NIH Public Access
Author Manuscript
J Geriatr Phys Ther. Author manuscript; available in PMC 2013 July 01.

Published in final edited form as:
J Geriatr Phys Ther. 2012 July ; 35(3): 112–117. doi:10.1519/JPT.0b013e318243e5f9.

Use of Stance Time Variability for Predicting Mobility Disability in Community-Dwelling Older Persons: A Prospective Study

Jennifer S. Brach, PhD, PT[a], **David Wert, MPT**[a], **Jessie M. VanSwearingen, PhD, PT**[a], **Anne B. Newman, MD, MPH**[b], and **Stephanie A. Studenski, MD, MPH**[c]

[a]Department of Physical Therapy, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA

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

[c]Division of Geriatric Medicine, Department of Medicine, University of Pittsburgh, Pittsburgh, PA

Abstract

Background and Purpose—Mobility disability is a serious and frequent adverse health outcome associated with aging. Early identification of individuals at risk for mobility disability is important if interventions to prevent disability are to be instituted. The objectives of this prospective study were to: 1) determine the magnitude of stance time variability (STV) that discriminates individuals who currently have mobility disability (prevalent mobility disability) and 2) determine the magnitude of STV that predicts a new onset of mobility disability at one year (incident mobility disability).

Methods—552 community-dwelling older adults were evaluated as part of the Cardiovascular Health Study, a longitudinal cohort study. Stance time, in milliseconds (ms), was determined from 2 passes on a 4-meter computerized walkway at self-selected walking speed, and STV was defined as the standard deviation (SD) from approximately 12 individual steps. Mobility disability was defined as self-reported difficulty walking a half mile. Receiver operating characteristic (ROC) curves were plotted to determine an optimal cutoff value for stance time variability for prevalent and incident mobility disability, and the area under the ROC curve was computed.

Results—The optimal cut-off score for STV (maximizing sensitivity and specificity) for prevalent mobility disability was 0.037 sec(sensitivity = 65%, specificity = 65%, AUC = 0.70) and for incident 1 year mobility disability was 0.034 sec(sensitivity = 61%, specificity = 60%, AUC = 0.65). The use of likelihood ratios demonstrated a gradient of risk across values of STV, with mobility risk increasing as values of STV increased.

Discussion and Conclusion—Values of STV may be useful in identifying older adults with mobility disability and at risk for future disability. We recommend the more conservative estimate for identifying risk, STV=0.034 s, which maximizes the sensitivity and minimizes false negatives. The relatively modest values on the validity indices could possibly be improved by increasing the reliability of the measurement of STV. Clinicians should interpret the cut-off values liberally and

Corresponding author: Jennifer S. Brach, PhD, PT, 6035 Forbes Tower, Pittsburgh, PA 15260, jbrach@pitt.edu, Telephone: 412-383-6533, Fax: 412-648-5970.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

A portion of this research was presented at APTA CSM 2007, Boston, MA

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

use STV in conjunction with other measures until further work is completed to validate STV as an indicator of mobility disability.

Keywords

Gait variability; Disability; Sensitivity; Specificity; Older Adults

INTRODUCTION

Gait variability, defined as fluctuations in gait characteristics from step to step, has been shown to be related to future falls and mobility disability in older adults.[1–4] Specific measures of gait variability can reflect any of a number of spatial (step length, step width) or temporal (stance time, stride time) gait characteristics. Prior studies have reported on step length,[4–6] step width,[6–9] stride time[5,7,10] and stance time[2,10] variability. Stance time variability (i.e. the variability in the time from initial foot-floor contact until final foot-floor contact) has been shown to be related with the central nervous system and psychomotor function,[11] and with future mobility disability.[2] Brach et al. (2007) investigated the ability of stance time variability (STV) to predict incident mobility disability (self-reported ability to walk ½ mile) in a cohort of community-dwelling older adults. Greater STV was found to be related to incident mobility disability; however a specific cut-point of STV related to mobility disability was not established.[2]

Physical therapists often perform evaluations on their patients to guide clinical decision making for current intervention and prevention of future disability. In order for STV to be a useful indicator of mobility disability, the magnitude (cut-point) of STV that discriminates mobility disability must be determined. A cut-point of STV would provide useful diagnostic and prognostic information to clinicians for distinguishing patients with current mobility disability problems and for assisting in predicting which patients are at risk for developing future mobility disability. Developing the measure of STV is accomplished by establishing the construct and predictive validity for mobility disability using validity indices [sensitivity, specificity, receiver operating characteristic (ROC) curve and area under the curve (AUC)] to establish meaningful cut-point values.

