HHS Public Access

Author manuscript

J Am Geriatr Soc. Author manuscript; available in PMC 2022 November 01.

Published in final edited form as:

J Am Geriatr Soc. 2021 November ; 69(11): 3328–3330. doi:10.1111/jgs.17360.

Estimating Cardiorespiratory Fitness in Older Adults using a Usual-paced 400m Long-Distance Corridor Walk

Reagan E. Moffit, BS[1], **Yuiia (Susanna) Qiao, ScM**[1], **Kyle D. Moored, PhD**[1], **Adam J. Santanasto, PhD, MPH**[1], **Brittney S. Lange-Maia, PhD, MPH**[2], **Peggy M. Cawthon, PhD**[3], **Bret H. Goodpaster, PhD**[4], **Elsa S. Strotmeyer, PhD, MPH**[1], **Anne B. Newman, MD, MPH**[1], **Nancy W. Glynn, PhD**[1]

[1]Department of Epidemiology, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA, USA

[2]Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, IL, USA

[3]Translational Research Institute, AdventHealth Research Institute, Orlando, FL, USA

[4]Research Institute, California Pacific Medical Center, San Francisco, CA 94143, USA

Introduction

Cardiopulmonary exercise testing (CPET) is the gold standard measure of aerobic fitness (VO_2peak), a powerful indicator of an older adults' capacity to perform daily and recreational activities (VO_2peak >18 mL/kg/min indicative of functional independence).[1] However, maximal effort during CPET performance may be limited by functional status and is not always feasible in epidemiologic studies due to rigorous staff training, equipment requirements, participant burden, and potential inconsistency across clinical centers. Subsequently, a fast-paced overground long-distance corridor walk (LDCW), a safer and less-expensive alternative for older adults, was validated against treadmill CPET.[2] However, many clinical and epidemiologic studies include a usual-paced 400m LDCW in lieu of a fast-paced walk.[3] With increasing frailty and age, even a usual-paced 400m LDCW may be challenging and elicit ones' maximal capacity, as evidenced by comparable performance on fast-paced and usual-paced 400m LDCW tests for those older and lower functioning.[4] Therefore, the usual-paced LDCW may estimate CPET performance, though this has not been previously shown.

This report examined whether a usual-paced 400m LDCW was related to VO_2peak measured from treadmill CPET.

Corresponding Author: Nancy W. Glynn, PhD, Department, of Epidemiology, Graduate School of Public Health, University of Pittsburgh, 130 DeSoto Street, 5120 Public Health, Pittsburgh, PA 15261, 412.383.1309 (phone), epidnwg@pitt.edu.

Author Contributions: Ms. Moffit and Dr. Glynn had full access to all of the data in the study and take responsibility for the integrity of the data and accuracy of the data analysis. All authors: interpretation of data, critical revision of manuscript for important intellectual content. All authors read and approved the submitted manuscript.

Preliminary findings were presented at the 2014 American College of Sports Medicine Annual Meeting, Orlando, FL, May, 2014.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Sponsor's Role: None

Methods

Community-dwelling older adults (N=36) aged 70-89 years were enrolled in the cross-sectional Study of Energy and Aging - Pilot (SEA-P), the pilot to the Study of Muscle, Mobility, and Aging (SOMMA).[5] Institutional Review Boards at the University of Pittsburgh and California Pacific Medical Center approved SEA-P, and written informed consent was obtained.

Participants were instructed to complete the 400m LDCW at their "usual or normal walking pace" down a long hallway marked with traffic cones spaced 20m apart with time to completion (seconds) recorded. VO_2peak was determined using a modified Balke protocol following American College of Sports Medicine criteria,[6] with strong encouragement to reach a respiratory exchange ratio >1.05 and Borg RPE >16.[5] Treadmill speed was held constant at the participants' fastest of two usual-paced gait speed 6m walks. Treadmill grade began at 0% and increased by 2% every 2 minutes until volitional exhaustion.[5] Covariates examined: age, sex, and physical fatigue (Situational Fatigue Scale[7]).

Two participants completed the usual-paced 400m LDCW, but were unable to finish CPET; final analytic sample N=34. We generated Pearson correlations between VO_2peak and covariates. Linear regression analysis estimated VO_2peak (outcome) and usual-paced 400m LDCW time (independent variable), adjusted for covariates. Statistical analyses were conducted using SAS v9.4 (SAS Institute, Inc., Cary, NC).

