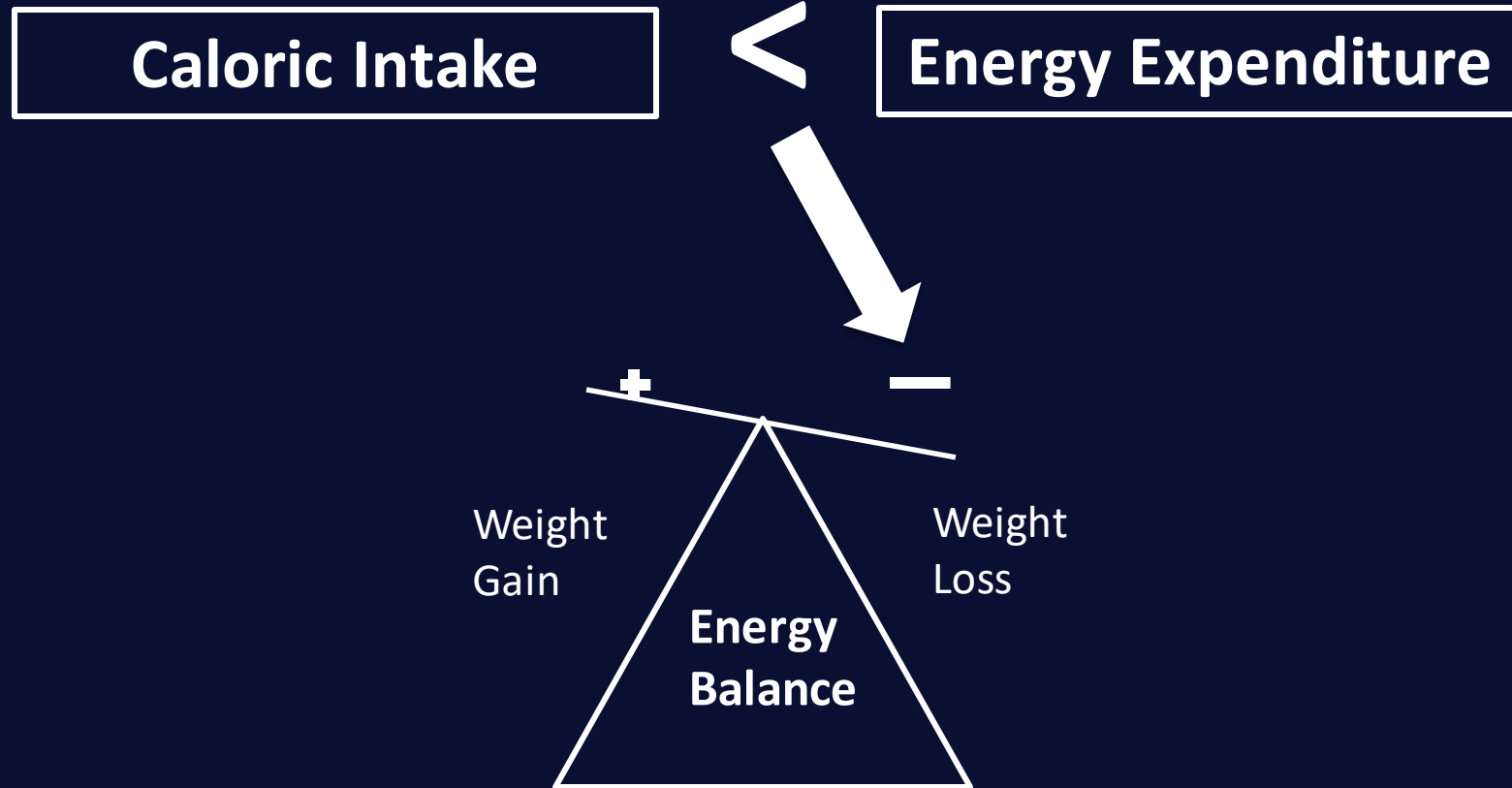
<https://www.npr.org/sections/health-shots/2018/11/03/663155917/ready-for-the-time-change-here-are-tips-to-stay-healthy-during-dark-days-ahead>

How does working at night
contribute to obesity?

