Examination of the impact of firefighters' work schedule on sleep regularity and performance

Data from the Portland Firefighter Study

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(Presented at the Northwest Occupational Health Conference in Olympia, WA. Oct, 2023.)

Background

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Images from Portland fire and rescue

Why are fire departments making these transitions?

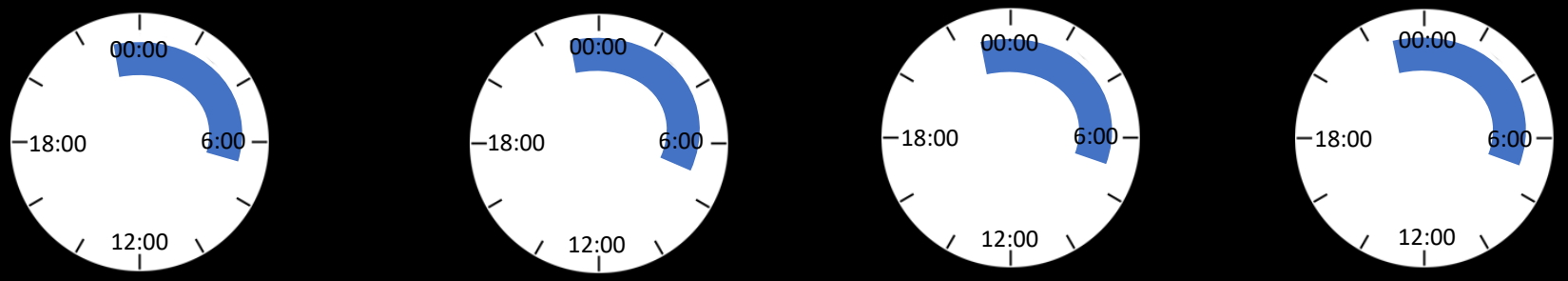
- Based on our needs assessment and focus groups:
  - Be fully present while at home with family
  - More consecutive nights of sleep in their own bed
  - Full engagement with various aspects of recovery

- More opportunities for controlling bed times

  Sleep regularity

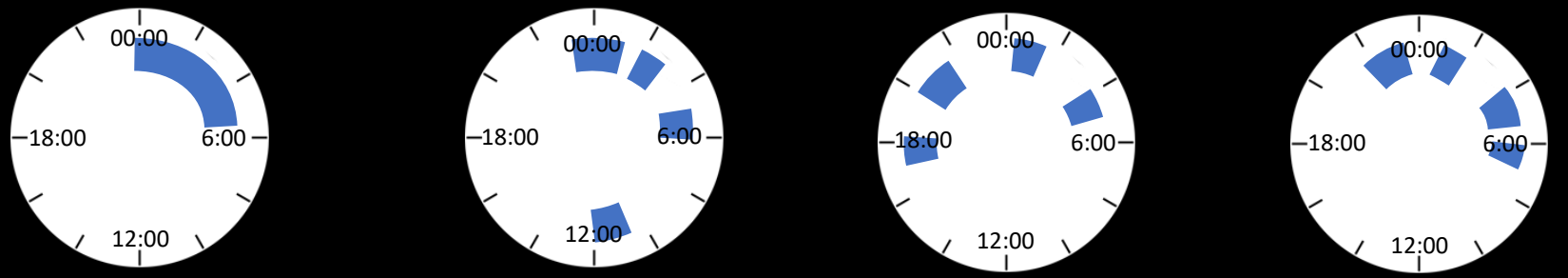
Sleep regularity

Regular sleep-wake pattern



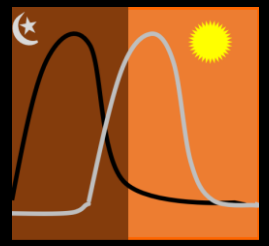
Day 1 Day 2 Day 3 Day 4

Random sleep-wake pattern



SRI 0 (random) ⟷ 100 (regular)

