

Project 1: Characterizing sedentary behavior, physical activity, and sleep in the ACT cohort

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Today's Objectives

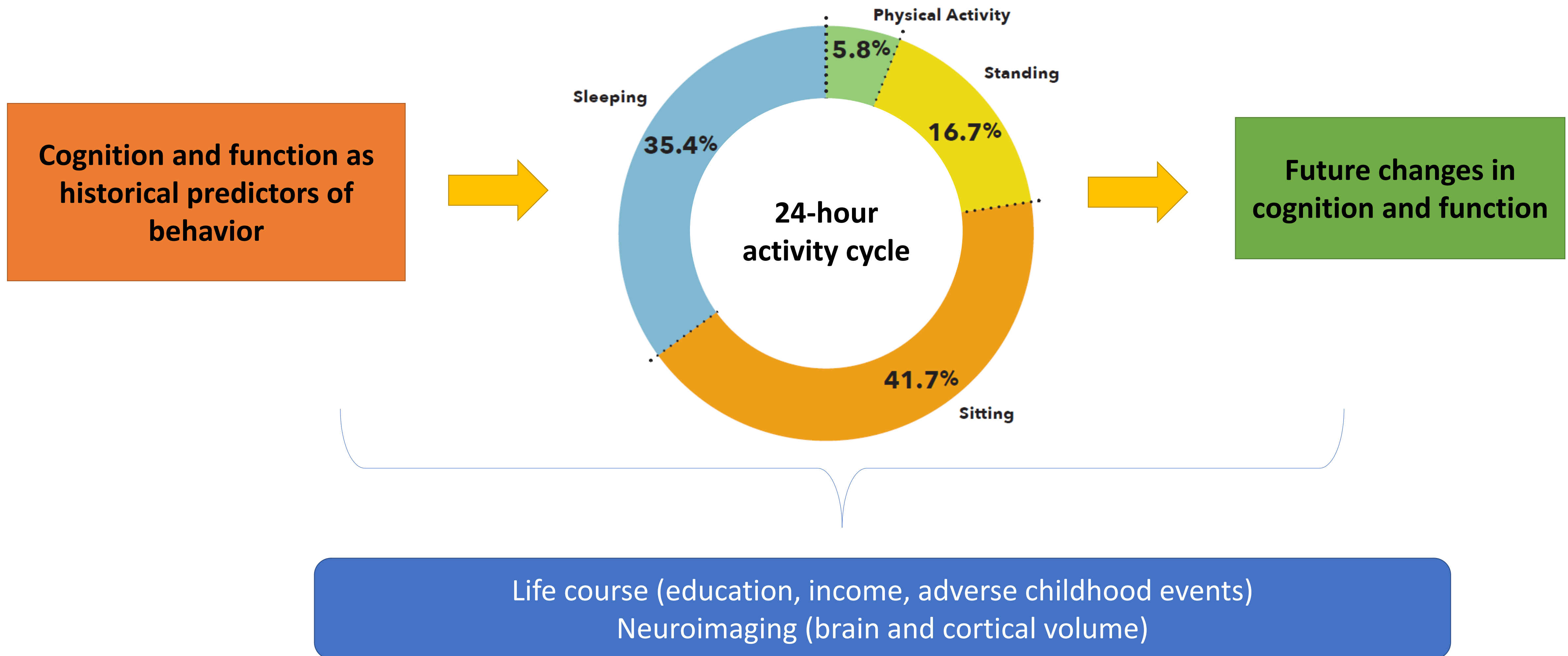
- Overview of the goals of Project 1 in the U19 (Mikael Anne)
- Current state of data collection efforts (Shirley, Liam)
- 24-hour activity cycle methods (Yinxiang)





ACT Project 1: Overview

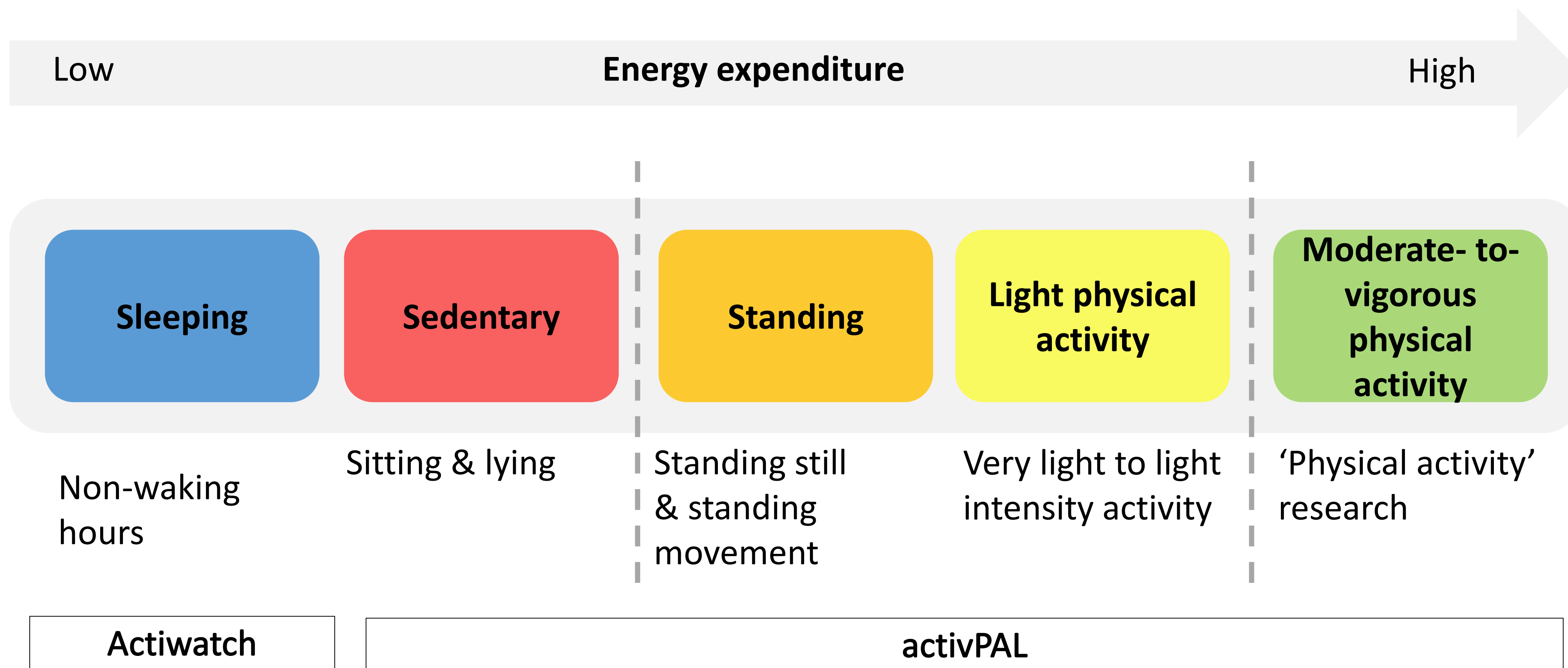
Project 1 (U19): Overall Goal



Why the 24-Hour Activity Cycle?

