Published in final edited form as:

J Am Geriatr Soc. 2010 January ; 58(1): 98–103. doi:10.1111/j.1532-5415.2009.02611.x.

Personal Mastery and Lower Body Mobility in Community-Dwelling Older Persons: the InCHIANTI Study

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Abstract

Objectives—We tested the hypothesis that in older persons sense of personal mastery, defined as the extent to which one regards one's life chance as being under one's own control, predicts change in lower extremity performance during a 6-year follow-up.

Design—Prospective cohort study.

Setting—Community-based.

Participants—626 participants aged 65 years and older.

Measurements—Personal mastery was assessed at baseline using Pearlin's mastery scale. Lower extremity performance was measured at baseline and at 6-year follow-up using the Short Physical Performance Battery (SPPB) of lower extremity function.

Results—Higher sense of mastery was associated with significantly less steep decline in lower extremity performance. Participants in the two lowest quartiles of personal mastery had, respectively, a 2.6 (95%CI=1.4–5.1, $p=0.01$) and 3.2 (95%CI=1.6–6.6, $p=0.002$) higher risk of experiencing a substantial decline (≥ 3 points) in SPPB scores after 6 years compared to those in the highest quartile.

Conclusions—Older individuals with poor sense of personal mastery are at high risk of accelerated lower extremity physical function decline. Whether interventions aimed at improving personal mastery may prevent disability remains unknown.

Keywords

Personal mastery; lower body mobility; physical performance; SPPB

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Author Contributions: All the authors took part in every aspect of this paper including the design, preparation of the manuscript and writing of this paper.

Conflict of interests: The authors declare that they have no conflict of interest to disclose concerning this manuscript.

INTRODUCTION

Research on the psychological characteristics that can affect health in the elderly has mostly examined relations between negative dimensions (e.g., depression) and physical health [1,2]. More recently, there has been an interest in examining whether positive psychological attitudes may promote healthier aging, especially in terms of maintaining physical function. There is emerging evidence that psychological well-being and personal coping resources are associated with lower morbidity and mortality, and faster and more complete recovery after a medical event [3,4]. In a study of disabled older women, emotional vitality (defined as having high sense of personal mastery, being happy, and having low depressive and anxiety symptoms) reduced the risk of subsequent new disability and mortality [5].

Personal control beliefs, also referred to as “personal mastery”, reflect individuals’ beliefs regarding the extent to which they are able to control their life and environment [6]. In particular, 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 the person would react to stresses, difficulties, and adversities of life [7]. It has been suggested that the impact of sense of mastery may grow stronger in old age, because older persons face biological and environmental experiences that challenge their perceived competence in affecting a number of potentially controllable outcomes [6]. Indeed, epidemiological studies of older persons have found that personal mastery was associated with depressive symptoms [8,9], fear of falling and consequent activity restriction [10], disability [11] and mortality [12]. We found no reports that directly addressed the relationship between personal mastery and objective measured lower extremity performance, one of the most informative indicators of health and risk of negative health outcomes in older persons [13]. To address the hypothesis that low sense of mastery may predict decline in physical performance, we examined the relationship between personal mastery and lower extremity performance in a sample of community-dwelling older Italians. We hypothesized that lower personal mastery would be associated cross-sectionally with worse lower extremity performance and longitudinally with accelerated decline of lower extremity performance.

METHODS AND MATERIALS

Study Population

Participants were part of the InCHIANTI (**In**vecchiare in **Chianti**, aging in the Chianti area) study, a prospective population-based study of older persons in Tuscany (Italy) designed to investigate factors contributing to decline of mobility in late life. A description of the study rationale, design and methods is given elsewhere [14]. Briefly, in 1998-1999 the sample was randomly selected from two sites, Greve in Chianti and Bagno a Ripoli, using a multistage stratified sampling method: 1270 persons ≥ 65 years were randomly selected from the population registry of the two sites, another 29 subjects ≥ 90 years were oversampled. Thirty-nine participants were not eligible because they already died or emigrated. Among those who were eligible, 1155 (91.6%) were enrolled. Data collection included: 1) a home interview 2) physical performance testing and medical examination at the study clinic; 3) a 24-h urine collection and a blood drawing. Participants were seen again for a three-year follow-up visit (2001-2003) and six-year follow-up visit (2004-2006). All respondents signed informed consent and the Italian National Institute of Research and Care on Aging Ethical Committee approved the study protocol.