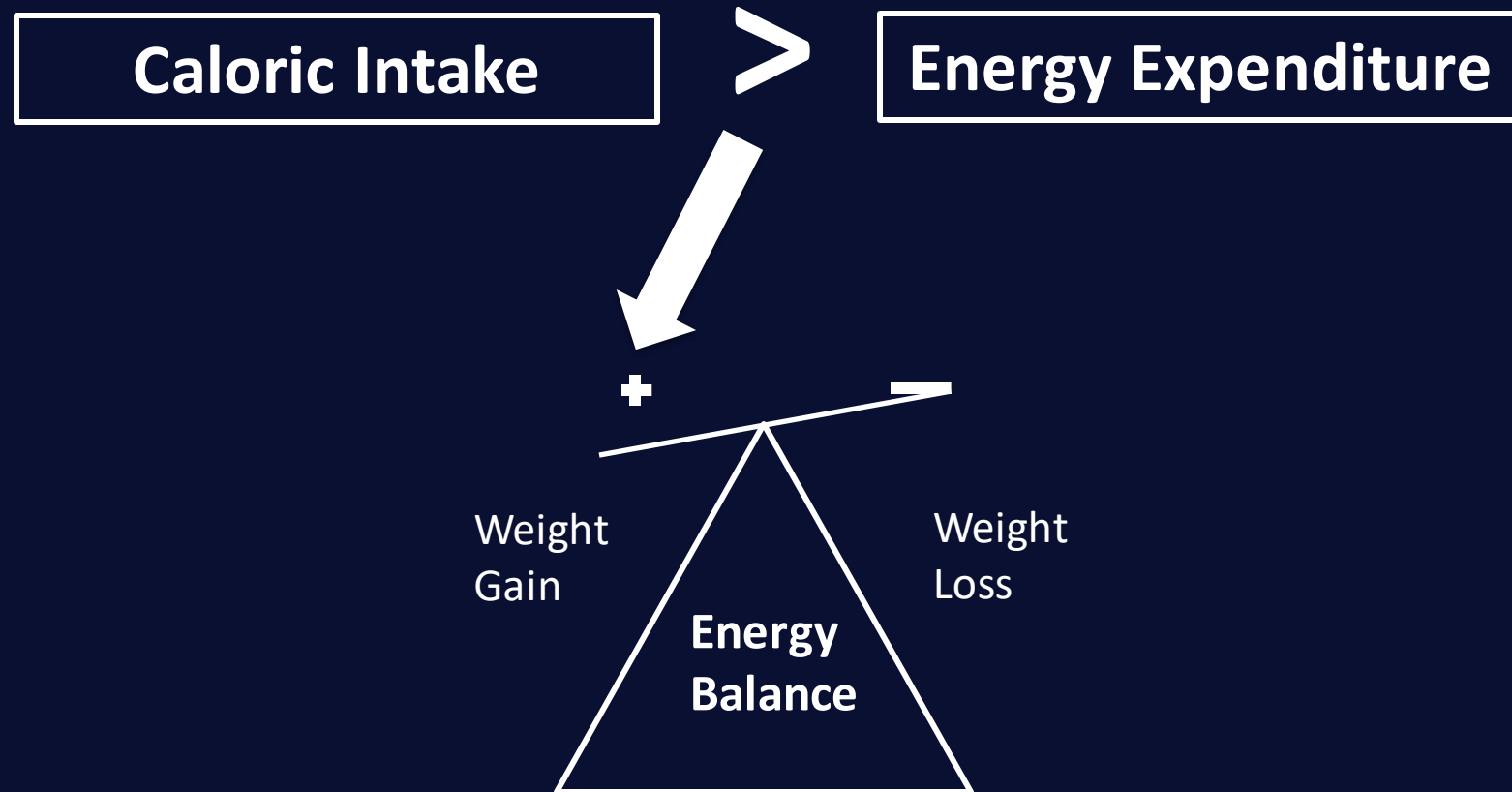
Energy Balance and Weight



Energy Balance and Weight

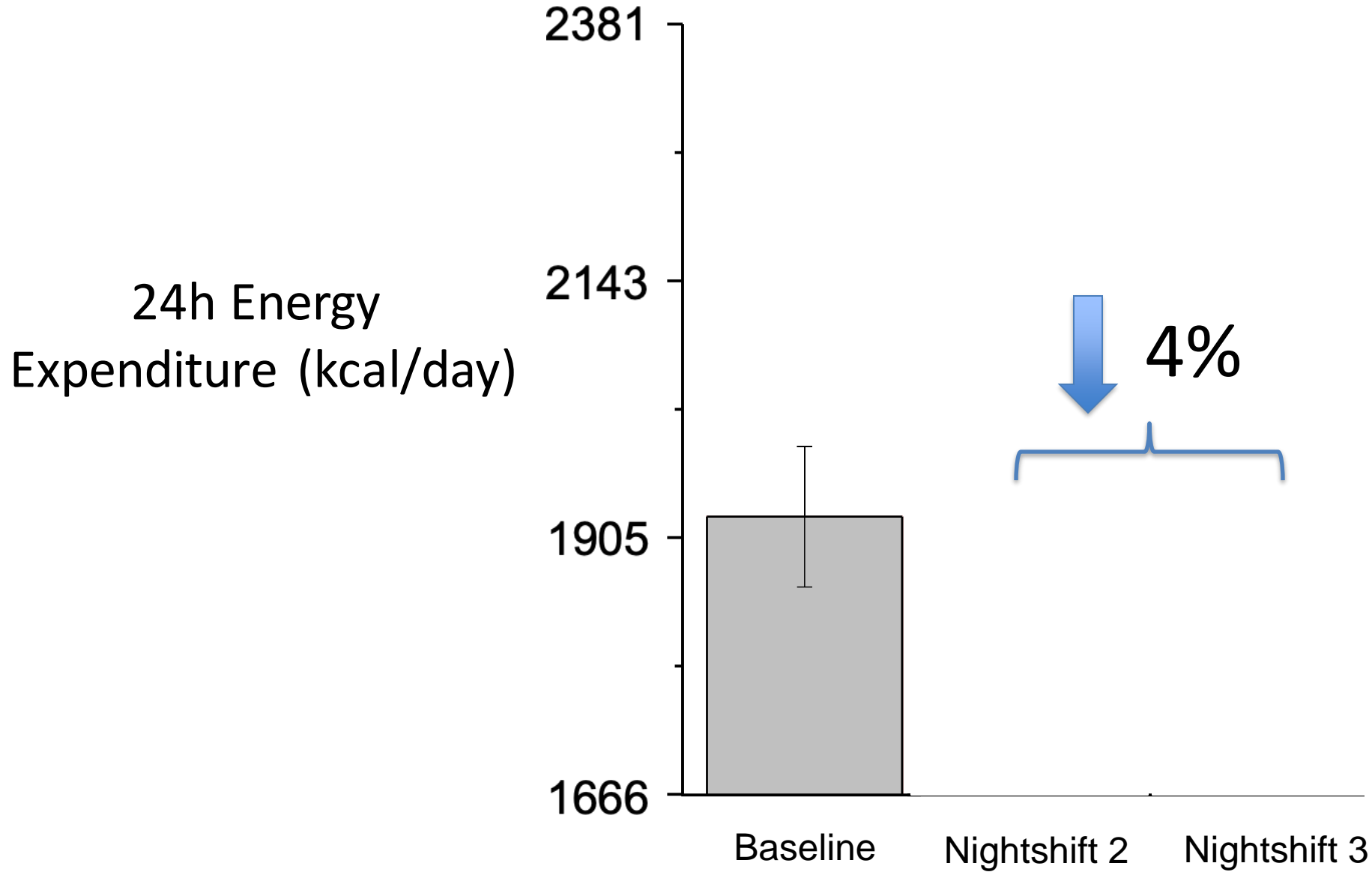


Energy Balance and Weight



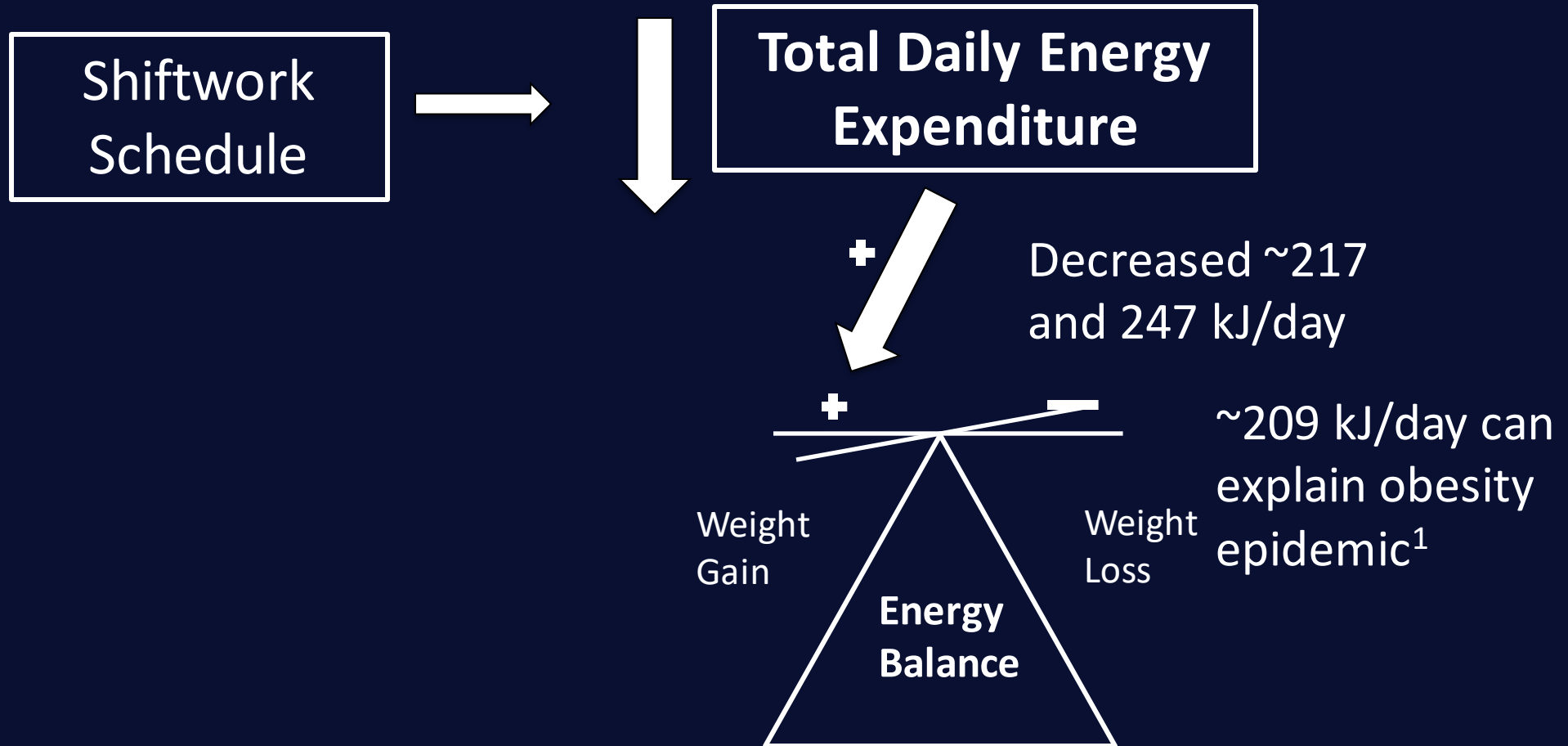
So what happens with shift work?

Average Total Daily Energy Expenditure



±SEM

Shift work alters energy expenditure



¹Hill, Science 2003

Shift work and health consequences



3-fold increase in accidents; 25 to 40% higher risk of depression and anxiety

Up to 40% increased risk in heart disease

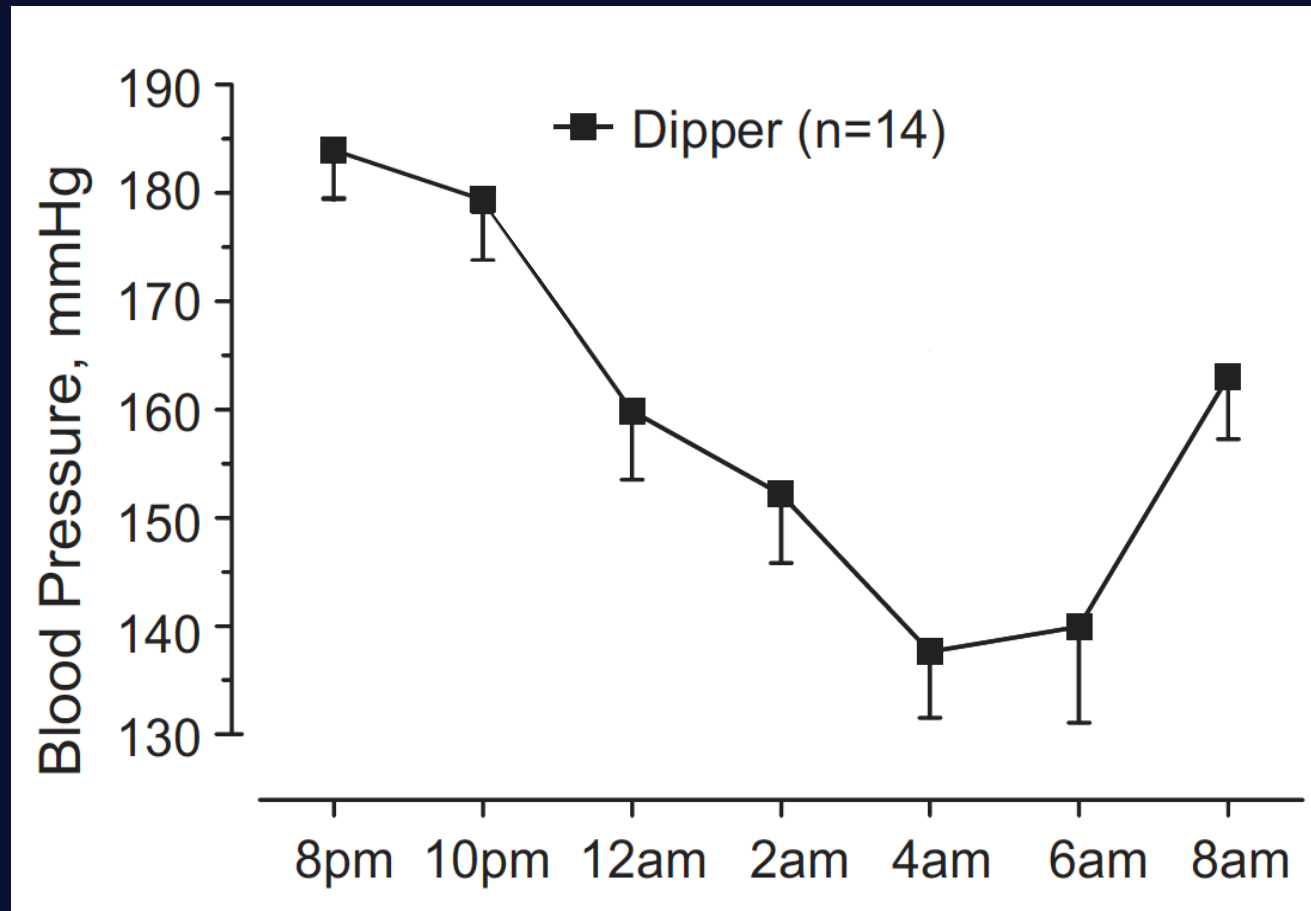
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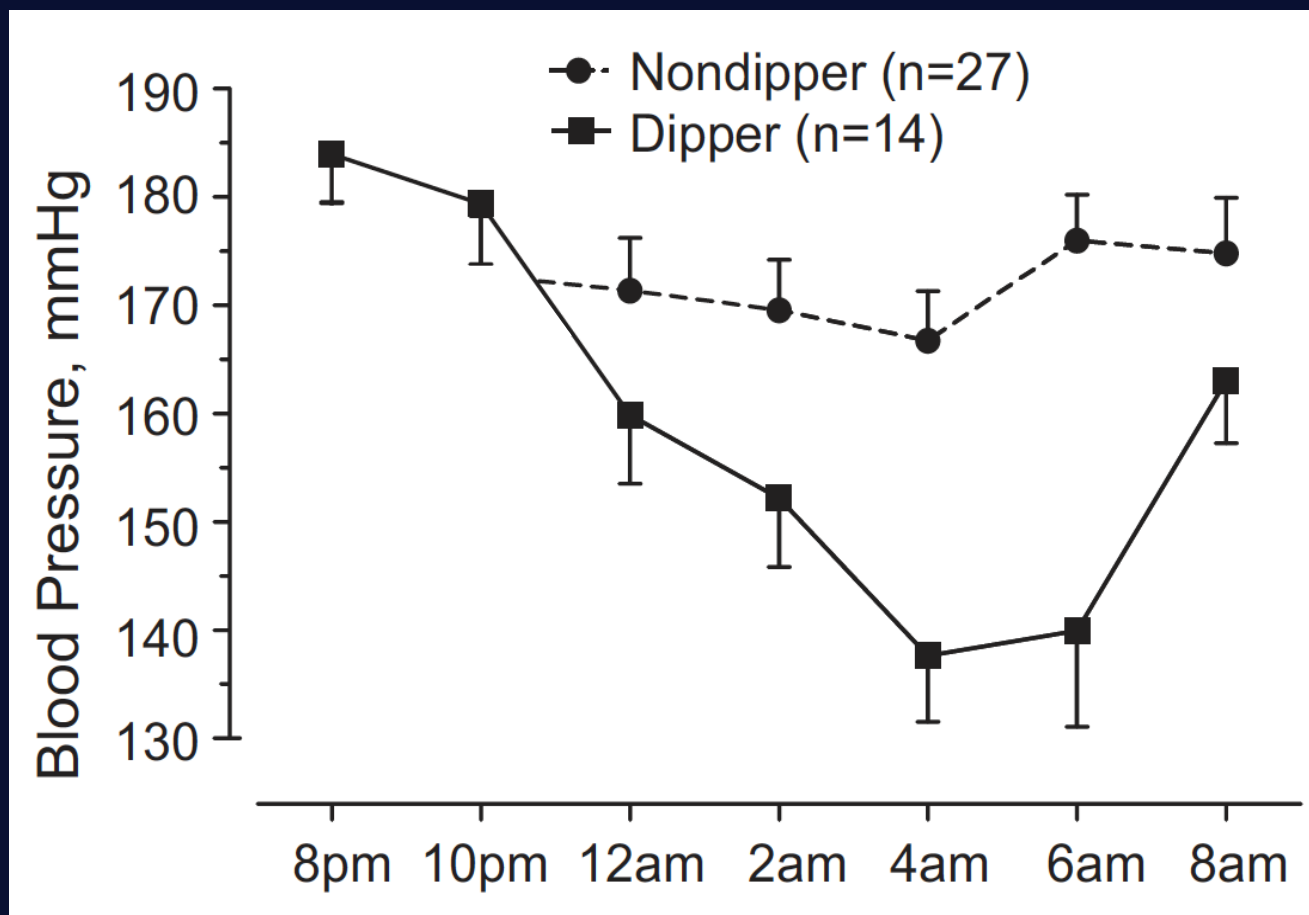
**Why increased
cardiovascular risk?**