- 24HAC is a novel paradigm in the field of physical behavior research, growing in prominence
- Physical activity, sedentary behavior & sleep are interrelated
 - Levels of one inherently impact levels of the others across the 24-hour day
- 24HAC paradigm allows us to test hypotheses about the balance of these 3 behaviors over the 24-hour day and its relationship with cognition and function

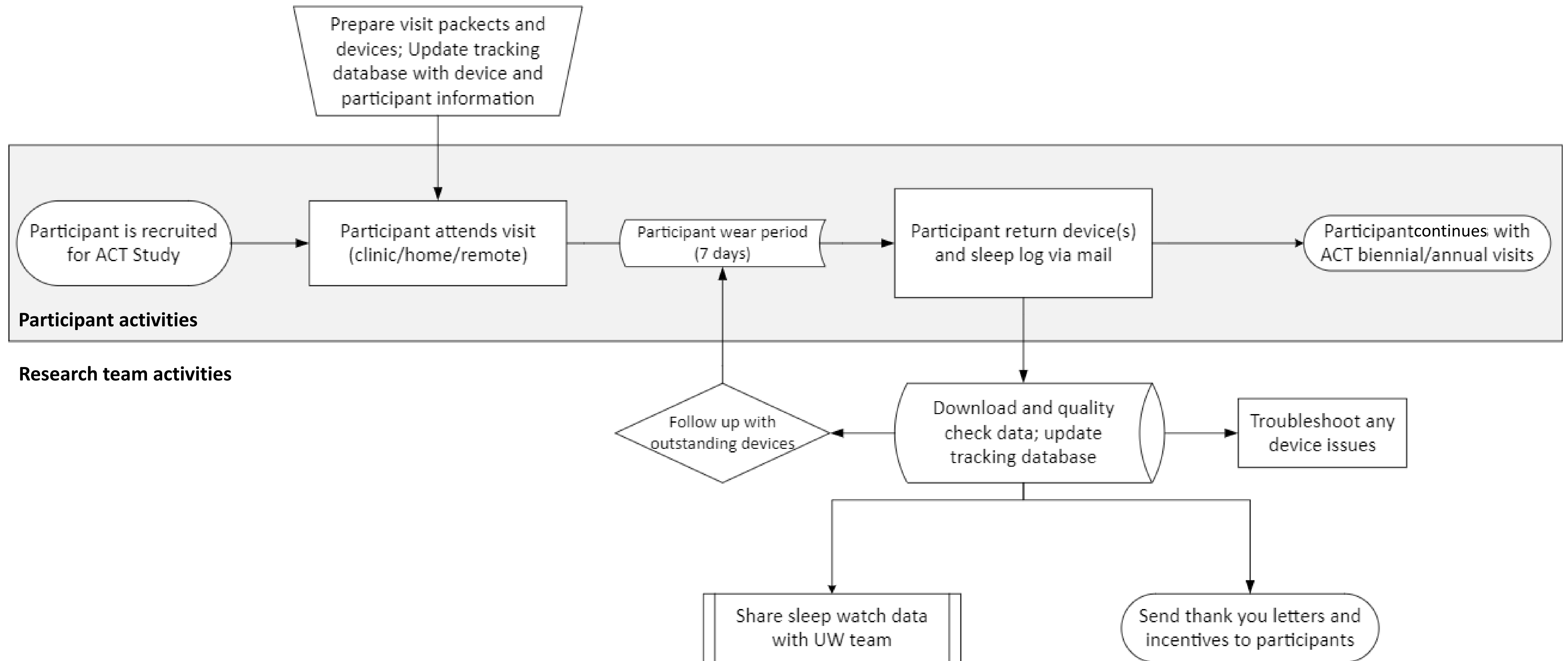
Spectrum of behaviors that ACT-AM will measure in the U19