Of the 1155 participants aged ≥ 65 enrolled in the study, we excluded 203 because of missing data on personal mastery or physical performance at baseline. In cross-sectional analyses we included all 952 remaining participants. At 6-year follow-up, of these 952 participants, 173 had already died and 47 were lost (33 refused, 14 emigrated). Additionally, 87 did not

participate in the complete follow-up performance session mainly because of cognitive (24 needed an interview with a proxy) or physical impairment (14 were unable to walk independently) and 19 had a missing performance score at follow-up. This left 626 participants for whom 6-year follow-up data on physical performance were available. These served as the primary subjects for longitudinal analyses. As compared to participants included in this analysis, those who were not included were significantly older (76.3 vs 72.2), more often sedentary (26.1% vs 12.9%) and disabled in activities of daily living (9.5% vs 2.7%) and in instrumental activities of daily living (34.4% vs 13.6%), took more medications (2.4 vs 1.8), had poorer cognitive function (Mini Mental State Examination) (23.8 vs 25.7), lower extremity performance (Short Physical Performance Battery) (8.9 vs 10.4) and personal mastery (18.5 vs 19.6).

Personal mastery

Personal mastery was assessed at baseline with the Pearlin & Schoolers's "Personal Mastery Scale" [7], which addresses the extent to which persons regard their life circumstances as being under one's own control in contrast to being fatalistically ruled by external factors. The Pearlin's mastery scale is a widely used measure in health research of personal control belief [12,15]. The scale included in the InCHIANTI interview was an abbreviated version of the Pearlin & Schoolers's Personal Mastery Scale, consisting of 6 items, which are each answered on a 5-point scale (from strongly disagree to strongly agree); the scores range from 6 to 30, with higher scores indicating greater mastery. This version has shown a reasonable reliability in the InCHIANTI population [10] and in our specific sample (Cronbach's alpha=0.72), comparable to those obtained by the complete or other abbreviated versions used in different studies [5, 15].

Physical performance

Lower body performance was assessed at baseline and at 6-year follow-up with the Short Physical Performance Battery (SPPB) [13], which was derived from three objective tests of physical function: 4-meter walking speed, repeated chair rises and standing balance in progressively more challenging positions. Walking speed was defined as the better performance (time) of 2 walks at usual pace over a 4-meter course. For the chair-stand test, participants were asked to rise 5 times from a seated position as quickly as possible with their hands folded across the chest, and performance was expressed as total time to complete the test. For the standing balance tests, participants were asked to stand in 3 progressively more difficult positions for 10 seconds each: feet in side-by-side, semitandem and full tandem positions. Each test was scored 0 to 4 as per previously determined criteria [16] with a value of 0 indicating the inability to complete the test and 4 the highest level of performance. Scores from the three tests were summed into a composite score ranging 0 to 12, higher scores reflect better physical function. The SPPB has excellent reliability and is highly sensitive to important change such as self-reported decline in ability to walk a block or to climb one flight of stairs, and the loss of 1 point is considered a clinically meaningful change [17]. Moreover, the SPPB is a strong predictor of nursing home admission, disability in self-care tasks and mobility, and death among older adults [13,16]. In previous research [2] on depression and SPPB, a decrease by 3 or more points during follow-up (i.e., a decline of at least 2 points more than the median change of -1) was considered a "substantial decline". We applied the same operational criteria to the dependent variable in longitudinal analyses.

Covariates

The following covariates were selected. Age, gender, education (years), smoking habit (current/former/non-smoker), alcohol use (<30 vs ≥30 g/day), Mini Mental State Examination (MMSE) score, body mass index (BMI), and number of prescribed and non-prescribed drugs.

