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Age-Associated Declines in Complex Walking Task Performance: The Walking InCHIANTI Toolkit

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Abstract

OBJECTIVES—To describe a set of complex walking tasks (CWTs) that can be used to evaluate mobility and to characterize age- and sex-specific performance on these tests.

DESIGN—A population-based study of persons living in the Chianti geographic area (Tuscany, Italy).

SETTING—Community.

PARTICIPANTS—One thousand two hundred twenty-seven persons (aged 20–95) selected from the city registries of Greve and Bagno a Ripoli (Tuscany, Italy).

MEASUREMENTS—Gait velocity (m/s) was measured during 13 walking tests (Walking InCHIANTI Toolkit (WIT)) used to examine walking ability under a range of conditions and distances. Other measures included performance on the Short Physical Performance Battery and self-reported health and functional status, including disability in activities of daily living.

RESULTS—Age-associated differences on the WIT were reflected in the number of older adults unable to complete CWTs and a decrease in gait velocity. For all tasks, decrements in walking speed with increasing age were significantly larger at aged 65 and older. Performance on CWTs was highly variable and could not be explained by usual gait speed measured under low-challenge conditions alone.

CONCLUSION—CWTs may provide important insight into mobility function, particularly in persons with normal or near-normal usual gait speed. Further research is needed to elucidate the specific physiological mechanisms that contribute to declining performance on CWT with increasing age.

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Keywords

mobility; aging; performance-based measures

Mobility, defined as the ability to walk safely and independently in one's environment, is critical to maintaining independence in activities of daily living (ADLs), in preserving social relationships and in ensuring quality of life.^{1,2} In older adults, impaired mobility predicts the onset of disability in tasks essential to living independently in the community and in caring for oneself.^{2,3} Mobility limitations tend to occur early in the process leading to ADL disability.²⁻⁵

Walking in daily life involves negotiating diverse environments with varying terrains (cluttered, slippery), ambient conditions (adverse weather, low light), and attentional demands (noisy or distracting environments). In addition, walking is often performed in conjunction with other tasks such as carrying loads, scanning the environment, changing directions, avoiding obstacles, or engaging in social interactions. Complex walking tasks (CWTs), involving adaptation to change in task and environmental demands, require physiological resources beyond those needed for walking under less-difficult conditions and so are reflective of mobility in home and community environs.⁶⁻⁸ Evaluation of mobility in older adults typically involves observing their speed, stability, step length, and foot clearance during self-paced walks performed on straight, uncluttered, and well-lit courses. Rarely do performance-based tests include walking under complex and challenging conditions such as those encountered in daily life. Recent research has shown that older adults who would be classified as independently mobile using standard measures demonstrate limitations in walking under more-complex conditions.⁸⁻¹⁰ Performance on complex tasks, such as the heel/toe walk and fast-pace walk with a pivot turn, is a good predictor of adverse health outcomes, including falls and fractures, suggesting that inclusion of complex locomotor tasks may be important in evaluating mobility limitations.¹¹⁻¹³

The purpose of this article is to describe a set of CWTs that were used to evaluate mobility in a large sample of community-living older adults and to characterize age- and sex-specific performance on these tests. The current battery of walking tests was based on a person-environment interaction model of mobility disability, which proposes that factors within the physical environment mediate the relationship between functional limitations related to walking and the development of mobility disability. The tests measured walking performance in the face of physical challenges often encountered when walking in a community environment, such as walking while performing a secondary cognitive task, carrying a package, or stepping over one or more obstacles.^{6,9,10} Locomotor adaptation was further challenged by asking subjects to perform some tasks at a fast pace or for long distances. It was expected that performance on CWTs would be lower than on simple walking tasks and that the magnitude of the performance gap between simple tasks and CWTs would be higher in older persons. It was also expected that the variability of performance in CWTs would be greater in participants with higher performance in simple walking tasks.

METHODS

Study Population

The InCHIANTI study is an epidemiological study of risk factors for mobility disability in old age. The study population includes a representative sample of the population living in Bagno a Ripoli and Greve located in the Chianti region of Tuscany, Italy. The study design and data collection have been previously described.¹⁴

The current analyses used cross-sectional data from baseline testing, which occurred between September 1998 and March 2000. Of the original 1,453 persons who consented to participate in the study, 1,308 were evaluated for mobility testing, and 1,227 were able to complete the baseline 7-m walk test. The Italian National Council on Aging (INRCA) ethical committee examined and approved the study baseline protocol. All participants were informed of the study procedure, purposes, and known risks, and all gave their informed consent.

