

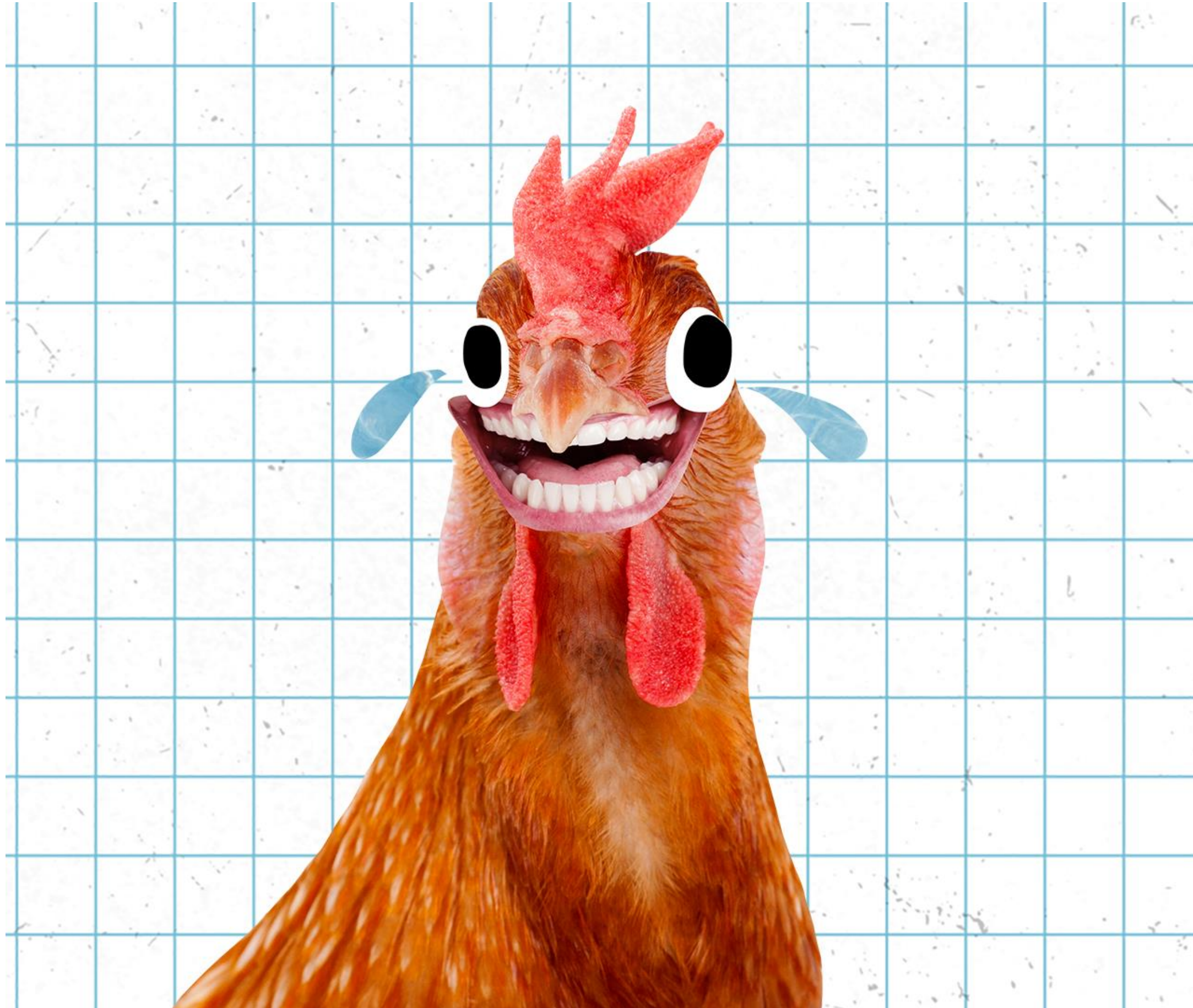


Updates from ACT U19 Project 1: Physical activity, sedentary behavior and sleep (24-hour activity cycle)

