

Objective

- Heart rate variability (HRV) is a modifiable, non-invasive marker of autonomic function that has been associated with cardio- and cerebrovascular health in older adults.
- Wearable-derived HRV offers a scalable approach for assessing autonomic health. However, the validity and clinical utility of Fitbit-derived HRV in older adults remain unclear.
- The objectives of the current study were to validate Fitbit-derived HRV against gold-standard laboratory-based HRV and to examine associations with cardio- and cerebrovascular health and structural neuroimaging measures.

Methods

Sample

- N = 100 older adults without dementia recruited from studies at UCSF who completed 30 days of remote Fitbit monitoring and underwent MRI within 365 days of their Fitbit monitoring
- N = 30 clinically heterogeneous participants who completed Fitbit and in-lab HRV monitoring

Measures

Heart rate variability

- Fitbit-derived: Average nightly HRV during sleep was quantified using the root mean square of successive differences (RMSSD).
- Gold-standard: In-laboratory measured respiratory sinus arrhythmia (RSA)

Outcome Variables

Neuroimaging

- Hippocampal volume
- Frontal lobe volume
- White matter hyperintensity volume
- Global fractional anisotropy (FA)
- Global mean diffusivity

Cardiovascular

- Resting heart rate
- Average daily steps
- Vascular burden score (total sum of 4 vascular risk factors and 4 vascular diseases)