Total number of chronic diseases (including heart failure, coronary heart disease including angina and myocardial infarction, stroke, chronic obstructive lung disease, hypertension, diabetes, cancer, dementia and hip arthritis) was calculated as a global marker of poor physical health; diseases were ascertained according to a standardized, pre-established criteria and algorithms based upon those used in the Women's Health and Aging Study [18] using information on self-reported history, pharmacological treatments, medical exam data and hospital discharge records. Number of ADL and IADL disabilities was defined as self-report of inability or needing personal help in performing any basic or instrumental activities of daily living [19]. Level of physical activity in the previous 12 months was classified as sedentary/light/moderate-high [20]. Depressive symptoms were assessed using the Center for Epidemiological Studies-Depression Scale (CES-D) [21]. A score ≥ 20 was operationally defined as clinically relevant "depressed mood" [2]. All the covariates mentioned were assessed at the baseline session. In longitudinal analyses we also included as a covariate the inability to complete the 400 meters walk test at 3-year follow-up [22] in order to control for important change in physical function. For this test the subject was invited to walk at a steady pace for 400 m; a maximum of two standing rests were allowed for 2-minute intervals each and total time to perform the test was measured by a photocell-based system. In a previous article [22] based on the InCHIANTI sample, baseline SPPB predicted loss of ability to walk 400 m at the 3-year follow-up.

Statistical Analyses

Variables were reported as percentage or means $\pm$ SD as appropriate. Descriptive analyses were performed on characteristics of the study population. The cross-sectional association between personal mastery and SPPB was tested using multivariate linear regression analysis. Pearson's correlation was used to evaluate the association between personal mastery and depressive symptoms. Change in physical performance was computed by subtracting the baseline performance score from the 6-year follow-up score. Multivariate linear regression models were used to analyze the effect of personal mastery on change in physical performance. Changes in SPPB scores across personal mastery quartiles were compared using analysis of covariance. Substantial decline in lower extremity performance was defined as a decrease of 3 or more points between baseline and 6-year follow-up. Logistic regression was used to compare the odds of substantial decline in SPPB score at follow-up across personal mastery quartiles. The analyses were repeated in a subset of healthy participants with no ADL disabilities and with SPPB >9 at enrollment and in a subset of participants without depressed mood at baseline.

All analyses were adjusted for age and sex. All longitudinal analyses were additionally adjusted for baseline SPPB in order to correct for the "regression to the mean". Multivariate analyses were also adjusted for covariates that in age- and sex adjusted analyses were significantly related to lower extremity performance. All analyses were performed using SAS (v. 8.2, SAS Institute, Inc., Cary, NC) with a statistical significance level set at $P < 0.05$.

RESULTS

The mean ($\pm$ SD) age of the study sample was 74.3 (± 6.8) years and 55.8% were women. Table 1 describes the characteristics of participants for the total baseline sample and according to SPPB score subgroups: 0-4 (severe mobility limitation), 5-9 (mild to moderate mobility limitation), and 10-12 (good mobility). Baseline personal mastery scores ranged from 6 to 30, with a mean ($\pm$ SD) score of 19.6 (± 4.1). Personal mastery scores were significantly higher across groups from low to high lower extremity function. At baseline, after adjustment for age, sex, MMSE, depressed mood, BMI, number of drugs and chronic diseases, number of ADL and IADL, and physical activity, personal mastery score was associated with SPPB score ($\beta = 0.1$, $SE = 0.02$, $p < .0001$). At baseline, the age- and sex-adjusted Pearson's correlation

coefficient between personal mastery and depressive symptoms assessed with CES-D was -0.52 ($p < .0001$).

Change in SPPB score between baseline and 6-year follow-up ranged from -12 to 4 , with a mean ($\pm$ SD) change of -1.7 (± 2.7). Lower extremity performance declined during the follow-up in 363 (58.0%) participants; in particular, SPPB scores declined by 3 or more points for 162 (25.9%) participants. SPPB scores did not change between baseline and follow-up for 203 (32.4%) participants and 60 (9.6%) participants improved their performance scores.

Multivariate linear regression models were used to examine the relationship between personal mastery and change in SPPB; higher sense of mastery was associated with significantly less steep decline in performance ($\beta = 0.1$, $SE = 0.03$, $p = 0.001$) after adjusting for age, sex, MMSE, number of chronic diseases, baseline SPPB and inability to perform the 400 m walk at 3-year follow-up. To explore the functional form of the association between personal mastery and change in physical performance, personal mastery scores were divided into quartiles: 6 to 17 ($n = 158$), 18 to 20 ($n = 174$), 21 to 22 ($n = 155$) and 23 to 30 ($n = 130$). Figure 1 shows age- and sex-adjusted means of change in performance across the four groups; increasing levels of personal mastery were associated with smaller physical decline. A similar trend was also observed in a subset of 508 participants with no ADL disabilities and $SPPB > 9$ at enrollment (Figure 1).