Mikael Anne Greenwood-Hickman, MPH, Collaborative Scientist, KPWHRI

Susan McCurry, PhD, UW

Dori Rosenberg, PhD, MPH, Senior Investigator, KPWHRI



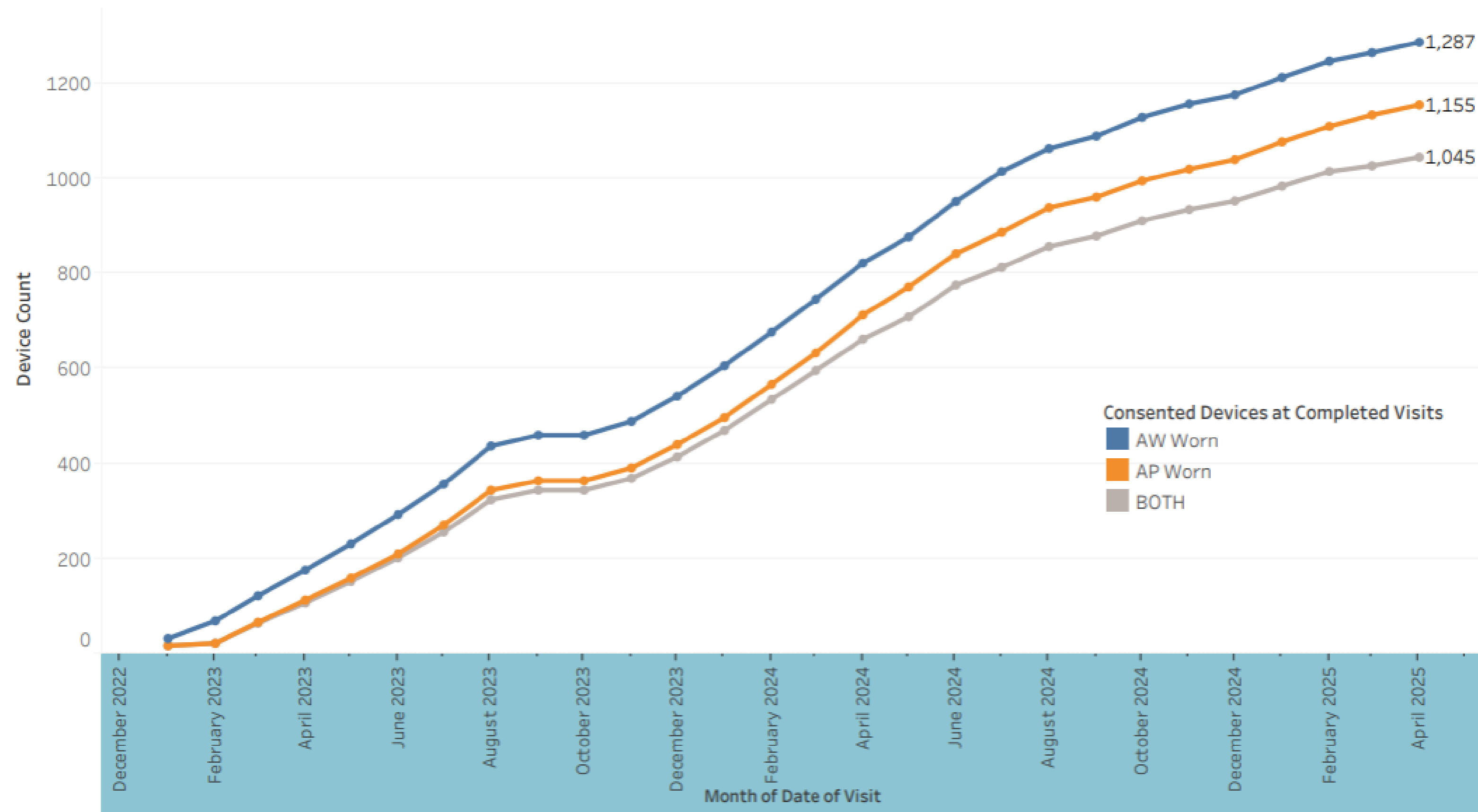
- What do chickens do at the gym?
- Work on their pecks!



Update on data collection

Figure 1. Devices Worn Through April 30, 2025

Cumulative Consented Devices Worn (Data Downloaded) at Completed Visits.



Data indicate that progress continues toward the goal of 1,000 devices worn in Wave 4, cumulatively for each device type.



Trajectories of cognitive and physical function in relation to the 24-hour activity cycle

Background

- Studies show that physical activity, sedentary time, and sleep are associated with cognitive and physical function
 - Limitation: Reverse causality cannot be ruled out
- A limited number of prior studies have demonstrated that cognition and physical function predict physical activity and sedentary behavior
 - Some show no bidirectional associations
- Less is known about whether cognition or physical function predicts sleep
- More studies are needed to characterize to what extent these relationships are bidirectional