Sleep regularity



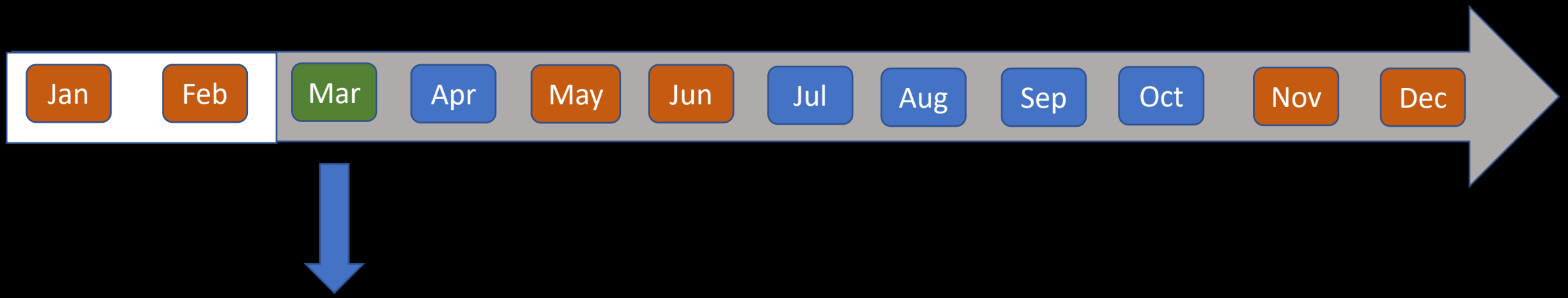
24/48 = 1 day on shift, 2 days off

1/3/2/3 = 1 day on shift, 3 days off, 2 days on, 3 days off

Wave 1 (Baseline)

Wave 2 (1st follow-up)

Wave 3 (2nd follow-up)



Schedule change

Project Aims

Aim 1:

a) Characterize PF&R SRIs on the 24/48 and after working on the 1/3/2/3 schedule for ~2 and ~9 months

b) Determine how a stations call volume impacts SRI

Aim 2:

Determine how SRI impacts alertness/vigilance

Methods

Aims 1a and b

- 14-day continuous actigraphy data
- 14-day daily sleep diary
- Then estimated SRI from sleep diary-validated sleep-wake summaries

REDCap®

Aim 2

- 14-day twice-daily three-minute simple psychomotor vigilance task (PVT)
- Determined median reaction time and lapses from each three-minute PVT trial (upon wake and before sleep)

Analyses

Aims 1a and b

- An additional three-category call volume variable created
  - Low (≤1770 calls/year)
  - Medium (~2360 calls/year)
  - High (≥3700 calls/year)
- Fit a mixed model to assess relationship b/w SRI and call volume