Mobility disability is a serious and frequent adverse health outcome associated with aging and is often a result of chronic disease.[12] Establishing a specific value of STV that can be used to identify and predict mobility disability and who may benefit from interventions to improve gait variability would provide physical therapists with a valuable clinical tool for early detection and intervention of this serious health outcome.

The purpose of this study was to: 1) determine the magnitude of STV that discriminates individuals who currently have mobility disability (prevalent mobility disability) and 2) determine the magnitude of STV that predicts a new onset of mobility disability at one year (incident mobility disability).

METHOD

Study Design

This study is based on a subsample of participants in the Cardiovascular Health Study (CHS). The CHS is a population-based, ongoing longitudinal multi-center study of coronary heart disease and stroke risk in community-dwelling older adults age 65 years and older.[13,14] At the initiation of the CHS in 1989–90, individuals were identified from the Health Care Financing Administration sampling frame using age and gender stratified random samples. Individuals who were 65 years or older, non-institutionalized, expected to remain in the area

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

for 3 years and able to give informed consent were included in the study. Individuals who were wheelchair- dependent in the home or were receiving hospice care, radiation therapy or chemotherapy for cancer were excluded.[13,14] In 1989–90 an original cohort of 5201 predominately Caucasian (i.e. > 95% Caucasian) men and women were enrolled, and in 1992–93 a cohort of 687 African Americans was added. The study was approved by the University of Pittsburgh Institutional Review Board and all subjects signed informed consent prior to participation.

Study Participants

Participants in the current study included men and women who attended the 1998–99 clinic visit for the CHS at the Pittsburgh site (considered baseline for this analysis), who could walk without the assistance of another person, and who could follow directions to complete the gait assessment. Individuals who used an assistive device were included if they could ambulate without the assistance of another person and if they did not have loadbearing restrictions. Of the 610 people who attended the 1998–99 clinic visit, 552 (90%) met then inclusion and exclusion criteria for the current study.

Assessments

Stance Time Variability—The GaitMat II™ system was used for the gait analysis.[15] The GaitMat II™ consists of an approximately 4-meter long walkway on which the subject walks and a computer system which controls the GaitMat II™ and analyzes the data. In addition to the 4-meter long walkway, there are initial and final one meter inactive sections to allow for acceleration and deceleration of the participant. The GaitMat II™ is an automated gait analysis system based on the opening and closing of pressure sensitive switches which are represented on the computer screen as footprints when the participant walks on the walkway. After two practice passes on the GaitMat II™, each participant completed two passes on the GaitMat II™ at their self-selected walking speed for data collection.

Stance time was determined as the time one foot was in contact with the floor (i.e. from initial foot-floor contact until final foot-floor contact). The standard deviation of stance time determined from all of the right and left steps recorded over 2 passes, approximately 10–12 steps, was calculated for each person and used as the measure of STV. This measure of STV has fair test-retest reliability.[16]

Mobility Disability—Mobility disability was assessed by interview based on self-reported ability to walk one-half mile.[17–19] At baseline (the time of the gait assessment) participants were asked “Do you have difficulty walking one-half mile?” Individuals who reported difficulty walking one half mile at baseline were classified as having *prevalent mobility disability*. Participants were contacted by telephone one year after the baseline to once again determine mobility disability status. Participants were asked “Have you had a change in your ability to walk a half mile, about 5 or 6 blocks?” Individuals who reported having a change in their ability to walk a half mile were asked a follow-up question to determine how their walking ability changed. Response categories were less difficulty walking, new onset of difficulty walking, more difficulty walking, and can no longer walk. Only individuals who did not report mobility disability at baseline were included in the incident mobility analyses. Individuals who at baseline reported no difficulty walking one half mile and then reported a new onset of difficulty walking, more difficulty walking, or no longer able to walk were classified as having *incident mobility disability*. The few individuals who reported an improvement in their walking following a report of no difficulty walking were classified as having no difficulty walking a half mile.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Data Analysis

Sensitivities and specificities were calculated using established methods[20] from the numbers at each value of STV and plotted as an ROC curve for each mobility disability outcome. Sensitivity was plotted on the y-axis and 1-specificity was plotted on the x-axis. The area under the curve (AUC) was obtained. Sensitivities and specificities were reported for the optimal value, the value of STV that was closest to the upper left-hand corner of the graph, determined from the ROC curve (i.e. the value that maximizes both sensitivity and specificity and when the relative costs of misclassification were considered to be equal) and for two additional values in which either sensitivity or specificity were maximized, without completely sacrificing the other (i.e. the value was above 0.50).

Positive and negative predictive values were calculated for the three cutoff values described above. The positive predictive value (PPV) is the number of subjects with the condition who test positive divided by the number of subjects with positive test results. The negative predictive value (NPV) is the number of subjects without the condition who test negative divided by the number of subjects with a negative test result. Both the PPV and the NPV are presented as a percentage.