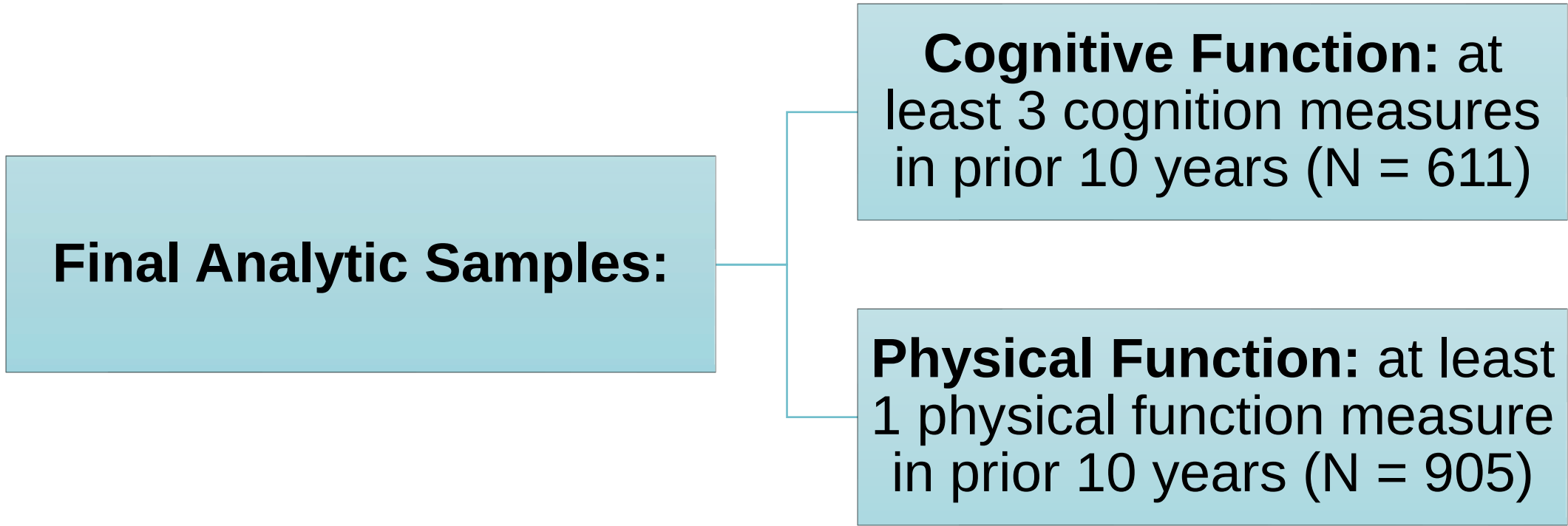
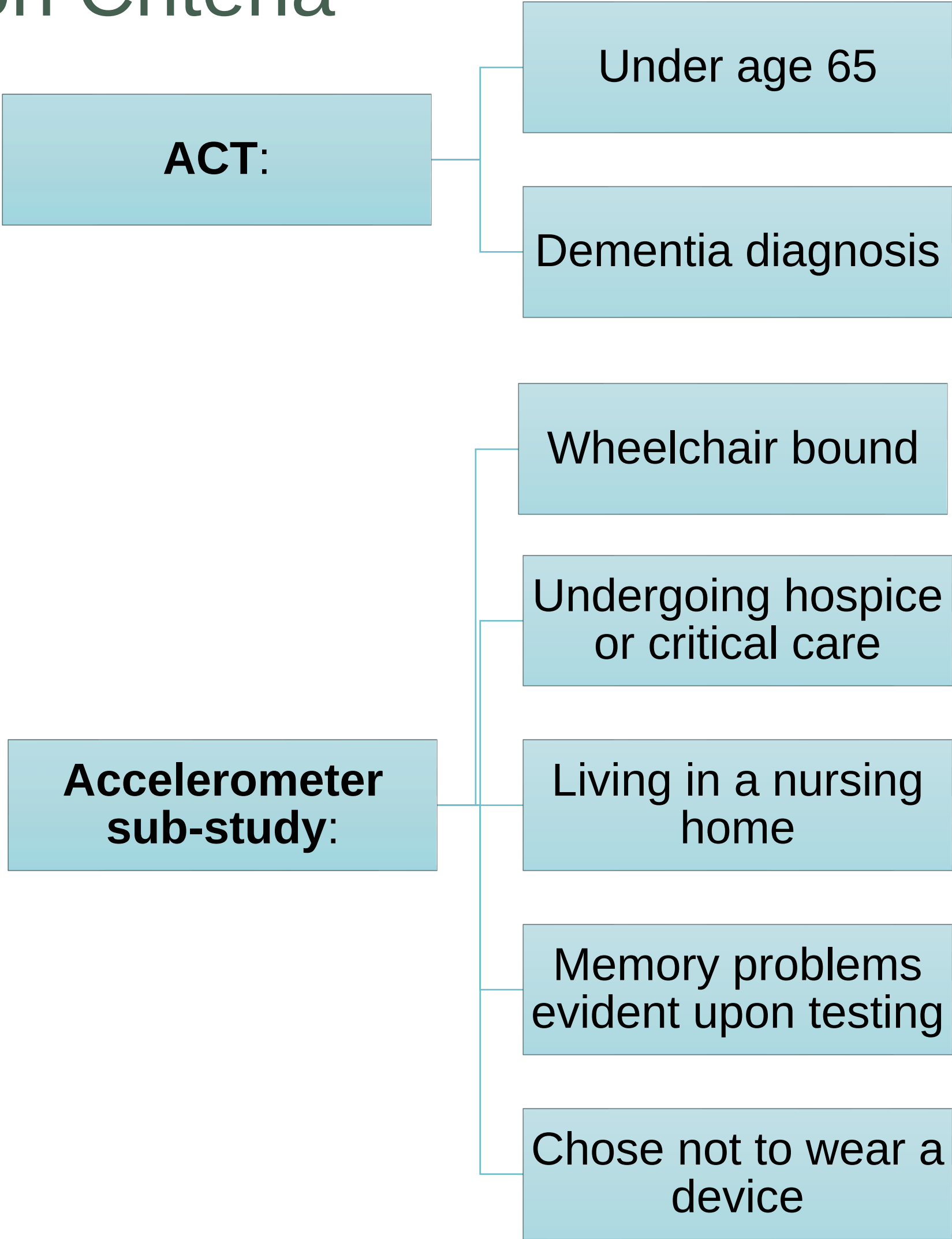


