Published in final edited form as:

Arch Phys Med Rehabil. 2011 July ; 92(7): 1074–1079. doi:10.1016/j.apmr.2011.02.006.

Sensory-motor and psychosocial correlates of adaptive locomotor performance in older adults

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Abstract

Objectives—To identify sensory-motor and psychosocial factors independently associated with inability to perform adaptive walking tasks in older adults

Design—Cross-sectional cohort study

Setting—Population-based older cohort

Participants—Community-living elderly (age ≥ 65 years) who could walk 7 m at self-selected normal speed (n = 720).

Interventions—Not applicable

Main Outcome Measures—Walking performance was assessed in four walking tests: fast walking, obstacle crossing, narrow-based walking and walking while talking. Possible correlates of the inability to perform the walking test included knee extensor strength, lower limb coordination, Cumulative Somatosensory Impairment Index (CSII), visual acuity and contrast sensitivity, cognition, depression, personal mastery, social support and years of education.

Results—The results of binary logistic regression analyses, adjusted for demographics and self-selected normal speed, demonstrated that poor knee extensor strength was associated with inability to perform tasks demanding increase in walking speed (fast walking and obstacle crossing). Both, poor lower limb coordination and higher CSII were significantly associated with failure in tests

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A part of the material was presented at The Gerontological Society of America's 63rd Annual Scientific Meeting, New Orleans, LA, USA, Nov 2010

Potential financial conflicts of interest: none

Device Status Statement: The manuscript submitted does not contain information about medical device(s).

Reprints: Reprints will not be available from the authors

SUPPLIERS

Hand-held dynamometer: Nicholas Manual Muscle Tester, model BK-5474, Fred Sammons, Burr Ridge, IL).
SPSS Inc. IL, USA

Financial Disclosure: I certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on me or on any organization with which I am associated AND, if applicable, I certify that all financial and material support for this research (e NIH g, or NHS grants) and work are clearly identified in the title page of the manuscript.

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that demanded precise control over foot placement (obstacle crossing and narrow-base walking). Higher CSII was associated with failure in all tests except in the walking while talking. In contrast, poor cognition was associated with inability to perform walking while talking. Poor personal mastery was the only variable that was associated with failure in all walking tests.

Conclusion—The results demonstrated a systematic and coherent pattern in these associations and indicated possible sensory-motor and psychological parameters that should be specifically investigated and should be intervened if a patient reports a difficulty/inability in walking in certain situations.

Keywords

adaptive locomotion; aging; fast walking; obstacle crossing; narrow-based walking; walk-and-talk

Mobility is defined as the ability to walk safely and independently in one's natural environment¹ and thus, is a prerequisite for one's independence in activities of daily living (ADLs and IADLs)², preserving social interactions and for maintaining overall quality of life³. It is not surprising that improving mobility is a major goal in rehabilitation of older persons.

Although the ability to walk provides the basis of mobility, 'the ability to walk' and 'mobility' are not synonymous⁴. The natural environment commonly imposes varied challenges while walking; for example, increasing walking speed when necessary, avoiding or stepping over obstacles, walking longer distances, accommodating different kinds of surfaces (e.g. slippery surfaces or slopes, narrow paths), performing simultaneous cognitive activities (e.g. holding a conversation), postural transitions (e.g. picking up something from the floor), and walking under suboptimal ambient conditions (e.g. low light levels) etc.¹. Therefore, adaptive locomotion is the mainstay of mobility.

Recently, it was demonstrated that age-associated decline in the walking speed on adaptive locomotor task is much steeper compared to the speed in level walking at a self-selected pace⁵. A few studies have also described biomechanical differences between young and older adults during adaptive locomotion that may be important in safely facing challenges while walking^{6,7}. Surprisingly, there is no solid knowledge of the factors that may contribute to the ability of accommodating various environmental challenges while walking, in older persons. Understanding these factors is critical for two reasons; first, for matching specific mobility impairment that an older individual with a particular sensory-motor and/or psychosocial deficit may encounter and second, for designing targeted interventions in order to sustain and improve mobility. The objective of the present study was to identify sensory-motor and psychosocial factors associated with the inability to perform adaptive walking tasks in the older adults who can walk 7 meters (m) at self-selected normal speed. We hypothesized that the sensory-motor and psychosocial attributes associated with the inability of older persons to successfully perform adaptive locomotion would be specific to the challenge imposed.

