UNIVERSITY OF SOUTH CAROLINA
Arnold School of Public Health

TecHealth
Technology Center to Promote Healthy Lifestyles

The mean level, between-person differences, and within-person variability of older adults' daily sleep duration and quality

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Presenting at the 2023 SBM Annual Meeting, April 28 (Phoenix, AZ)

Background

- Sleep quality is critical for sustaining older adults' brain health
- Sleep duration is a one of the critical determinants of sleep quality, but mixed results exist in the literature.
  - *the longer duration the better?*
  - *optimal sleep duration with individual differences*
  - *focuses on overall (between-person) associations*

- Sleep duration varies within-person night to night
  - *these variations may be meaningful in determining sleep quality*
- Using daily diary method to record sleep duration and quality:
  - *Study not just mean levels, but also the between- and within-person associations between sleep duration and sleep quality*

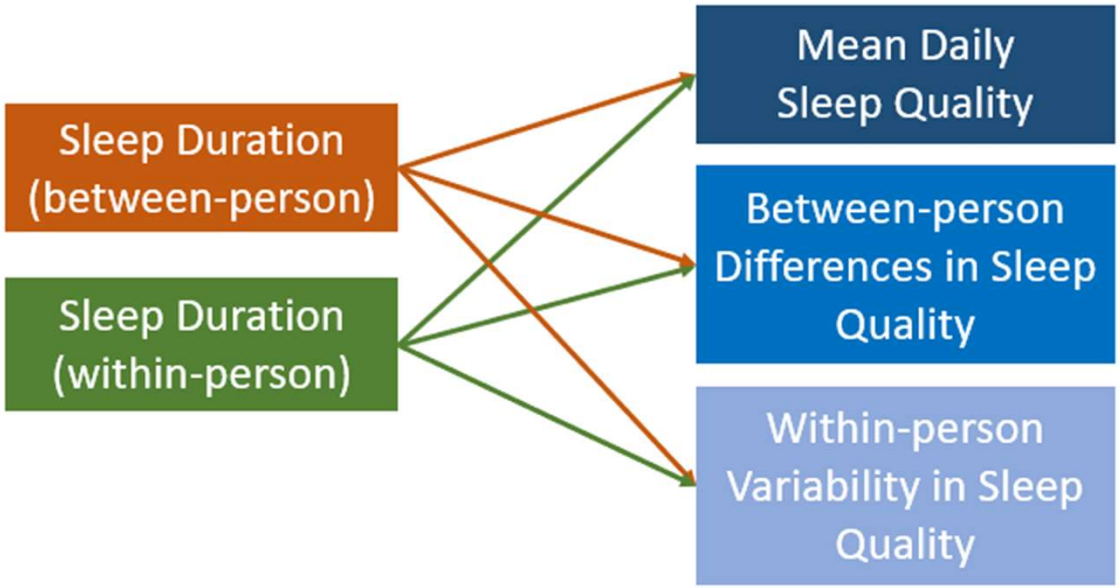
(Arora et al. 2022;Yaffe et al., 2014;Mesas et al., 2011)

Image credit: Getty Images/iStockphoto

Research question

- Applied a novel statistical method to smartphone-based daily diary data

To what extent the daily sleep duration between- and within-older adults ↔ Mean levels, the between-person differences, and the within-person variations of sleep quality?