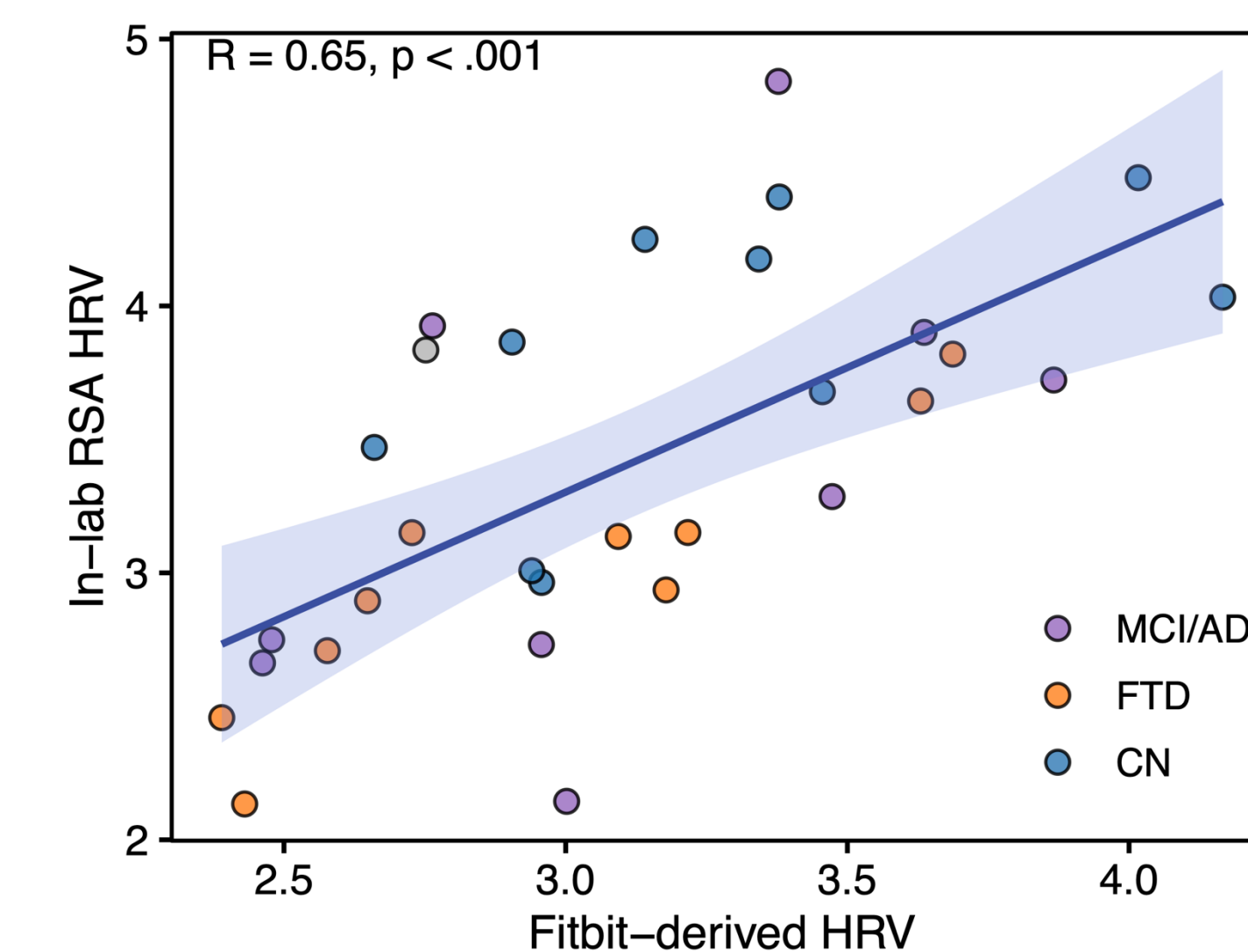
Statistical Analyses

- Pearson correlation evaluated convergent validity between Fitbit-derived HRV and in-laboratory RSA
- Regression models examined associations between Fitbit-derived HRV and cardiovascular and neuroimaging outcomes
- Models adjusted for age, sex, education and CDR global