Aim 2

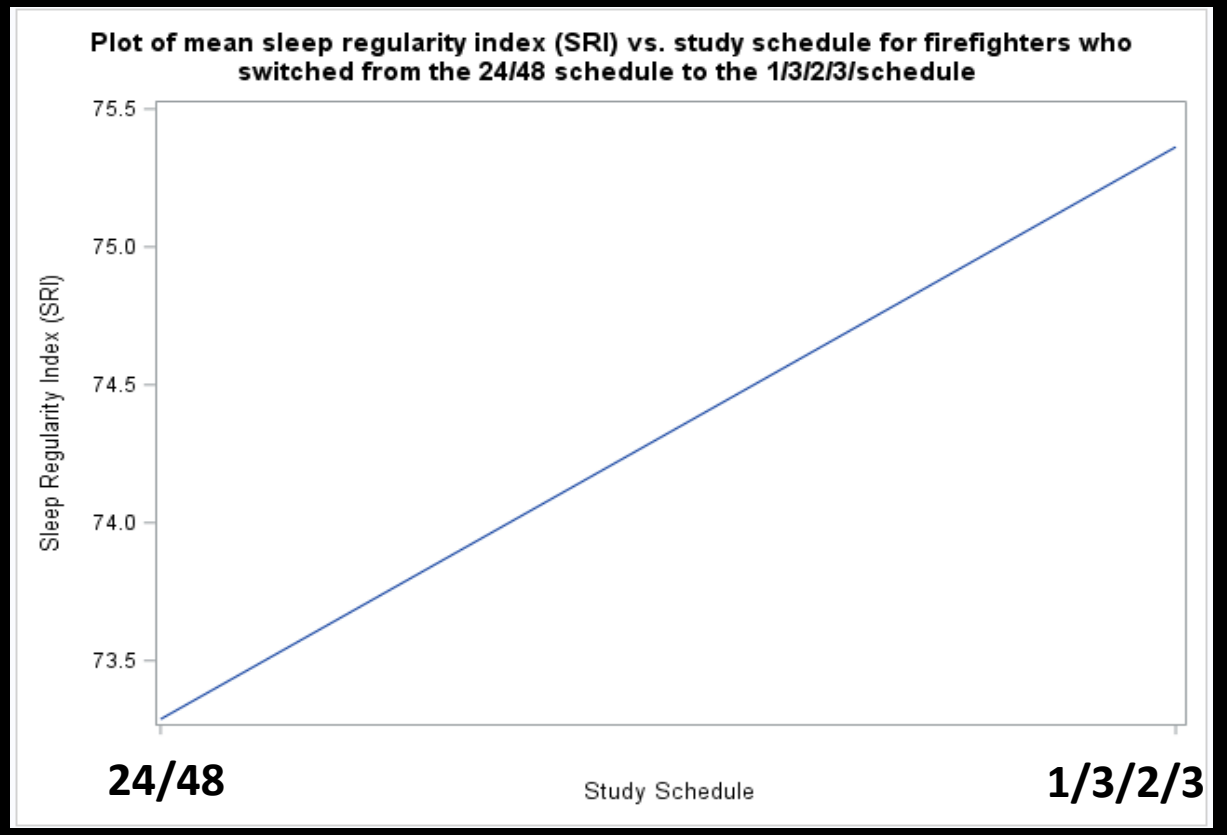
- Fit separate mixed models for both PVT outcomes (median reaction time and lapses)

Results – Participant Characteristics

- N at baseline = 115 (92% male)
- Age
  - 25% 25-34
  - 46% 35-44
  - 27% 45-54
  - 2% ≥ 55
- Call volume
  - 3% Low (≤1770 calls/year)
  - 30% Medium (~2360 calls/year)
  - 61% High (≥3700 calls/year)
  - 6% Other (Travelers, KR)
- Race
  - 84% White
  - 1% African-American
  - 3% Latino/Hispanic
  - 2% Asian
  - 2% Native Hawaiian or Pacific Islander
  - 7% Two or more races
  - 1% Other
  - 1% Unknown