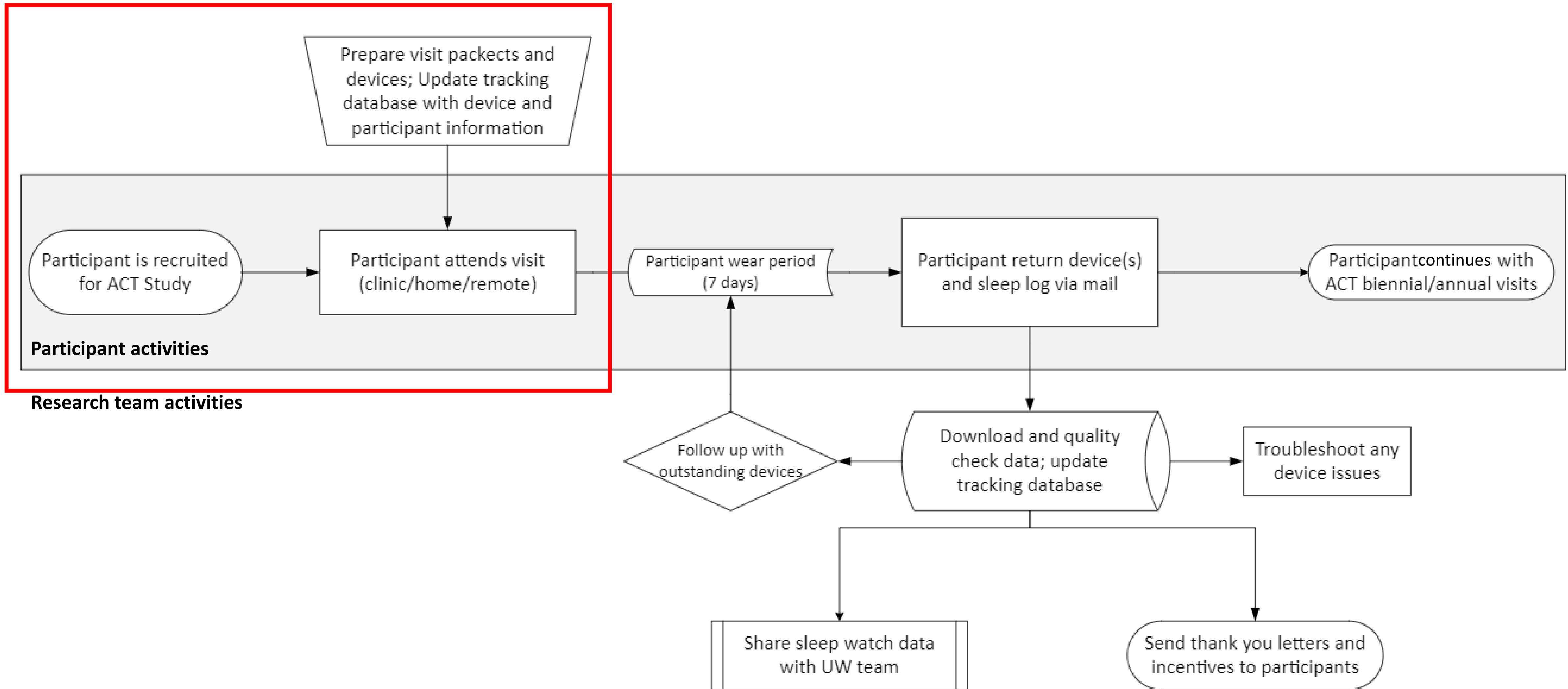


Project 1: Data Collection Update

Project 1: data collection workflow

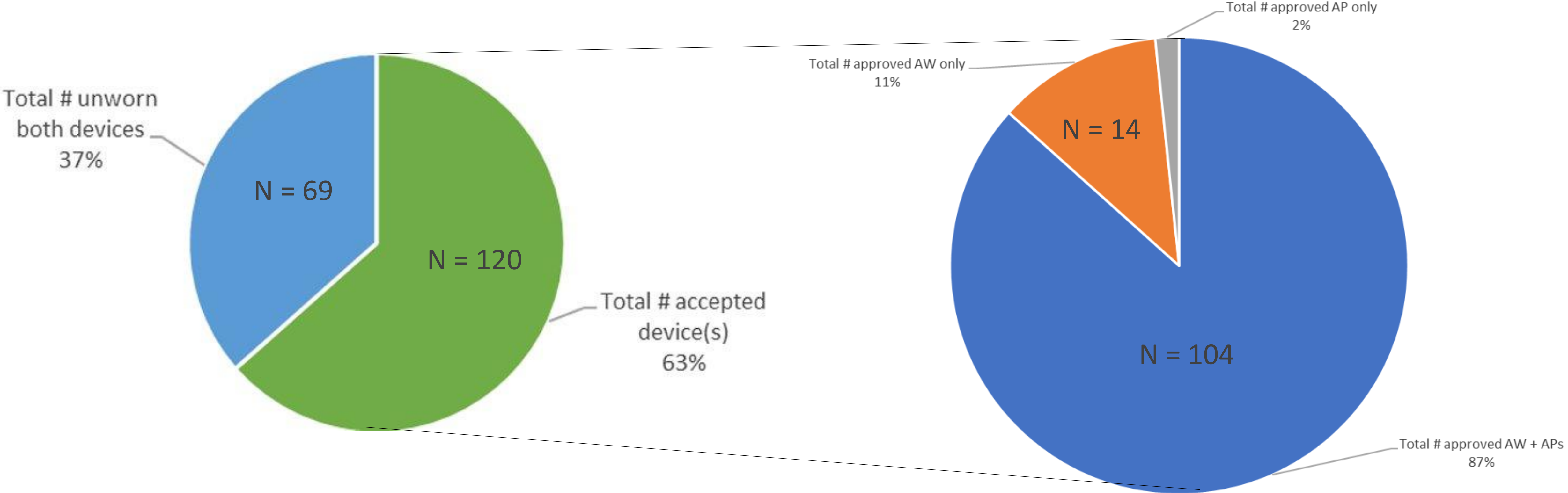


Pre-wear



Recruitment Progress (1/5/23 - 5/5/23)