Goal of This Study

- Leverage extensive historic data available in the Adult Changes in Thought (ACT) cohort study
- Examine whether trajectories of cognitive and physical function over the prior 10-years is associated with physical activity, sedentary time, and sleep in a sample of community dwelling older adults



Exclusion Criteria



Outcomes – Sedentary behavior, Physical activity, Sleep



activPAL (thigh)

- Sitting
- Standing
- Steps
- Mean sitting bout duration



ActiGraph wGT3X+ (waist)

- Light intensity physical activity (VM counts 19-518 per 15s epoch)
- Moderate-to-vigorous physical activity (MVPA; VM counts > 518 per 15s epoch)



Sleep:

- Time-in-bed from sleep log
- PROMIS 8-item sleep disturbance (higher scores = more sleep disturbance; mean of 50, SD of 10)

Evenson KR et al. Calibrating physical activity intensity for hip-worn accelerometry in women age 60 to 91 years: The Women's Health Initiative OPACH Calibration Study. Prev Med Rep. 2015;2:750-6. doi: 10.1016/j.pmedr.2015.08.021



Cognitive Function Trajectories Analysis

Exposure – Cognition Trajectories



We measured cognitive function with the Cognitive Abilities Screening Instrument (CASI)



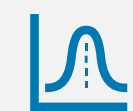
CASI measures global cognition including assessment of attention, orientation, memory, visual construction, and verbal fluency



Raw scores range from 0 to 100 with scores less than 86 indicating possible dementia



We used item response theory scores for the CASI (CASI-IRT), which addresses CASI's non-linear measurement properties and limited sensitivity for high scorers



CASI-IRT scores are linear in scale and have a mean of 0 and SD of 1



Participants had to have at least 3 CASI-IRT scores over 10-years prior to wearing accelerometers

Statistical Analysis

- **Step 1:** Growth mixture modeling (GMM) of CASI-IRT score trajectories in the 10 years prior to device wear to classify participants into latent groups of cognitive function
- **Step 2:** Each participant was assigned to CASI-IRT trajectory group with the highest probability estimated by the final GMM
- **Step 3:** Associations between identified latent cognitive groups and outcomes estimated using the Bolck, Croons, and Hagenaars (BCH) method
 - Accounts for the uncertainty in the group membership assignments
- Outcome models included the following covariates:
 - Demographics: age, sex, living alone or with others, education (≥ 16 years vs. < 16 years), retirement status
 - Health status: body mass index (BMI), Center for Epidemiologic Studies Depression Scale (CES-D) continuous score, self-rated health (fair/poor vs. good/excellent)
 - Accelerometer awake wear time (ActiGraph and activPAL outcomes only)
- Alpha 0.05
- Latent Gold Version 6.0
 - Syntax available on GitHub: <https://github.com/yinxiangwu/cognitive-trajectory-LG-analysis>