The positive likelihood ratio is the likelihood that a positive test result was found in an individual with, as compared to an individual without, mobility disability and is calculated as [sensitivity/(1-specificity)]. For the positive likelihood ratios, values of STV were grouped into 9 intervals for prevalent mobility disability and 6 intervals for incident 1 year mobility disability. Each STV interval was 0.005 secwide with values <0.019 secand >0.066 (for prevalent disability) and < 0.022 secand >0.045 sec(for incident disability) placed into one category because of small cell sizes. The formation of the intervals was initiated by first determining the optimal cut-off value from the ROC curves. The percentage of individuals with mobility disability in each interval was calculated as the number of individuals with mobility disability in an interval divided by the total number of individuals in the interval to quantify the risk gradient across the intervals for both prevalent and incident mobility disability. The positive likelihood ratio and the 95% confidence interval were calculated for each interval of STV for each outcome of mobility disability. A likelihood ratio of 1.0 indicates no additional risk prediction from the use of a test and is equivalent to a test in which sensitivity and specificity are both 50%.

RESULTS

Baseline subject characteristics are shown in Table 1. The mean age of the sample was 79.4 years (SD=4.1), 60.9% were female and 22.8% were African American. The perceived health of the sample was quite good, with 31.5% reporting their health as very good or excellent and 54.7% reporting their health as good. The sample had good mobility with only 63 of the 552 participants (11.4%) using an assistive device and a mean gait speed of 1.01 m/s (SD=0.23).

Of the 552 individuals included in the study, 125 or 22.6% reported difficulty walking one half mile at baseline and were classified as having prevalent mobility disability. Of the 427 individuals who did not report mobility disability at baseline, 399 individuals had 1-year follow- up mobility disability data available (28 or 7% lost to follow-up). Of these 399 individuals, 59 or 14.8% reported difficulty walking one half mile at the 1 year follow-up (incident mobility disability).

As determined from the ROC analysis, the optimal cut-off score for STV (maximizing sensitivity and specificity) for prevalent mobility disability was 0.037 sec (AUC = 0.70) and for incident 1 year mobility disability was 0.034 sec(AUC = 0.65); figures 1 and 2.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Sensitivity and specificity values for mobility disability at the optimal cut-off value determined from the ROC curve and for additional values of STV that maximize either sensitivity or specificity and positive and negative predictive values are shown in Table 2.

Across the intervals of STV for the outcome of prevalent mobility disability (Table 3), the risk for disability increased as the values of STV increased: disability risk (for each range of STV the number of participants with mobility disability/number of participants at that range of STV) started at 3% (1/40) for STV <0.019 sec and increased for each consecutively higher band at 13% (11/87), 14% (15/105), 21% (17/80), 26% (18/69), 29% (13/45), 33% (14/43), 40% (12/30), and 53% (24/45) for STV values > 0.066 s. The data correspond to likelihood ratio estimates demonstrating an increased risk for disability from baseline risk with STV values 0.037 to .042 (likelihood ratio = 1.21) and increasing progressively as the values of STV increase.

For the outcome of incident 1 year mobility disability (Table 4), the risk for disability also demonstrated an overall increasing gradient from the lowest to the highest STV values with some fluctuation of values at the middle intervals: disability risk was 5% (3/66) for STV values <.022 secand increased for each higher band at 14% (13/90), 10% (6/61), 13% (8/62), 20% (8/41), and 27% (21/79) for STV values >0.045 s. The transition point for increased risk according to likelihood ratios started at STV values of 0.040–0.045 sec(likelihood ratio = 1.4), and there was increase for values > 0.045 sec(likelihood ratio = 2.12).

DISCUSSION

Diagnosis is a process in which patient data are collected and evaluated in order to classify a condition, determine prognosis, and identify possible interventions.[21] Diagnostic tests, such as STV, can be used to assist in the classification process. We identified two different values of STV for identifying individuals with prevalent mobility disability (0.037 sec) and at risk for developing mobility disability one year later (0.034 sec). It is not surprising that the cut-point identified for predicting mobility disability at one year was lower than the cut-point for identifying individuals with prevalent mobility disability (i.e. 0.034 sec versus 0.037 sec) since individuals with prevalent mobility disability have greater STV and were removed for the incident mobility disability analyses.