Measures of Walking

The Walking InCHIANTI Toolkit (WIT) included 13 tests of walking ability under a range of conditions and distances. The order and a brief description of walking tests were as follows.

1. 4-m usual-pace walk
2. 4-m fast-pace walk
3. 4-m fast-pace walk within a 25-cm corridor marked on the floor
4. 4-m fast-pace walk within a 15-cm corridor marked on the floor
5. 7-m usual-pace walk
6. 7-m usual-pace walk with steps as long as possible
7. 7-m fast-pace walk over two obstacles (the first 6-cm tall and the second 30-cm tall, positioned, respectively, after 2 m and 4 m from the starting line), normal light conditions
8. 7-m fast-pace walk with obstacles (as described in item 7) while wearing standard sunglasses (worn over corrective lenses as needed) to mimic a semidark environment
9. 7-m usual-pace walk while carrying a 40 cm × 22 cm × 22 cm package (weight = 0.05 kg) that obstructed the view of the feet
10. 7-m usual-pace walk and talk (naming animals with names starting with a specific letter given to the participant at the beginning of the test)
11. 7-m usual-pace walk involving picking up one (a spoon) of three objects from the floor during the course
12. 400-m fast-pace walk (20 times in a 20-m loop) 13.
13. 60-m fast-pace walk while wearing a jacket that increased the weight of the participant 15%

Of these tests, walks 2 through 4, and 6 through 13 constituted the CWTs. In a parallel study involving 30 subjects, test–retest reliability (2-week interval) of the WIT was found to be high, with 11/14 intraclass correlation values above 0.80 and all except one (7 m holding a package) above 0.75.

Subjects wore comfortable shoes and used gait devices as needed. The time for each test was recorded via photocells mounted on the start and finish lines. A colored tape marked the start but not the finish line to avoid the participant slowing down in the final portion of the course. For each test, subjects initially touched the starting line and began walking with their preferred foot when the examiner said “start.” A test was considered complete when the first foot crossed the second photocell. A rest of 2 to 3 minutes occurred between tests at the subject’s request.

A geriatrician and a physical therapist evaluated participants to determine eligibility for participation in the In-CHIANTI walking protocol. General exclusion criteria were inability to walk without assistance or use of a walker. Exclusion criteria for specific tests were (1)

object pickup, 400-m and 60-m walks—inability to maintain balance while standing with feet together for 10 seconds; (2) object pickup—inability to transfer without help; (3) walk with light package—use of a walking aid; (4) 400-m and 60-m walks—inability to walk without assistance for 8 m, uncontrolled hypertension (systolic blood pressure >180 mmHg or diastolic blood pressure >100 mmHg), bradycardia (<40 beats/min), tachycardia (>125 beats/min), severe dyspnea at rest or with minimal effort, or recent history (previous 3 months) of myocardial infarction, angina pectoris, heart surgery, hip or knee surgery, or loss of consciousness; (5) obstacle walk with sunglasses—participant errors (striking an obstacle, or stumbling) when performing the obstacle walk without sunglasses; and (6) walk and talk—severe cognitive impairment or poor hearing. In this study, data were included only from individuals able to complete the 7-m walk test.

Other Measures

Weight and height, objectively measured employing a standard protocol, were used to calculate the body mass index as kg/m². Lower extremity performance was evaluated using the Short Physical Performance Battery (SPPB), which includes three timed subtests: rising from a chair five times, 4-m usual-pace walk, and up to three hierarchical balance tests (side by side, semitandem, and tandem stances).^{15,16} Time measures were then converted to an ordinal scale with a range of 0 (lowest) to 12 (highest performance). The SPPB has been shown to be a strong predictor of physical disability in older adults.^{15,16}

Participants were asked to report level of independence (1 = no difficulty, 2 = with difficulty, but without help, 3 = with help, 4 = unable) in six basic ADLs (walking, bathing, dressing, eating, transferring, and toileting) and eight instrumental activities of daily living (IADLs; meal preparation, shopping, money management, telephone use, light housework, heavy housework, transportation, and medication management). The total number of activities in which the person required assistance or was unable to perform (score of 3 or 4) was calculated.

Statistical Analysis

Gait speed on each of the 13 walking tests was converted to z-scores. Ten scores distributed across 10 tasks had z-scores greater than 3.29 and were considered outliers and excluded from analyses.