Results

SEA-P participants were mean age 78.2±5.1 years, largely male (59%) and white (94%), with physical fatigue score=6.4±4.2 (scale range: 0-20), and Short Physical Performance Battery score=10.9±1.3 (test range: 0-12), indicating higher function. Participants had a VO_2peak of 22.1±5.6 mL/kg/min (range: 7.8-33.4 mL/kg/min). Time to complete the usual-paced 400m LDCW was 339.6±60.4s (range: 252.5s-536.0s). VO_2peak was strongly inversely correlated ($r=-0.64$, $p<.0001$, Figure 1) with usual-paced 400m LDCW time and moderately inversely correlated with age ($r=-0.41$) and physical fatigue score ($r=-0.42$), both $p<.02$.

Every 30 seconds longer (i.e., slower) time to complete the usual-paced 400m LDCW was associated with a 1.5 mL/kg/min lower measured VO_2peak adjusted for age and physical fatigue score ($p=.0002$), explaining 41% of the 57% total model variance in VO_2peak (Supplemental Table 1). Age (8%) and fatigue (8%) also contributed to the explained variance in VO_2peak (both $p=.03$). Adding sex did not improve the estimation of VO_2peak, $p=.27$.

Discussion

We established that usual-paced 400m LDCW time strongly estimated cardiorespiratory fitness in older adults after age and physical fatigue adjustment. As expected, age was associated with VO_2peak, but usual-paced 400m LDCW time explained >5-fold more of the model variance than age. Physical fatigue score also explained some variance in VO_2peak,

supporting existing evidence that higher fatigue relates to poorer exercise capacity[8,9] All participants completed the LDCW, but two were unable to finish the CPET, highlighting the utility for an alternative measurement of VO_2peak.

Limitations include small sample size and using a less sensitive measure of one's perception of fatigue.[9,10] Furthermore, the SEA-P sample was relatively high functioning, hence more research is needed to confirm our findings in lower functioning older adults. A strength was measuring VO_2peak with the well-established, standardized modified Balke protocol.

Our findings demonstrate initial support for using a usual-paced 400m LDCW as a viable alternative for measuring cardiorespiratory fitness in older adults, thus providing another low-cost, safer option for research and clinical settings. The ability to identify at-risk older adults with poor walking endurance indicative of prevalent or impending mobility limitations is important for early interventions. Future research in SOMMA may confirm and extend this work, as its large sample will allow for subgroup analyses by age, sex, physical function, and fatigability severity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Financial Disclosure:

This work was supported by the National Institutes of Health, National Institute on Aging, American Recovery and Reinvestment Act grant RC2 AG036594, the University of Pittsburgh Claude D. Pepper Older Americans Independence Center Research Registry P30 AG024827. Additionally, the National Institute on Aging Epidemiology of Aging training grant T32 AG000181 at the University of Pittsburgh supported KJM and BSL. AJS was supported by National Institute on Aging grant K01 AG057726.

References

1. Huggett DL, Connelly DM, Overend TJ. Maximal aerobic capacity testing of older adults: a critical review. J Gerontol A, Biol Sci Med Sci. 2005;60(1):57–66. doi:10.1093/gerona/60.1.57 [PubMed: 15741284]
2. Simonsick EM, Fan E, Fleg JL. Estimating cardiorespiratory fitness in well-functioning older adults: treadmill validation of the long distance corridor walk. J Am Geriatr Soc. 2006;54(1):127–132. doi:10.1111/j.1532-5415.2005.00530.x [PubMed: 16420209]
3. Rolland YM, Cesari M, Miller ME, Penninx BW, Atkinson HH, Pahor M. Reliability of the 400-m usual-pace walk test as an assessment of mobility limitation in older adults. J Am Geriatr Soc. 2004;52(6):972–976. doi:10.1111/j.1532-5415.2004.52267.x [PubMed: 15161464]
4. Lange-Maia BS, Newman AB, Strotmeyer ES, Harris TB, Caserotti P, Glynn NW. Performance on fast- and usual-paced 400-m walk tests in older adults: are they comparable? Aging Clin Exp Res. 2015;27(3):309–314. doi:10.1007/s40520-014-0287-y [PubMed: 25373610]
5. Richardson CA, Glynn NW, Ferrucci LG, Mackey DC. Walking energetics, fatigability, and fatigue in older adults: the study of energy and aging pilot. J Gerontol A, Biol Sci Med Sci. 2015;70(4):487–494. doi:10.1093/gerona/glu146 [PubMed: 25190069]
6. ACSM's Guidelines For Exercise Testing And Prescription. 9th ed. Lippincott Williams & Wilkins; 2013.
7. Yang C-M, Wu C-H. The situational fatigue scale: a different approach to measuring fatigue. Qual Life Res. 2005;14(5):1357–1362. doi:10.1007/s11136-004-5680-0 [PubMed: 16047510]