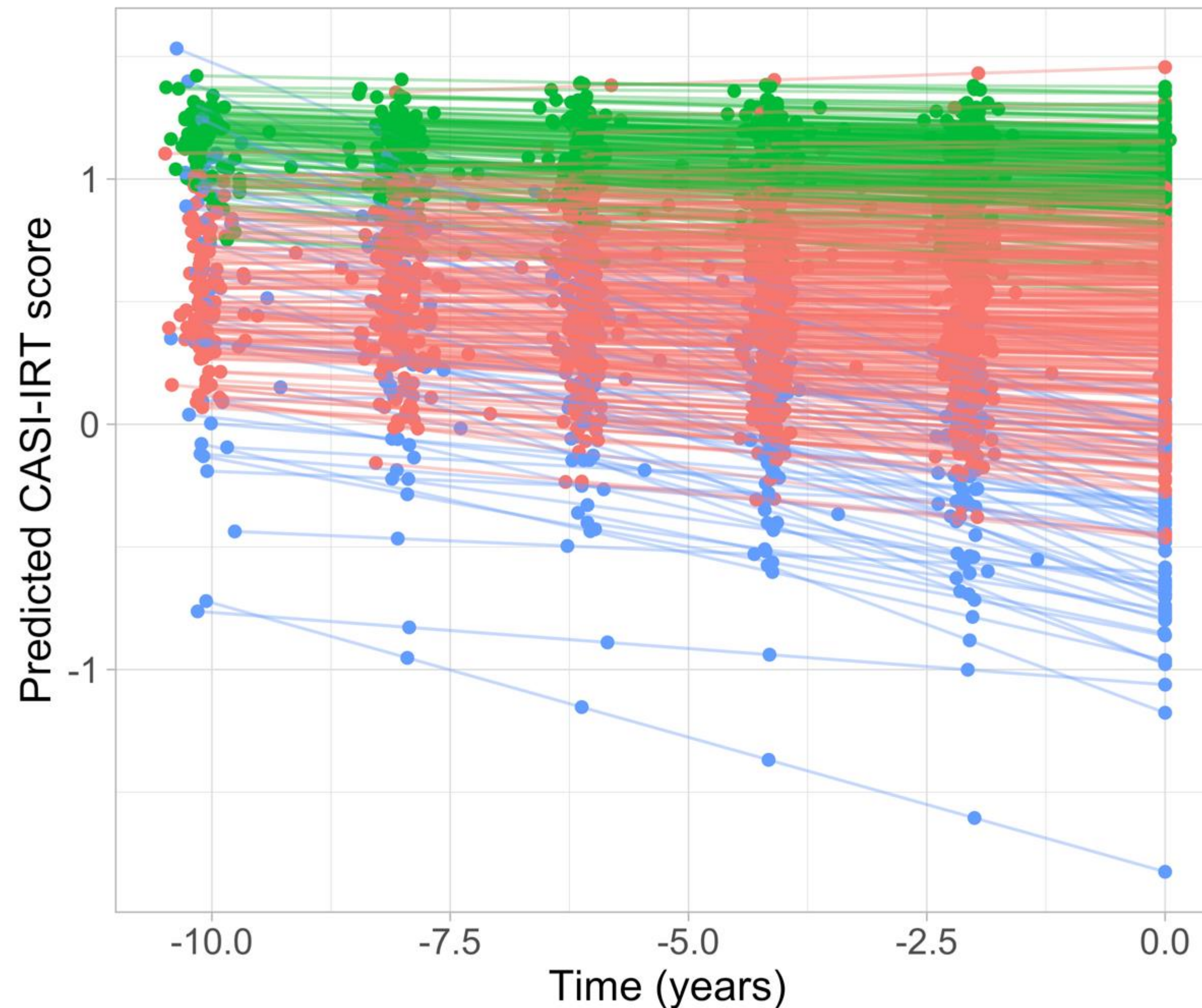
Participant Characteristics

Characteristic (N = 611)	N (%) or mean (SD)
Age in years, mean (SD)	80.3 (6.5)
Female, n (%)	349 (57.1)
Education 16+ years, n (%)	432 (70.7)
Able to walk ½ mile, n (%)	435 (71.5)
Not working for pay, n (%)	523 (85.6)
Living alone, n (%)	227 (37.2)
Self-rated health fair/poor, n (%)	50 (8.2)
BMI (kg/m ²), mean (SD)	26.7 (4.7)
CESD Score, mean (SD)	3.6 (3.8)

Summaries of sedentary behavior, physical activity, and sleep

Variable	Mean (SD)
activPAL sitting hrs/day	10.0 (2.0)
activPAL standing hrs/day	4.0 (1.7)
activPAL stepping hrs/day	1.4 (0.6)
activPAL steps/day	6355 (3409)
activPAL mean sitting bout duration mins	16.1 (8.0)
ActiGraph LPA hrs/day	4.6 (1.3)
ActiGraph MVPA hrs/day	1.0 (0.7)
Time in bed hrs/day	8.6 (1.1)
PROMIS sleep disturbance score	46.51 (7.90)

Predicted CASI-IRT scores in the sample



High stable 34% (Green)

Mean age = 80, 69% women, 80% 16+ years education, 77% able to walk at a normal pace

Average stable 56.1% (Pink)

Mean age = 79, 51% women, 68% 16+ years education, 74% able to walk at normal pace

Declining 9.8% (Blue)

Mean age = 89, 50% women, 55% 16+ years education, 37% able to walk at normal pace

Had more sitting and time in bed
Had less standing, steps, MVPA

Outcome models

Compared to the average stable CASI-IRT group, the declining group had:



- 16 mins/day less activPAL stepping time ($p = 0.042$)
- 1517 fewer activPAL steps ($p = 0.031$)
- 16.3 fewer mins/day ActiGraph MVPA ($p = 0.033$)

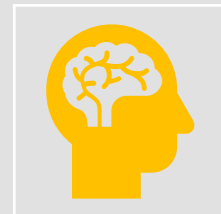


- No significant differences for SB outcomes
- No significant differences for sleep outcomes