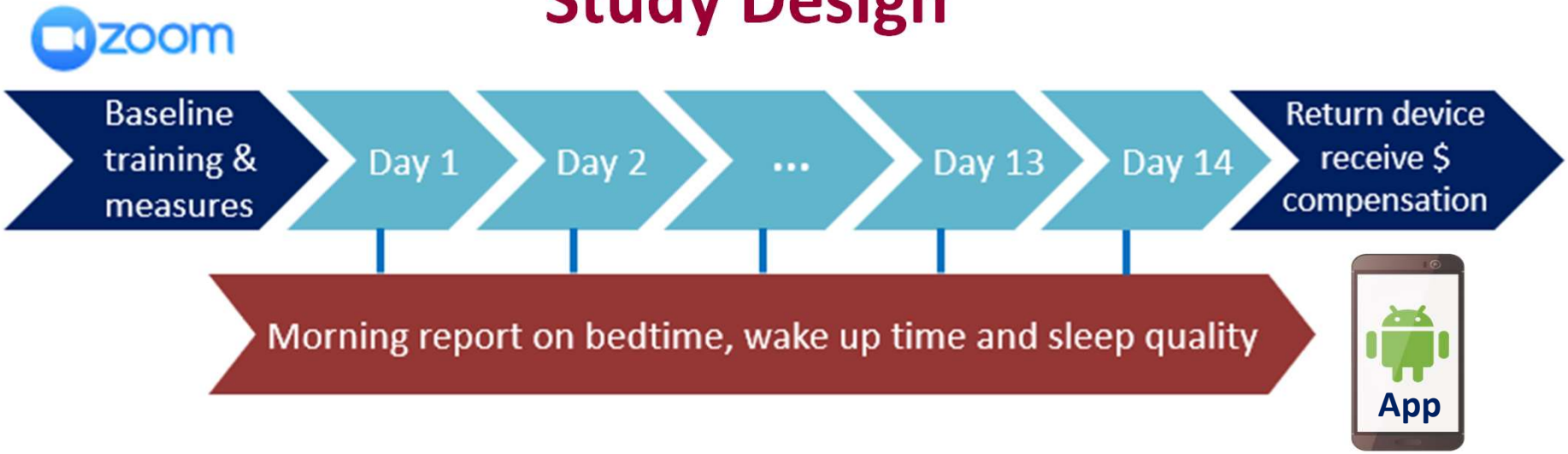
Participants

- Sample= 84 older adults living in Columbia, South Carolina
  - Mean age: 68.48 yrs (*SD*= 7.12)
  - 38% male, 28% non-White
  - Can walk independently

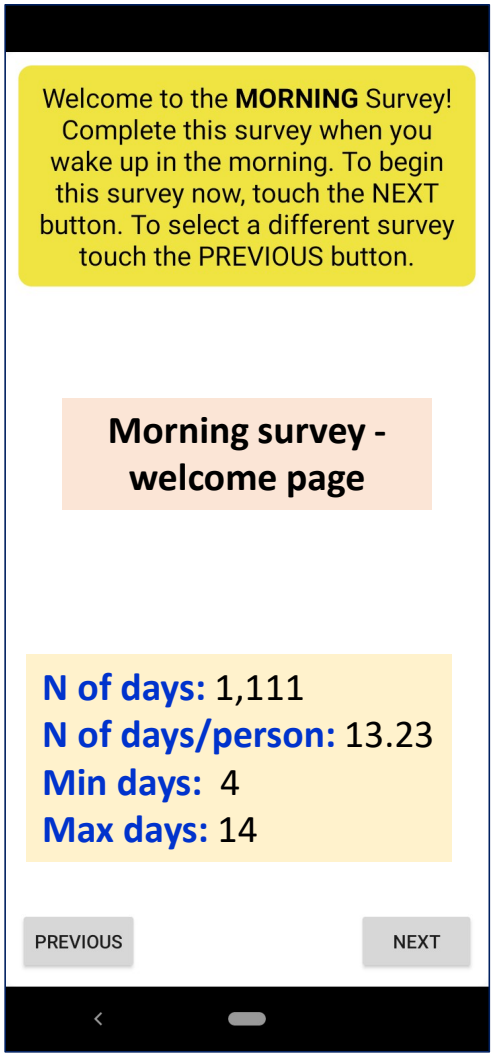
- Had at least one neuropsychological disease risk factor:
  - Family history of Alzheimer's disease and related dementias
  - Subjective cognitive decline
  - Overweight or obese at enrollment (BMI >25)
- Data collection started: January 2021
  - After the COVID-19 pandemic