METHODS

Participants

The InCHIANTI study population is a representative sample of the population living in the Chianti countryside of Tuscany, Italy. The study design and data collection have been described previously elsewhere⁸. In 1998, 1453 adults were randomly recruited from the population registry of the two study sites. Follow-up data were collected after 3 and 6 years. The protocol was approved by the ethical committee of the Italian National Institute of

Research and Care of Aging and participants signed on informed consent. The present study uses the year 3 data of the study participants (2001–02, $n = 1167$) who were originally evaluated. Older participants (age ≥ 65 years) those who could walk 7 m distance at a self-selected usual walking speed and those with scores ≥ 18 on Mini Mental State Examination (MMSE) test were included in this analysis.

Primary outcome measures

Adaptive walking tests—Walking tests were carried out in a clinical setting. Participants used their usual gait aids. Those who needed manual assistance for walking or used a walker were excluded. The starting location was marked with a colored tape. The end of the 7 m walking path was not marked, to prevent slowing in anticipation. The time to complete the walking test was measured using two photocells positioned at the start and end of the path. The time data was then converted into walking speed (m/s). Initially, participants were asked to walk at their self-selected usual speed (normal speed).

For increasing demands while walking participants were asked to walk in the following four challenging walking tests. 1. Fast walking: participants were asked to walk as fast as possible. If the participant could not increase the speed by at least 0.1 m/s⁹, a failure was recorded. 2. Obstacle crossing: Participants were required to cross over two obstacles placed in the path while walking as fast as possible. The obstacles were 6-cm and 30-cm tall, positioned, respectively, after 2m and 4m from the starting line. The participant failed the test if they tripped on or touched the first obstacle or needed manual assistance for any reason. 3. Narrow path walking: participants were instructed to walk at their usual pace, but to stay between lines of colored tape placed 25 cm apart. Failure to complete this test was recorded if the participant stepped on or outside the tape lines two or more times. 4. Walk-and-talk: participants were required to walk while performing a cognitive verbal task in which they were asked to recite names of animals starting with a specific letter. They were instructed to focus equally on the verbal and the locomotor task. If the participant could not verbalize even one name, a failure was recorded. The participant also failed the test if he/she could not successfully complete the trial, if it was perceived unsafe by the tester for the participant to perform (e.g. unsteady, heart surgery in last 3 months or systemic blood pressure >180 mmHg or diastolic Blood pressure > 100 mmHg) or if the participant refused to perform the walking trial. A zero value was assigned for gait speed for in case of failure.

Sensory-motor Domain—Lower limb strength was represented by the strength of the knee extensor muscle groups and measured using a hand-held dynamometer¹⁰. The location of the dynamometer was on the anterior surface of the right leg 10 cm above the proximal margin of external malleolus. The maximum value of three repeated measurements was noted¹⁰.

A standard heel-shin clinical test in the supine position was used to assess lower limb coordination. The participant was instructed to place the right heel on the left shin just below the knee, and then slide it down to the foot, repeating this movement 10 times. The total time required to perform the test was measured in seconds¹¹.

The lower limb somatosensory function was assessed using a Cumulative Somatosensory Impairment Index (CSII). In this test a cumulative score is developed from standard clinical assessments of vibrotactile sensitivity, pressure sensitivity, ankle proprioception and plantar graphesthesia¹².

A standard Snellen eye chart placed at a distance of 3 m was used to test visual acuity. Visual acuity scores of 0/0 to 11/10 were graded from 0 to 11¹³. Visual contrast sensitivity was measured using the standard Pelli-Robson chart test. The last correctly identified letter

was noted and the associated log contrast sensitivity was recorded¹⁴. The vision testing was completed using binocular vision with participant's usual corrective lenses.