Conclusions



Those with declining cognition over 10-years had lower later life physical activity levels compared to those with stable cognition



Bidirectional associations may exist in the association between physical activity and cognition



More research is needed to confirm null findings for sedentary behavior (examining domains) and sleep (using device based measures)



Future research should examine more cognitive domains



Physical Function Trajectories Analysis

Exposure – Physical Function Trajectories



We measured physical function in two ways:

- 1) Objective physical performance - Short Performance-Based Physical Function (**sPPF**)
- 2) self-report of impairment to Activities of Daily Living (**ADLs**)



sPPF: composite score from 3 physical performance tasks (chair stand, 10 ft walk, grip strength), scores range 0-12, higher = better



ADLs: summary score of activities of daily living participants report difficulty with, scores range 0-16, higher = worse function



Participants had to have at least 1 sPPF and ADL score over 10-years prior to wearing accelerometers

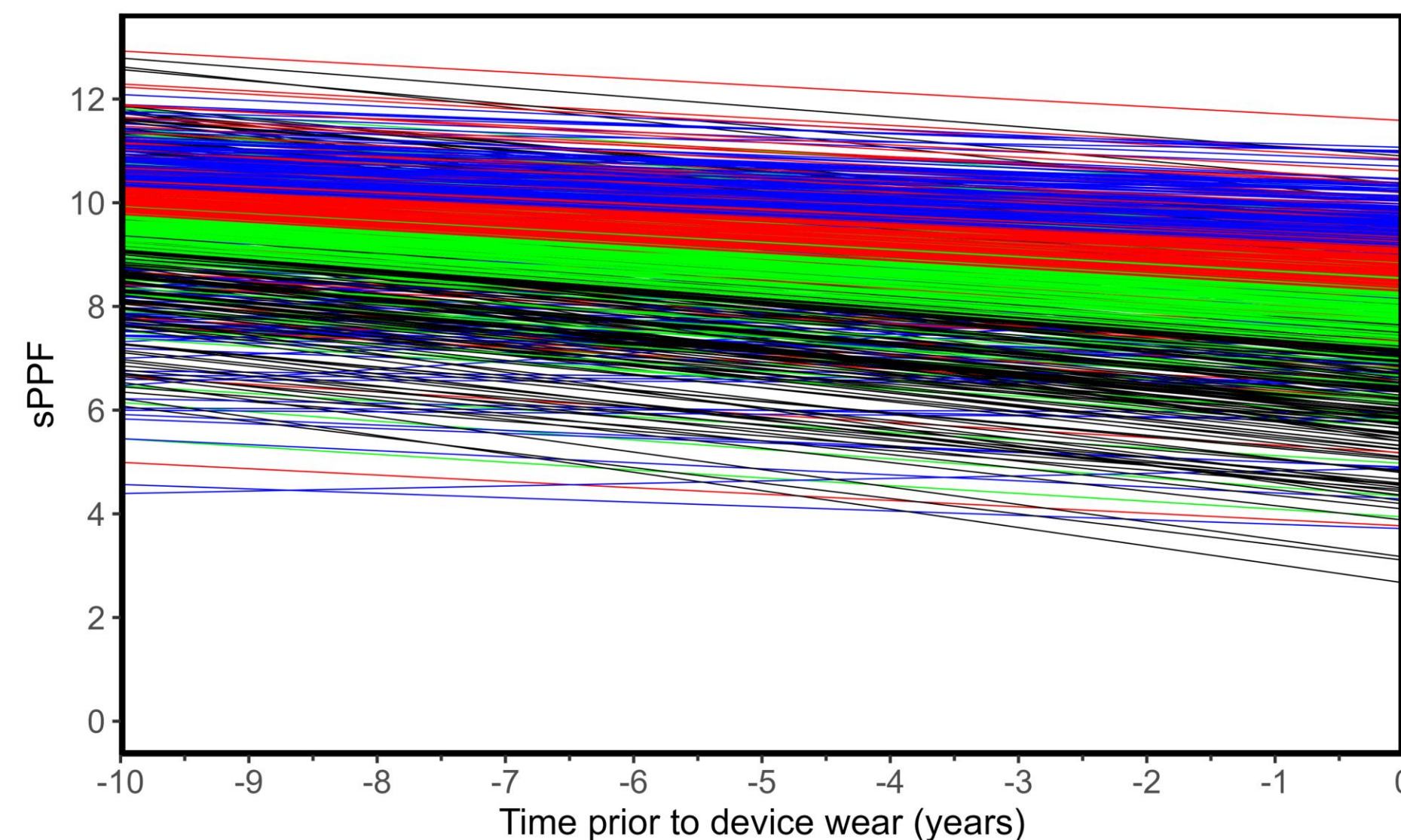
Statistical Analysis

- Linear Mixed Effects Models to define subject-specific trajectory slopes and intercepts for two each measure of physical function over the prior 10 years.
- Multivariable linear regression to investigate the relationship between sPPF and ADL trajectories and 24HAC behavior outcomes.
- Outcome models included the following covariates:
 - Demographics: age, gender, living alone or with others, education (≥ 16 years vs. < 16 years), retirement status
 - Health status: CASI-IRT, body mass index (BMI), Center for Epidemiologic Studies Depression Scale (CES-D) continuous score, self-rated health (4-level, Excellent/Very good/Good vs Fair/Poor)
 - Accelerometer awake wear time (ActiGraph and activPAL outcomes only)
- Bootstrapped confidence intervals
- Alpha 0.05
- SAS 9.4 and R (4.3.2) utilizing the 'lme4' package for Linear Mixed Effect Models