8. Alexander NB, Taffet GE, Horne FM, et al. Bedside-to-Bench conference: research agenda for idiopathic fatigue and aging. J Am Geriatr Soc. 2010;58(5):967–975. doi:10.1111/j.1532-5415.2010.02811.x [PubMed: 20722821]

9. Schrack JA, Simonsick EM, Glynn NW. Fatigability: A prognostic indicator of phenotypic aging. J Gerontol A, Biol Sci Med Sci. 2020;75(9):e63–e66. doi:10.1093/gerona/glaa185 [PubMed: 32936913]

10. Glynn NW, Santanasto AJ, Simonsick EM, et al. The Pittsburgh Fatigability Scale for older adults: development and validation. J Am Geriatr Soc. 2015;63(1):130–135. doi:10.1111/jgs.13191 [PubMed: 25556993]

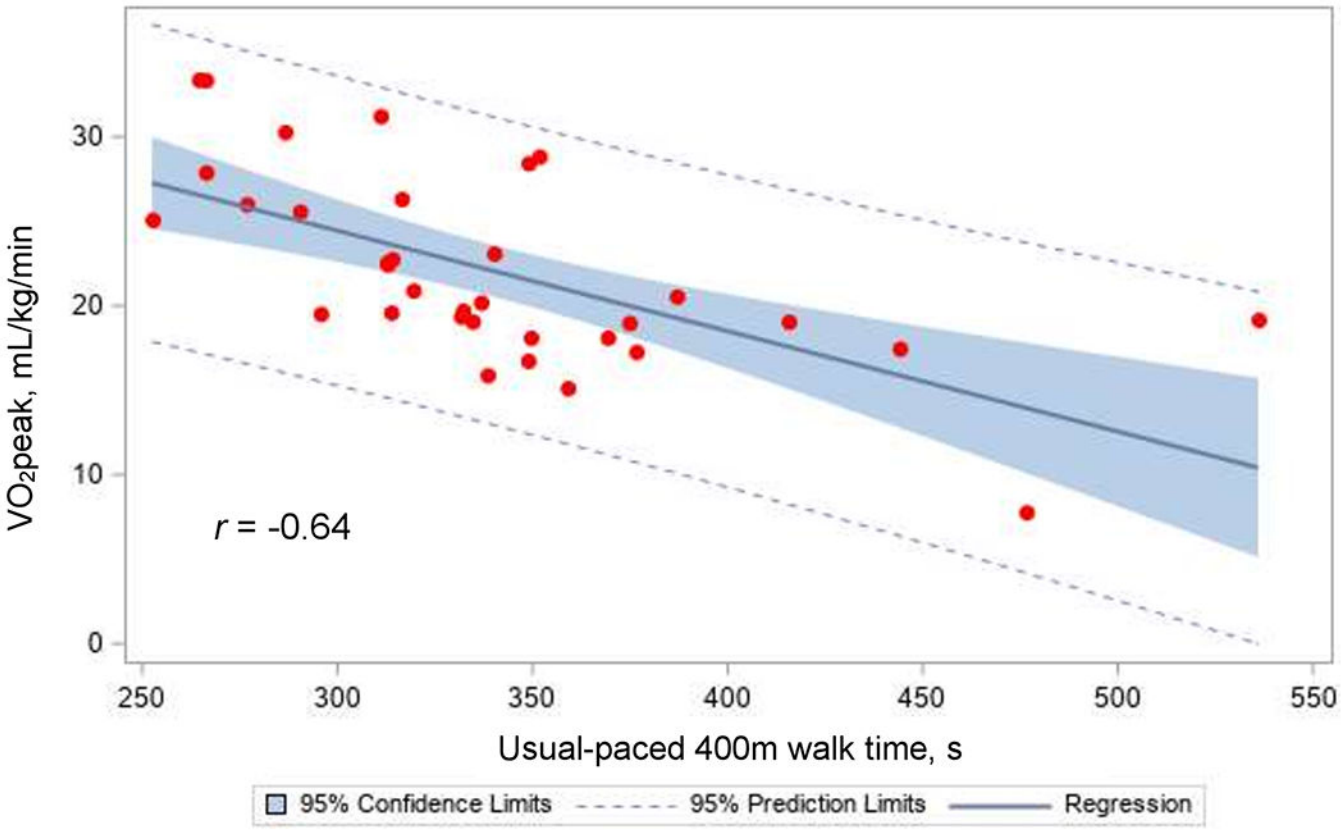

Figure 1.

Correlation between time to complete a usual-paced 400m long-distance corridor walk and cardiorespiratory fitness (VO_2peak) measured by treadmill cardiopulmonary exercise testing with a modified Balke protocol.