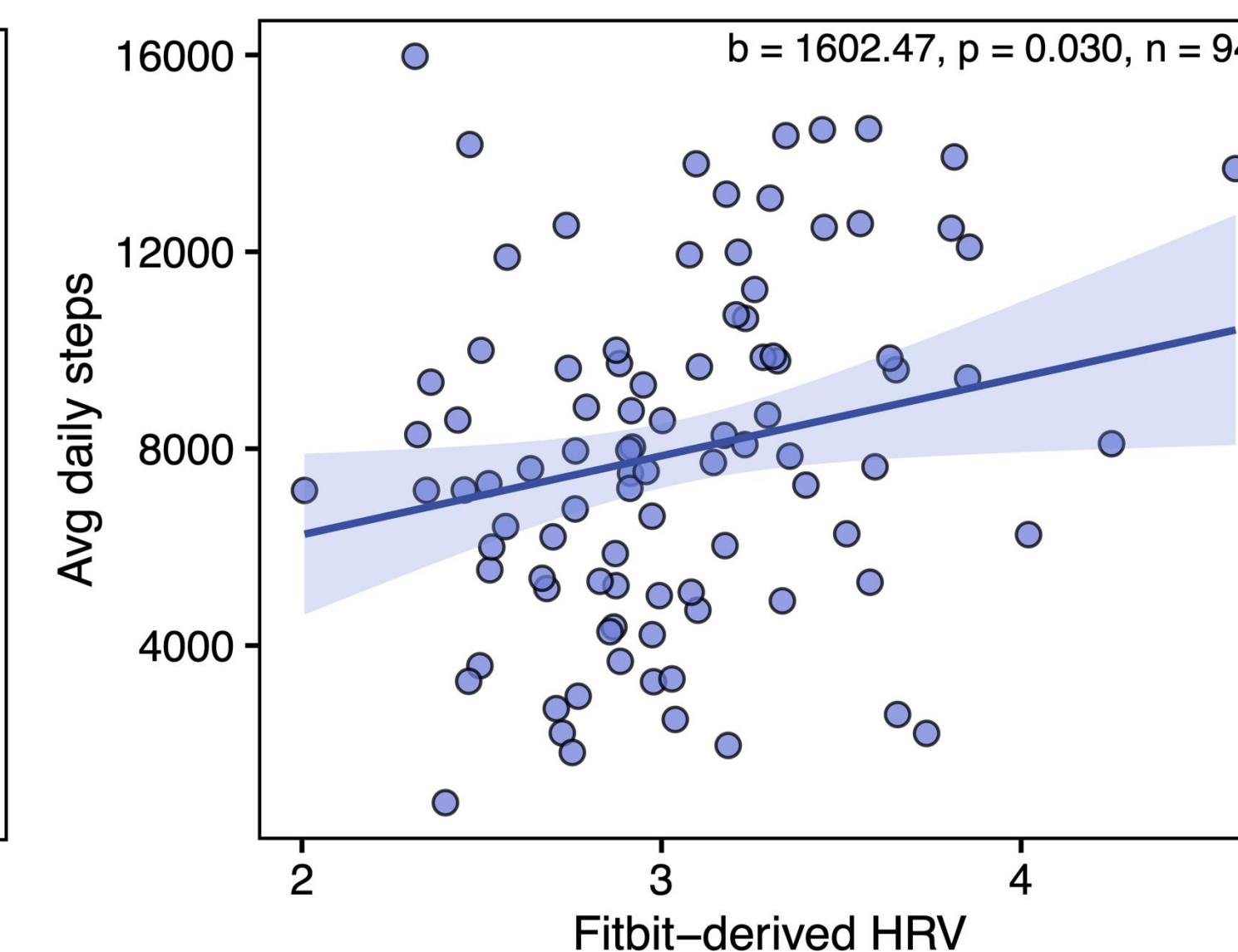
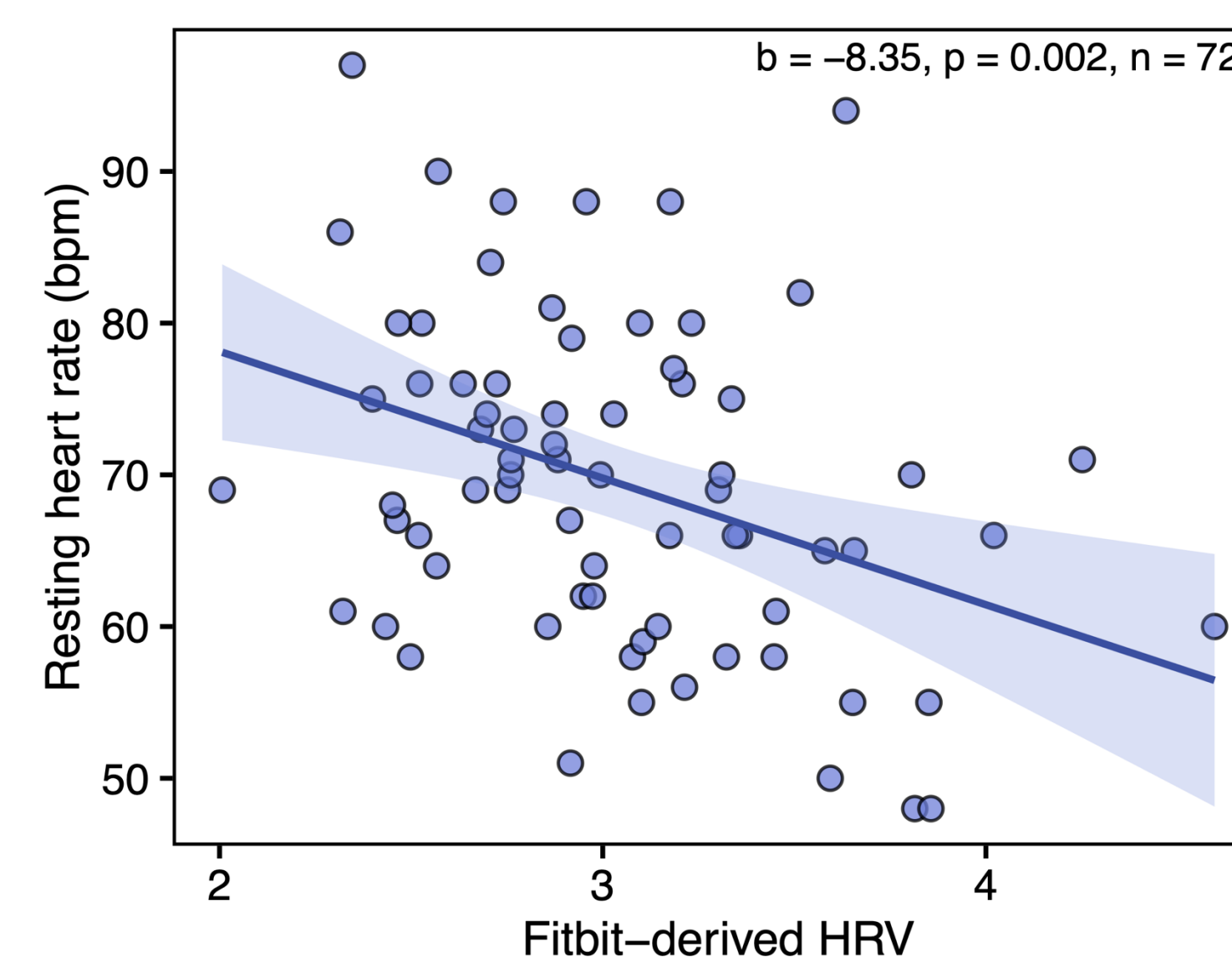
Table 1. Participant characteristics