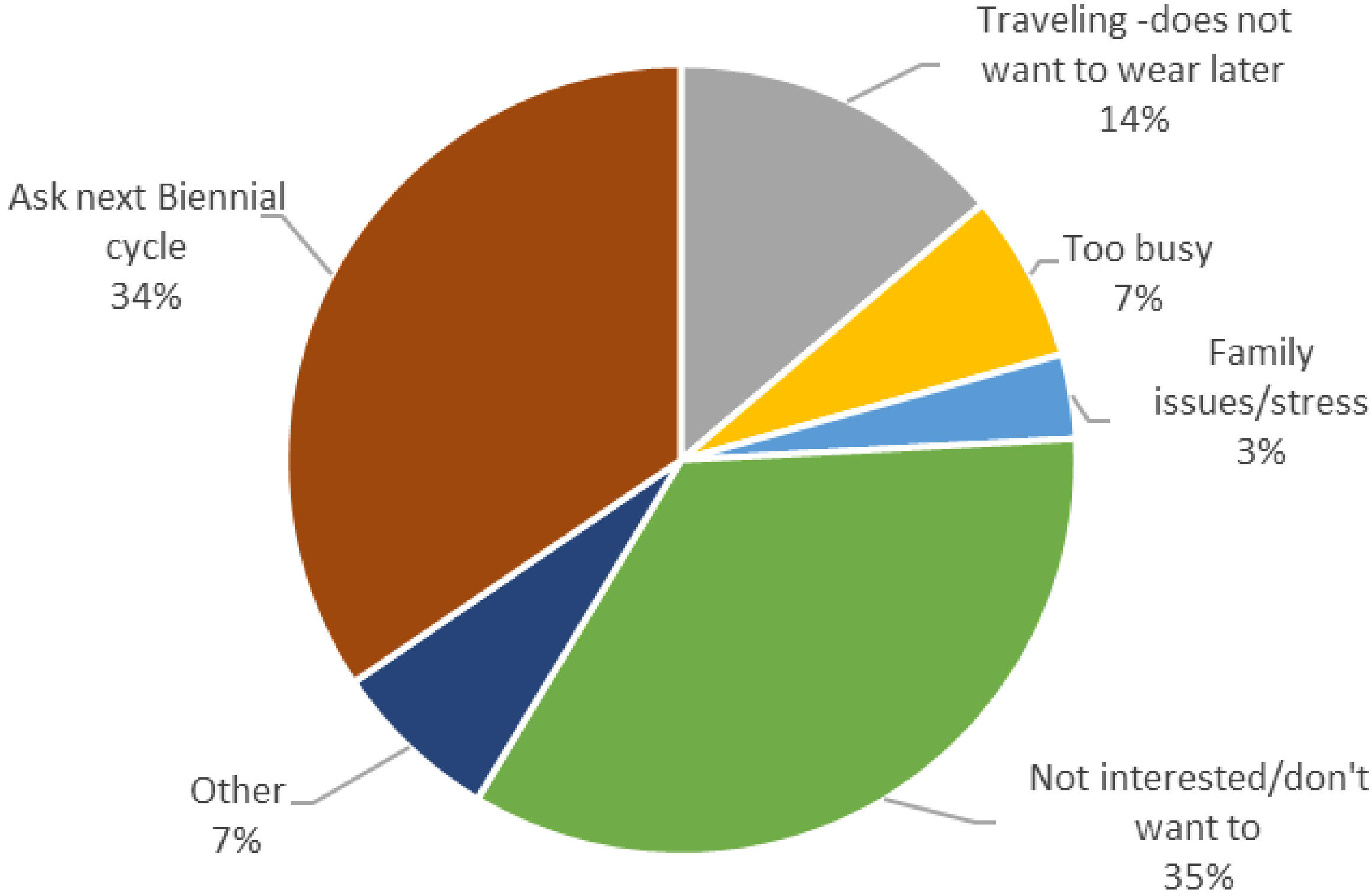
Clinic visit acceptance/refusal rates



N = 189 clinic visits

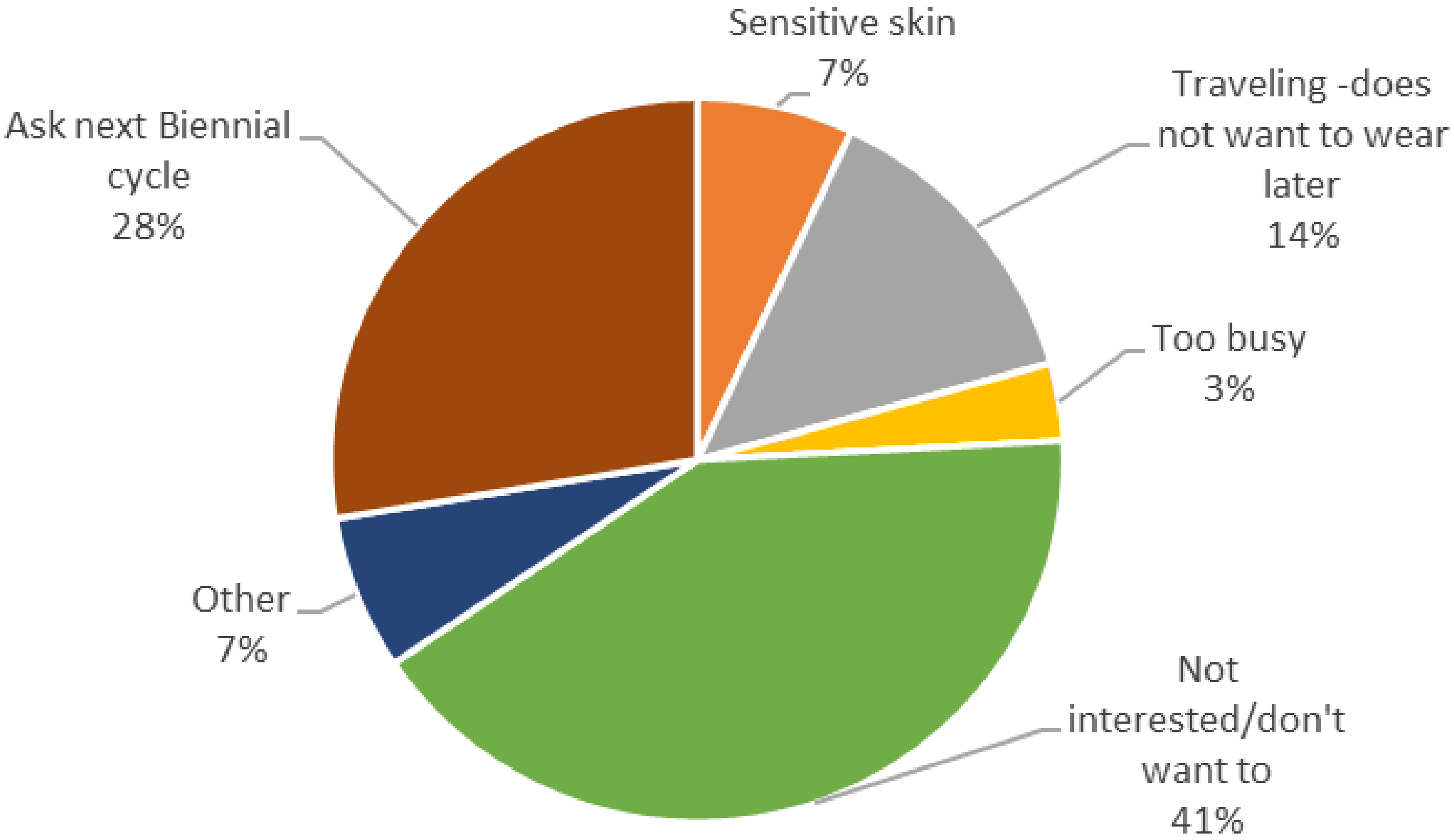
Refusal reason rates for devices in clinic visits