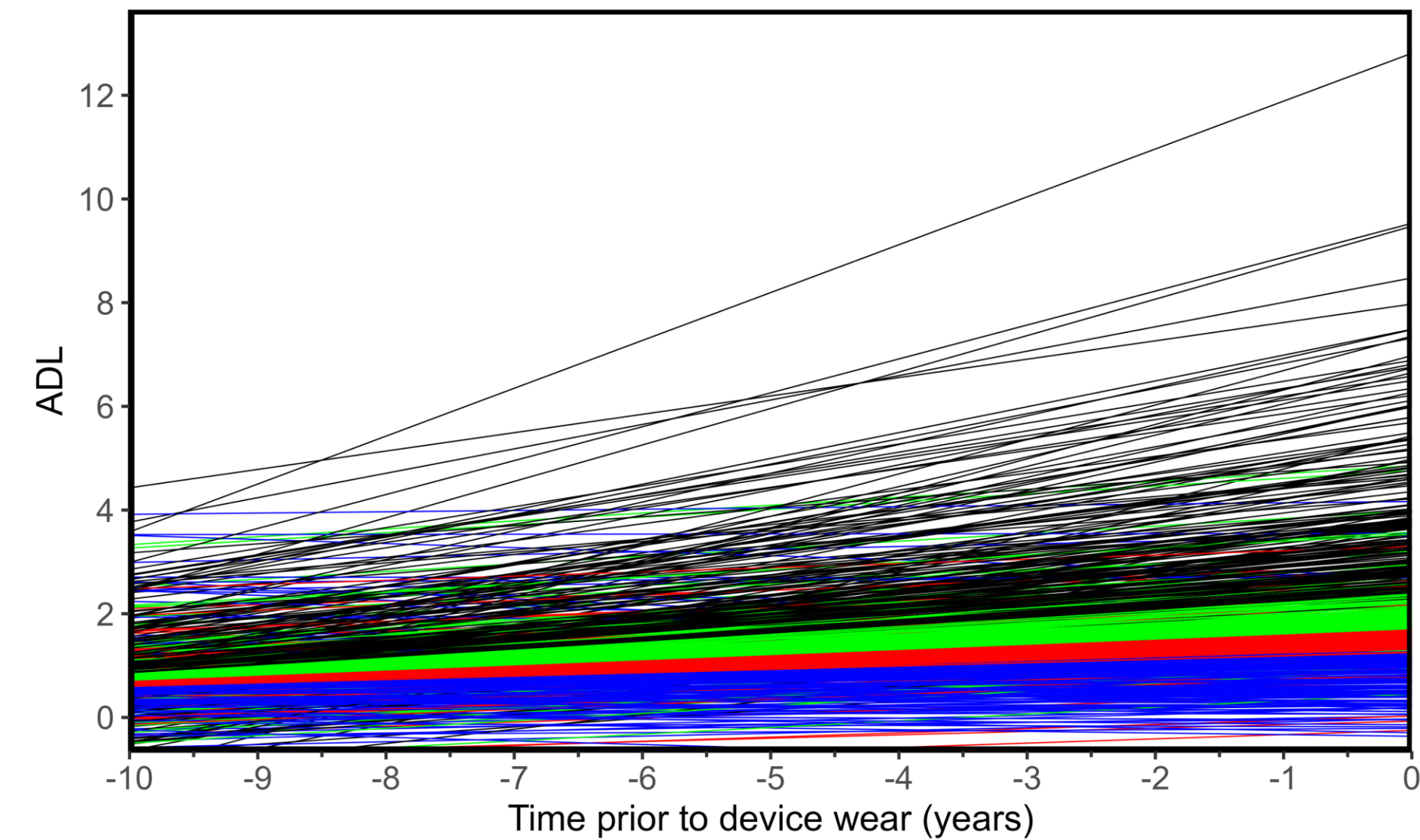
Participant Characteristics

	N = 905
Age (Years), Mean (SD)	77.6 (6.9)
Sex, %	
Female	55.5%
Male	44.5%
Race, %	
Asian	3.1%
Black	1.4%
White	90.6%
Other or mixed*	4.8%
Latino/Hispanic Ethnicity, %	1.3%
Currently Work for Pay, %	18.6%
Education Level 16+ years, %	74.8%
Live alone, %	34.0%
Self-rated health, %	
Excellent	19.7%
Very good	43.4%
Good	29.9%
Fair/Poor	7.0%
Depressive symptoms CES-D Score ≥ 10, %	8.5%
Charlson Comorbidity Index , Median [IQR]	0 [0, 2]
Average Pain Rating, Median [IQR]	2 [1, 3]
ADL Impairment score, Median [IQR]	1 [0, 2]
sPPF score, Median [IQR]	9 [8, 11]
CASI score, Mean (SD)	0.6 (1.0)
BMI, Mean (SD)	26.9 (4.8)

Estimated trajectories of sPPF (left) and ADL by quantiles of individual-specific fitted slope



Slope group — Black: Slope 0th- 25th percentile — Red: Slope 50th- 75th percentile
— Green: Slope 25th- 50th percentile — Blue: Slope 75th- 100th percentile



Lines slope group: — Blue: 0th- 25th percentile — Green: 50th- 75th percentile
— Red: 25th- 50th percentile — Black: 75th- 100th percentile

Steepest decline (Black)
Middle-high decline (Green)
Middle-low decline (Red)
Most stable (Blue)

Outcome models



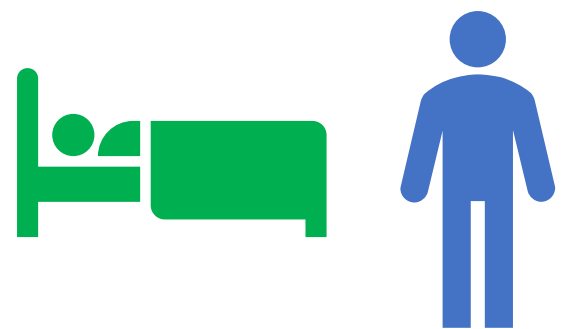
- More steeply decreasing sPPF slope over prior 10 years was associated only with fewer steps and less MVPA.

- Decrease of 3 sPPF points over 10 years →
 - **-1180 steps** (-2853, -185)
 - **-15.7 mins MVPA** (-35.6, -2.3)



- A steeper increasing slope of ADL impairment was associated with fewer steps, less MVPA, more sitting time, longer mean sitting bout duration, and more time-in-bed.

- Increase of 4 ADL points over 10 years →
 - **- 1372 steps** (-2223, -638)
 - **- 13.0 mins MVPA** (-22.6, -5.0)
 - **+ 35.0 mins sitting** (4.3, 65.0)
 - **+ 3.5 mins mean sit bout duration** (0.8, 6.2)
 - **+ 35.5 min in bed** (6.5, 43.5)

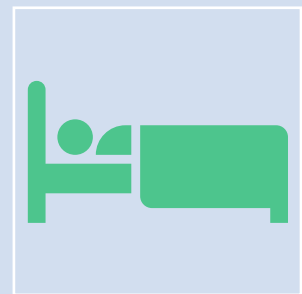