Demographic data were summarized and compared for four age groups of participants using analysis of variance for continuous variables and chi-square for categorical variables. Descriptive statistics were used to characterize age- and sex-based differences in gait velocity calculated from time measures for each walk. For participants able to perform the tasks, the relative cost of walking under complex, compared with low-challenge, conditions was calculated as the absolute and percentage change in gait speed between the CWT and its appropriate reference walk. The 7-m usual-pace walking task was the reference test for all CWTs performed at usual pace, and the 4-m fast-pace walk was the reference for all CWTs performed at fast pace. Logistic regression analysis was used to examine the contribution of age by category (<65, 65–74, 75–84, and ≥85), sex, balance component of the SPPB, and usual gait speed on the 7-m usual-pace walk (<0.9 m/s, 0.9–1.11 m/s, 1.12–1.30 m/s, >1.30 m/s) to the probability of being a nonperformer on at least one CWT. Linear regression analyses were also performed using the CWT as the response and the 7-m usual-pace walk as the explanatory variable, and tested for heteroscedasticity (variance of errors not being constant across observations) using the Cook-Weisberg test.¹⁷

Gait speed was plotted as a function of age for men and women separately, and LOWESS smoothing lines (using locally weighted regression curves) were fitted. The nonlinear relationship between age and performance on each of the walking tests was formally tested by

comparing the slope of decline in gait speed before aged 65 and aged 65 and older using piecewise linear regression.¹⁷ Analyses were performed using Stata Statistical Software (Release 8, Stata-Corp, College Station, TX), and figures were produced using S-PLUS (S-PLUS version 7.0 for Windows, Insightful Corporation, Seattle, WA). Data from men and women were analyzed separately, and nonperformers were excluded from the model.

RESULTS

Table 1 compares demographic and functional characteristics according to age group. Older participants had significantly lower SPPB scores, higher rates of ADL and IADL disability, and fewer years of schooling than younger participants.

Age and Sex Differences in the Performance of CWTs

Age-associated differences in the performance of CWTs were reflected in the number of older adults who were able to walk under simple but not complex task conditions and in a decline in gait speed in those able to complete the CWTs.

Nonperformance on Walking Tasks

The percentage of individuals able to perform the WIT was lower in the older age groups. Figure 1 compares the percentage of nonperformers by age group for each of the complex walking tests. Of subjects younger than 65, 3.2% (9/277) were unable to perform one or more of the CWTs, compared with 15.6% (86/553) of those aged 65 to 74, 42.7% (126/295) of those aged 75 to 84, and 77.5% (79/102) of those aged 85 and older.

Approximately 80% of nonperformers were subjects excluded or unable to successfully complete the task for medical or safety reasons, whereas 20% were theoretically eligible but refused. Subjects who could not perform a test for safety or medical reasons were significantly ($P < .001$) older (excluded mean age 81 ± 8 ; refused mean age 76 ± 7), had slower usual gait speed (excluded $\leq 0.8 \pm 0.3$ m/s; refused $\leq 0.9 \pm 0.3$ m/s), and had lower SPPB scores (excluded mean score 5.8 ± 4.0 ; refused mean score 8.8 ± 3.0) than subjects who refused to do so.

The logistic regression analysis showed that age, balance, and usual gait speed, but not sex, were significantly ($P < .001$) associated with the probability of being a non-performer on one or more CWTs. A participant who was aged 85 and older was 10.9 times as likely to be a nonperformer (95% confidence interval (CI) = 4.2–28.1) as someone younger than 65, after controlling for the other variables. A person who scored 0 on the balance component of the SPPB was 31.3 times as likely to be a nonperformer (95% CI = 6.5–150.6) as someone with a score of 4. Finally, a person whose usual gait speed was slower than 0.90 m/s was 6.9 times (95% CI = 3.6–13.0) as likely to be a nonperformer as someone whose usual gait speed was faster than 1.3 m/s.

Changes in Gait Speed of Performers

For participants able to complete the CWTs, older participants tended to walk slower than younger participants, and in each age group, women were slower than men. Table 2 shows mean gait speed (m/s) for each of the 13 walking tasks (in the order in which they were performed) according to age group and sex.