Actiwatch



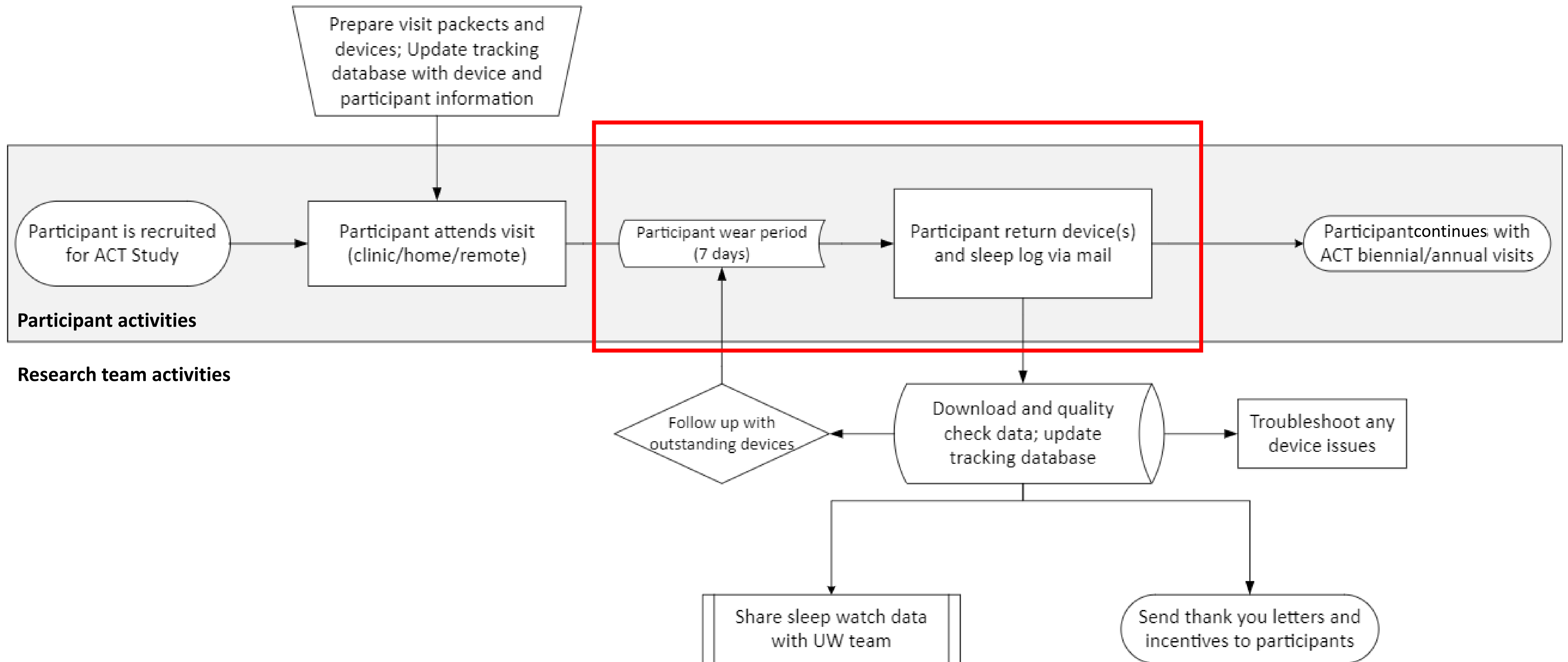
N = 30

activPAL

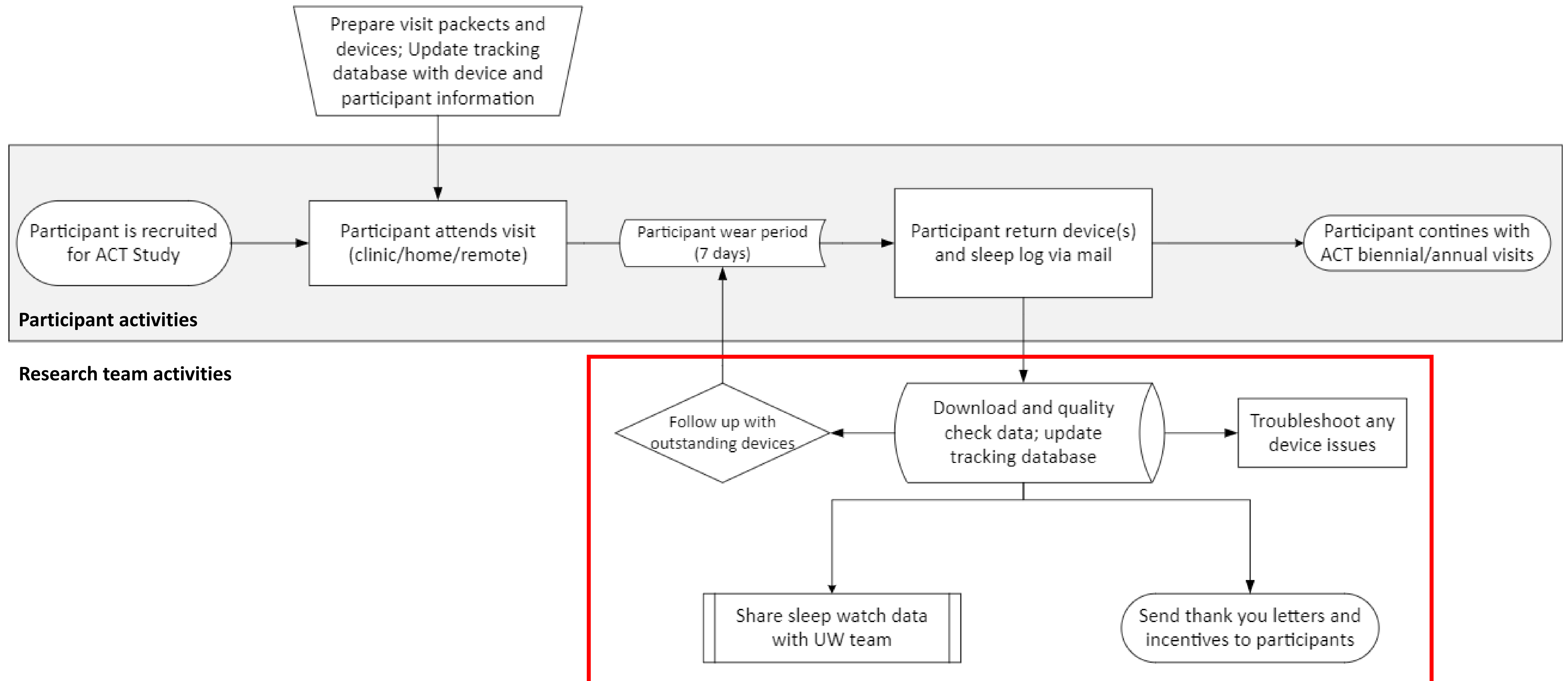


N = 31

Wear period



Post-wear



Post-wear: completed sleep logs

Sleep Log Instructions: (1) Complete the log every day. (2) Record the date and time you went to bed to sleep ("lights out") and the time you got up to start your day as displayed on your sleep watch in military time. If you do not wear a sleep watch, please use your own clock or watch.