Furthermore, we considered a decline in SPPB score by 3 or more points (i.e., a decline of at least 2 points more than the median change of -1) as a “substantial decline” in physical performance [2]. Among the 626 participants of the longitudinal sample, 162 (25.9%) experienced a substantial decline in SPPB score during follow-up. After adjustment for age, sex, MMSE, physical activity, number of chronic diseases, depressed mood, baseline SPPB and inability to perform the 400 m walk at 3-year follow up, those in the two lowest quartiles of personal mastery at baseline, compared to those in the first quartile, had respectively an OR of 2.6 (95%CI=1.4–5.1, $p = 0.01$) and 3.2 (95%CI=1.6–6.6, $p = 0.002$) of experiencing a substantial decline in lower extremity performance after 6 years (Table 2). To obtain a picture of the effect of personal mastery free of the possible confounding effect of poor physical functioning or depression, we performed additional analyses restricted to two subsets of healthy participants: 1) 508 subjects with no ADL disabilities and $SPPB > 9$ at baseline, and 2) 501 participants without depressed mood at enrollment. Again, we found that participants in the two lowest quartiles of personal mastery had higher risk of substantial decline in lower extremity performance compared to those in the highest quartile (Table 2).

DISCUSSION

Using data from a population-based study of older persons, we found evidence that poor sense of mastery predicts greater subsequent decline in physical performance over a 6-year follow-up after adjusting for health status and functioning. Lower personal mastery also predicted poorer lower extremity performance when the analysis was restricted to a subset of participants free of physical disability and with a high level of functioning at baseline. Our results are consistent with findings from other epidemiological studies of older persons. Personal mastery has been shown to have direct favorable effects or to mitigate the influence of stressors such as diseases on depressive symptomatology [8,9]. Poor personal mastery has also been shown to be associated with fear of falling and activity restriction in the InCHIANTI sample [10]. Low mastery has also been shown to be a risk factor for disability in an older population [11]. Moreover, greater feelings of mastery were directly associated with a reduced mortality risk in community-dwelling older persons [12]. Emotional vitality, defined as a high sense of personal mastery, feelings of happiness, and low depressive-anxiety symptoms, was associated with a reduced risk of subsequent new disability and mortality in a sample of disabled older

women [5]. Our findings are also consistent with the literature showing that positive aspects of psychological functioning, such as personal coping resources, are associated with better physical health [3,4].

In recent years, it has been debated whether psychological well-being and ill-being comprise opposite ends of a continuum, or are best constructed as distinct and independent dimensions of emotional functioning [23]. In our study, the association between personal mastery and depressive symptoms was significant but moderate. In addition, the association between personal mastery and physical performance remained significant after adjustment for depressive symptoms or after the exclusion of subjects with depressed mood at baseline.

There are different behavioral and biological pathways through which positive psychological functioning may potentially influence physical health, including improved stress resistance, physiological responses and behavior relevant to health [6]. Personal control beliefs influence coping responses and adaptation and may influence whether an event is judged to be stressful [24]; low perceived control and consequent lack of coping resources may lead to physiologic changes that increases the vulnerability to the effect of subsequent stress [25]. The emergent literature also suggests that positive psychological well-being could directly affect health-relevant neural, hormonal and immunologic process [26]. Furthermore, individuals with greater sense of mastery are more likely to perform health-protective behaviors, utilizing proper preventive care and health services [27]. A series of studies [28-30] examined the moderating effect of personal mastery on the relationship between different stressors (patient behavior problems, caregiver role overload) and psychological and physical health in a sample of elderly spousal Alzheimer caregivers. Findings from these studies have shown that personal mastery may mitigate the physiological effect of stress by modulating the norepinephrine reactivity [29] and immune cell β_2 -adrenergic receptor sensitivity [30].