Gait velocity was higher in the 4-m fast-pace test and the 7-m long-stride walk than in the 4-m usual-pace walk. Walking speed was slower on all other tasks than on the reference task. The absolute difference in gait speed under complex conditions (Table 3) was largest in the oldest age group (mean difference 0.31 ± 0.10 seconds) and smallest in the youngest age group (mean difference 0.20 ± 0.08 seconds). For eight of the 10 CWTs, the oldest group showed the

largest decline in speed and the youngest the smallest decline. Absolute differences in gait speed for the carrying a light package and the walk-and-talk task were comparable across all four age groups.

The percentage decline with age in gait speed on a CWT and that on the reference-walking task is summarized in Figure 2, which uses box plots to show the variation in percentage difference by age and task. Across all age groups, the greatest percentage decline in speed was found in the 15-cm corridor walk, with the lowest difference found in the walk while carrying a light package. This finding was consistent with the absolute change results. In contrast to absolute change, percentage decline increased with age for walk and talk and carrying a package. Because the oldest group had a slower usual gait speed than the youngest group, a comparable absolute decline translated into a larger percentage decline. In addition, the cost for walking under complex conditions (average percentage difference for all tasks) was greatest in the group aged 85 and older (27%) and was progressively lower in younger age groups (75–84 = 20%, 65–74 = 16%, and <65 = 11%).

Figure 3 shows the relationship between age and gait speed using scatterplots of the 7-m usual-pace gait (Figure 3A), the 7-m fast-pace with obstacles in normal light (Figure 3B), and the 7-m usual-pace walk and talk (Figure 3C). Also shown are LOWESS smoothing curves for men and women. There was a substantial decline in speed aged 65 and older. In piecewise regression analysis, for all walking tasks, the per year difference in gait speed was significantly smaller before the age of 65 than after ($P < .001$, for testing difference in slope before 65 and at ≥ 65). Although men were consistently faster on all walks than women, the rate of decline with increasing age was comparable for the two sexes. Between the ages of 20 and 65, the magnitude of change in gait velocity on all walking tasks was small but statistically significant ($P < .01$). The only exceptions were for the 7-m usual-pace, 7-m package, and 7-m walk-and-talk tasks, which did not show a decline in gait speed in men between the ages of 20 and 65.

The rate of decline in gait speed per year of age varied according to task. In addition, because older participants tended to walk slower, the absolute decline in speed caused by adding complexity to gait resulted in a higher percentage reduction in older than in younger participants. For example, in the 7-m usual-pace task, the annual rate of decline in gait speed in men aged 65 to 74 was 0.026 m/s, which translated to a 1.9% average annual decline. Because gait speed in men aged 85 and older was slower, this same decline translated to an average 3.2% decline per year of age.

Relationship Between Usual Gait Speed and Performance on CWTs

Usual gait speed in the 7-m usual-pace task accounted for an average of 60% of the variance gait speed on CWTs. Coefficient of determination values ranged from a low of 0.54 for the walk-and-talk task to a high of 0.69 for walking with a light package.

The relationship between usual gait speed and performance on a CWT is shown in the scatterplot of Figure 4. As expected, slow gait speed on the 7-m usual-pace walk test was associated with slow gait speed on the 7-m usual-pace walk-and-talk test, although the variability of performance in walk and talk increased progressively with higher gait speeds on the simple 7-m usual-pace task. For example, for participants who walked at 1.0 m/s on the 7-m usual-pace test, performance on the 7-m walk-and-talk test varied from 0 (unable to perform) to 1.4 m/s. Tests for heteroscedasticity were performed and were statistically significant ($P < .001$ for all tasks).

DISCUSSION

Age- and sex-based differences in performance in the 13 walking tests of the WIT, designed to examine mobility under a broad range of challenging conditions similar to those encountered during daily life and requiring locomotor adaptations beyond that needed for walking under simple, low-challenge conditions are described.^{6,9,10}

Rationale for Selection of Walking Tasks

The current battery of walking tasks were based on an environmental model of mobility disability, which categorizes environmental features into eight dimensions (distance, temporal demands, physical load, terrain, postural transitions, attentional demands, ambient conditions, and density) representing the spectrum of external demands that have to be met for an individual to be fully mobile in the community.^{6,9,10} Thus, added elements of complexity included carrying a package, talking, avoiding multiple obstacles, retrieving an object, and reducing the base of support. Further complexity was added by varying distance (4 m to 400 m), temporal demands (self-paced vs fast pace), and ambient conditions (normal vs reduced light).