Day	Date	Time you got up for the day	Time you tried to go to sleep ('light's out')	Please note and describe any of the following: <ul style="list-style-type: none"> • Unusual bed time (in or out) • Not a typical day
Day 1 (day you put on the device)	___/___/___ MM DD YYYY	n/a	___:___ Hour Min	What time did you put on the devices today? ___:___ Hour Min
Day 2	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Day 3	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Day 4	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Day 5	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Day 6	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Day 7	___/___/___ MM DD YYYY	___:___ Hour Min	___:___ Hour Min	
Last Day	___/___/___ MM DD YYYY	___:___ Hour Min	n/a	What time did you take off the devices? ___:___ Hour Min

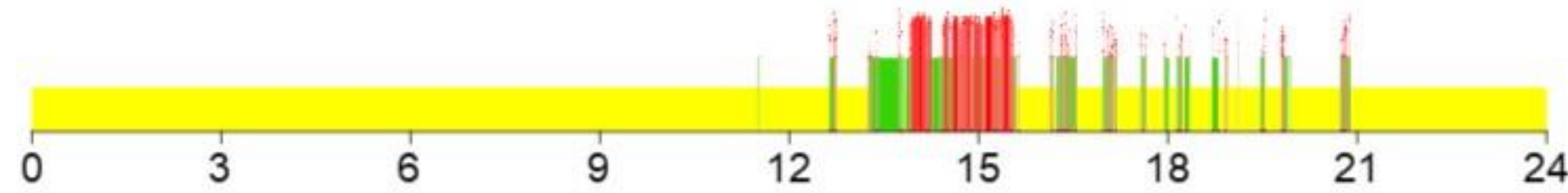
Did you experience any of the following while wearing the device(s)?:

1. <u>Skin irritation</u> : <input type="checkbox"/> Yes <input type="checkbox"/> No	2. <u>Swelling</u> : <input type="checkbox"/> Yes <input type="checkbox"/> No
a. If <u>Yes</u> , with which device(s)? <input type="checkbox"/> activPAL <input type="checkbox"/> Actiwatch	b. If <u>Yes</u> , with which device(s)? <input type="checkbox"/> activPAL <input type="checkbox"/> Actiwatch
3. <u>Other problem</u> (Please describe):	

Please return the activPAL and sleep watch and the tracking log in the pre-stamped envelope.

Post-wear: activPAL data

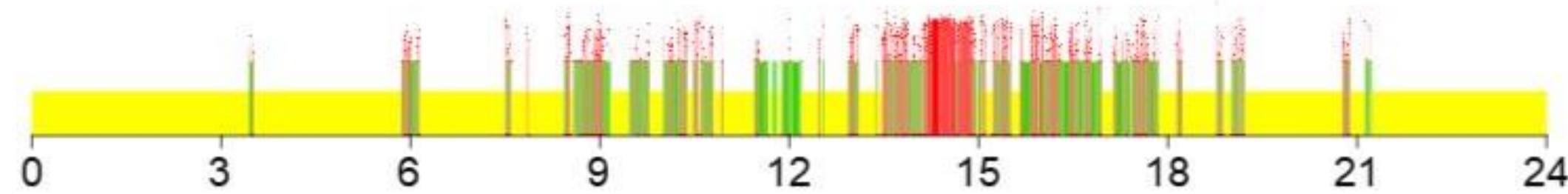
Day 1



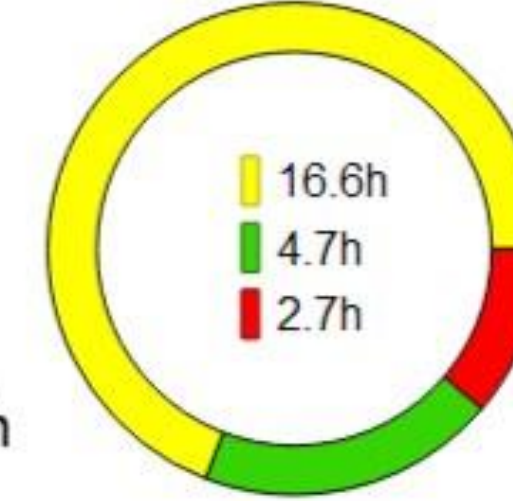
Steps
9992
Sit to Stands
22
Activity Score
34.18 MET.h



