

How Walking Speed Relates To Brain Health Outcomes In Men And Women: Findings From The Framingham Heart Study

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The gap between quick and usual walking speed tracks executive function in both sexes and dementia risk in women.

Background

Gait speed is a widely used indicator of aging and neurological health, yet men and women differ in gait determinants including physical capacity, executive-motor control, and responses to verbal instructions. **Usual walk speed (UWS)** represents habitual mobility, while **quick walk speed (QWS)** requires responding to commands and increasing effort and may relate to health outcomes differently by sex.

We examined sex-specific associations of usual walk speed, quick walk speed, and their difference (gait adaptability) with cognition, depressive symptoms, incident stroke, and incident dementia in the Framingham Heart Study.

Population

- **Offspring Cohort:** participants who attended their 7th exam (1999-2005) and a call back exam for cognitive and gait assessments
- **Sample 1 n = 2,308:** cognition, depression, and stroke analyses
- **Sample 2 n = 1,252:** dementia-free participants at baseline, aged ≥ 60 years, used for incident dementia analyses

Gait Assessment

UWS Usual pace

QWS As fast as possible

Gait
Adaptability
(QWS - UWS)

4-meter walking course (Speed in m/s)

Outcomes

1. **Cognition:** Logical Memory Delayed (verbal memory); Trails B-A (executive function)*
 2. **Depression:** CES-D score ≥ 16
 3. **Stroke:** Incident ischemic or hemorrhagic
 4. **Dementia:** Incident, clinician-adjudicated
- * log-transformed and sign-reversed so that higher values indicate better executive function

Statistical Analysis

Cross-sectional associations with cognition (linear) and depression (logistic) adjusted for age and education. Incident stroke and dementia assessed via Cox models adjusted for age and APOE $\epsilon 4$. UWS, QWS, and gait adaptability modeled continuously (per 1 SD slower).

Sample Characteristics

Table 1. Baseline characteristics by sex for the cross-sectional/stroke sample and the dementia sample

Characteristic	Cross-sectional, depression & stroke sample (n = 2,308)		Dementia sample (n = 1,252)	
	Women (n = 1,247)	Men (n = 1,061)	Women (n = 650)	Men (n = 602)
Age, years, mean $\pm$ SD	61.2 $\pm$ 9.2	61.8 $\pm$ 9.1	68.6 $\pm$ 5.8	68.7 $\pm$ 5.8
Education, n (%)				
No high school degree	27 (2.2)	52 (4.9)	25 (3.8)	43 (7.1)
High school degree	381 (30.6)	249 (23.5)	236 (36.3)	162 (26.9)
Some college	439 (35.2)	265 (25.0)	228 (35.1)	148 (24.6)
College degree	400 (32.1)	495 (46.7)	161 (24.8)	249 (41.4)
APOE $\epsilon 4$ carrier, n (%) ¹	276 (22.8)	228 (22.2)	144 (22.5)	134 (22.9)
Walking speed, m/s, median [IQR]				
Quick walking speed	2.00 [1.33, 2.00]	2.00 [1.33, 2.00]	1.33 [1.33, 2.00]	2.00 [1.33, 2.00]
Usual walking speed	1.33 [1.00, 1.33]	1.33 [1.00, 1.33]	1.33 [1.00, 1.33]	1.33 [1.00, 1.33]
Difference (quick – usual)	0.33 [0.20, 0.67]	0.67 [0.33, 0.67]	0.33 [0.20, 0.67]	0.53 [0.33, 0.67]

Notes.

Values are mean $\pm$ SD, median [IQR], or n (%). ¹APOE $\epsilon 4$ carrier percentages are among participants with available genotyping. SD, standard deviation; IQR, interquartile range.

Results

Table 2. Associations of quick walking speed, usual walking speed, and their difference with neuropsychological performance, depressive symptoms, incident stroke, and incident dementia, stratified by sex

Outcome	Model	Cases / N	Quick walking speed (per 1 SD slower)		Usual walking speed (per 1 SD slower)		Difference (quick – usual) (per 1 SD smaller)	
			Estimate	p	Estimate	p	Estimate	p
Logical Memory Delayed Recall $\beta \pm SE$	Women		0.097 $\pm$ 0.101	0.335	0.127 $\pm$ 0.098	0.196	-0.012 $\pm$ 0.095	0.897
	Men		-0.101 $\pm$ 0.109	0.354	-0.146 $\pm$ 0.107	0.176	-0.031 $\pm$ 0.106	0.767
Trails B-A (log-transformed) $\beta \pm SE$	Women		-0.011 $\pm$ 0.006	0.053	-0.002 $\pm$ 0.005	0.753	-0.012 $\pm$ 0.005	0.029
	Men		-0.031 $\pm$ 0.006	<0.001	-0.028 $\pm$ 0.006	<0.001	-0.014 $\pm$ 0.006	0.030
High depressive symptoms (CES-D ≥ 16) OR (95% CI)	Women		1.23 (1.02–1.47)	0.027	1.24 (1.04–1.48)	0.016	1.03 (0.87–1.23)	0.740
	Men		1.26 (0.95–1.67)	0.111	1.29 (0.98–1.69)	0.075	1.06 (0.80–1.40)	0.700
Incident stroke (10-year follow-up) HR (95% CI)	Women	30 / 1247	1.09 (0.76–1.56)	0.627	1.13 (0.80–1.59)	0.484	0.96 (0.66–1.41)	0.849
	Men	39 / 1061	1.55 (1.11–2.17)	0.011	1.68 (1.23–2.29)	0.001	0.96 (0.68–1.35)	0.814
Incident dementia (10-year follow-up) HR (95% CI)	Women	52 / 639	1.28 (1.02–1.62)	0.036	1.11 (0.85–1.45)	0.433	1.33 (1.02–1.73)	0.034
	Men	32 / 586	1.39 (0.94–2.07)	0.101	1.37 (0.95–1.99)	0.096	0.98 (0.68–1.42)	0.920

Notes.

Estimates reflect each 1 SD slower walking speed; the difference (quick – usual) is scaled so higher values indicate reduced capacity to accelerate. $\beta \pm SE$ from linear regression (neuropsychological outcomes); OR (95% CI) from logistic regression (depressive symptoms); HR (95% CI) from Cox regression (incident stroke, incident dementia).

Models adjusted for age and education (cross-sectional outcomes) or age and APOE $\epsilon 4$ status (dementia). Cases / N shown for incident outcomes. Bold indicates $p < 0.05$. CES-D, Center for Epidemiologic Studies Depression Scale; CI, confidence interval.

Slower UWS and QWS were associated with executive dysfunction in both sexes and stroke only in men. Only the quick-minus-usual difference, an index of gait adaptability, identified dementia risk, selectively in women. A single quick-walk trial adds minimal burden yet may sharpen brain-health risk stratification beyond usual gait speed alone.

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