Variable	HRV Validity Cohort (N = 30)	Clinical Analyses Cohort (N = 100)
Age	57.6 (12.4)	69.6 (11.1)
Sex (female)	9 (30%)	59 (59%)
Education (years)	17.3 (2.7)	17.1 (2.7)
CDR (0)	10 (33.3%)	70 (70%)
MMSE	26.5 (6.6)	28.8 (1.7)
Fitbit-derived HRV (log RMSSD)	3.1 (0.5)	3.0 (0.5)
Average daily steps	--	7953.9 (3450.5)
Resting heart rate	--	69.6 (10.9)
Vascular burden score	--	1.4 (1.1)

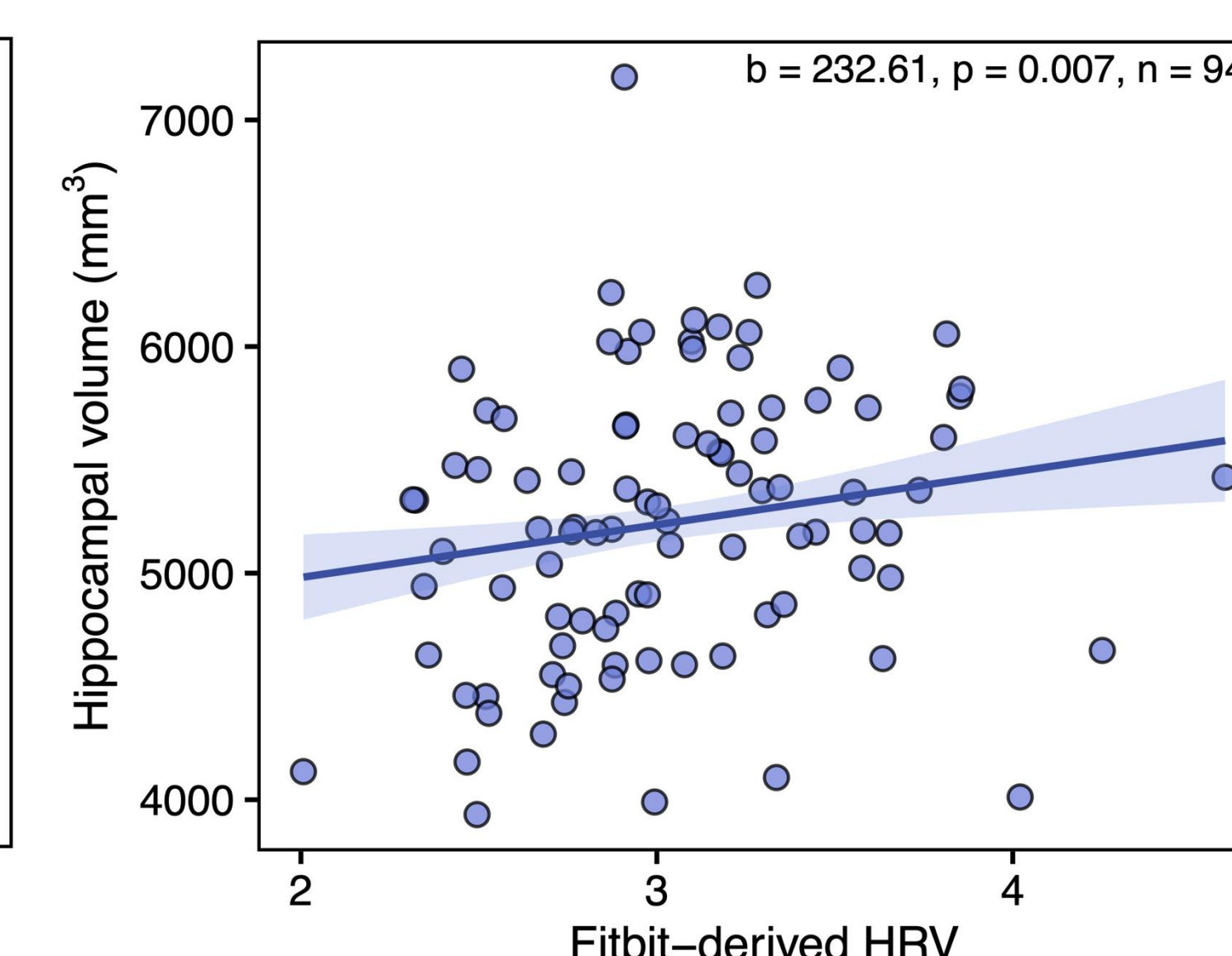
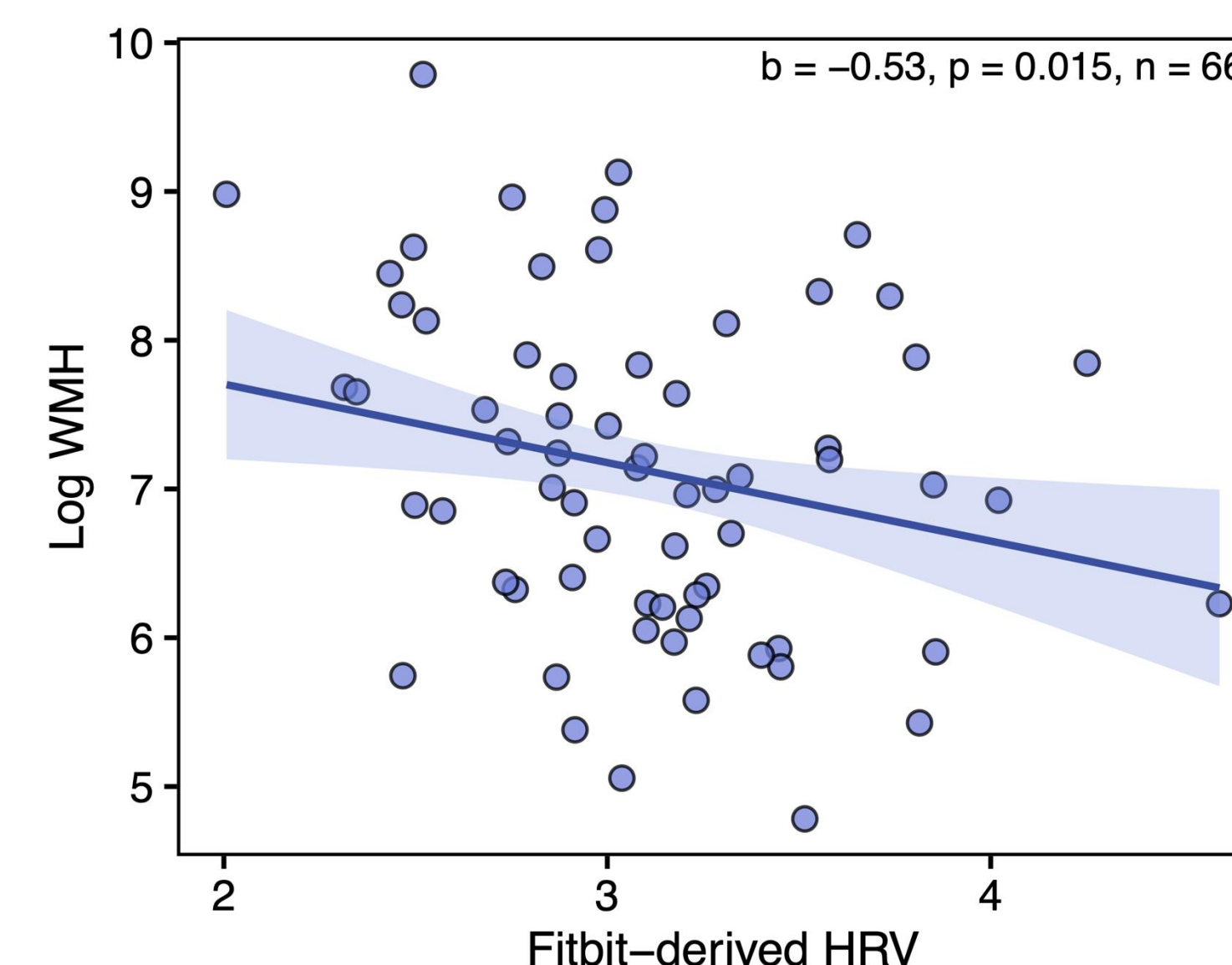
Fitbit-derived HRV demonstrates validity with gold-standard in-laboratory HRV