Age-Associated Change in Performance on CWTs

Increased complexity affected walking performance in two ways. First, it increased the number of older adults who, although able to walk under simple low-challenge conditions, were unable to walk under complex conditions. Second, increasing complexity resulted in a decline in gait speed from reference walks, and the magnitude of decline can be interpreted as inversely related to the degree of adaptive ability.

For all walking tests, the decline in gait speed was greater at aged 65 and older, and as expected, the magnitude of the performance gap between simple walks and CWTs was greater in older participants, most likely reflecting a decline in adaptive ability. One study¹⁸ suggests that the neural control of walking involves three conceptually different tasks: generation of a rhythmic locomotor pattern for progression, control of equilibrium, and the capacity to adapt gait to accommodate behavioral goals and environmental context. Declines in performance of CWTs in older adults are most likely the result of factors affecting the neural control of equilibrium and adaptation, rather than age per se.

Numerous studies have documented that balance and locomotor adaptation tend to become impaired with age. Several researchers have shown an age-related decline in mediolateral control of the center of mass, resulting in decreased stability in the frontal plane in older adults.^{19–22} This mechanism probably explains the age-related decline of gait speed in the 25-cm and 15-cm fast-pace corridor walks, which require increased control of the mediolateral control of the center of mass in response to the new restricted base of support.

Carrying a load in front of the body obscures the environment immediately in front of the feet and reduces the availability of visual information to guide foot placement.²³ Nevertheless, across all ages, carrying a light package had little effect on gait speed, a result consistent with a previous study²³ that found that carrying a light load did not affect gait velocity or limb trajectory during level walking but did when stepping up to a raised surface was required.

A pronounced age-associated decline in the ability to negotiate obstacles was found, especially under low-light conditions (wearing sunglasses), with the greatest performance decrements in the oldest adults. Previous research has shown an age-related decrease in the ability to modify gait kinematics during tasks such as obstacle avoidance^{19,24} and when carrying loads.²⁵ An age-associated change in the way visual information is sampled when walking under complex conditions, such as during obstacle crossing, has also been reported.²⁵

Low-light conditions are associated with greater risk for falls in older adults, although previous research showed that walking with reduced light on level surfaces did not change gait speed.^{26,27} Nevertheless, consistent with the findings of the current study, reducing available light resulted in slower gait speed when walking in a cluttered environment and negotiating obstacles²⁸ or irregular surfaces.²⁹ Slower walking speed during obstacle navigation with reduced ambient light has been attributed to a more-cautious gait pattern designed to reduce fall risk.²⁶ Finally, performance on the walk-and-talk task was consistent with reports of age-related declines in the ability to adapt to changing attentional demands associated with dual task conditions such as talking when walking^{13,30} and obstacle negotiation.^{31,32}

Overall the findings of the current study are consistent with the hypothesis that the ability to adapt gait to environmental challenge decreases with age, although further research is needed to elucidate the specific physiological mechanisms that contribute to declining performance on CWT with increasing age. In addition, whether the capacity to adapt predicts the development of full mobility disability (independent of age) should be verified in further studies. There is almost certainly an overlap of the skills tested in the 13 walking tasks of the WIT. Future research may reduce this redundancy through evaluating the independent predictive value of each walking task to identify the minimal necessary constellation of tasks that should be incorporated into measures of mobility.

Performance-based measures of mobility function such as the WIT, could be useful in research and clinical practice, potentially providing a standardized approach to evaluating locomotor adaptation. They may be useful as predictors of future health outcomes, for example, allowing the identification of individuals at risk for development of physical disability. In addition, they may provide a rationale for targeted interventions designed to improve balance and mobility function and decrease disability. This is critical in light of research demonstrating that improvements in balance and mobility in older adults appear to be training specific.^{33,34} For example, in older adults, performance on dual task tests of balance and mobility improved after dual-task training but not single-task balance and mobility training.³⁴

The use of CWTs may not be possible or even necessary in some individuals. Old age, poor balance, and slow usual gait speed were associated with inability to perform CWTs. This suggests that they may be of limited value in persons who already show restricted mobility as indicated by poor balance and slow usual gait speed. However, in participants with higher usual gait speed, performance on CWTs varied widely, suggesting their potential usefulness in identifying older adults who do not have frank disability (based on usual gait speed) but who are already in the early stage of the disablement process. Analyses currently underway using longitudinal data from the InCHIANTI study will allow the capacity of CWTs to predict health-related outcomes in older adults performing well on usual gait tests to be determined.