An important limitation of our study is the loss of participants to follow-up. Participants lost to follow-up were significantly older, more disabled and had poorer cognitive function compared to those available for longitudinal analysis; this could limit the generalization of the findings. However, participants lost to follow-up had also significantly lower mean baseline score of personal mastery and physical performance. Therefore, censoring of these participants probably led to an underestimation of the relationship between sense of mastery and lower extremity performance. Another limitation to the generalizability of the study is the low education level of participants. Finally, it could be that other factors not measured in this study could have contributed to a decline in SPPB during follow-up.

A major strength of this study is the use of a standardized, objective battery of physical performance tests for lower extremity function (SPPB), which are probably less biased by personality, mood and cognition than self-report measures.

Our findings suggest that personal mastery is an important psychological factor associated with lower extremity performance decline in the elderly. These results may help explaining why some older vulnerable individuals are able to maintain their independence better than others given similar physical characteristics. These findings may be also important in prevention and recovery programs. Enhancement of a sense of control over one's life and development of adaptive coping skills could buffer, by modulating specific physiologic pathways, the detrimental effect of stress on physical health of the older person. This hypothesis should be tested in appropriately designed clinical trials.

Acknowledgments

Elements of Financial/ Personal Conflicts	*Author 1 YM		Author 2 SB		Author 3 AMC		Author 4 RV		Author 5 KVP		Author 6 LF		Author 7 JMG	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		X		X		X				X		X		X
Grants/Funds		X		X		X				X		X		X
Honoraria		X		X		X				X		X		X
Speaker Forum		X		X		X				X		X		X
Consultant		X		X		X				X		X		X
Stocks		X		X		X				X		X		X
Royalties		X		X		X				X		X		X
Expert Testimony		X		X		X				X		X		X
Board Member		X		X		X				X		X		X
Patents		X		X		X				X		X		X
Personal Relationship		X		X		X				X		X		X

Financial Disclosure: “The **InCHIANTI study baseline** (1998-2000) was supported as a “targeted project” (ICS110.1/RF97.71) by the Italian Ministry of Health and in part by the U.S. National Institute on Aging (Contracts: 263 MD 9164 and 263 MD 821336); the **InCHIANTI Follow-up 1** (2001-2003) was funded by the U.S. National Institute on Aging (Contracts: N.1-AG-1-1 and N.1-AG-1-2111); the **InCHIANTI Follow-ups 2 and 3 studies** (2004-2010) were financed by the U.S. National Institute on Aging (Contract: N01-AG-5-0002); supported in part by the Intramural research program of the National Institute on Aging, National Institutes of Health

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Figure 1.

Age- and sex-adjusted mean change in physical performance according to quartiles of personal mastery in the whole longitudinal sample and in a subset of participants with no ADL disabilities and SPPB > 9 at baseline.

Table 1

Characteristics of the study population at baseline.

	Total sample (n=952)	SPPB				p*
		0 - 4 (n=63)	5 - 8 (n=119)	9 - 10 (n=149)	11 - 12 (n=621)	
Age (years) (<i>Mean</i> ± <i>SD</i>)	74.3±6.8	81.7±7.9	80.0±6.9	76.3±6.4	71.8±5.3	<.000
Sex female (%)	55.8	69.8	72.3	73.2	47.0	<.000
Site (%)						1
Greve in Chianti	46.5	50.8	44.5	38.2	48.5	0.47
Bagno a Ripoli	53.5	49.2	55.5	61.7	51.5	
Education (years) (<i>Mean</i> ± <i>SD</i>)	5.5±3.3	4.2±2.4	4.1±2.2	5.2±3.6	5.9±3.3	0.65
Smoking status (%)						0.48
non smoker	59.1	69.8	74.0	69.1	52.8	
former smoker	27.1	22.2	16.8	20.1	31.2	
current smoker	13.8	7.9	9.2	10.7	15.9	
Alcohol use (≥3 drinks/day) (%)	15.0	6.4	7.6	4.0	20.0	0.41
BMI (<i>Mean</i> ± <i>SD</i>)	27.5±4.1	28.5±5.0	28.1±4.7	27.5±4.2	27.4±3.9	0.18
N of drugs (<i>Mean</i> ± <i>SD</i>)	2.2±2.1	3.7±2.5	3.2±2.1	2.6±1.8	1.8±1.8	0.001
MMSE scores (<i>Mean</i> ± <i>SD</i>)	25.3±3.2	22.4±4.2	23.6±3.4	24.8±3.3	26.0±2.8	0.32
Depressed mood (%)	20.7	42.9	39.5	26.2	13.5	0.001
Personal Mastery (<i>Mean</i> ± <i>SD</i>)	19.6±4.1	15.6±3.8	16.8±4.0	18.9±3.7	19.6±4.1	<.000
N chronic Diseases (<i>Mean</i> ± <i>SD</i>)	1.2±0.9	2.0±1.2	1.7±1.1	1.3±0.9	1.0±0.8	<.000
N of ADL disabilities (<i>Mean</i> ± <i>SD</i>)	0.1±0.5	1.2±1.5	0.1±0.5	0.0±0.1	0.0±0.1	1
N of IADL disabilities (<i>Mean</i> ± <i>SD</i>)	0.6±1.5	4.1±2.4	1.5±2.0	0.4±0.9	0.1±0.3	<.000
						1
						<.000