The values for sensitivity, specificity, area under the ROC curve (AUC), positive predictive value, and positive likelihood ratio were quite modest, thus potentially limiting their clinical usefulness. The area under the ROC curve (AUC) is a measure of the overall performance of a diagnostic test or the accuracy of the diagnostic test. The AUC has values ranging from 0 to 1 with the closer the AUC is to 1 the better overall diagnostic performance of the test. An AUC value of .5 represents an uninformative test.[22] Our AUC values for prevalent mobility disability and incident mobility disability (i.e. AUC = .70 and .65 respectively) indicate only fair discriminate value for those outcomes.

Correct diagnosis relies, in part, on the ability to minimize error during the testing process to avoid false positive or false negative results.[21] The measure of STV that we evaluated had only fair test-retest reliability.[16] The reliability of STV may be influenced by the number of steps used to calculate the measure. Including a greater number of steps in the calculation of STV could potentially improve the reliability and potentially the diagnostic characteristics of the measure as well.[23]

The PPV, which is used to judge whether or not a patient has the condition of interest, was quite low. The PPV of a diagnostic test should be interpreted with caution since it is dependent on the overall prevalence of the condition. In this study, a relatively small number of subjects had mobility disability at baseline (i.e. 23%) and an even smaller number of

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

individuals developed incident mobility disability over the 1-year follow-up (i.e. 15%). The one year incidence of mobility disability was similar to that reported in the Iowa EPESE sample which has been described as not representative of older adults in general, other samples in the EPESE study had incident rates closer to 20–25%.[17]

A reoccurring question in the field of gait variability is if greater variability is associated with negative outcomes. In this study, the likelihood ratios suggest a risk gradient for progressive (increasing) values of STV for prevalent mobility disability, thus suggesting that greater values of STV are undesirable. Greater values of STV have also been associated with poor perception of health, difficulty performing activities of daily living, and lower levels of physical activity.[16] Further research is needed to determine if interventions that can decrease STV during usual walking can also reduce or prevent mobility disability.

Stance time variability was measured using a computerized gait analysis system that may not be available for most clinicians interested in identify older adults who are at risk for mobility disability. Recent work has demonstrated that an observational rating of gait variability (the Modified Gait Abnormality Rating Scale variability item, GARSM) is an acceptable alternative measure of gait variability for identifying older adults at risk for mobility disability in clinical settings.[24] However, the ability to have a computerized gait analysis system in the clinic should not be overlooked as lower cost alternatives become available.

When interpreting our results the following limitations should be considered. The outcome of interest, mobility disability, was based on self-report that may not accurately reflect a persons' ability. However, self-report of walking ½ mile has been used to adequately represent mobility disability in several studies of older adults.[17–19] A performance-based measure of disability, such as the long distance corridor walk, may be a more appropriate outcome to investigate.[25;26] A gradient of increasing risk with increasing STV was demonstrated for prevalent mobility disability. The gradient for incident 1-year mobility disability was not continuous across the STV values and was nearly equal for STV values between 0.022 and 0.045 s. This result is most likely attributable to the small number of individuals who developed incident mobility disability (i.e. 15%) resulting in unstable estimates.

The current, prospective study is the first to evaluate the predictive validity of STV for mobility disability at one year using comprehensive validity indices of sensitivity, specificity, ROC curves, AUC, positive and negative predictive values, and likelihood ratios. The relatively modest values on the validity indices could possibly be improved by increasing the reliability of the measurement of STV. Given the modest values for the validity indices for STV clinicians should not consider our suggestions for cut-off values of STV as defined boundaries for indicating who is at risk for developing mobility disability. Clinicians should interpret the values liberally and use STV in conjunction with other measures until further work is completed to validate STV as an indicator of mobility disability. We have shown an increasing risk for mobility disability associated with greater values of STV during usual walking. This suggests that irregular timing of gait is a predictor of mobility disability and future efforts are needed to determine if interventions aimed at reducing STV could also prevent mobility disability.

Acknowledgments

The research reported in this article was supported by contract numbers N01-HC-85079 through N01-HC-85086, N01-HC-35129, N01 HC-15103, N01 HC-55222, N01-HC-75150, N01-HC-45133, grant number U01 HL080295 from the National Heart, Lung, and Blood Institute, with additional contribution from the National Institute of Neurological Disorders and Stroke. A full list of principal CHS investigators and institutions can be found at

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

http://www.chs-nhlbi.org/pi.htm. At the time of data collection, JS Brach was supported by the National Institutes of Health Public Health Service grant TG 32AG00181. Currently, JS Brach is supported by a National Institutes on Aging and American Federation of Aging Research Paul Beeson Career Development Award (1 K23 AG026766-01) and the University of Pittsburgh Older American's Independence Center grant (1 P30 AG024827-01).