Limitations of the Study

In this study, CWTs were performed in a fixed rather than random order. The last two tests to be performed included the 400-m fast-pace walk and the 60-m fast-pace heavy jacket walk. Because the greatest percentage of nonperformance was on these two tasks, it is possible that fatigue rather than absolute task difficulty may have influenced these results. Although gait speed was the outcome measure used in this analysis, other indicators of poor walking performance, such as evidence of unsteadiness, striking an obstacle while crossing, or making errors on a secondary cognitive task, are also important but were not included in this analysis. Ultimately, age is not an adequate explanation for decline in CWTs; further research that incorporates longitudinal data is necessary to determine the factors, such as comorbidities, balance, strength, and impaired adaptation, that may contribute more directly to this decline.

CONCLUSION

The tests in the WIT represent an initial effort at developing a comprehensive approach to measuring mobility function based on a person–environment interaction model of mobility disability. Additional research is needed to determine the minimal set of specific tasks required to evaluate mobility and to elucidate the physiological mechanisms contributing to declining performance on CWTs seen in older adults.

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Figure 1.
A comparison of percentage of nonperformers by task and age.

Figure 2.

A comparison of the variation in percentage decline in gait speed from reference walk according to task and age. For each task, box plots are presented by age with the top plot data from those aged 85 and older, followed by 75–84, 65–74, and the lowest box plot < 65. Within the box plots, the median is shown as a vertical line, the ends of the box identify the 25th and 75th percentiles, and the horizontal line marks the 5th and 95th percentiles.

Figure 3.

Scatterplot showing gait speed (m/s) in three walking tasks (A = 7-m usual pace; B = 7-m fast pace, obstacles; C = 7-m usual pace, walk and talk) as a function of age. Also shown are LOWESS smoothing curves for men (black lines) and women (gray lines).

Figure 4.

The relationship between usual gait speed (measured under low-challenge conditions) and speed on the walk-and-talk test, for men (gray circles) and women (black squares) aged 20 to 95. Data from nonperformers (excluded or unable for safety and medical reasons) are plotted as 0.

Table 1
Sociodemographic and Clinical Characteristics of Study Sample According to Age Category

Characteristic	<65 (n = 277)	65–74 (n = 553)	75–84 (n = 295)	≥85 (n = 103)	P-value*
Age, mean ± SD [†]	44.0 ± 12.9	69.5 ± 2.8	78.6 ± 2.9	88.0 ± 2.44	
Female, %	52.7	53.2	58.0	61.2	.27
Study site, Greve, %	51.6	47.2	47.5	37.9	.13
Years of school, mean ± SD	10.6 ± 4.4	6.1 ± 3.2	4.9 ± 3.2	3.6 ± 2.5	<.001
Body mass index, mean ± SD	26.2 ± 4.1	27.9 ± 4.1	27.3 ± 4.1	26.3 ± 4.0	<.001
Short Physical Performance Battery score, mean ± SD	11.8 ± 0.6	11.1 ± 1.7	9.6 ± 2.7	7.1 ± 3.3	<.001
Activity of daily living disability, %					<.001
0	99.3	98.7	95.6	81.6	
1–3	0.7	0.9	4.4	16.5	
4–6	0.0	0.4	0.0	1.9	
Instrumental activity of daily living disability, %					<.001
0	98.2	93.1	70.8	30.1	
1–3	1.8	5.6	22.4	39.8	
4–8	0.0	1.3	6.8	30.1	

* P-values were calculated using analysis of variance for continuous variables and chi-square test for categorical variables.

[†] No test of difference in mean age was performed, because the groups are defined according to age.

SD = standard deviation.

Table 2
Walking Speed (m/s) According to Age and Sex for Walking Tests in the Walking InCHIANTI Toolkit