	SPPB					<i>p</i> [*]
	Total sample (n=952)	0 - 4 (n=63)	5 - 8 (n=119)	9 - 10 (n=149)	11 - 12 (n=621)	
Physical activity (%)						1
sedentary	17.4	71.4	40.3	21.5	6.6	
light	76.7	28.6	57.1	74.5	85.8	
moderate/high	5.9	0.0	2.5	4.0	7.6	

SPPB, Short Physical Performance Battery; SD, Standard Deviation; BMI, Body Mass Index; MMSE, Mini Mental State Examination; ADL, Activities of Daily Living; IADL Instrumental Activities of Daily Living

* p-values for age- and sex-adjusted general linear models or logistic regression models as appropriate

Table 2

Association of Personal Mastery with Substantial Decline in SPPB between baseline and 6-year Follow-up.

SPPB decline by 3 or more points between baseline and 6-year follow-up						
Whole longitudinal sample						
n = 626						
Personal Mastery	Model 1*			Model 2**		
	O.R.	95% C.I.	p	O.R.	95% C.I.	p
	Ref			Ref		
	23 - 30 (Q4)					
	21 - 22 (Q3)	(0.91 - 3.51)	0.09	1.97	(0.98 - 3.97)	0.06
Personal Mastery	18 - 20 (Q2)	(1.38 - 4.94)	0.003	2.62	(1.35 - 5.10)	0.01
	6 - 17 (Q1)	(1.88 - 6.91)	0.0001	3.20	(1.56 - 6.57)	0.002
Participants with no ADL disabilities and SPPB > 9 at baseline						
n = 508						
Personal Mastery	Model 1*			Model 2**		
	O.R.	95% C.I.	p	O.R.	95% C.I.	p
	Ref			Ref		
	23 - 30 (Q4)					
	21 - 22 (Q3)	(0.95 - 4.11)	0.07	2.17	(1.01 - 4.67)	0.05
Personal Mastery	18 - 20 (Q2)	(1.43 - 5.84)	0.003	2.78	(1.32 - 5.85)	0.01
	6 - 17 (Q1)	(1.34 - 6.01)	0.01	2.49	(1.09 - 5.73)	0.03
Participants without depressed mood at baseline						
n = 501						
Personal Mastery	Model 1*			Model 2**		
	O.R.	95% C.I.	p	O.R.	95% C.I.	p
	Ref			Ref		
	23 - 30 (Q4)					
	21 - 22 (Q3)					
Personal Mastery	18 - 20 (Q2)					
	6 - 17 (Q1)					

n = 501

Participants without depressed mood at baseline

	Model 1*			Model 2**		
	O.R.	95% C.I.	p	O.R.	95% C.I.	p
21 - 22 (Q3)	1.83	(0.92 - 3.64)	0.09	1.97	(0.95 - 4.06)	0.07
18 - 20 (Q2)	2.51	(1.28 - 4.91)	0.01	2.50	(1.24 - 5.04)	0.01
6 - 17 (Q1)	3.00	(1.41 - 6.41)	0.01	3.09	(1.41 - 6.77)	0.01

* Adjusted for age, sex and baseline SPPB

** Adjusted for age, sex, MMSE, physical activity, number of chronic diseases, depressed mood, baseline SPPB and inability to perform 400 m walk at 3-year follow up SPPB, Short Physical Performance Battery; MMSE, Mini Mental State Examination; ADL, Activities of Daily Living