Psychosocial domain—Cognitive function was evaluated by the Mini Mental State Examination (MMSE)¹⁵. MMSE is a widely used tool for measuring global cognitive impairment across multiple domains (orientation, memory, concentration, language and praxis) with scores ranging between 0–30, higher scores indicating better cognition. The Center for Epidemiological Studies Depression scale (CES-D), a 20 item self-report questionnaire, was used to assess depressive symptoms. Scores can range from 0 to 60, with higher scores indicating more depressive symptoms¹⁶. To evaluate the sense of personal mastery, a short version Pearlin and Schooler Mastery Scale (PSMS) was used (6 items, scores ranging from 6 to 30, higher scores indicate more mastery). Sense of mastery addresses the extent to which a person has a feeling of being in control of his or her own life circumstances and how s/he would react to stresses, difficulties and adversities of life¹⁷. Social support from 12 categories of people was included to measure the degree of available social support. Participants were asked about the availability of these 12 people (1 = completely available to 4 = not available) in a hypothetical scenario where help or assistance was required. The mean score was calculated with higher scores indicating less support¹⁸. Education was recorded as years of formal education.

Demographic variables of age (years), sex, height (cm) and weight (Kg) were included as covariates.

Descriptive variables: History of multiple falls in the previous year and total number of medications were recorded for descriptive purposes only.

Statistical Analysis

Variables with a skewed distribution (CSII, visual acuity, MMSE, CESD and PSMS) were log₁₀ transformed for the analysis and back-transformed for data presentation. Missing values were <5% and were replaced by overall means. The differences between those who could and who could not perform a specific adaptive locomotor task were determined using analysis of covariance or multinomial logistic regression analysis, as appropriate, adjusting for normal walking speed. The sensory-motor and psychosocial parameters that were significantly different between the groups were further included in the binomial logistic regression analysis to identify factors that were independently associated with the inability to perform that adaptive walking test. Statistical analyses were performed using SPSS version 18.0. A $p < 0.05$ was considered for statistical significance.

RESULTS

A total of 784 participants who walked 7 m at a normal self-selected speed and had MMSE score ≥ 18 were initially included. The error record was missing for 64 participants leading to inability in determining their failure. They were older than those who had a complete error record (age 75.3 vs. 78.3, $p < 0.001$). However, there were no differences in their mean weight, height or normal walking speed. In the final analysis 720 participants were included. Table 1 describes the demographic, sensory-motor, psychosocial and descriptive characteristics of the study population. Out of these 720 participants, 46 participants either refused or were identified unsafe and 94 participants could not increase their speed even though they completed the fast walking task. A total of 151 participants failed obstacle crossing (75 refused or identified unsafe, 54 tripped or touched first object, 22 needed manual assistance for any reason). In the narrow-based walking task 72 participants either refused or were identified by testers as unsafe for the task and 74 participants stepped

outside the marking tapes more than once. One hundred forty-eight participants failed walk-and-talk test (71 refused or identified unsafe, 77 participants could not verbalize any names).

The participants who failed in the adaptive walking test were significantly different on multiple characteristics compared to those who successfully completed that adaptive walking test, even after adjusting for normal self-selected walking speed. Table 2 lists the variables that were significantly different between these two groups, in each walking test.

Fully adjusted binary logistic regression analysis showed that lower knee extensor strength, higher CSII and lower personal mastery were significantly associated with failure in fast walking test. Higher age, lower knee extensor strength, poor lower limb coordination, higher CSII and lower personal mastery were associated with inability to successfully complete obstacle crossing test. Higher age, poor lower limb coordination, lower MMSE scores and lower personal mastery were associated with failure in walk-and-talk test. Finally, higher age, poor lower limb coordination and higher CSII were associated with inability to perform narrow-based walking (Table 3).

DISCUSSION

This study investigated sensory-motor and psychosocial parameters associated with the inability to perform adaptive walking performance under varied challenges. The results demonstrated a systematic and coherent pattern in these associations.