Task	Men				Women		
	<65 (n = 131)	65-74 (n = 259)	75-84 (n = 124)	≥85 (n = 40)	<65 (n = 146)	65-74 (n = 294)	75-84 (n = 171)
	Mean ± Standard Deviation						
4-m usual pace	1.36 ± 0.19	1.21 ± 0.24	1.06 ± 0.23	0.81 ± 0.29	1.30 ± 0.19	1.09 ± 0.22	0.89 ± 0.23
4-m fast pace*	1.90 ± 0.28	1.66 ± 0.32	1.42 ± 0.33	1.18 ± 0.36	1.70 ± 0.24	1.39 ± 0.26	1.15 ± 0.29
4-m 25-cm corridor*	1.69 ± 0.35	1.38 ± 0.29	1.14 ± 0.33	0.87 ± 0.28	1.53 ± 0.27	1.16 ± 0.27	0.93 ± 0.29
4-m 15-cm corridor*	1.61 ± 0.28	1.29 ± 0.29	1.05 ± 0.29	0.81 ± 0.24	1.39 ± 0.29	1.09 ± 0.26	0.85 ± 0.27
7-m usual pace	1.51 ± 0.20	1.34 ± 0.25	1.14 ± 0.27	0.81 ± 0.33	1.39 ± 0.19	1.17 ± 0.20	0.95 ± 0.25
7-m long stride	1.78 ± 0.29	1.52 ± 0.27	1.26 ± 0.30	1.03 ± 0.33	1.47 ± 0.27	1.22 ± 0.25	0.99 ± 0.26
7-m obstacles, light*	1.76 ± 0.28	1.41 ± 0.30	1.17 ± 0.30	0.89 ± 0.39	.47 ± 0.26	11.11 ± 0.25	0.89 ± 0.28
7-m obstacles, dark*	1.74 ± 0.28	1.39 ± 0.25	1.17 ± 0.23	0.96 ± 0.21	1.42 ± 0.24	1.10 ± 0.21	0.94 ± 0.21
7-m light package	1.49 ± 0.20	1.33 ± 0.22	1.14 ± 0.25	0.93 ± 0.25	1.38 ± 0.23	1.14 ± 0.22	0.95 ± 0.24
7-m walk and talk	1.26 ± 0.23	1.05 ± 0.25	0.88 ± 0.30	0.69 ± 0.27	1.16 ± 0.25	0.95 ± 0.22	0.74 ± 0.23
7-m object pickup	1.30 ± 0.19	1.10 ± 0.21	0.88 ± 0.23	0.68 ± 0.23	1.20 ± 0.18	0.95 ± 0.19	0.74 ± 0.21
400-m*	1.71 ± 0.23	1.39 ± 0.20	1.16 ± 0.22	0.98 ± 0.24	1.51 ± 0.20	1.21 ± 0.18	1.03 ± 0.21
60-m, 15% body weight jacket*	1.73 ± 0.25	1.39 ± 0.22	1.15 ± 0.21	0.99 ± 0.26	1.49 ± 0.23	1.18 ± 0.20	1.00 ± 0.21

Note: Nonperformers were excluded.

* These tasks were performed at a fast pace. The others were performed at subject's usual pace.

Table 3
Absolute Change in Gait Speed (m/s) from Reference Walking Task

Tasks	Mean $\pm$ Standard Deviation			P-value*
	<65	65–74	75–84	
4-m, 25-cm corridor [†]	0.19 $\pm$ 0.25	0.25 $\pm$ 0.25	0.25 $\pm$ 0.21	<.001
4-m, 15-cm corridor [†]	0.30 $\pm$ 0.26	0.34 $\pm$ 0.26	0.35 $\pm$ 0.22	.01
7-m, long stride	–0.17 $\pm$ 0.28	–0.10 $\pm$ 0.19	–0.05 $\pm$ 0.18	<.001
7-m, obstacles, light [†]	0.19 $\pm$ 0.26	0.27 $\pm$ 0.28	0.28 $\pm$ 0.22	<.001
7-m, obstacles, dark [†]	0.23 $\pm$ 0.26	0.30 $\pm$ 0.27	0.32 $\pm$ 0.20	<.001
7-m, light package	0.02 $\pm$ 0.16	0.03 $\pm$ 0.16	0.05 $\pm$ 0.17	.09
7-m, walk and talk	0.24 $\pm$ 0.20	0.26 $\pm$ 0.22	0.25 $\pm$ 0.22	.71
7-m, object pickup	0.20 $\pm$ 0.16	0.24 $\pm$ 0.16	0.26 $\pm$ 0.16	<.001
400-m [†]	0.19 $\pm$ 0.21	0.24 $\pm$ 0.22	0.24 $\pm$ 0.19	.003
60-m, 15% body weight jacket [†]	0.20 $\pm$ 0.22	0.27 $\pm$ 0.24	0.29 $\pm$ 0.19	<.001

* P-values from analysis of variance.

[†] These tasks were performed at a fast pace. The others were performed at subject's usual pace.