24-hour Blood Pressure Patterns – “Dipping”



Modified from Okamoto et al., Hypertension 2009

24-hour Blood Pressure Patterns – “Dipping”

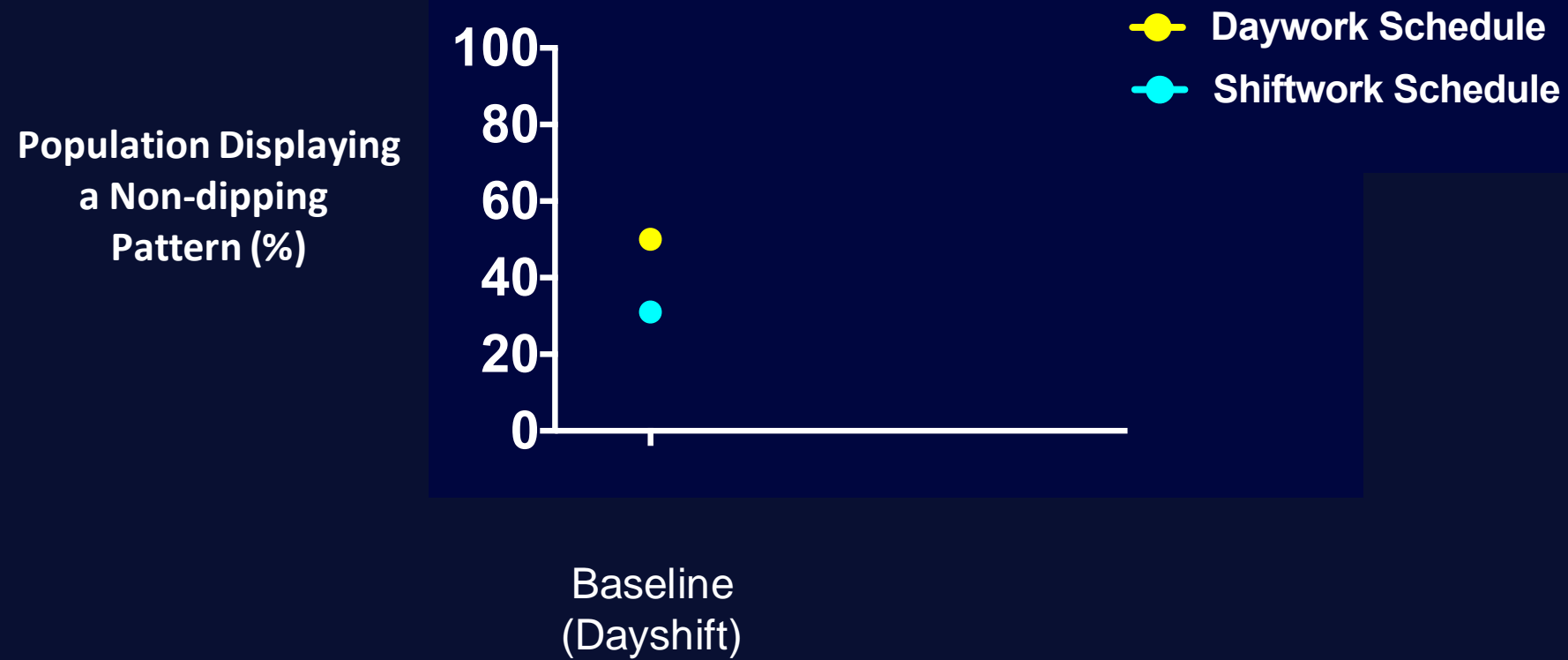


We tested how overnight blood pressure changes in response to shiftwork

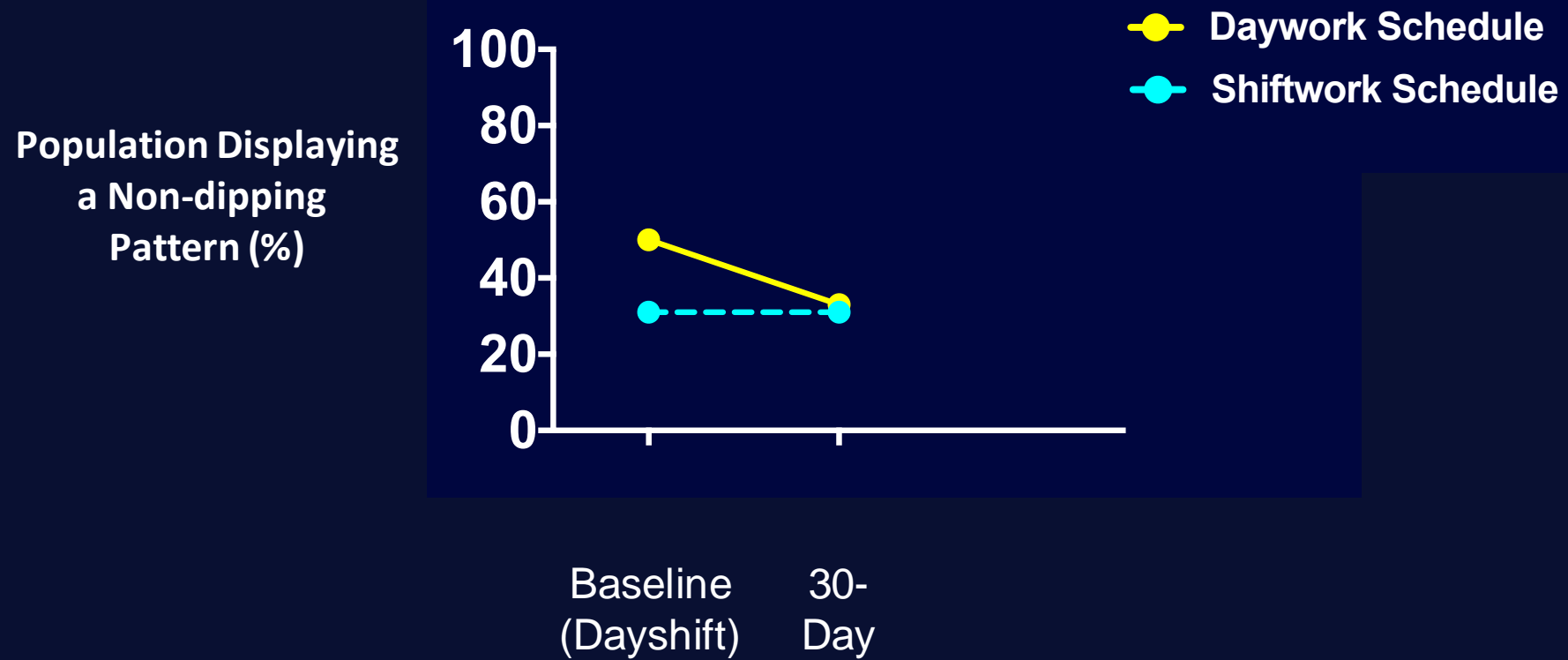
- Participants were fitted with a 24-h ambulatory blood pressure monitor
 - Sampled every 30 minutes during sleep and waking



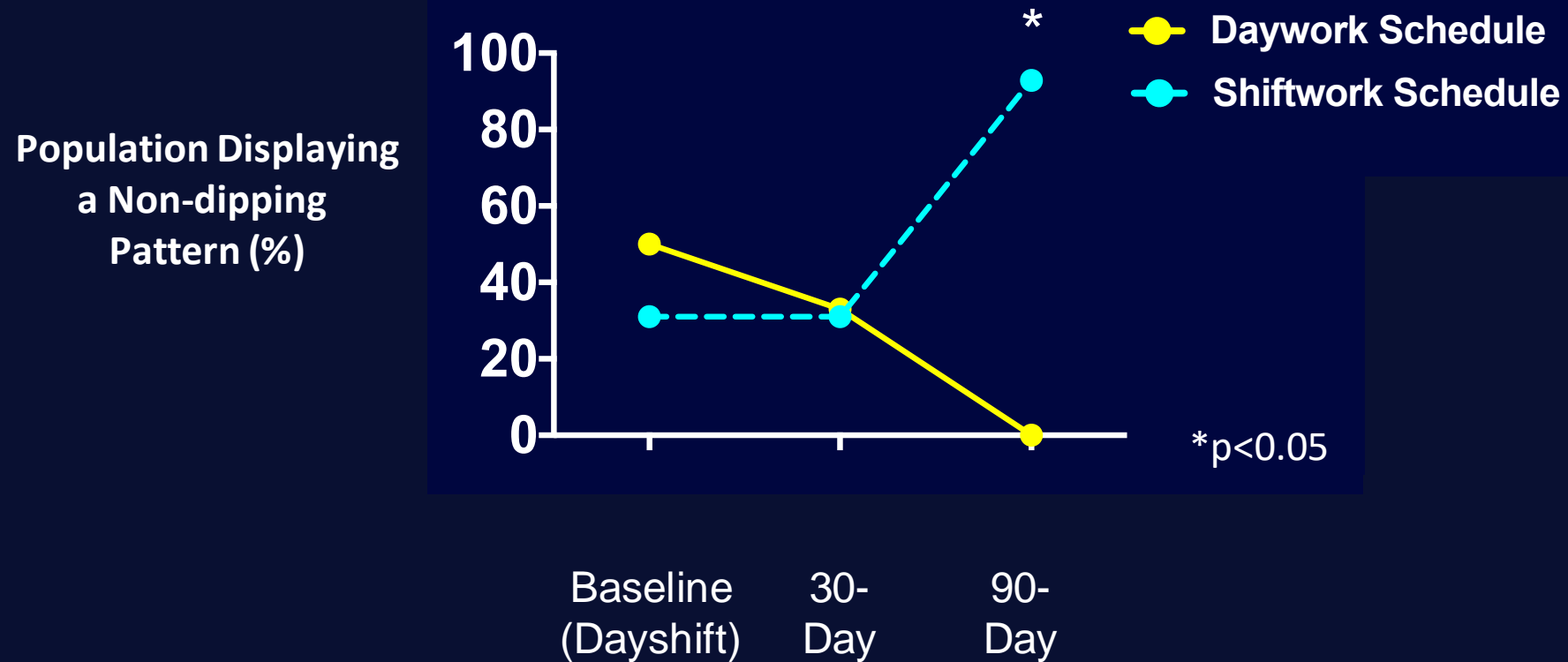
Transitioning to a Shift Work Schedule Alters Overnight Dipping



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Transitioning to a Shift Work Schedule Alters Overnight Dipping