Poor knee extensor strength was associated with the inability to perform locomotor tasks that demanded increase in walking speed (fast walking and obstacle crossing at fast speed) but not in tasks that could be performed at a self-selected speed. Higher strength is required for higher push-off forces needed to propel the body farther forward¹⁹. Therefore, older persons with weak lower limb musculature may be particularly vulnerable in situations when temporal constraints are imposed while walking. In addition, while stepping over an obstacle, the strength of hip flexors is directly relevant for the ability to lift the leg in order to step over the obstacle²⁰. In this study external constraints were not imposed on how the fast walking task should be completed. In real life situations when the need to increase the walking speed can be externally controlled, particularly, with respect to a moving target (e.g. increasing walking speed while crossing a street to avoid collision with an incoming car) other sensory inputs (vision and/or hearing) and cognition could become critical for calculating possible 'time to impact'²¹.

Higher CSII was strongly associated with inability to perform all locomotor tests except in the walk-and-talk suggesting the prime role of lower limb somatosensory functions while walking with an additional challenge. These results are supported by our previous findings that demonstrated the role of CSII in the decline of dynamic postural control¹².

It is possible that older persons have difficulty utilizing *conscious* perception of somatosensation (as measured in CSII) while simultaneously performing attentionally demanding cognitive task (walk-and-talk test). In contrast, higher cognition was strongly associated with only the ability to perform walk-and-talk test. Several studies have reported association between various gait variables and cognition^{22,23}. However, due to the simplicity of measurement and clinical as well as functional relevance, walking speed is the most commonly studied outcome measure. A recent review by Al Yahya et al. suggests that the type of cognitive task may have differences in the magnitude of impact on gait variables and overall, this impact is relatively more in older adults compared to young adults²⁴. Few studies have, however, comprehensively examined the factors associated inability to perform secondary cognitive task while walking. For the first time, this study has shown that even within the older population who are not cognitively impaired, those at the lower end of

the spectrum may not be able to perform adaptive locomotion when secondary verbal cognitive task is imposed.

Both, poor lower limb coordination and higher CSII were strongly associated with failure in the tests that demanded precise control over foot placement, as in obstacle crossing and narrow-base walking test. The biomechanics of obstacle crossing has been extensively studied in older adults and in various pathological populations as the model for understanding risk of falling²⁵. Narrow-based walking has been suggested as possible clinical tool for measuring physical function in high functioning older adults^{26–27}. The deficit in lower limb coordination is one of the basic causes of gait abnormality and induces wider than normal base of support while walking in order to improve stability (e.g cerebellar pathologies)²⁸. Lower limb somatosensory deficits can lead to mal-adaptive gait alterations^{29–30}. For the first time, our findings suggest that both these parameters could be critical while walking in conditions that necessitate fine control of limb trajectory and foot placement. Surprisingly, vision functions of contrast sensitivity and/or acuity were not associated either with obstacle crossing or with narrow-based walking. It is possible that optimum ambient light conditions in addition to high contrast obstacles and marking tapes did not put excessive demands on vision function. Overall, the findings suggest that ability to safely traverse particularly in cluttered environments may significantly depend on lower limb coordination and somatosensory impairment. However, performing the task under suboptimal conditions may also depend on vision functions.

In these fully adjusted regression models gender, height, weight, visual acuity, social support, education and depressive symptoms were not associated with adaptive locomotion. In contrast, personal mastery was the only variable that was associated with all 4 tests indicating its possible role in the ability to accommodate challenges while walking. Our previous findings have shown that higher personal mastery is associated with lower fear of falling in elderly persons¹⁹. Similarly, the protective role of personal mastery against depressive symptoms is also evident³¹. Higher depression is known to cause slower movement speed³². Together, the findings indicate that personal mastery that addresses how a person will react to difficulties and challenges of life¹⁷ may play a more global role in adaptive locomotion by counteracting fear of falling and depression. This study could not establish a clear relationship between fear of falling and adaptive locomotion and this topic will need to be further examined. However, it is reasonable to hypothesize that older individuals who experience fear of falling may first avoid venturing in environments that pose higher adaptive locomotor demands, possibly, causing further decline in their sensory-motor tuning required for dynamic postural control⁴.