Higher HRV is associated with lower resting heart rate and greater average daily steps



Higher HRV is associated with lower WMH volume and larger hippocampal volume



No significant associations were observed between HRV and frontal lobe volume, global FA, global mean diffusivity, or vascular burden score

Outcome	Covariates	N	beta	p-value
Resting heart rate	Age, sex, edu	n = 72	-8.35	p < 0.01*
Avg daily steps	Age, sex, edu	n = 94	1602	p = 0.03*
Vascular burden score	Age, sex, edu	n = 93	-0.25	p = 0.29
WMH volume (log)	Age, sex, edu, TIV	n = 66	-0.53	p = 0.02*
Hippocampal volume	Age, sex, edu, TIV	n = 94	233	p < 0.01*
Frontal volume	Age, sex, edu, TIV	n = 94	455	p = 0.77
Global FA	Age, sex, edu	n = 72	0.003	p = 0.81
Global mean diffusivity	Age, sex, edu	n = 72	-0.014	p = 0.27

Discussion

- Fitbit-derived HRV demonstrates convergent validity with laboratory-based HRV and is associated with markers of cardio- and cerebrovascular health.
- Fitbit-derived HRV is significantly associated with hippocampal volume, a region vulnerable to age-related brain atrophy and affected early in Alzheimer's disease.
- Findings support the potential clinical utility of Fitbit-derived HRV for identifying vascular risk and characterizing autonomic dysfunction in older adults.
- Findings also support the potential of HRV as a modifiable target to support healthy brain aging.
- Future studies with large sample sizes and longitudinal data are needed to validate these findings.

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