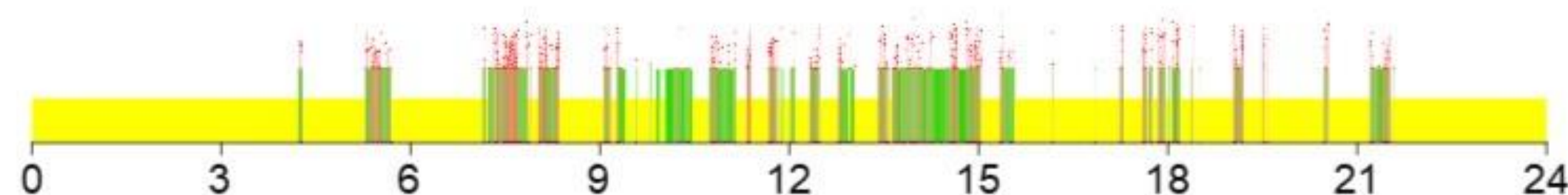
Day 2



Steps
13666
Sit to Stands
45
Activity Score
36.04 MET.h



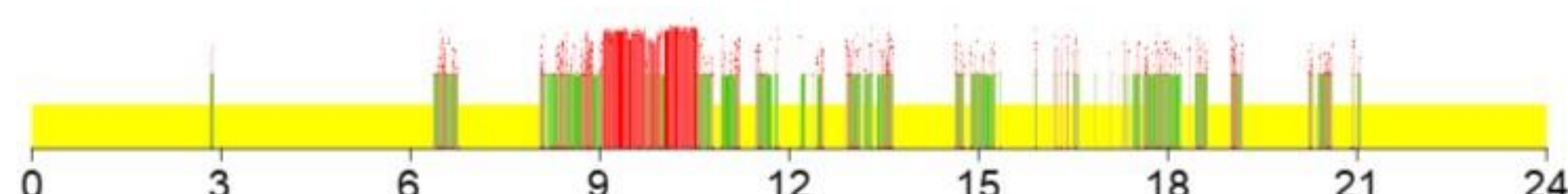
Day 3



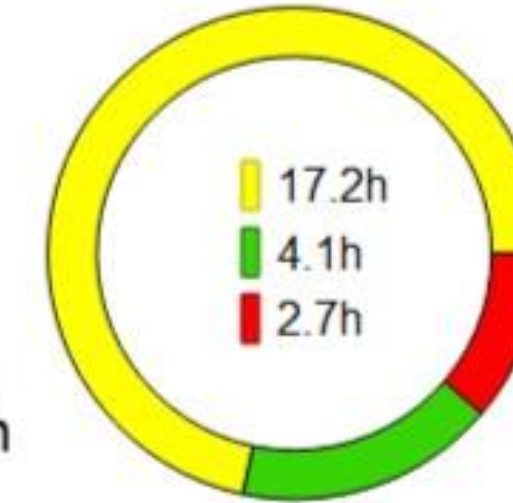
Steps
6114
Sit to Stands
52
Activity Score
33.11 MET.h



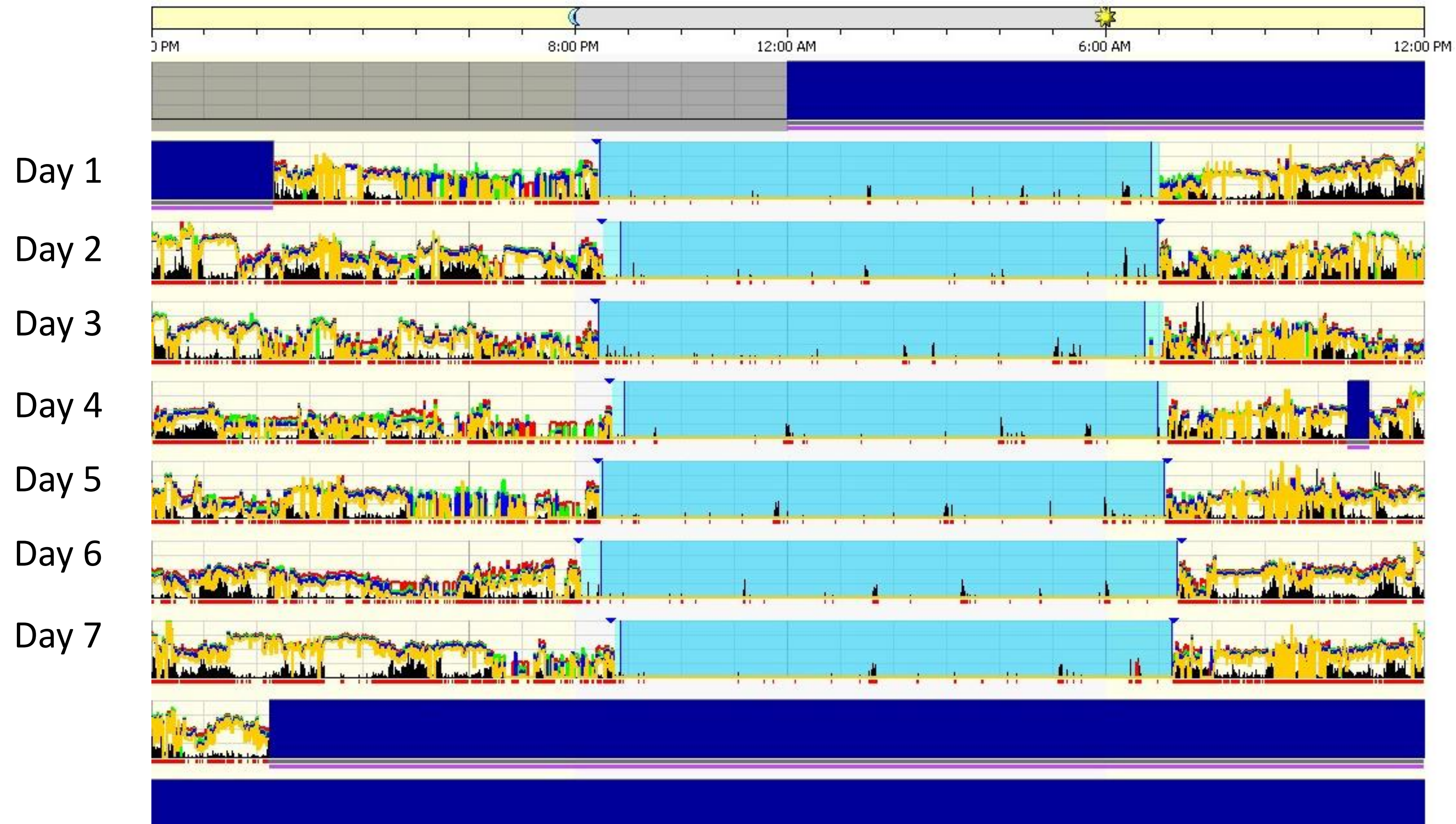
Day 4



Steps
15076
Sit to Stands
49
Activity Score
36.46 MET.h



Post-wear: Actiwatch data



Lessons learned & challenges to-date

- Device return rate- 100%
- Change to call cascade
- General feedback from PPTs
 - Overall positive
 - Common themes from sleep logs: uncomfortable/heavy watch, forgetting to press event marker button
- Device fielding challenges
- Ongoing tracking database refinements
- Recruitment and refusal reasons



24 Hour Activity Cycle Methods

Analysis of the 24-Hour Activity Cycle

An illustration examining the association with cognitive function in the Adult Changes in Thought (ACT) Study

Presented by Yinxiang Wu

University of Washington & Kaiser Permanente

- **Studied three popular analytical approaches** for summarizing 24HAC data and for modeling outcome associations with the 24HAC exposure
- **Illustrated and applied these approaches to assess an association with a cognitive outcome in a cohort of 1034 older adults**
- Discussed statistical challenges, and **provided guidance on interpretation and selecting an appropriate approach**

Reference:

Wu Y, Rosenberg DE, Greenwood-Hickman MA, McCurry SM, Proust-Lima C, Nelson JC, Crane PK, LaCroix AZ, Larson EB, Shaw PA. Analysis of the 24-h activity cycle: An illustration examining the association with cognitive function in the Adult Changes in Thought study. *Front Psychol.* 2023 Mar 27;14:1083344.