This study has several limitations. First of all, our findings are based on cross-sectional associations and therefore they may suggest but not definitively prove causal relationships. For example, inability to accommodate common challenges while walking may reduce personal mastery or poor personal mastery may lead to avoidance tendency. Future studies are warranted to establish temporal direction of these relationships. Further, only representative specific challenges were included in this study. Thus, factors correlated with other challenges such as walking on slippery surfaces or walking in a dynamic environment that necessitate continuous ongoing adaptation for avoiding a possible collision may not be directly inferred. Additionally, our findings may not be applicable to other age groups as older persons use more cautious strategies in challenging environments³³.

CONCLUSION

In older persons, disability usually occurs first in mobility and sets a downward spiral of progressive disablement³⁴. Therefore, understanding factors associated with adaptive

locomotion that provides the foundation for mobility is critical. For the first time, our results demonstrated sensory-motor and psychological parameters that are associated with the inability to perform adaptive locomotion under specific challenges. The results may have direct practical implications as they indicate which older persons may experience difficulty walking safely under certain condition. On the other hand, from clinical perspectives, results also suggest possible sensory-motor and psychological parameters that should be specifically investigated and should be intervened for improving mobility if a patient reports difficulty/inability in walking in certain situations. Further longitudinal studies should be performed to establish temporal direction of the relationships.

Acknowledgments

The InCHIANTI study was supported as a “targeted project” (ICS 110.1\RS97.71) by the Italian Ministry of Health and in part, by National Institute on Aging Contracts N01-AG-916413, N01-AG-821336, N01-AG-5-0002, and NIA Grant R01 AG027012 and the Intramural Research Program, National Institute on Aging, NIH.

List of abbreviations

ADL	Activities of Daily Living
IADL	Instrumental Activities of Daily Living
m	meter
cm	centimeter
s	second
MMSE	Mini Mental State Examination
CSII	Cumulative Somatosensory Impairment Index
CFS-D	Center for Epidemiological Studies Depression scale
PSMS	Pearlin and Schooler Mastery Scale

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Table 1

Demographic, sensory-motor, psychosocial and descriptive characteristics and the walking speeds in four adoptive locomotor conditions of the study population (n=720).

Variables	% or mean (SD)
Age (years)	75.3 (5.9)
Sex (women%)	55.3%
Weight (kg)	68.9 (11.9)
Height (cm)	161.1(9.1)
Knee Extensor strength (kg)	16.0 (4.5)
LLcoordination (sec)	12.7 (4.6)
CSII	2.7 (1.7)
Contrast sensitivity	1.7 (0.1)
Visual acuity	0.34 (0.11)
MMSE	25.8 (2.9)
CESD	15.5 (8.6)
PSMS	20.1 (5.3)
Social support	25.9 (9.4)
Formal education (years)	5.8 (3.4)
Normal walking speed (m/s)	1.23 (0.27)
Descriptive variables	
Total medications	2.7 (2.1)
History of multiple falls (%)	8.2%
Walking speed in ALP conditions	
Fast walking speed (m/s)	1.23 (0.66)
Obstacle-crossing walking speed (m/s)	0.31 (0.55)
Narrow-base walking speed (m/s)	0.99 (0.57)
Walk-and-talk speed (m/s)	0.79 (0.47)

LLcoordination: Lower limb coordination

CSII: lower limb Cumulative Somatosensory Impairment Index

MMSE: Mini mental state examination

CESD: Center for Epidemiological Studies Depression scale

PSMS: Pearlin and Schooler Mastery Scale

Table 2

The mean $\pm$ SD (or %) for those who were unable to perform the ALP and those who successfully completed the ALP are displayed in table 2a (fast walking and obstacle crossing conditions) and table 2b (narrow-base walking and walk-and-talk conditions). The first value in each cell corresponds to those who were unable to perform the ALP. All analyses were adjusted for normal self-selected walking speed