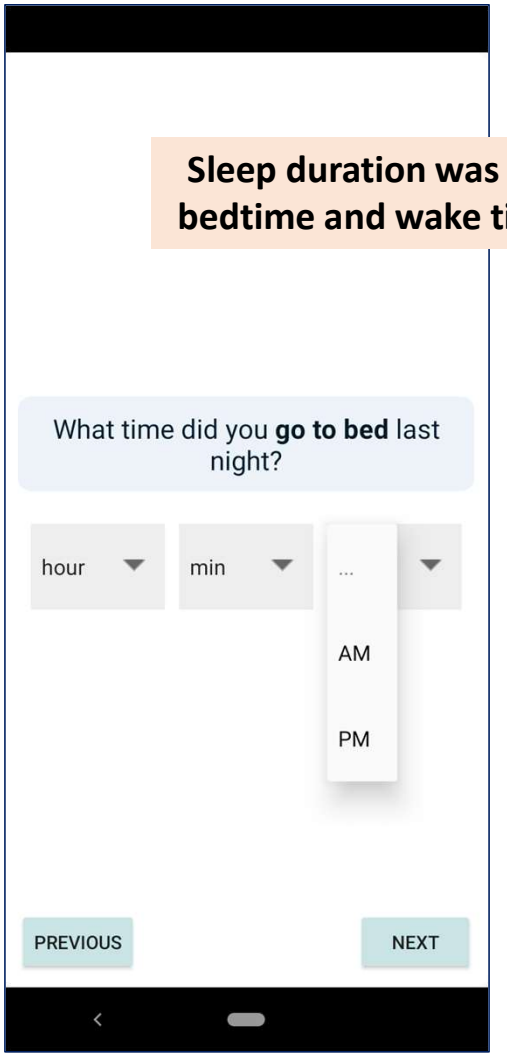
Image credit: Getty Images/iStockphoto

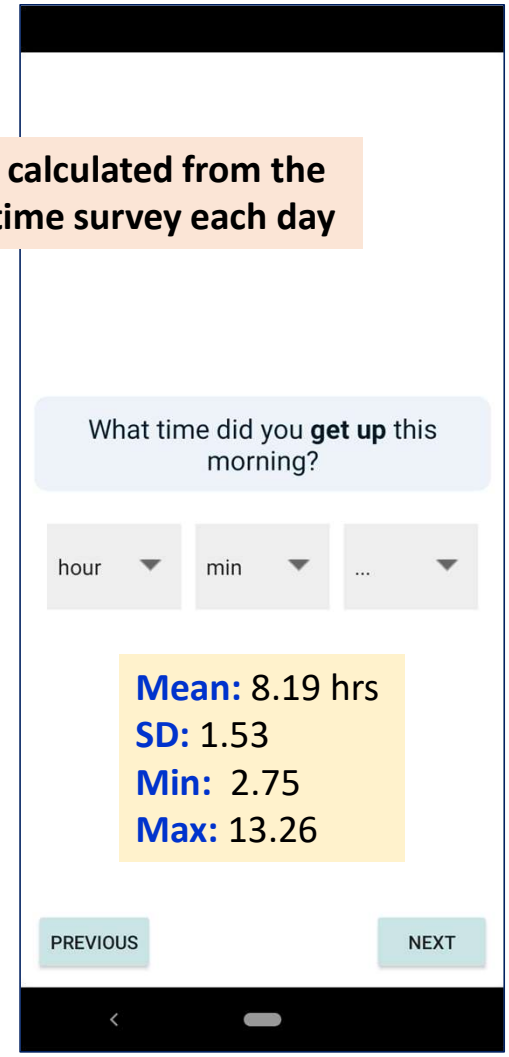
Study Design

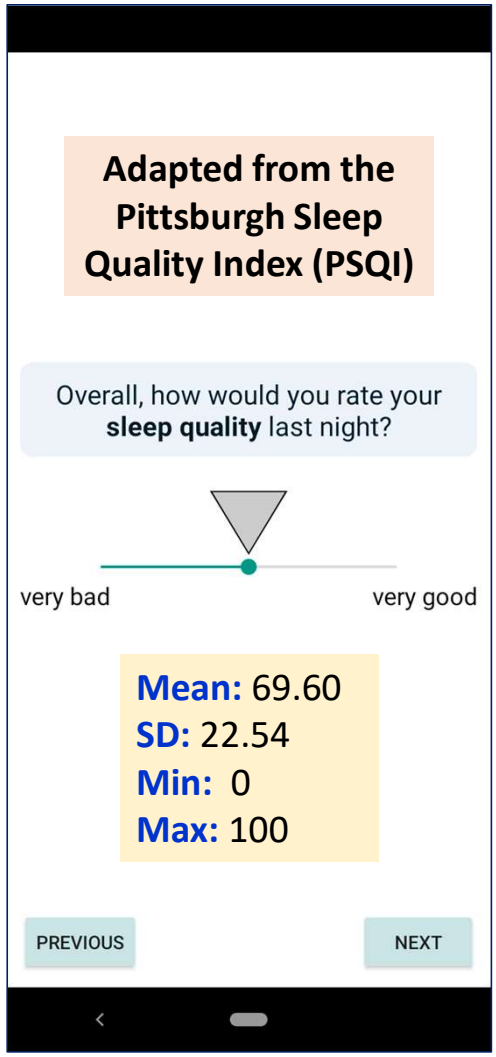


- **Study duration:** 14 days (between Jan 2021 and Nov 2021)
- **Daily morning survey:**
  - reported bedtime last night and wake up time (hours, mins, am/pm) each morning
  - rated perceived sleep quality using a 0-100 sliding scale


Welcome to the **MORNING** Survey! Complete this survey when you wake up in the morning. To begin this survey now, touch the NEXT button. To select a different survey touch the PREVIOUS button.
Morning survey - welcome page
N of days: 1,111
N of days/person: 13.23
Min days: 4
Max days: 14
PREVIOUS
NEXT