Available analytical approaches

- Isotemporal Substitution Model (ISM)

estimating the effect of time reallocation between any two activity behaviors

- Compositional Data Analysis (CoDA)

estimating the effect of arbitrary reallocation of time

- Latent Profile Analysis (LPA)

identifying subpopulations with distinct 24HAC patterns

Available Data:

- collected between 2016 and 2018 (first wave of *activPAL* data)
- **1034** subjects with at least 4 valid *activPAL* wear days
- **24HAC data:**
 - sit, stand, step (*activPAL*)
 - sleep (sleep logs)
- **outcome variable:**
 - CASI-IRT score
- **demographic and clinical covariates:**
 - age, gender, education, race/ethnicity, physical function, etc

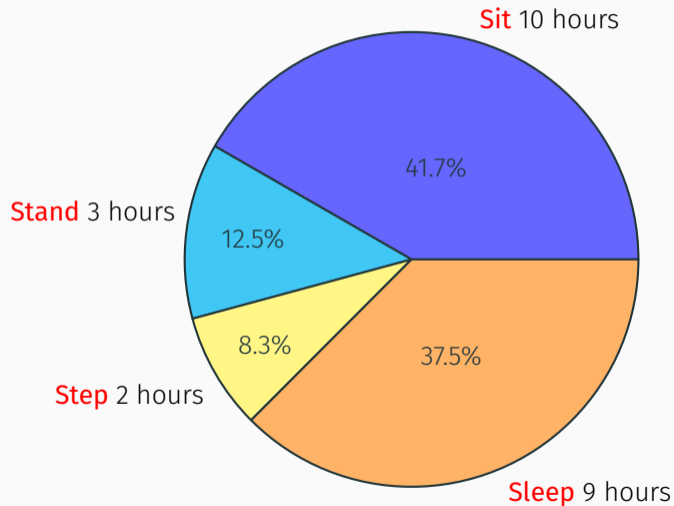
Descriptive statistics

The sample of 1034 subjects:

- mean (SD) **age** 77 (7) years, range = [65, 100]
- 55.8% **female**
- 90% **White**, 1.7% **Black**, 2.9% **Asian**, 0.2% **Native Hawaiian/Pacific Islanders**, 4.9% **Other/Unknown**
- 1.4% **Hispanic**
- 92.1% of the subjects reported **good to excellent self-rated health**
- 74.6% had **no difficulty walking half a mile**
- mean (SD) of **CASI-IRT score** was 0.61 (0.69)

24HAC statistics

24HAC (averaged across valid wear days)



Latent Profile Analysis (LPA)

LPA assumes that there is a latent categorical variable that classifies individuals into different **subpopulations** with **distinct 24HAC patterns**.

For example, in our ACT 24HAC analysis, different profiles were defined by groups of people having different percentages of time spent on sit, stand, step, and sleep

We applied LPA to the ACT data:

- Identified distinct 24HAC profiles
- Analyzed the association of the identified 24HAC profiles with CASI-IRT score using multivariable linear regression
- Performed the analysis in LatentGold 6.0 software

LPA: identified 24HAC profiles

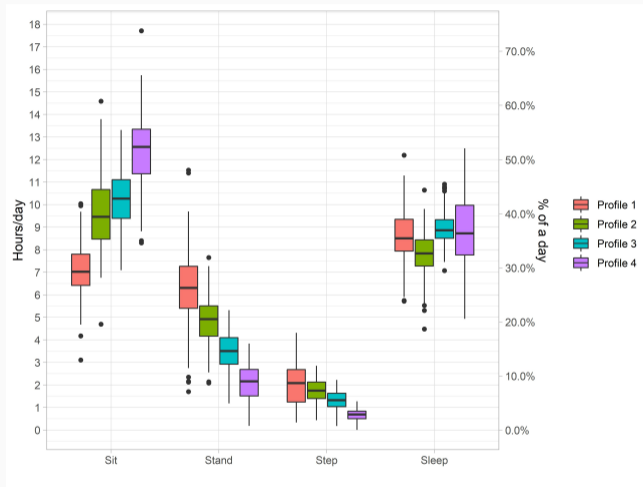


Figure 1: 24HAC profiles from latent profile analysis (4-class model). The boxplots presents sample quartiles (N=1034).

Table 1. Association of latent profiles with the outcome CASI-IRT score, adjusted for the potential misclassification

No adjustment (N=1034)	$\hat{\beta}$	Robust SE	p-value
average activity group	ref	ref	ref
most active group	-0.048	0.096	0.62
moderately active lower sleeper	0.018	0.099	0.86
least active group	-0.239	0.101	0.02

Summary

- In our paper, we illustrated 3 methods for 24HAC, summarized each method's pros and cons, and provided guidance on interpretation and selection of an appropriate method*
- Cross-sectional data analyses using the three methods found little to no evidence that less time spent on sedentary behaviors and more in physical activity was associated with better cognitive function
- Our analyses were simplified in this statistical methods paper and have many limitations, providing only a limited view of the complex relationship between 24HAC and cognitive function

* Note: Rcode for analyses provided on GitHub: https://github.com/yinxiangwu/24HAC_illustrations

- ISM, CoDA, and LPA can be useful beyond 24HAC settings
- Each of these methods can be easily applied/extended with other commonly used outcome variables e.g. binary, survival
- We plan to analyze how longitudinal change in cognitive function is associated with future physical function
- There is lot more to learn in the future!

Acknowledgments

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THANK YOU!

Questions & Comments

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