The change in dipping magnitude was correlated with a change in sleep onset timing variability

Shift work and health consequences



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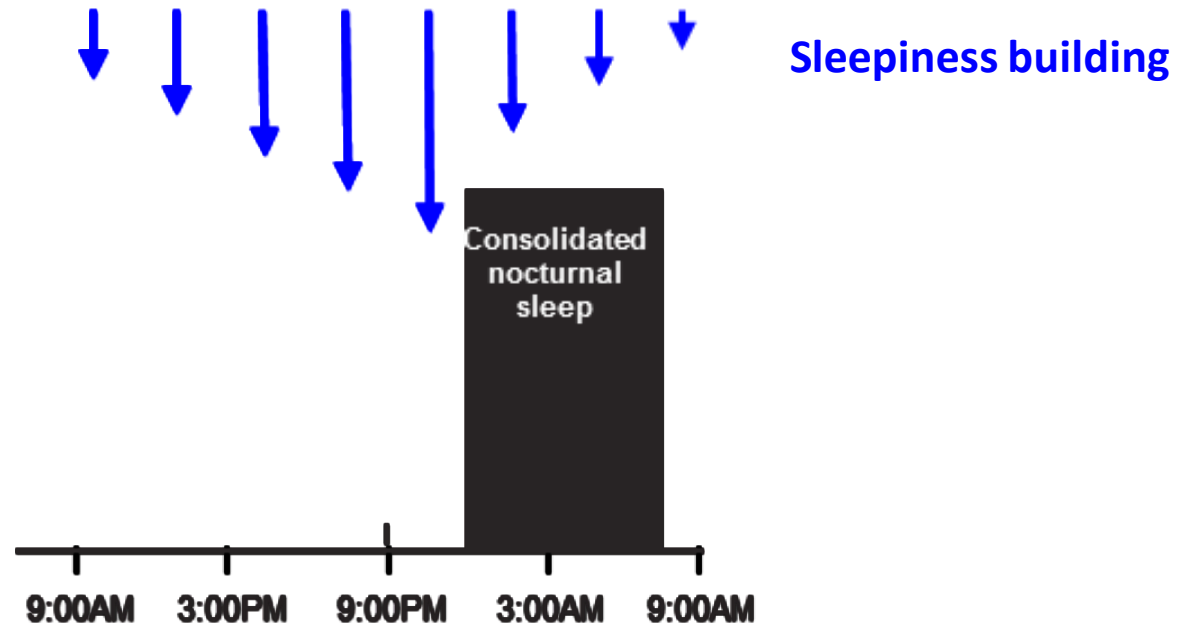
Up to 45% increased risk in obesity

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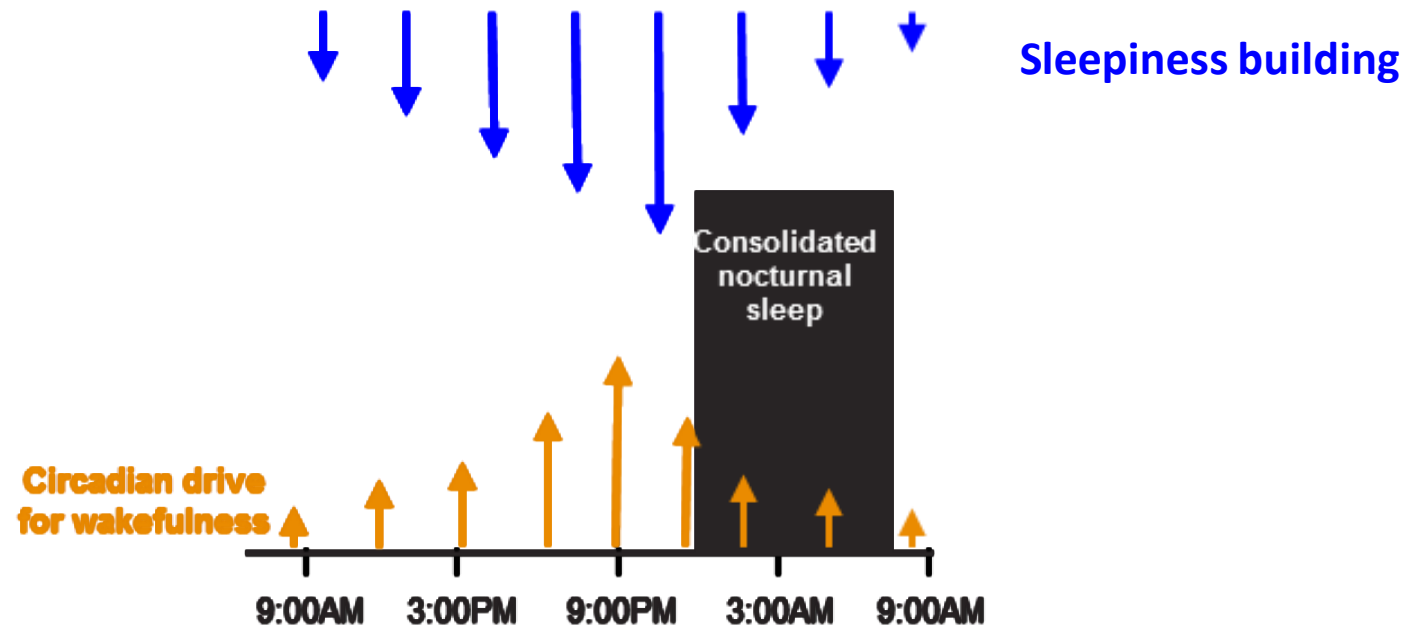
Sleep and Wakefulness

