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Response to Letter to the Editor

Response to "Comment on: Fatigability: A Prognostic Indicator of Phenotypic Aging"

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We appreciate the response to our editorial (1) by Palmberg et al. that introduced a modified computational approach for assessing performance fatigability (ie, slowing down/performance deterioration) from a usual-paced 6-minute walk test (6MWT) in older adults. Measures of performance fatigability derived from usual-paced overground walking tests are a necessary and important addition to the field (2), especially because several historical and ongoing studies of older adults, including the Lifestyle Interventions and Independence for Elders study, the Study of Muscle, Mobility and Aging, and the Active Aging—resilience and external support as modifiers of the disablement outcome (AGNES) project, among others conduct usual-paced walking tests to evaluate physical function or mobility disability (3), not aerobic fitness (4).

To this end, Palmberg et al. combined the foundational work of Simonsick et al. (5) (based on fast-paced 400 m walk) and Murphy et al. (6) (based on fast-paced 6MWT) to develop an alternative method for detecting performance fatigability using a usual-paced 6MWT in a population of Finnish adults aged 75, 80, and 85 years. This method substitutes the ratio of change in lap times between the second and the next to the last lap as the numerator with total distance walked as the denominator. Although intuitively appealing, applying the Simonsick et al. (5) approach to a usual-paced walk not designed or expected to induce fatigue and subsequent performance deterioration may need further evaluation. However, Palmberg et al.'s equation may be suitable to capture performance fatigability during a 6MWT in older and/or functionally limited individuals for whom usual and fast gait speed converge (7), as these individuals likely perform at peak effort even during a usual-paced walk over a prolonged distance or time.

Extending the application of the Palmberg et al. equation to younger and/or better functioning older adults requires additional investigation. Although few studies include both fast- and usual-paced long-distance walks, the Developmental Epidemiologic Cohort Study (DECOS) of community-dwelling older adults was designed in large part to develop and test new methods including both fast- and usual-paced 400 m walks assessed 8–14 days apart (7). A total of 59 older adults completed both walks (mean age 78.4 ± 5.8 years, 58% women, Short Physical Performance Battery [SPPB] score 10.6 ± 1.4). Average completion times for the fast- and usual-paced 400 m walks were 333.3 and 380.3 seconds, respectively (7). Overall, the time differences between the second and ninth laps for the usual-paced walk (0.5 ± 1.8 seconds) were nearly half that for the fast-paced walk (0.9 ± 2.1 seconds) (7). We further examined this data using the lap time variation approach developed for the Baltimore Longitudinal Study of Aging by Tian et al. (8) and it showed that variation in the usual-paced walk (1.1 ± 0.7 seconds) was also lower than for the fast-paced walk (1.7 ± 1.2 seconds). Collectively, these findings suggest that equations for performance fatigability based on a fast-paced walk may not translate to a usual-paced walking test because of lower overall speed and variability. Moreover, the DECOS data indicate that participants tend to have variable walking speed patterns during both 400 m walks (Table 1). For example, some participants, especially those with higher functioning (SPPB ≥10), had faster walking speeds toward the end of the walking test (laps 8–10) compared to the second lap (Table 1). Therefore, an equation that uses the second lap time as an indicator of a participant's fastest speed might not be appropriate for younger and/or higher functioning older adults.

The work by Palmberg et al. marks an important first step, bringing to the forefront a clear gap in knowledge and urging a scientific priority for establishing valid and sensitive measures of performance fatigability that simulate real-life situations. Most current methods for detecting performance fatigability require a sustained effort and may not be sufficiently challenging for younger and/or

Table 1. Comparisons of Lap Time (seconds) for the Fast- and Usual-Paced 400 m Walk Tests Stratified by Physical Function: The Developmental Epidemiologic Cohort Study (N = 59)

	First Lap	Second Lap	Third Lap	Fourth Lap	Fifth Lap	Sixth Lap	Seventh Lap	Eighth Lap	Ninth Lap	Tenth Lap
*Fast-paced 400 m walk**										
Overall	31.2	32.2	33.3	34.2	35.0	33.9	33.8	33.6	33.7	33.5
	(25.4–34.6)	(27.5–37.2)	(27.6–37.0)	(28.3–37.6)	(29.0–41.0)	(28.3–39.1)	(27.8–39.1)	(27.8–37.6)	(27.5–37.4)	(27.0–37.1)
Lower function	34.8	37.2	37.0	37.6	41.0	39.1	39.1	36.9	37.0	36.8
(n = 23)	(31.3–36.6)	(32.8–39.4)	(33.5–40.9)	(34.4–41.3)	(35.8–43.7)	(35.3–42.5)	(34.9–41.4)	(34.3–41.5)	(34.4–41.6)	(34.6–40.9)
Higher function	28.0	29.3	29.7	30.1	30.9	30.2	28.9	29.0	29.1	28.8
(n = 36)	(24.9–32.1)	(26.5–33.0)	(26.1–33.4)	(27.0–34.4)	(28.2–34.9)	(26.9–34.4)	(27.0–33.8)	(26.5–33.7)	(26.6–33.9)	(26.3–34.0)
Usual-paced 400 m walk										
Overall	35.6	38.0	38.6	39.3	39.5	39.0	38.4	38.1	38.0	38.1
	(32.8–39.0)	(34.4–41.1)	(34.3–42.0)	(34.7–42.2)	(35.7–42.7)	(35.2–42.1)	(34.9–42.3)	(34.8–41.8)	(34.7–41.8)	(34.0–41.7)
Lower function	38.3	40.3	41.8	41.7	42.7	41.3	41.6	40.9	41.3	41.6
(n = 23)	(34.8–40.3)	(37.9–43.4)	(37.9–44.8)	(38.8–44.5)	(39.8–45.8)	(39.2–43.9)	(38.6–44.0)	(39.2–43.5)	(38.3–43.9)	(37.8–43.4)
Higher function	33.9	35.9	36.4	36.8	37.4	36.0	36.2	36.0	35.7	35.9
(n = 36)	(30.0–37.0)	(32.0–38.8)	(32.6–40.0)	(32.3–39.4)	(33.1–40.6)	(32.8–39.6)	(33.0–39.8)	(33.0–39.6)	(32.8–40.0)	(32.8–39.9)

Notes: All values are given as median (IQR). Lower function categorized as Short Physical Performance Battery (SPPB) score <10; higher function as SPPB ≥10.

*There were 2 participants who did not complete the 10th lap.

higher-functioning populations, thus applying walking tasks more indicative of daily living, or perhaps in free-living situations, may improve the ability to detect performance decrements. Additionally, developing advanced methods that capture more detailed aspects of walking patterns to measure performance fatigability, perhaps using accelerometry-based gait parameters (9) or activity fragmentation (10), will be beneficial to detect slowing or periods of rest across different populations, particularly those who are unable to complete the full walking task due to activity-limiting symptoms such as pain. These future directions are imperative for establishing the most sensitive metrics of this important prognostic indicator of phenotypic aging (1).

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Conflict of Interest

JAS and EMS are on the editorial board of JGMS.

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