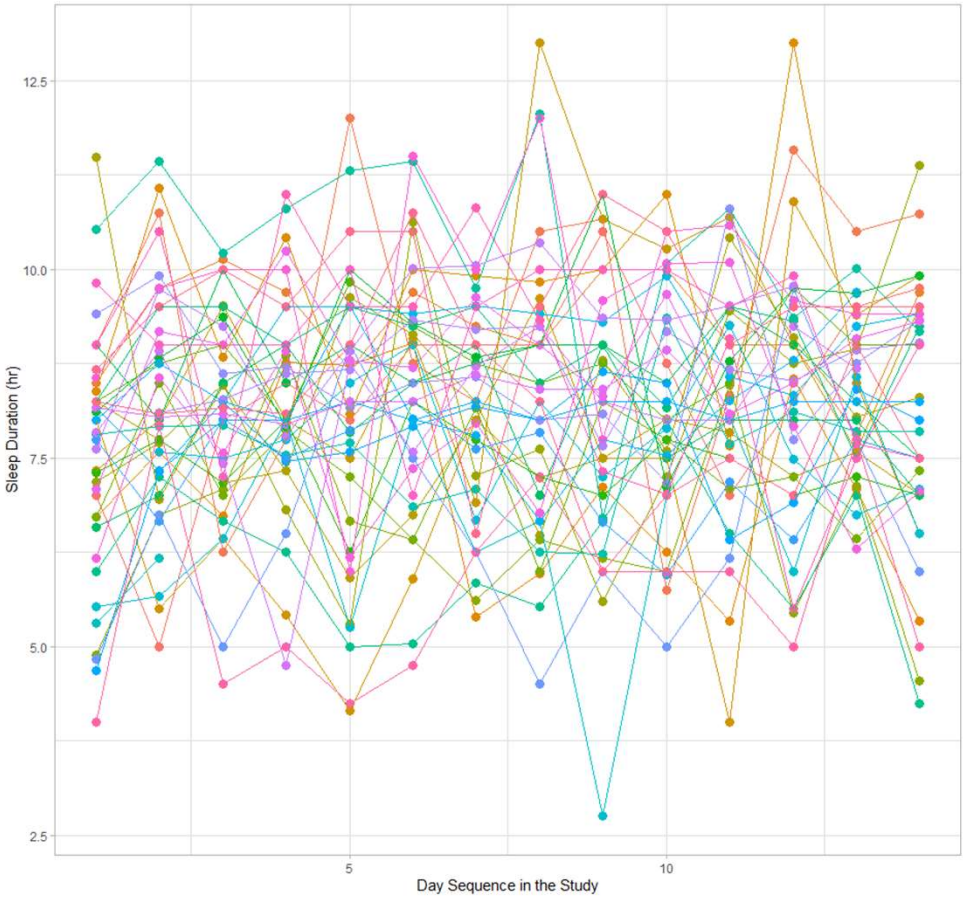

Sleep duration was calculated from the bedtime and wake time survey each day
What time did you **go to bed** last night?
hour
min
...
AM
PM
PREVIOUS
NEXT


What time did you **get up** this morning?
hour
min
...
Mean: 8.19 hrs