Sleep Pressure

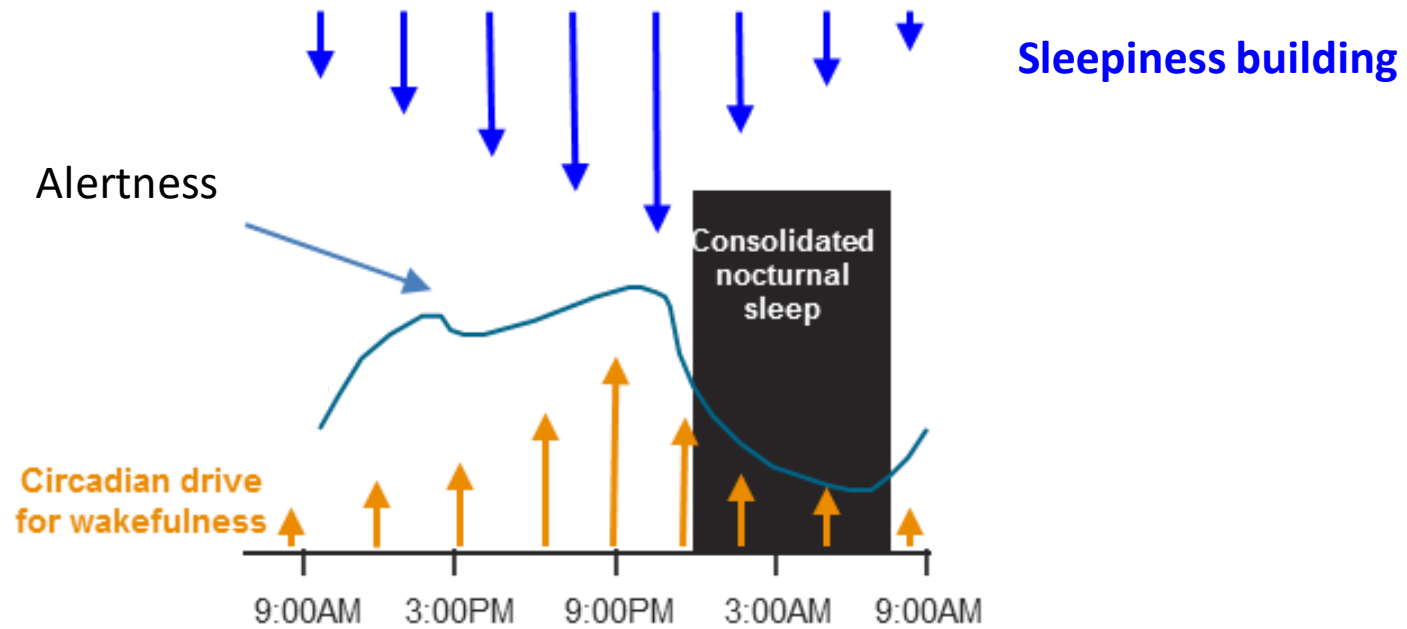


Sleep and Wakefulness

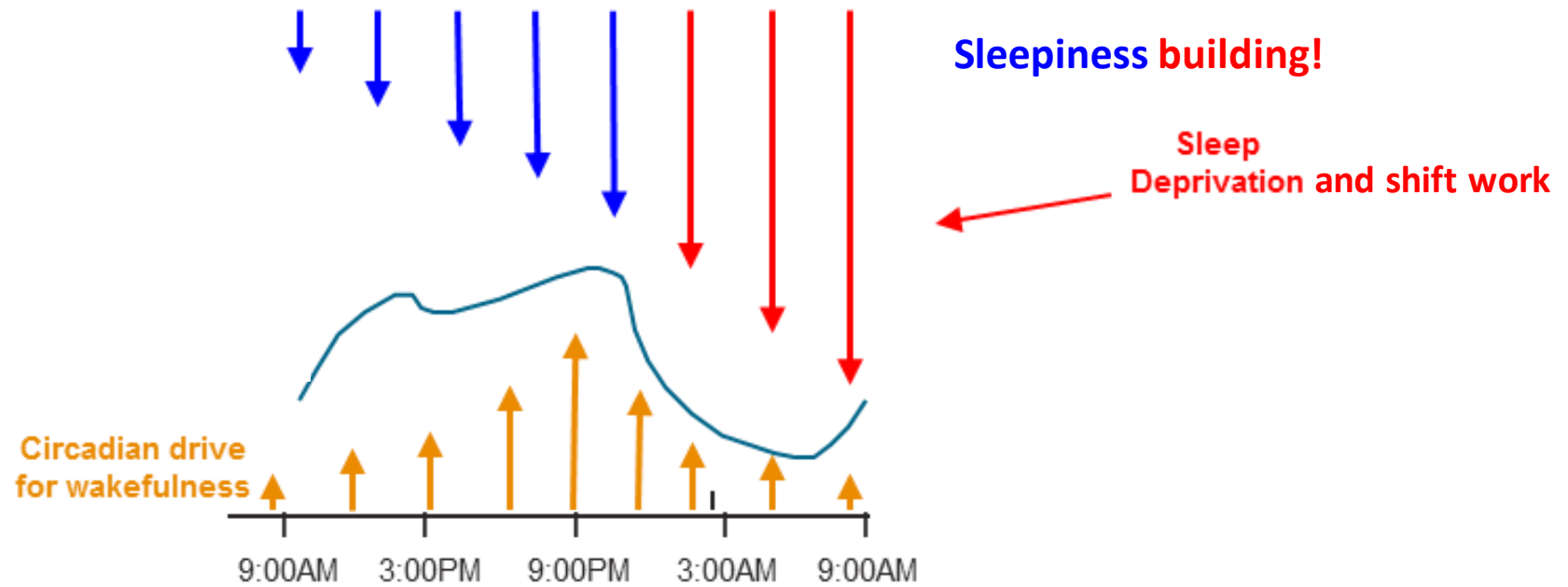
Circadian clock increases alertness



Sleep and Wakefulness



Sleep Loss



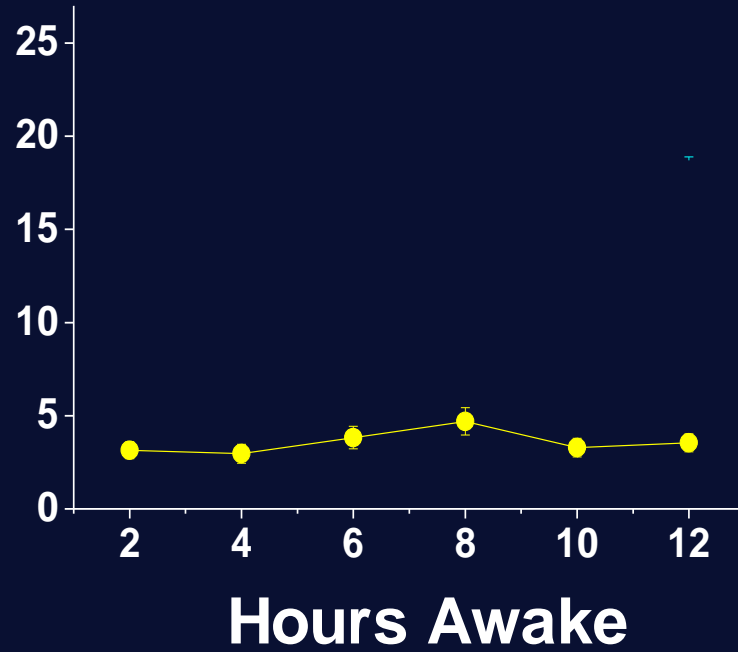
32-day in-Laboratory Study to Test Influence of Time of Day and Chronic Sleep Restriction (CSR) on Performance



250

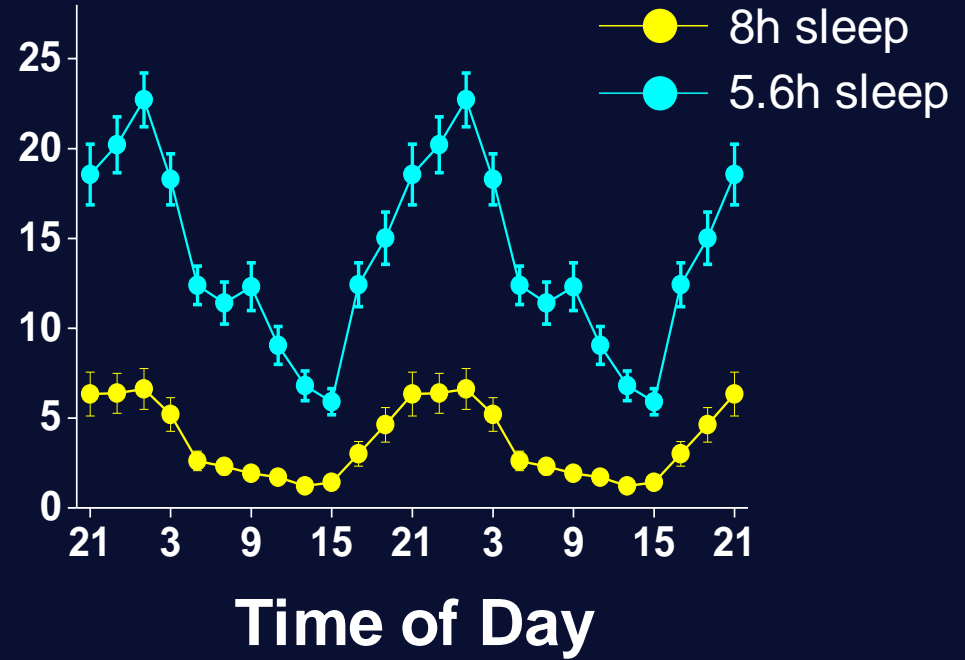
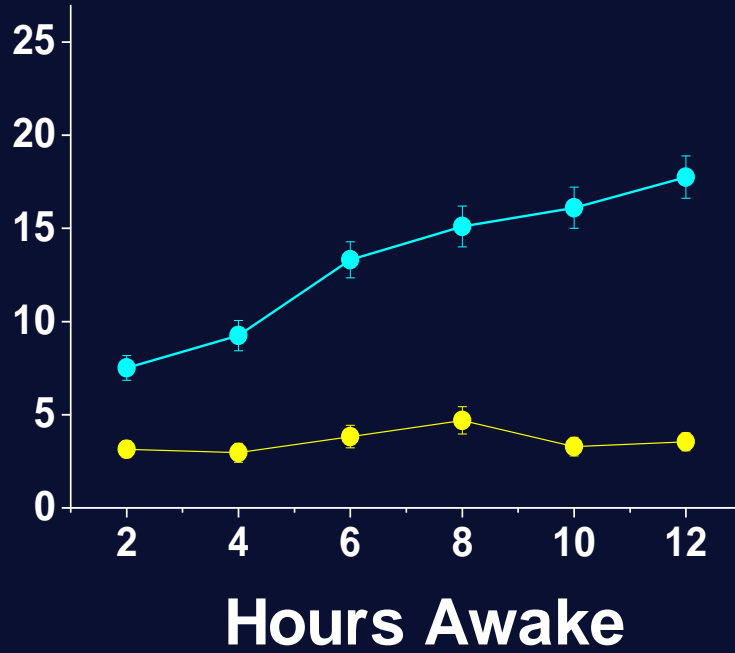
Shiftwork, sleep loss, and performance

Lapses of Attention



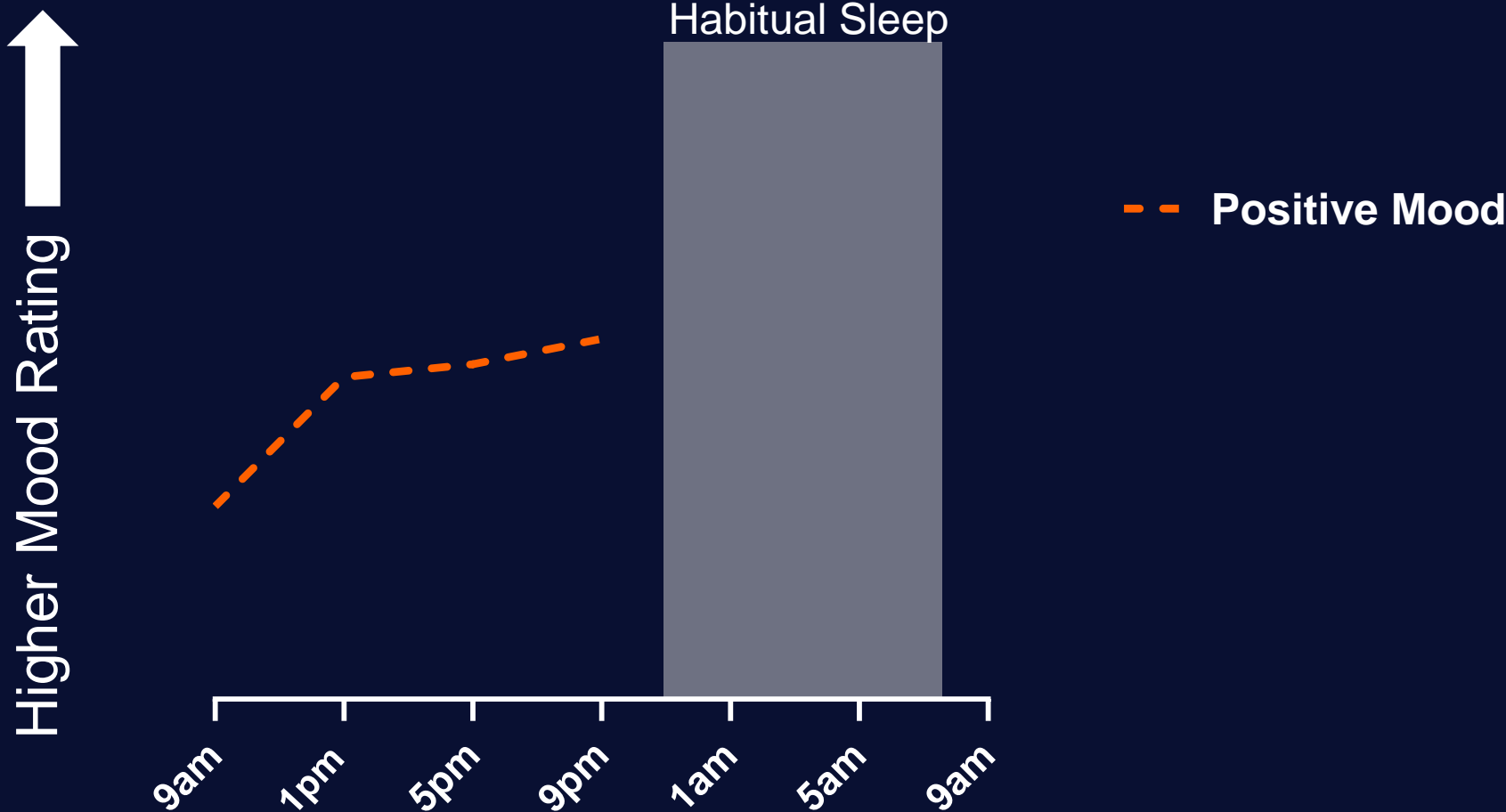
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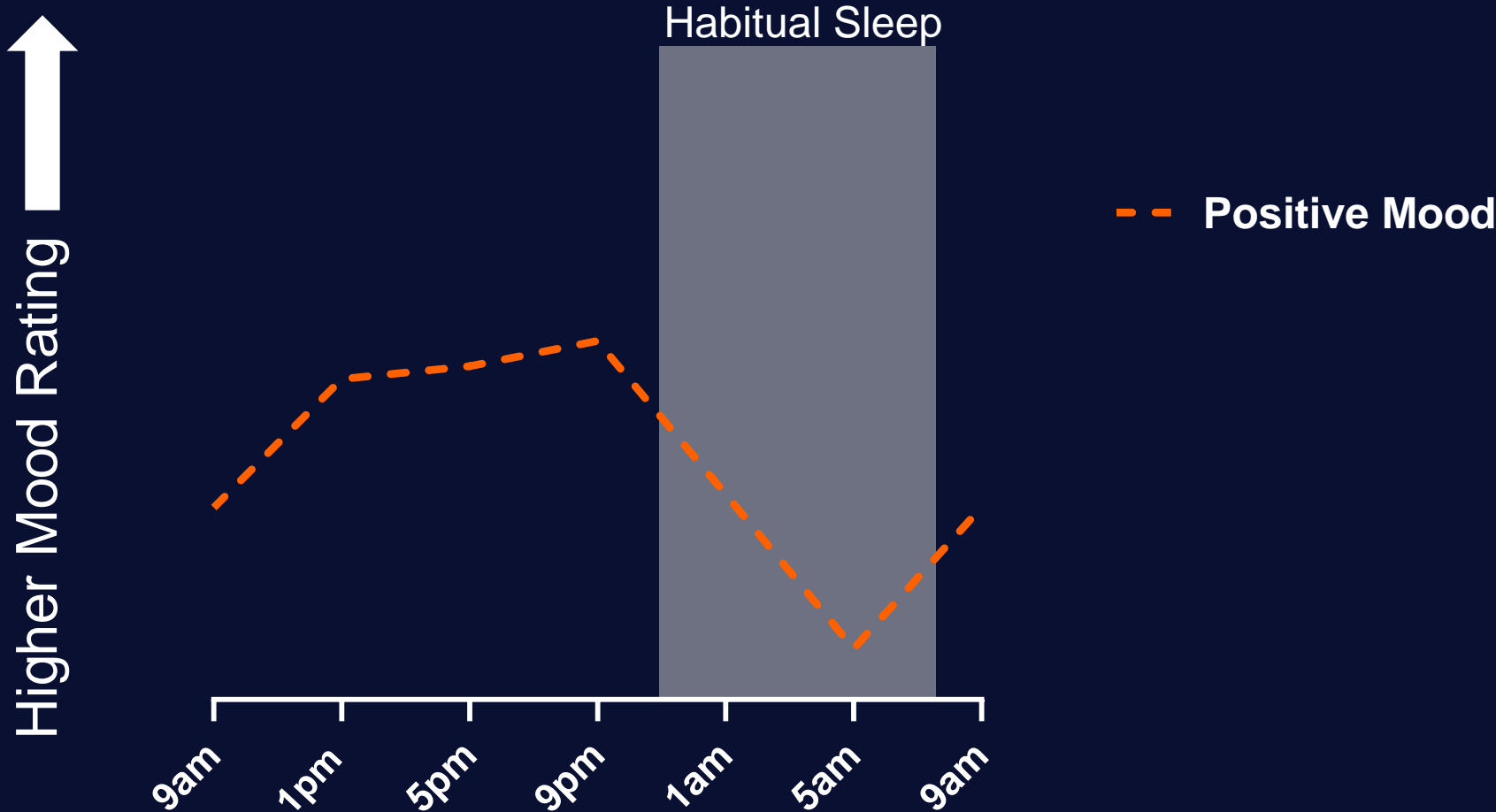