REFERENCES

1. Hausdorff JM, Rios DA, Edelberg HK. Gait variability and fall risk in community-living older adults: a 1-year prospective study. Arch Phys Med Rehabil. 2001; 82:1050–1056. [PubMed: 11494184]
2. Brach JS, Studenski S, Perera S, VanSwearingen JM, Newman AB. Gait variability and the risk of incident mobility disability. J Gerontol Med Sci. 2007; 62A:983–988.
3. Gabell A, Nayak USL. The effect of age and variability in gait. J Gerontoly. 1984; 39:662–666.
4. Maki BE. Gait changes in older adults: predictors of falls or indicators of fear? J Am Geriatr Soc. 1997; 45:313–320. [PubMed: 9063277]
5. Owings TM, Grabiner MD. Step width variability, but not step length variability or step time variability, discriminates gait of healthy young and older adults during treadmill locomotion. J Biomech. 2004; 37:935–938. [PubMed: 15111081]
6. Owings TM, Grabiner MD. Variability of step kinematics in young and older adults. Gait Posture. 2004; 20:26–29. [PubMed: 15196516]
7. Owings TM, Grabiner MD. Measuring step kinematic variability on an instrumented treadmill: how many steps are enough? J Biomechs. 2003; 36:1215–1218.
8. Brach JS, Berlin JE, VanSwearingen JM, Newman AB, Studenski SA. Too much or too little step width variability is associated with a fall history in older persons who walk at or near normal gait speed. J Neuroengineering Rehabil. 2005:2.
9. Richardson JK, Theis SB, DeMott TK, Ashton-Miller JA. A comparison of gait characteristics between older women with and without peripheral neuropathy in standard and challenging environments. J Am Geriatr Soc. 2004; 52:1532–1537. [PubMed: 15341557]
10. Hausdorff JM, Edelberg HK, Mitchell SL, Goldberger AL, Wei JY. Increased gait unsteadiness in community-dwelling elderly fallers. Arch Phys Med Rehabil. 1997; 78:278–283. [PubMed: 9084350]
11. Brach JS, Studenski S, Perera S, VanSwearingen JM, Newman AB. Stance time and step width variability have unique contributing impairments in older persons. Gait Posture. 2008; 27:431–439. [PubMed: 17632004]
12. Fried L, Bandeen-Roche K, Chaves P, Johnson B. Preclinical Mobility Disability Predicts Incident Mobility Disability in Older Women. J Gerontology Biol Sci Med Sci. 2000; 55A:M43–M52.
13. Fried LP, Borhani NO, Enright PL, et al. The cardiovascular health study:design and rationale. Ann Epidemiol. 1991; 1:263–276. [PubMed: 1669507]
14. Tell GS, Fried LP, Hermanson B, Manolio TA, Newman AB, Borhani NO. Recruitment of adults 65 years and older as participants in the cardiovascular health study. Ann Epidemiol. 1993; 3:358–366. [PubMed: 8275211]
15. Walsh, JP. Foot fall measurement Technology. In: Craik, RL.; Oatis, CA., editors. GaitAnalysis: Theory and Application. Louis: Mosby-Year Book, Inc; 1995. p. 125-142.
16. Brach JS, Perera S, Studenski S, Newman AB. Reliability and validity of measures of gait variability in community-dwelling older adults. Arch Phys Med Rehabil. 2008; 89:2293–2296. [PubMed: 19061741]
17. Guralnik JM, Ferrucci L, Pieper C, et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol Biol Sci Med Sci. 2000; 55A:M221–M231.
18. Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower extremity function in persons over the age of 70 years as a predictor of subsequent disability. New Engl J Med. 1995; 332:556–561. [PubMed: 7838189]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

19. The LIFE Study Investigators. Effects of a physical activity intervention on measures of physical performance; results of the Lifestyle Interventions and Independence in Elders pilot (LIFE-P) study. J Gerontol Biol Sci Med Sci. 2006; 61A:1157–1165.

20. Sackett, DL.; Haynes, RB.; Guyatt, GH.; Tugwell, P. Clinical Epidemiology: A Basic Science for Clinical Medicine. Boston: Little,Brown and Company; 1991.

21. Jewell, DV. Guide to Evidence-Based Physical Therapy Practice. Sudbury: Jones and Bartlett; 2008. Appraising Evidence About Dianostic Studies; p. 235-260.

22. Zhou, XH.; Obuchowski, NA.; McClish, DK. Statistical methods in diagnostic medicine. 1st ed.. New York: John Wiley & Sons; 2002.

23. Perera, S.; Brach, JS.; Talkowski, JB.; Wert, d; Studenski, SA. Measuring stride time variability: estimating test-retest reliability and required walk length using bootstrapping. [abstract]. In: Perera, S.; Brach, JS.; Talkowski, JB.; Wert, d; Studenski, SA., editors. Program & Abstracts of the ISPGR 18th International Conference 2007; 2007. p. 55-56.