SD: 1.53
Min: 2.75
Max: 13.26
PREVIOUS
NEXT

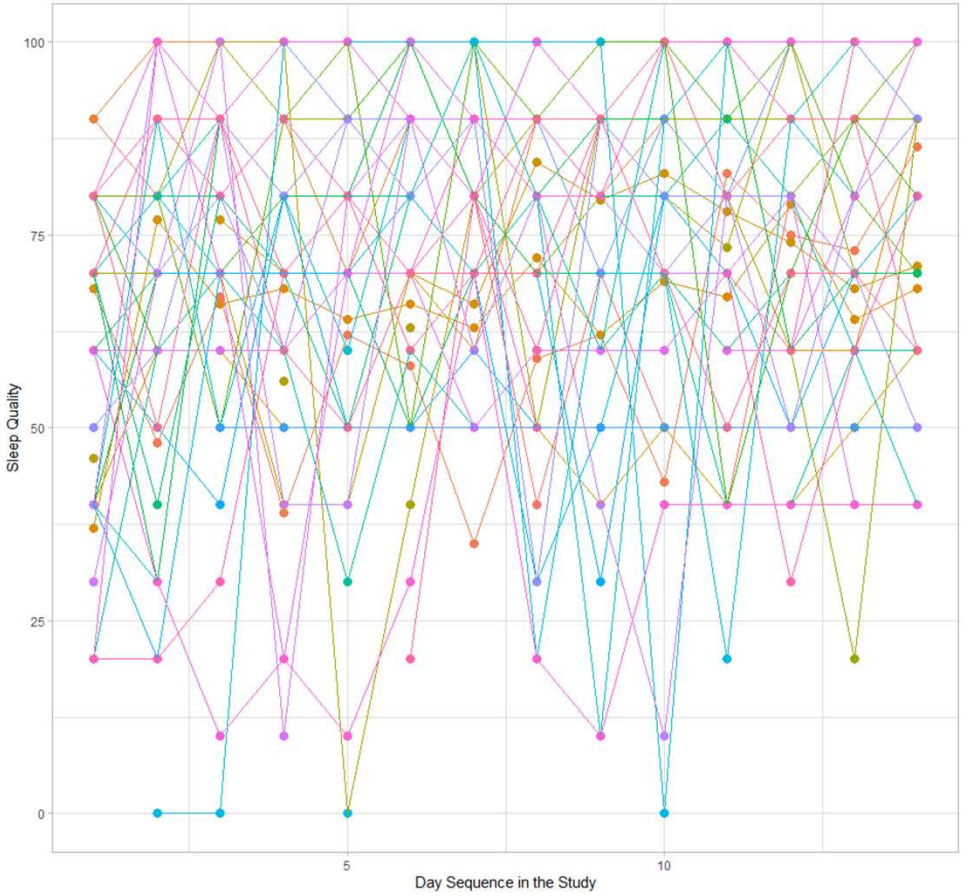

Adapted from the Pittsburgh Sleep Quality Index (PSQI)
Overall, how would you rate your **sleep quality** last night?
very bad
very good
Mean: 69.60
SD: 22.54
Min: 0
Max: 100
PREVIOUS
NEXT