Subjective Alertness

What about mood?

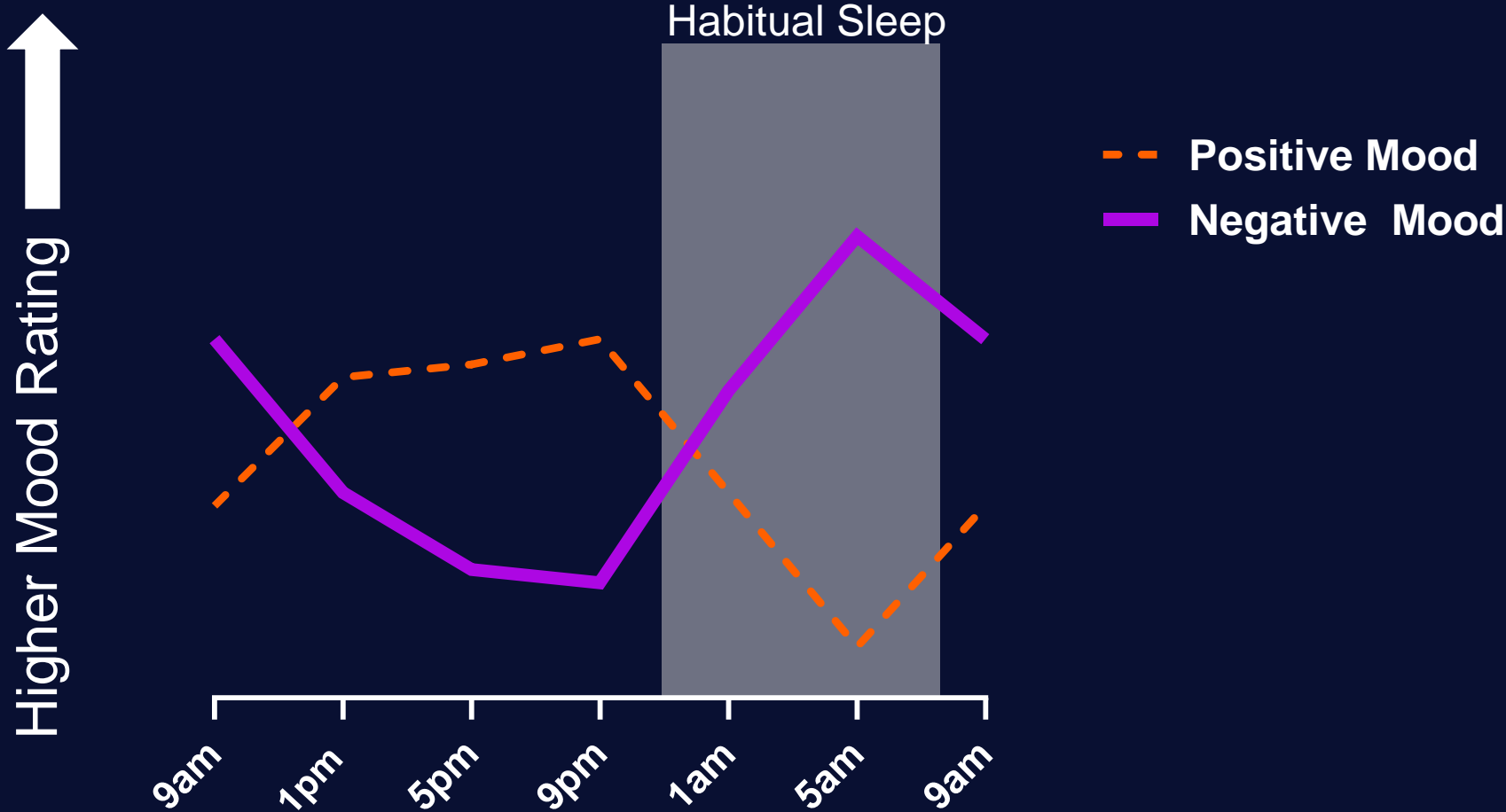


What about mood?

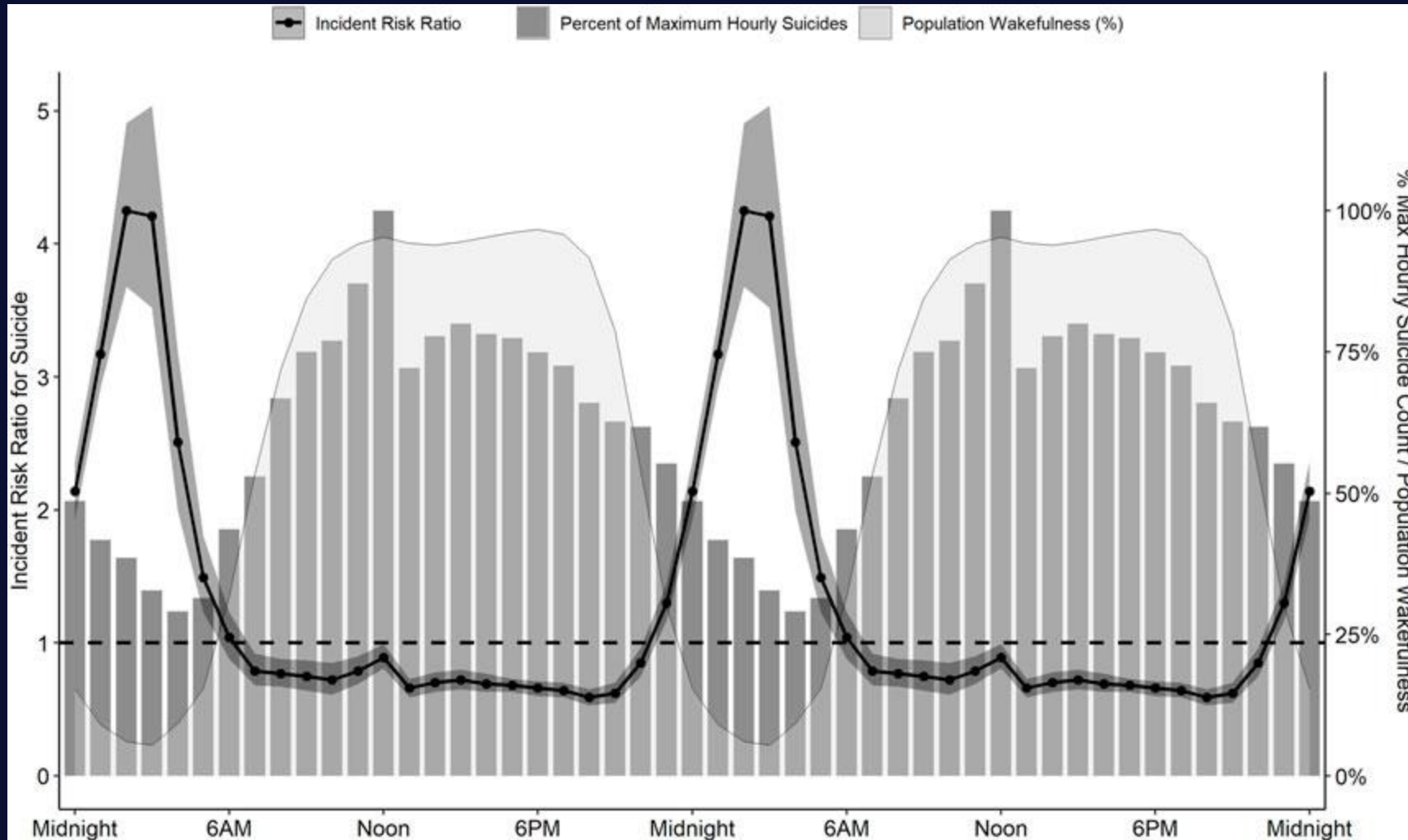


Modified from Emens et al., Psych Res 2020

What about mood?



What does higher negative mood mean in reality?



Summary: Part 1

- Shift work forces us to work against our internal biological clock.
- This misalignment not only disrupts sleep, but also causes impairments to our health.
- That is at the individual level, what about a person's work-family balance?



Shift Work Strain: Navigating Stress, Family, and Health

A Total Worker Health Approach[®]

Nicole P Bowles, PhD, Assistant Professor
Oregon Institute of Occupational Health Sciences
Oregon Health and Science University





Work-life balance









Work-life balance





Work family conflict

"...you go home and you're not well-rested and you're asked, "Where are we going to dinner tonight?" and it seems like such an insignificant question, [but] that's when a lot of people shut down and they just don't talk and what's important to your significant other you don't care about. Then that creates some tension which goes in a lot of different directions, like divorce."

-Representative quote from 24/48 firefighter

Watkins SL, Shannon MA, Hurtado DA, Shea SA, Bowles NP. *American journal of industrial medicine* (2021).