24. Huang WW, VanSwearingen JM, Brach JS. Gait variability in older adults: Observational rating validated by comparison with a computerized walkway gold standard. Phys Ther. 2008; 88:1146–1153. [PubMed: 18719005]

25. Newman AB, Haggerty CL, Kritchevsky S, Nevitt MC, Simonsick EM. Health ABC Collaborative Research Group. Walking performance and cardiovascular response: associations with age and morbidity -- the Health, Aging and Body Composition Study. J Gerontol Biol Sci Med Sci. 2003; 58A:M715–M720.

26. Newman AB, Simonsick EM, Naydeck B, et al. Association of long-distance corridor walk performance with mortality, cardiovascular disease, mobility limitation, and distance. JAMA. 2006; 295:2026.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

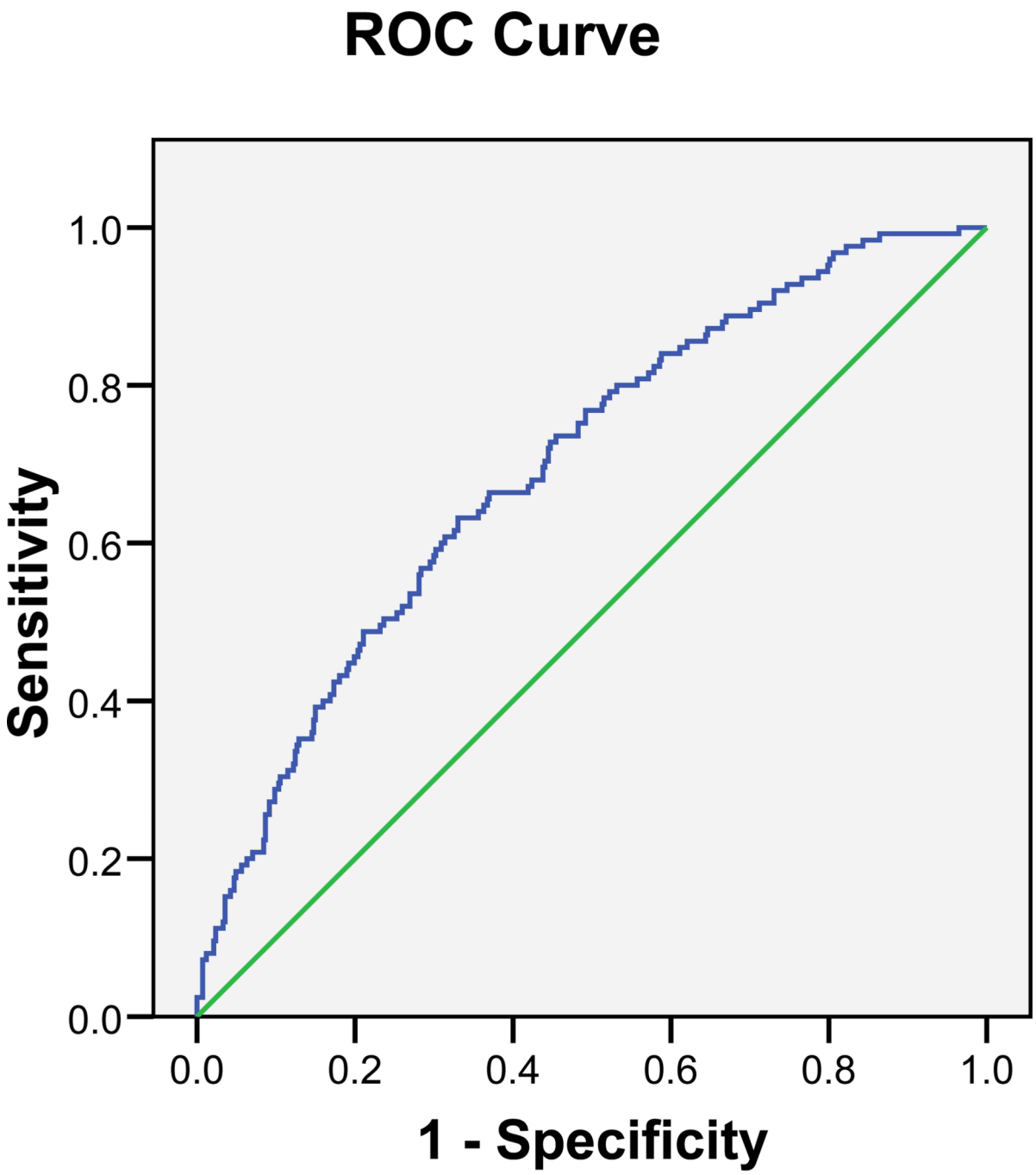

Figure 1.
Receiver operating characteristic (ROC) curve and area under the curve (AUC) for **prevalent** mobility disability (no disability compared to any disability, AUC = 0.70, n=552).