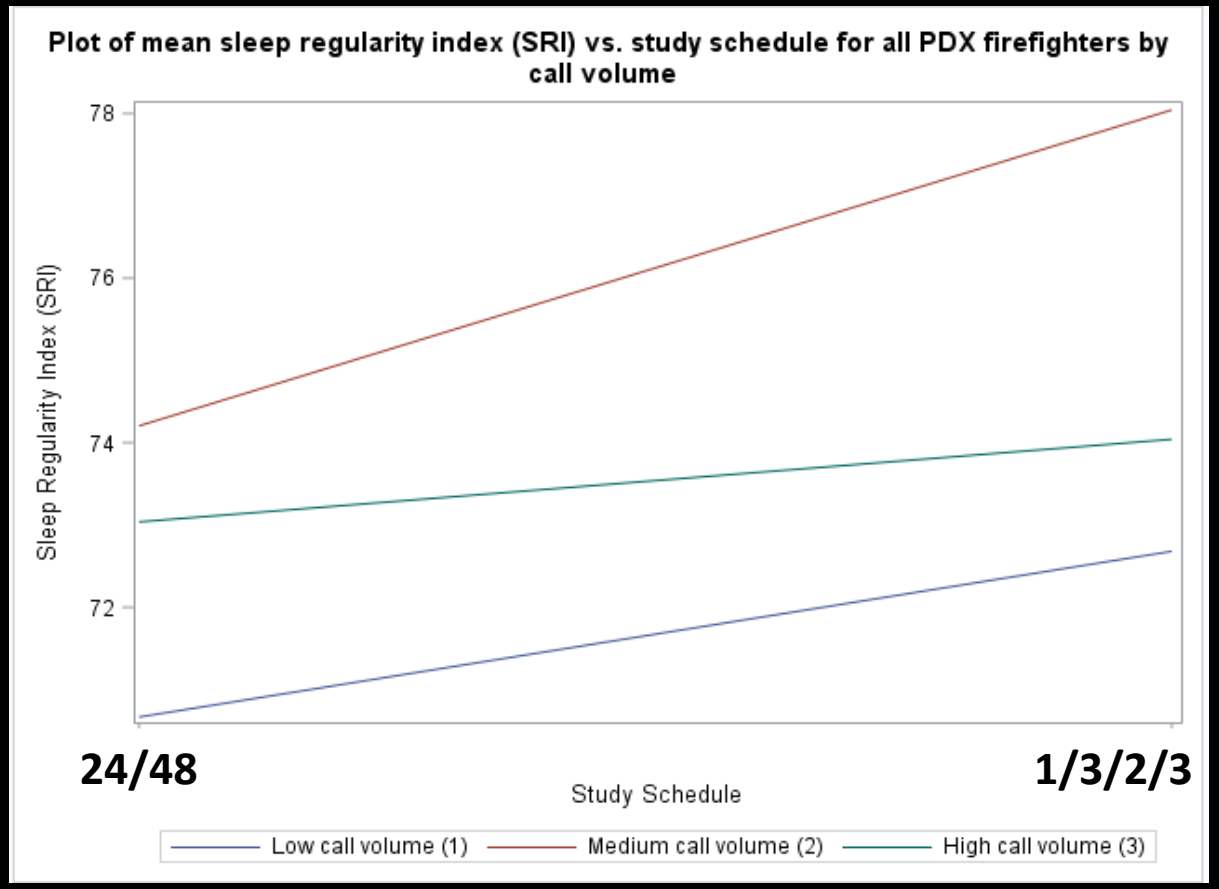
Results – Aim 1

- SRI increased by 2.73 ±1.91 on the 1/3/2/3 schedule compared to the 24/48 schedule (*p*=0.1579).



Results – Aim 1

- Even after separating into call volume categories, mean SRI was better on the 1/3/2/3



Results –Aim 2

- Median reaction times shortened by 0.29 ±0.28 for every unit increase in SRI (*p*=0.3002)
- PVT lapses also reduced by 0.05 ±0.04 for every unit increase in SRI (*p*=0.1591)

Discussion

- Overall sleep regularity increased following schedule change however:
  - Increase not clinically meaningful
  - Firefighters who work in high call volume stations showed no change, potentially suggestive of a ceiling effect
- Similarly, higher sleep regularity was associated with shorter reaction times and reduced number of lapses:
  - Change was clinically meaningful for median reaction time, effect size

Next steps

- Cluster analyses
- Increase sample size, increase power

Acknowledgements

- PI and mentor
  - Nicole Bowles, PhD
- Co-Investigators
  - Andrew McHill, PhD
  - David Hurtado, ScD
  - Steven Shea, PhD
  - Todd Bodner, PhD
- Research Coordinators and Support
  - LaTroy Robinson, BA
  - Omar Johnson Ordaz, BS
  - Ayeisha Haswarey
  - Jon Emens, MD
  - Joshua Gonzalez, PhD
  - Joey Hebl, BA
- Past Support
  - Kaylyn Fukuji, BA
  - Shelby Watkins, MPH, CPH
  - Walaa Abdelmoaty, MD

NIOSH grant
U19OH010154

The Oregon Institute of Occupational Health Sciences at Oregon Health & Science University via funds from the Division of Consumer and Business Services of the State of Oregon (ORS 656.630).

Research reported in this presentation was supported by the National Institute for Occupational Safety and Health (NIOSH) under Federal Training Grant T42OH008433. The content is solely the responsibility of the author and does not necessarily represent the official views of NIOSH.