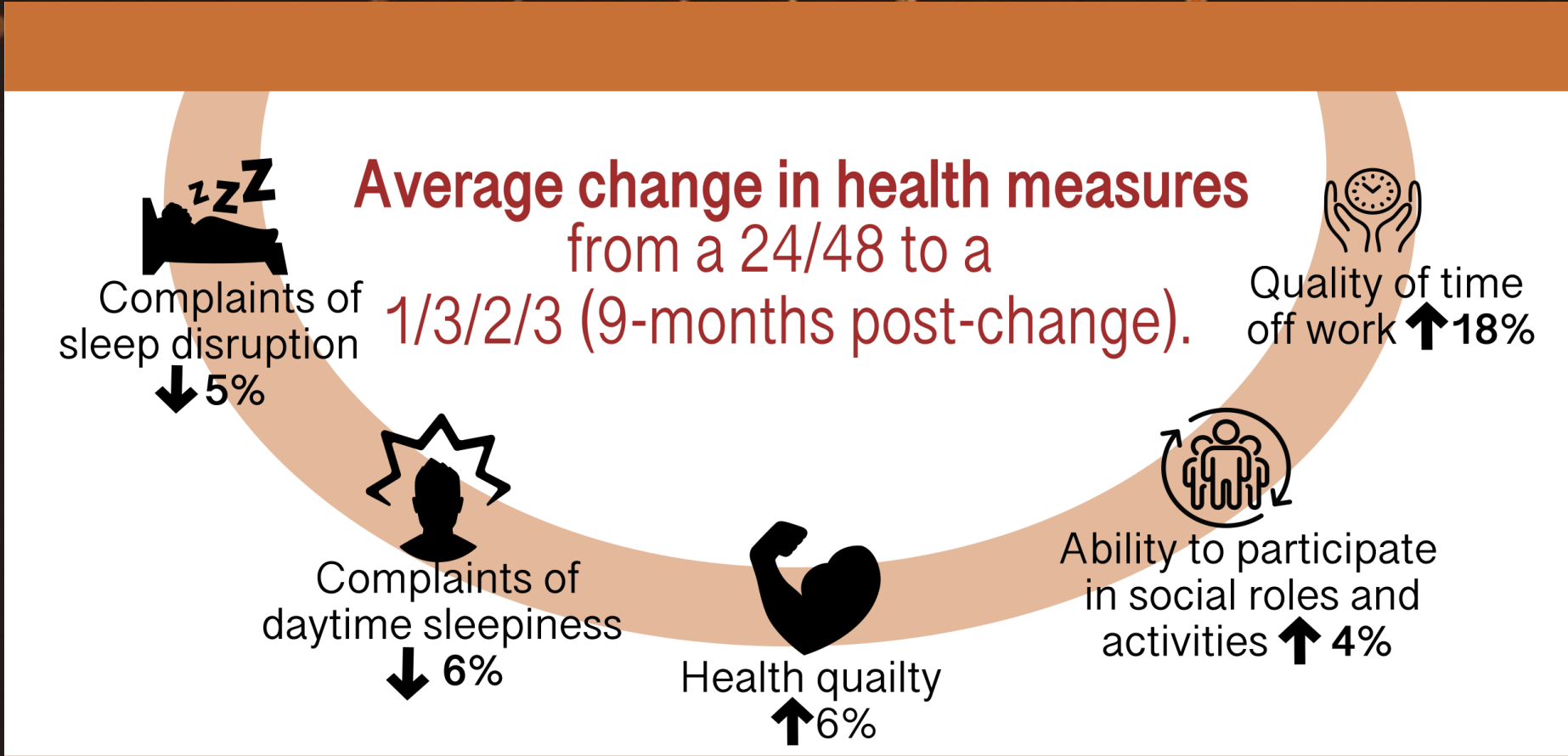
Work family conflict/recovery



“I’m definitely not as short with my kids. You get off shift and even if it was on the second day your kids would do something that were mildly irritating and you would just, at least I would just go off the deep end. And I am way, way better than I was 6 months ago [before the schedule change] and with that being said I am more involved with my kids than I was 6 months ago. Like right now I coach both of my kids’ basketball teams which is like every day 3-4 hours after school and I still feel great”.

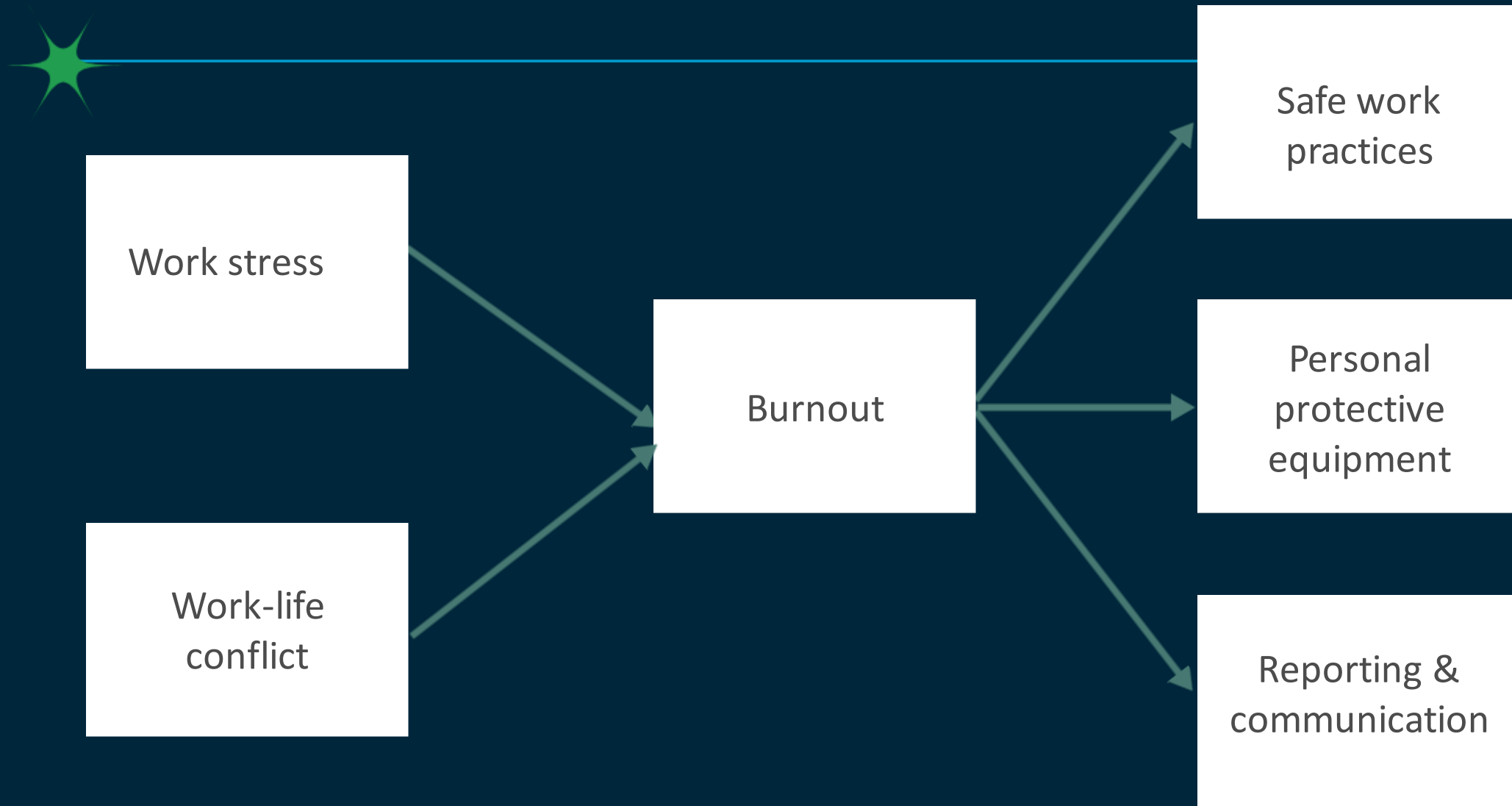
-Representative quote from 1/3/2/3 firefighter





Participant reported outcomes improved after schedule change.









Absence of community

Social
Isolation

"There is no respect in [this company], I don't see it at all. What makes you different than me when we both work for the same company that you can call me names and I can't do anything about it?... And [I'm] in public, in a cage, what can you say that doesn't further embarrass you?"

-Station Agent

Bowles NP, McEwen BS, and Boutin-Foster C. *American journal of industrial medicine* (2017).





Access to resources



“**[The union’s]** programs are for people based [by their headquarters] and **the time element** makes no sense because the average worker should be asleep or working [when the events are scheduled]. They **are not designed for the average worker**, programs are not for hourlies out in the field...The **union should consider that so people can attend**, you know where the workers are and the hours they work. It doesn’t really help us so you have to basically do it on your own if you are not too stressed out or recovering to do something.”

-Maintenance/construction

Bowles NP, McEwen BS, and Boutin-Foster C. *American journal of industrial medicine* (2017).







High demands



"In the schedule, the lunch break they give you is 35 or 40 minutes, but if you are put off schedule, and trains are always delayed, that time could be 20 minutes. Then you have to balance going to the bathroom or time to eat, and the bathroom time wins out."

-Train conductor

Bowles NP, McEwen BS, and Boutin-Foster C. *American journal of industrial medicine* (2017).





High demands



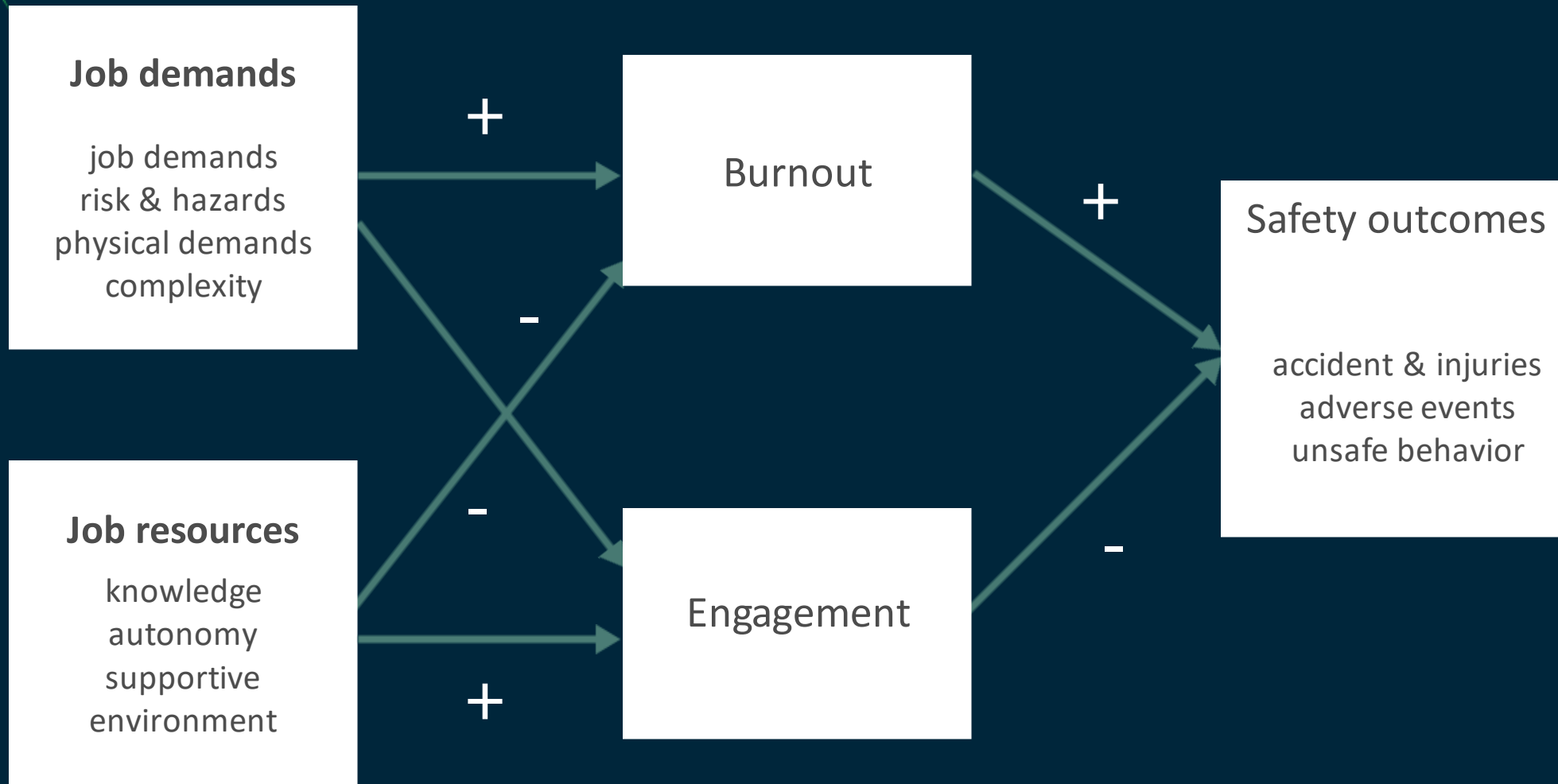
“You have some supervisors who look the other way because they understand, but you have some faction of supervisors who just love to make a bust.