- Standing time, Light-intensity PA, and self-reported sleep quality were not associated with either sPPF or ADL trajectory measures.

Conclusions



Bidirectional associations are likely in the association between physical function and physical activity and sedentary behavior, especially MVPA



More research is needed to confirm null findings for sleep (using device based measures) and light-intensity movement



Findings support need for physical activity interventions early in the life course to counteract a feedback loop of declining function and activity

Limitations of these analyses

- Global cognition measure only – no domain-specific measures
- sPPF uses grip strength, less likely associated with activity (balance from SPPB)
- Physical activity, sedentary behavior, and sleep assessed at one time point
- Lacked device-based measures of sleep
- Cannot rule out residual confounding
- ACT sample is not representative of the King County population as it is more educated and primarily non-Hispanic White
- We did not adjust for multiple comparisons
- Non-participants were less healthy which could make our results more conservative

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THANK YOU!
Questions & Comments

Article Contents

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JOURNAL ARTICLE ACCEPTED MANUSCRIPT

Historic Cognitive Function Trajectories as Predictors of Sedentary Behavior and Physical Activity in Older Adults

Dori E Rosenberg, PhD, MPH ✉, Yinxiang Wu, MA, Abisola Idu, MS, MPH, Mikael Anne Greenwood-Hickman, MPH, Susan M McCurry, PhD, Andrea Z LaCroix, PhD, MPH, Pamela A Shaw, PhD, MS

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Abstract

Background

We examined whether trajectories of cognitive function over 10 years predict later life physical activity (PA), sedentary time (ST), and sleep.

Methods

Participants were from the Adult Changes in Thought (ACT) cohort study. We