Substantial variability within participants and from day-to-day

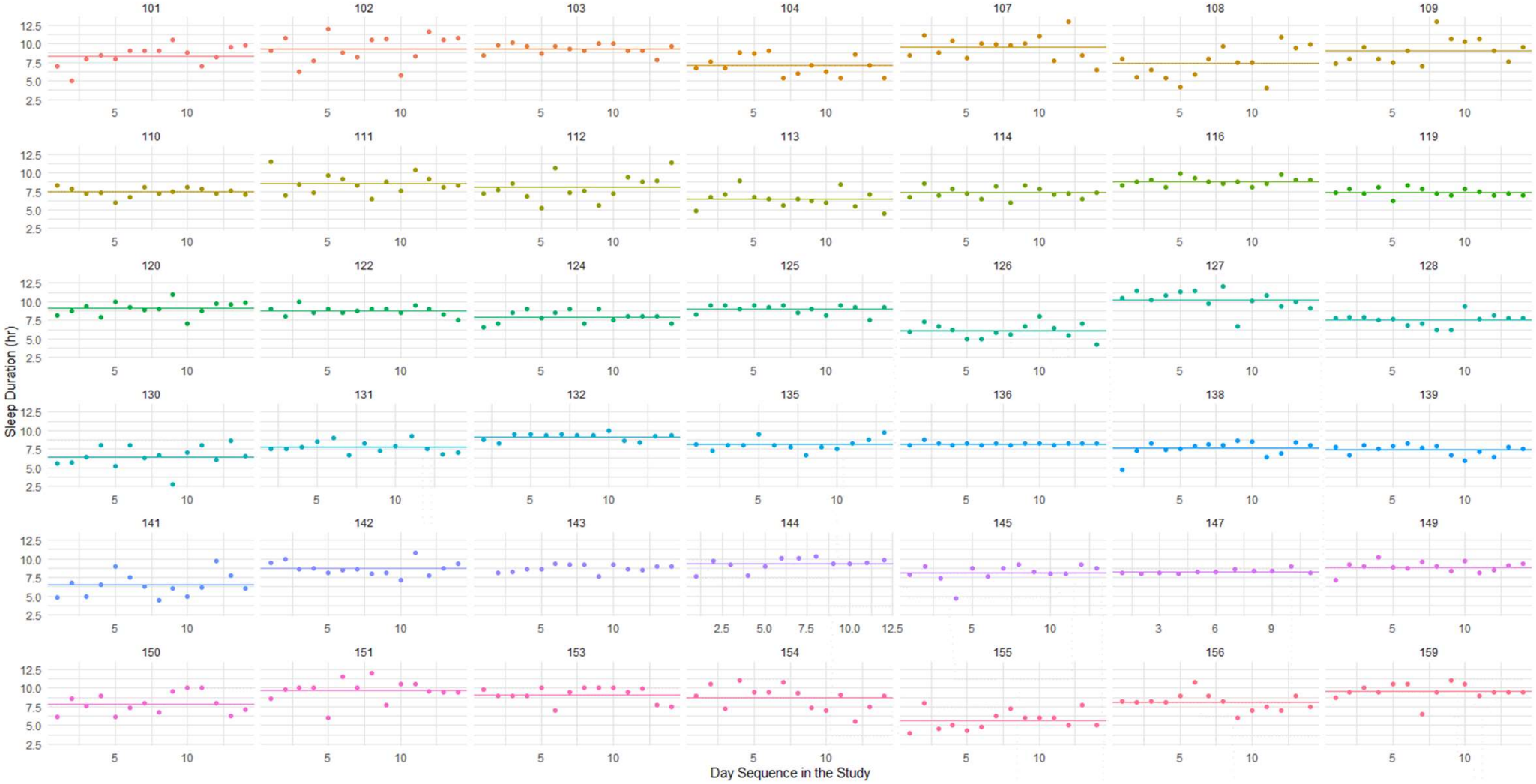
Sleep duration (hrs) across 14 days



Sleep quality across 14 days



Predictors: the between and within-person levels of sleep duration

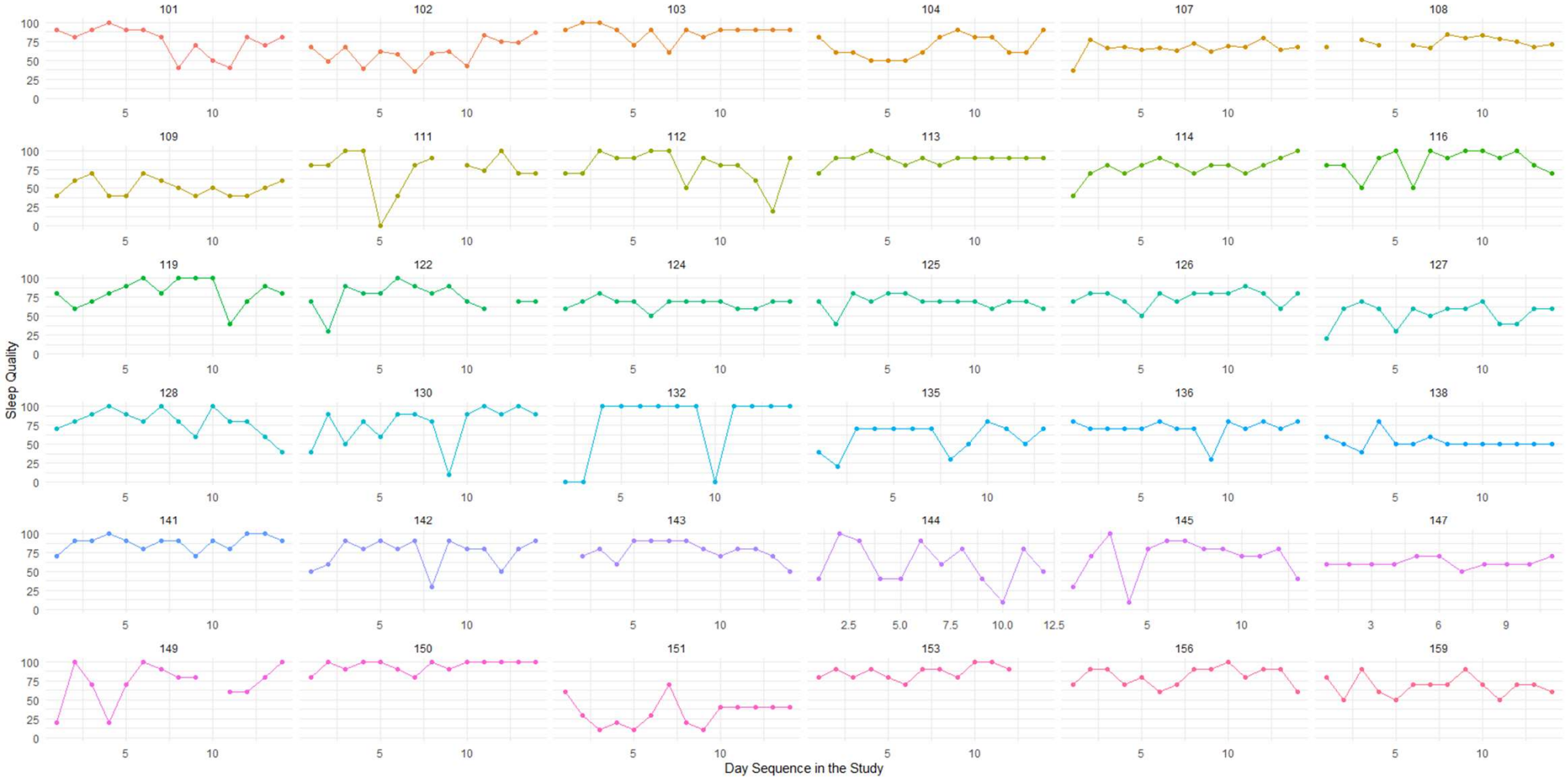


Outcomes 1 & 2 : The daily sleep quality level and the between-person differences (heterogeneity) of sleep quality

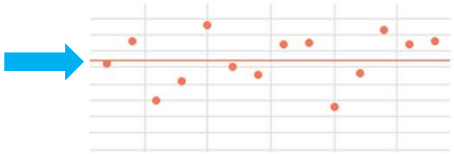
Raw scores of daily sleep quality rating across 14 days

The variability of mean daily sleep quality between older adults across 14 days

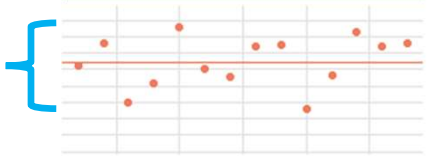
Outcome 3: the within-person variation (fluctuation) of sleep quality



Applied the Mixed-effects location-scale via MixWILD



Sleep Duration (between-person)



Sleep Duration (within-person)

Z= -1.33 (ns)

Z= 2.50*

Z= 0.26 (ns)

Z= 3.08**

Z= 2.36*

Z= -3.43***

Daily Sleep Quality

Between-person Difference in Sleep Quality

Within-person Variance in Sleep Quality

(Mean's Model)

(Between-person Model)

(Within-person Model)

MIX{WILD}

Mixed Model Analysis With Intensive Longitudinal Data