Some **supervisors hide behind poles** just to see if you fall asleep. We have a lot of them where I work, the fact that you can't just nod off for a few seconds **without losing your job**; the **fear of getting severely disciplined** is incredible...They are so conscientious about how the public views us, but I think most people understand it's 1:30 in the morning and the brain is trained to sleep.”

-Station agent

Bowles NP, McEwen BS, and Boutin-Foster C. *American journal of industrial medicine* (2017).





What can we do about this?!?!?

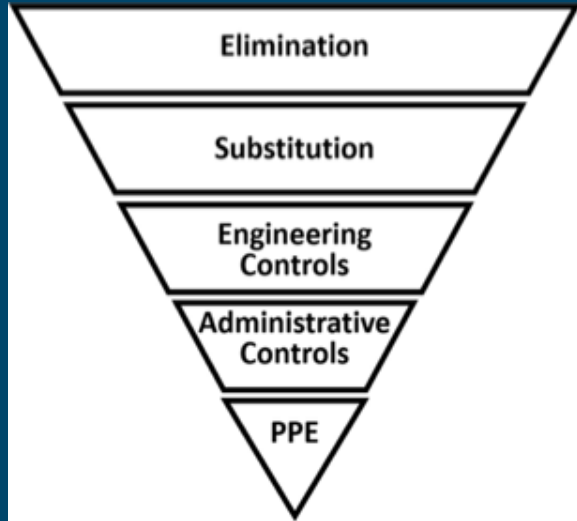


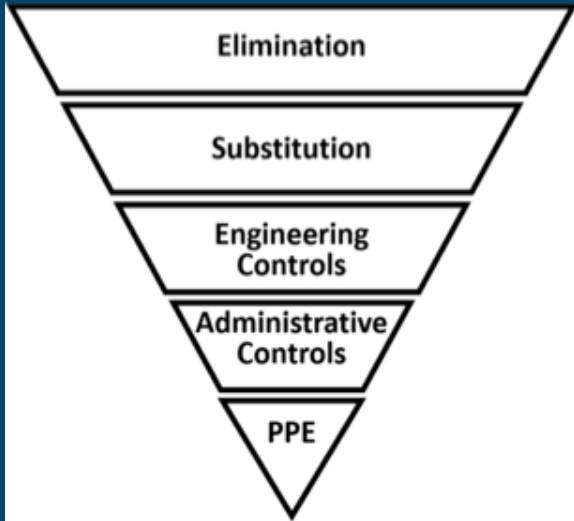


Shifting Towards Wellness: Solutions for Addressing Shift Work and Its Health Consequences

Nicole P Bowles, PhD, Assistant Professor
bowlesn@ohsu.edu







1 Elimination





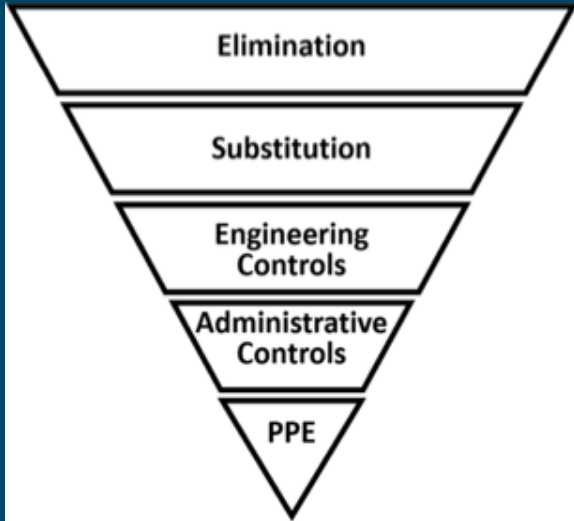
Elimination: Can we improve public messaging about planned construction?





Elimination: Can we get creative with our solutions?





1 Elimination

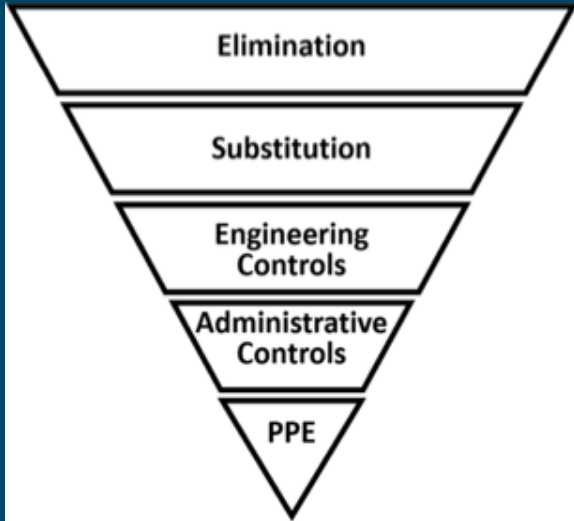
2 Engineering controls





Engineering controls: What is the best use of light at night?





1 Elimination

2 Engineering controls

3 Administrative controls





Administrative controls: Considerations for schedule start and time.





Sleep and alertness tips for shift workers at the individual level

Sleep Tips for shift workers

- Turn phone off during the daytime
- Blackout shades/ Heavy curtains or drapes/ construction paper on windows
- Quiet environment
 - Family education on sleep need
 - Kids/Pets
 - White noise/ Ear plugs / Rugs
- Cool environment
 - Air conditioner and/or Basement Bedroom
- Reduce family responsibilities
 - Child care, household chores
- Caffeine

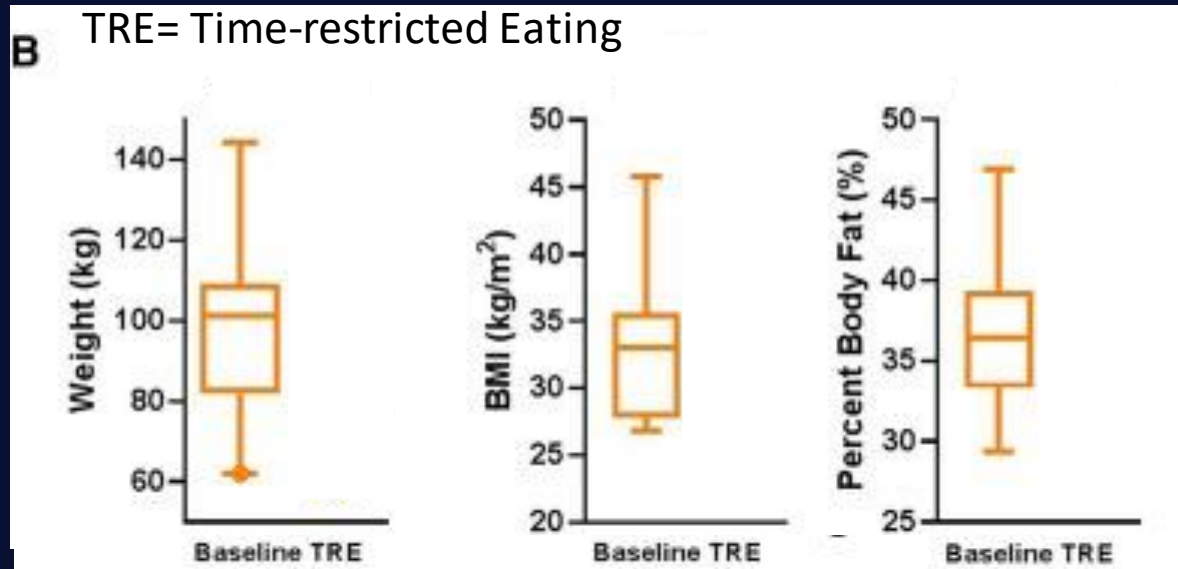
Anchor Sleep and Napping

- Goal adequate 24h sleep duration
- Major anchor sleep episode post-shift (~5-6 h) plus prophylactic nap in late afternoon (~2-2.5 h)¹
 - Can also try to delay sleep for a more consolidated sleep.
- Nap during night shift
 - Naps should be short to reduce risk of sleep Inertia
 - Pre-nap caffeine²

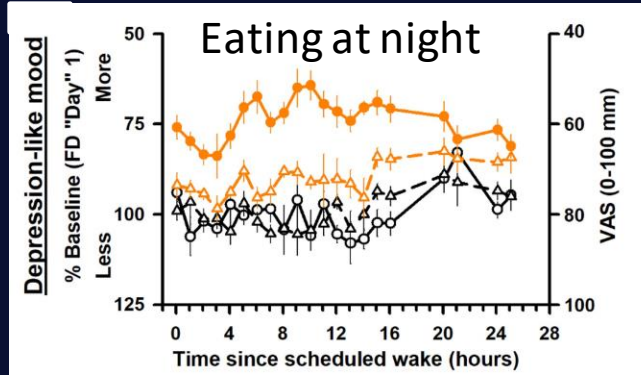
¹Schweitzer et al. 2006; ²Van Dongen et a; 2001

Restricting Calories to Earlier Improves Health and Mood

Overweight/Obese



Wilkinson et al., Cell Metab 2019



Qian et al., PNAS 2022

Schedule Design & Other Workplace Interventions

- Eliminate shifts > 10-12 hours
- Napping policy
- Limit the number of consecutive night shifts
 - The fewer, the better
 - >4 x12-hour night shifts associated with greatly increased risk of performance lapses¹
- Schedule rotating workers to rotate “clockwise”
- Screen workers - sleep apnea & other sleep disorders
- Educate workers
 - Risks of drowsy driving and working while sleep deprived
 - Most vulnerable circadian phases
 - Undiagnosed sleep disorders
 - Sleep hygiene
 - Physical activity

¹Folkard & Tucker (2003) *Occup Med.*

OTC stimulants

- Caffeine
 - Prophylactic Dosing¹
 - 100-200 mg prior to night shift
 - 100-200 mg during the night shift
 - Can exacerbate gastrointestinal problems
- Energy Drinks
 - No improvements in performance following energy drink at both 01:30 h and 05:30 h, but disrupted subsequent daytime sleep ²
- Nicotine
 - Negative health implications
 - Not advisable

¹ Wright et al. 1997; ² Jay et al. 2006



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Thank you! bowlesn@ohsu.edu, mchill@ohsu.edu