Table 2a		
Variable	Fast walking (Failed: n=140) [†]	Obstacle crossing (Failed: n=151) [†]
Age (years)	78.0 $\pm$ 7.2/74.6 $\pm$ 5.3 *	79.5 $\pm$ 6.5/74.2 $\pm$ 5.2 *
Sex (female%)	72.9/51.0 *	73.5/50.4 *
Weight (Kg)	67.1 $\pm$ 10.7/69.4 $\pm$ 11.9	67.1 $\pm$ 11.8/69.4 $\pm$ 11.7
Height (cm)	158.2 $\pm$ 8.6/161.8 $\pm$ 9.1	158.2 $\pm$ 8.5/161.8 $\pm$ 9.1 *
Knee extensor strength (kg)	13.9 $\pm$ 3.5/16.5 $\pm$ 4.5 *	13.1 $\pm$ 3.4/16.8 $\pm$ 4.4 *
LLcoordination (sec)	14.5 $\pm$ 4.7/12.3 $\pm$ 4.5 *	15.8 $\pm$ 7.8/11.8 $\pm$ 2.8 *
CSII	3.6 $\pm$ 2.1/2.4 $\pm$ 1.5 *	3.9 $\pm$ 1.9/2.3 $\pm$ 1.5 *
Contrast sensitivity	1.66 $\pm$ 0.07/1.66 $\pm$ 0.04	1.65 $\pm$ 0.07/1.69 $\pm$ 0.04 *
Visual acuity	0.31 $\pm$ 0.11/0.35 $\pm$ 0.11 *	0.30 $\pm$ 0.11/0.35 $\pm$ 0.11 *
MMSE	24.6 $\pm$ 3.0/26.2 $\pm$ 2.8 *	24.3 $\pm$ 3.1/26.3 $\pm$ 2.6 *
CESD	19.8 $\pm$ 9.8/14.1 $\pm$ 8.0 *	19.8 $\pm$ 9.7/14.0 $\pm$ 7.9 *
PSMS	17.1 $\pm$ 5.9/20.8 $\pm$ 4.8 *	16.4 $\pm$ 5.6/21.0 $\pm$ 4.7 *
Social support	26.1 $\pm$ 9.5/25.8 $\pm$ 9.3	25.3 $\pm$ 10.3/26.0 $\pm$ 9.1
Education	5.0 $\pm$ 2.8/5.9 $\pm$ 3.4	5.2 $\pm$ 3.4/5.9 $\pm$ 3.3 *

Table 2b		
Variable	Narrow-base (Failed: n=146) [†]	Walk-and-talk (Failed: n=148) [†]
Age (years)	79.6 $\pm$ 6.6/74.2 $\pm$ 5.1 *	79.1 $\pm$ 7.1/74.3 $\pm$ 5.1 *
Sex (female%)	60.3/54.0	56.8/54.9
Weight (Kg)	68.5 $\pm$ 11.5/69.0 $\pm$ 11.8	67.9 $\pm$ 10.4/69.2 $\pm$ 12.1
Height (cm)	160.1 $\pm$ 8.4/161.3 $\pm$ 9.2	160.5 $\pm$ 8.7/161.2 $\pm$ 9.2
Knee extensor strength (kg)	14.5 $\pm$ 3.6/16.4 $\pm$ 4.6 *	14.9 $\pm$ 3.9/16.3 $\pm$ 4.5 *

Table 2b

Variable	Narrow-base (Failed: n=146) [†]	Walk-and-talk (Failed: n=148) [†]
LLcoordination (sec)	15.3±7.9/12.0±2.9 *	15.0±7.6/12.1±3.2 *
CSII	3.7±2.0/2.4±1.5 *	3.6±2.1/2.4±1.5 *
Contrast sensitivity	1.66±0.07/1.69±0.04 *	1.66±0.07/1.68±0.04 *
Visual acuity	0.29±0.11/0.35±0.11 *	0.30±0.11/0.35±0.11 *
MMSE	24.8±3.1/26.2±2.7 *	24.0±3.2/26.4±2.6 *
CESD	18.5±9.6/14.4±8.2 *	18.2±9.7/14.5±8.2 *
PSMS	17.6±5.3/20.7±5.1 *	17.1±5.6/20.8±4.9 *
Social support	25.9±9.7/25.8±9.3	25.6±10.2/25.9±9.1
Education (years)	5.2±3.1/5.9±3.3	4.6±2.6/6.0±3.4 *