(Dzuber et al. 2020)

Controlling for demographics, day in study, physical activity level, living alone or not

*p<.05, **p<.01 ***p<.001

Summary of the findings using MixWILD program

Mean's model - The mean levels of daily sleep quality

- On days when older adults reported longer sleep duration than their typical, they reported better sleep quality

Between-person model - The differences in mean sleep quality between older adults

- On days when older adults reported longer sleep duration than their typical, they were more different from each other in their sleep quality reported

Within-person model - The degree of variability of sleep quality within older adults

- On days when older adults reported longer sleep duration than their typical, they were less erratic (variations) in sleep quality
- Older adults who had higher mean sleep duration had more variations in sleep quality

Conclusions

- Findings provide more nuanced information:
  - within-person changes in sleep duration may be a target for sustaining sleep quality.
    - associated with the mean level, the between-person differences, and the degree of within-person variations
- Future intensive longitudinal studies:
  - longer period to capture variability in sleep outcomes
  - measure various sleep outcomes: latency, disturbances, REM sleep
  - include larger representative older adults
  - consider factors that impact sleep outcomes: medications, naps

Using IL methods and analysis can help identify opportunities and strategies for promoting sleep health in older adults

Thank you for your attention!

Funding:

This study is supported by

- The USC ASPIRE-I pilot funding
- The USC Office for the Study of Aging

- The development of the **MixWILD** program were supported by the HIN/NHLBI grants: 5R01HL121330-05 and 1R01CA240713-01 (PIs: Dunton and Hedeker)

Acknowledgements

- Jonathan G. Hakun, PhD
- Krista Kicsak, MPH
- Jatyra Holmes, MS
- Kasey Drayton, BS
- Tyler Gheen, BS
- Neel Catie, BS
- Austin Mitchell, BS
- Abby Kiesow, BS
- Victoria Moy, BS
- Priya Patel, BS
- **Participants!**

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SOCIETY OF BEHAVIORAL MEDICINE

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