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ORIGINAL RESEARCH

Sensorimotor Peripheral Nerve Function and the Longitudinal Relationship With Endurance Walking in the Health, Aging and Body Composition Study

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Abstract

Objectives: To determine whether lower extremity sensorimotor peripheral nerve deficits are associated with reduced walking endurance in older adults.

Design: Prospective cohort study with 6 years of follow-up.

Setting: Two university research clinics.

Participants: Community-dwelling older adults enrolled in the Health, Aging and Body Composition Study from the 2000−2001 annual clinical examination (N=2393; mean age ± SD, 76.5±2.9y; 48.2% men; 38.2% black) and a subset with longitudinal data (n=1178).

Interventions: Not applicable.

Main Outcome Measures: Participants underwent peripheral nerve function examination in 2000−2001, including peroneal motor nerve conduction amplitude and velocity, vibration perception threshold, and monofilament testing. Symptoms of lower extremity peripheral neuropathy included numbness or tingling and sudden stabbing, burning, pain, or aches in the feet or legs. The Long Distance Corridor Walk (LDCW) (400m) was administered in 2000−2001 and every 2 years afterward for 6 years to assess endurance walking performance over time.

Results: In separate, fully adjusted linear mixed models, poor vibration threshold (>130μm), 10-g and 1.4-g monofilament insensitivity were each associated with a slower 400-m walk completion time (16.0s, 14.4s, and 6.9s slower, respectively; $P<.05$ for each). Poor motor amplitude (<1mV), poor vibration perception threshold, and 10-g monofilament insensitivity were related to greater slowing per year (4.7, 4.2, and 3.8

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additional seconds per year, respectively; $P<.05$), although poor motor amplitude was not associated with initial completion time.
Conclusions: Poorer sensorimotor peripheral nerve function is related to slower endurance walking and greater slowing longitudinally. Interventions to reduce the burden of sensorimotor peripheral nerve function impairments should be considered to help older adults maintain walking endurance—a critical component for remaining independent in the community.
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Sensorimotor peripheral nerve function deficits are common in older adults, even in the absence of diabetes.[1-3] In the Health, Aging and Body Composition (Health ABC) Study, recent work indicated that 55% of mobility-intact older adults (N=1680; mean age ± SD, 76.5±2.9y) at the 2000–2001 examination had evidence of lower extremity peripheral nerve impairment.[3] Poor peripheral nerve function in older adults is associated with worse lower extremity function,[4-7] reduced quadriceps and ankle dorsiflexion strength,[8,9] falls,[10-13] and lower extremity mobility limitations.[3] Worse lower extremity sensation and motor control resulting from sensorimotor peripheral nerve dysfunction can lead to altered gait mechanics and inefficient and unstable gait patterns.[14-19] Additionally, symptoms related to peripheral nerve impairments, including lower extremity pain or numbness, may make weight-bearing activities such as walking difficult.

Walking endurance—the ability to walk for a sustained time or distance—is important for independence and remaining active in the community. Although aerobic fitness plays a major role in endurance walking, factors such as peripheral nerve function may influence walking endurance over time, particularly given its impact on lower extremity function. However, work has been limited in exploring the impact of peripheral nerve impairments on walking endurance.

Evidence exists that walking endurance is worse in diabetic adults compared with nondiabetic healthy adults,[20] and also in the presence of a greater burden of lower extremity complications from diabetic peripheral neuropathy.[21] In the InCHIANTI Study,[22] motor nerve conduction velocity was cross-sectionally associated with slower completion of a fast-paced 400-m walking test for older diabetic and nondiabetic adults. Ideally, both motor and sensory nerve assessments and symptoms should be included to examine the full range of peripheral nerve function, not only clinical disease.[23] Furthermore, no longitudinal studies have examined whether peripheral nerve function contributes to a decline in endurance walking over time in old age.

This study aimed to (1) examine whether worse sensorimotor peripheral nerve function is cross-sectionally related to poorer endurance walking in older adults; and (2) determine whether worse sensorimotor peripheral nerve function is associated with greater slowing longitudinally over 6 years of follow-up in the Health ABC Study.

Methods

Study population

Participants were from the Health ABC Study, a longitudinal cohort study of community-dwelling older adults (N=3075; age range, 70–79y; 48.4% men; 41.6% black at baseline) from Pittsburgh, Pennsylvania and Memphis, Tennessee aimed at investigating factors related to the development of functional limitation and disability.[24] Participants had to self-report having no difficulty in walking a quarter mile, climbing 10 steps, or any basic activity of daily living; be free of any life-threatening cancers; and plan to remain in the study area for at least 3 years. Participants completed the baseline visit between April 1997 and June 1998 and provided written informed consent. In 2000–2001, 2404 participants had a clinic visit, with 2393 having complete nerve function and endurance walking data (fig 1). All study protocols were approved by institutional review boards at the University of Pittsburgh and the University of Tennessee Health Science Center.

List of abbreviations:

Health ABC **Health, Aging and Body Composition**
LDCW **Long Distance Corridor Walk**

Peripheral nerve function measures

Lower extremity sensory and motor nerve function was assessed in 2000–2001 by a trained examiner. Motor nerve function was measured objectively using amplitude (mV) and conduction velocity (m/s) of the peroneal motor response as previously described.[25] Stimulation occurred at the popliteal fossa and ankle using the NeuroMax 8.[a] Sensory nerve function was measured using vibration detection threshold and monofilament testing. Vibration detection threshold (in μm) was measured at the bottom of the great toe with a VSA-3000 Vibratory Sensory Analyzer.[b] Monofilament insensitivity was defined as the inability to detect 3 of 4 touches at the dorsum of the large toe with a standard 10-g and light 1.4-g monofilament.[c] Feet were warmed to 30°C, and measures were performed on the right unless contraindicated because of knee replacement, amputation, trauma, ulcer, or recent surgery, in which case the left side was tested unless also contraindicated. Clinically meaningful cut points of motor amplitude <1mV, conduction velocity <40m/s,[26] or vibration threshold >130μm were used to define impairment. These cut points were previously used by Ward et al[3] and are related to quadriceps strength declines over time[9] and incident mobility limitation.

Self-reported symptoms of peripheral neuropathy included (1) numbness, asleep feeling, prickly feeling, or tingling; (2) sudden stabbing, burning, or deep aches; or (3) an open, persistent sore or gangrene on either foot or leg in the past 12 months.

Endurance walking

The Long Distance Corridor Walk (LDCW) was administered in 2000–2001 and follow-up visits in 2002–2003, 2004–2005, and 2006–2007 to assess walking endurance.[27] Exclusion criteria included systolic blood pressure >200mmHg, resting pulse rate ≥120 beats/min, presence of an electrocardiogram abnormality, cardiac surgery, and worsening of chest pain or shortness of breath in the prior 3 months. This test included a warm-up where the participant was to cover as much ground as possible for 2 minutes, followed by the 400-m walk performed as quickly as possible at a pace that can be maintained.[28] Completion time for the 400-m