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

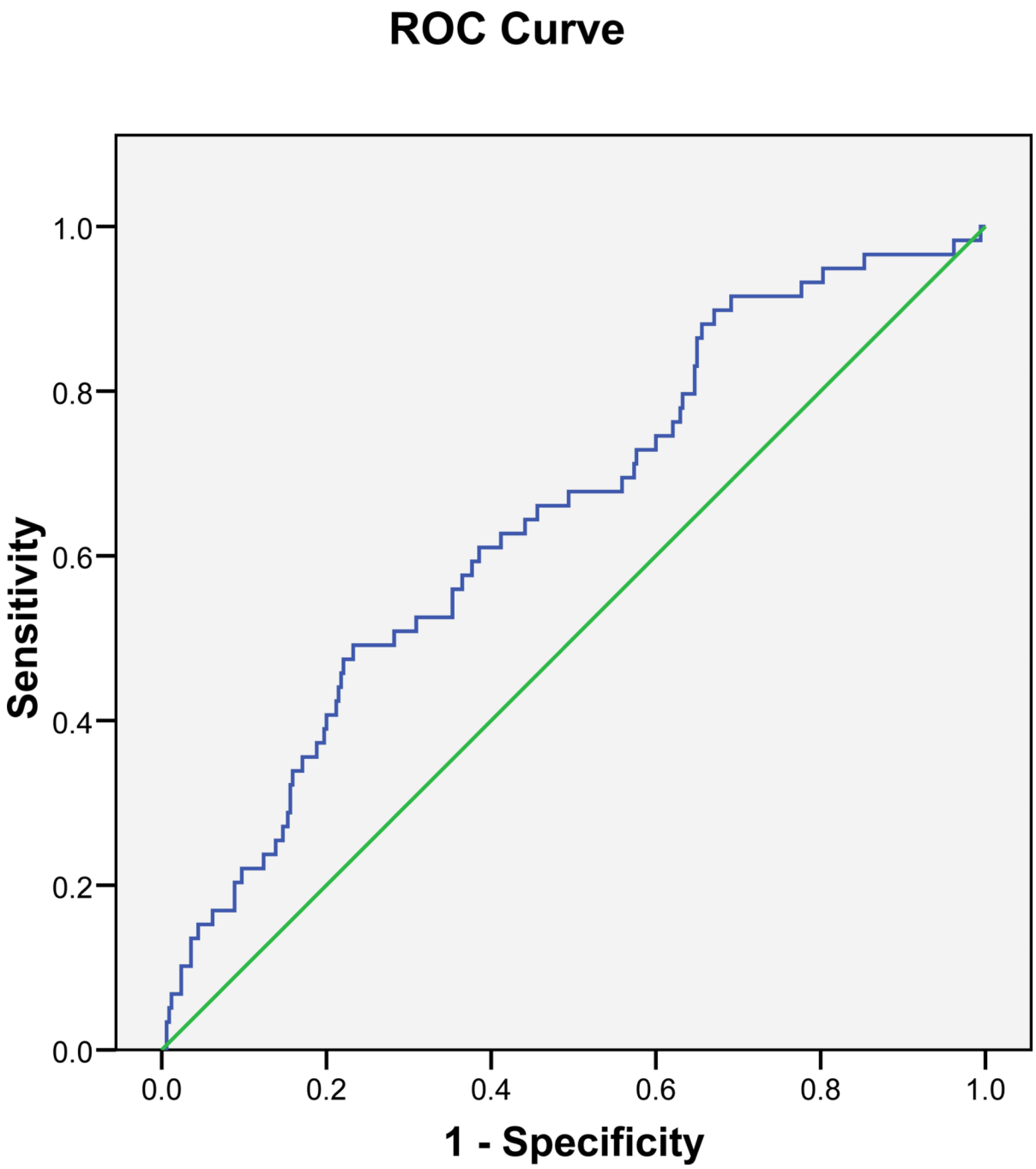

Figure 2.
Receiver operating characteristic (ROC) curve and area under the curve (AUC) for **1 year incident mobility disability** (no disability compared to any disability, AUC = 0.65, n=399).

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 1

Study Participant Characteristics at Baseline (n=552).