* denotes variables that were significantly different between the two groups

[†] denotes the number of participants, out of 720, who failed the ALP

LLcoordination: Lower limb coordination

CSII: lower limb Cumulative Somatosensory Impairment Index

MMSE: Mini mental state examination

CESD: Center for Epidemiological Studies Depression scale

PSMS: Pearlman and Schooler Mastery Scale

Table 3

Table 3a and 3b (3a: fast walking and obstacle crossing conditions and table 3b: narrow-based walking and walk-and-talk conditions). the results of fully adjusted binary logistic regression analysis to identify factors that were independently associated with inability to perform adaptive locomotion in each of the 4 conditions. Only the variables that were significantly different between those who completed and those who failed the ALP task (indicated by asterisks in table 2) were included in the analysis.

Table 3a					
Fast walking			Obstacle crossing		
variable	Beta (SE)	p	variable	Beta (SE)	Exp B (CI)
Age (years)	0.038(0.020)	.053	Age (years)	.065 (0.020)	.001 1.067 (1.026–1.110)
Sex	0.427(0.310)	.168	Knee Extensor strength (Kg)	-.109 (0.034)	.001 .897 (.839–.959)
Height (cm)	-0.001(0.016)	.935	LLcoordination (sec)	.109 (0.033)	.001 1.115 (1.046–1.189)
Knee Extensor strength (Kg)	-0.076(0.033)	.021	CSII	2.536 (0.635)	.000 12.626 (3.634–43.868)
LLcoordination (sec)	0.028(0.021)	.177	CS	-.958 (1.890)	.612 .384 (.009–15.589)
CSII	1.365 (0.542)	.012	PSMS	-3.341 (0.896)	.000 .035 (.006–.205)
CESD	-.492 (.935)	.599	Normal speed (m/s)	-1.680 (0.487)	.001 .186 (.072–.484)
PSMS	-2.204(0.882)	.012	Constant	.149 (3.999)	.970 1.161
Education (years)	-0.016(0.035)	.642			
Normal speed (m/s)	0.976(0.450)	.030			
Constant	2.170(4.691)	.644			

Table 3b					
Narrow-based walking			Walk-and-talk		
variable	Beta (SE)	p	variable	Beta (SE)	Exp B (CI)
Age (years)	.111 (.020)	.000	Age (years)	.100 (.021)	.000 1.105 (1.061–1.151)
Knee extensor strength (Kg)	.017 (.030)	.569	Knee extensor strength (Kg)	.032 (.030)	.291 1.032 (.973– 1.094)
LLcoordination (sec)	.118 (.032)	.000	LLcoordination (sec)	.106 (.032)	.001 1.111(1.044–1.183)
CSII	1.658 (.573)	.004	CSII	.800 (.543)	.140 2.227 (.769–6.450)
CS	-1.935 (1.993)	.332	CS	-.593 (2.072)	.775 .553 (.010–32.042)
Visual acuity	-.316 (.632)	.618	Visual acuity	.478 (.657)	.467 1.613 (445–5.849)
MMSE	.727 (2.224)	.744	MMSE	-9.343 (2.254)	.000 .000 (.000–.007)
CESD	.696 (.519)	.180	CESD	-.505 (.502)	.314 .604 (.226–1.614)
PSMS	-1.080(0.546)	.048	PSMS	-3.533 (.951)	.000 .029 (.005–.188)

Table 3b						
Narrow-based walking				Walk-and-talk		
variable	Beta (SE)	p	Exp B (CI)	Beta (SE)	p	Exp B (CI)
Normal speed (m/s)	-.147 (.452)	.745	.863 (.356-2.094)	-.059 (.041)	.150	.942 (.869-1.022)
Constant	-10.554 (5.611)	.060	.000	1.238 (.482)	.010	3.450 (1.342-8.872)
				6.902 (5.646)	.222	994.348

LLcoordination: Lower limb coordination
CSII: lower limb Cumulative Somatosensory Impairment Index
CS: Contrast sensitivity
MMSE: Mini mental state examination
CESD: Center for Epidemiological Studies Depression scale
PSMS: Pearlín and Schooler Mastery Scale