Baseline Characteristic	N (%)
Age, years	79.4 (4.1) *
Female	336 (60.9)
African American	126 (22.8)
Number of medications	3.3 (2.6) *
Reported a fall in past 12 months	100 (18.1)
Use an assistive device	63 (11.4)
Usual gait speed, m/s	1.01 (0.23) *
Blocks walked per week	32.7 (49.2) *
Reported no difficulty with ADL	466 (84.4)
Reported no difficulty with IADL	404 (73.2)

* mean (SD)

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 2

Validity Indices for Stance Time Variability for Prevalent and Incident Mobility Disability at the Optimal Cutoff Value Determined from the Receiver Operating Characteristic Curve (Bold) and for Cutoff Values which Maximize Sensitivity and Specificity.

Outcome (No. of Participants with outcome/ N)	Cutoff Value (No. of Participants Above Threshold)	No. of participants who were disabled identified at increased risk for disability	Sensitivity (95% CI)	Specificity (95% CI)	Positive Predictive Value (%)	Negative Predictive Value (%)
Prevalent mobility disability (125/552)						
	≥.034 (272)	88	0.70 (0.61–0.78)	0.57 (0.52–0.62)	32.4	86.8
	≥.037 (232)	**81**	**0.65 (0.56–0.73)**	**0.65 (0.60–0.69)**	**34.9**	**86.3**
	≥.040 (193)	72	0.58 (0.48–0.66)	0.72 (0.67–0.76)	37.3	85.2
Incident 1 year mobility disability (59/399)						
	≥.031 (201)	39	0.66 (0.53–0.78)	0.52 (0.47–0.58)	19.4	89.9
	≥.034 (172)	**36**	**0.61 (0.47–0.73)**	**0.60 (0.55–0.65)**	**20.9**	**89.9**
	≥.037 (141)	31	0.53 (0.39–0.66)	0.68 (0.62–0.72)	22.0	89.2

CI = Confidence Interval; **Bold** values of STV that maximize sensitivity and specificity

J Geriatr Phys Ther. Author manuscript; available in PMC 2013 July 01.

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

J Geriatr Phys Ther. Author manuscript; available in PMC 2013 July 01.

Table 3

Positive Likelihood Ratios across 9 Intervals of Stance Time Variability (STV) for Prevalent Mobility Disability (n=552)

	Mobility disability[a] (n=125)		No mobility disability[b] (n=427)		Positive Likelihood Ratio (95% CI)
STV in secs (#participants)	**No.**	**Proportion**	**No.**	**Proportion**	**95% CI**
<.019 (40)	1	1/125 = .008	39	39/427 = .09	.09 (.01–.65)
.019–.024 (87)	11	11/125 = .09	76	76/427 = .18	.49 (.27–.89)
.025–.030 (105)	15	15/125 = .12	90	90/427 = .21	.57 (.34–.95)
.031–.036 (80)	17	17/125 = .14	63	63/427 = .15	.92 (.56–1.51)
.037–.042 (69)	18	18/125 = .14	51	51/427 = .12	1.21 (.73–1.99)
.043–.048 (45)	13	13/125 = .10	32	32/427 = .08	1.39 (.75–2.57)
.049–.054 (43)	14	14/125 = .11	29	29/427 = .07	1.65 (.90–3.02)
.055–.066 (30)	12	12/125 = .10	18	18/427 = .04	2.29 (1.13–4.62)
>.066 (45)	24	24/125 = .19	21	21/427 = .05	3.92 (2.26–6.60)

[a] people who reported difficulty walking a half mile at baseline

[b] people who reported no difficulty walking a half mile at baseline

CI = Confidence Interval

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 4

Positive Likelihood Ratios across 6 Intervals of Stance Time Variability (STV) for Incident 1-year Mobility Disability (n=399)

	Mobility disability[a] (n=59)		No mobility disability[b] (n=340)		Positive Likelihood Ratio (95% CI)
STV, sec(No. of participants)	**No.**	**Proportion**	**No.**	**Proportion**	**95% CI**
.016–.021 (66)	3	3/59 = .05	63	63/340 = .19	.26 (.08, .80)
.022–.027 (90)	13	13/59 = .22	77	77/340 = .23	.96 (.57, 1.61)
.028–.033 (61)	6	6/59 = .10	55	55/340 = .16	.63 (.06,6.71)
.034–.039 (62)	8	8/59 = .14	54	54/340 = .16	.88 (.44, 1.75)
.040–.045 (41)	8	8/59 = .14	33	33/340 = .10	1.4 (.68, 2.88)
>.045 (79)	21	21/59 = .36	58	58/340 = .17	2.12 (1.40, 3.21)

[a] people who reported difficulty walking a half mile at 1 year follow-up

[b] people who reported no difficulty walking a half mile at 1 year follow-up

CI = Confidence Interval