Table 1
Demographic characteristics, and health outcomes of the groups.

	Cognitive healthy ($n = 2735$)	MCI ($n = 938$)	GCI ($n = 801$)	p-Value
Age (years)	71.3 ± 5.1	71.9 ± 5.5[††]	74.4 ± 6.2[$$,**]	<0.001
Gender (males)	1298 (47.5)	451 (48.1)	325 (60.3)	<0.001[a]
Educational history (years)	11.9 ± 2.5	10.9 ± 2.4[††]	10.3 ± 2.5	<0.001
MMSE (points)	27.4 ± 1.8	26.6 ± 1.8[††]	21.6 ± 1.8[$$,**]	<0.001
Fear of falling	1193 (43.6)	475 (50.6)	325 (40.6)	<0.001[a]
Fall history (fallers)	110 (4.0)	67 (7.1)	48 (6.0)	<0.001[a]
Medical illness (%)				
Hypertension	1237 (45.2)	464 (49.5)	395 (49.3)	<0.001[a]
Heart disease	443 (16.2)	193 (20.6)	128 (15.9)	0.006[a]
Stroke	98 (3.6)	61 (6.5)	64 (7.9)	<0.001[a]
Diabetes mellitus	362 (13.2)	138 (14.7)	102 (12.7)	0.41[a]
TUG (s)	8.1 ± 1.5	8.6 ± 2.3[††]	9.2 ± 3.2[$$,**]	<0.001
Walking aids use	60 (2.2)	37 (4.0)	67 (8.4)	<0.001[a]
GDS (points)	2.6 ± 2.5	3.4 ± 2.7[††]	3.4 ± 2.8[$$,**]	<0.001
Total number of medication doses	1.9 ± 2.1	2.3 ± 2.2[††]	2.2 ± 2.2[**]	<0.001

Underlined % = cells with significant adjusted standardized residuals; MMSE: Mini-Mental State Examination; TUG: timed up & go test; GDS: Geriatric Depression Scale.

[a] Values are means ± SD or n (%). All p-values were generated from one-way ANOVA or Chi-square.

[††] Significant difference between cognitive healthy and MCI (Bonferroni test, $p < 0.01$).

[**] Significant difference between cognitive healthy and GCI (Bonferroni test, $p < 0.01$).

[$$] Significant difference between MCI and GCI (Bonferroni test, $p < 0.01$).

3. Results

The characteristics in participants and comparison between groups are summarized in Table 1. Cognitive healthy participants were significantly younger, had a higher educational history, higher MMSE, faster TUG, lower rate of walking aids use, GDS, and number of medications than those with MCI and GCI ($p < 0.001$). Participants with GCI were significantly older, had a lower educational history, lower MMSE, slower TUG, and a higher rate of walking aid use than the other groups ($p < 0.001$). The rate of males was significantly different by group ($p < 0.001$; healthy: 47.5%, MCI: 48.1%, GCI: 60.3%). The prevalence of FoF was significantly different by group ($p < 0.001$; healthy: 43.6%, MCI: 50.6%, GCI: 40.6%). Participants with MCI showed the highest prevalence of FoF (standardized adjusted residuals = 4.2), while those with GCI showed the lowest prevalence of FoF (standardized adjusted residuals = −2.5). The prevalence of fallers was significantly different by group ($p < 0.001$; healthy: 4.0%, MCI: 7.1%, GCI: 6.0%). Participants with MCI showed the highest prevalence of fallers (standardized adjusted residuals = 3.3), while cognitive healthy participants showed the lowest prevalence of fallers (standardized adjusted residuals = −3.9).

Logistic regression analysis showed that classification to GCI (odds ratio [OR] = 0.63; 95% confidence interval [CI] = 0.53–0.76; $p < 0.001$) was independently associated with FoF accounting for the following confounding factors: age (OR = 1.03; 95% CI = 1.02–1.05; $p < 0.001$), gender (OR = 0.28; 95% CI = 0.25–0.32; $p < 0.001$), educational history (OR = 0.96; 95% CI = 0.93–0.99; $p = 0.003$), TUG (OR = 1.1; 95% CI = 1.06–1.16; $p < 0.001$), use of walking aids (OR = 2.07; 95% CI = 1.33–3.23; $p < 0.001$), GDS (OR = 1.16; 95% CI = 1.13–1.19; $p < 0.001$), and number of medications (OR = 1.08; 95% CI = 1.04–1.12; $p < 0.001$). Fall history, and classification to cognitive healthy and MCI did not show a significant relationship. The model was well calibrated between declines of observed and expected risk (Hosmer–Lemeshow $\chi^2 = 8.0$, $p = 0.44$) (Table 2).

4. Discussion

This is the first study to clarify the effect of cognitive impairment, by dividing participants into several groups based on cognitive performance, on the prevalence of FoF in community-dwelling older adults. The present study found that MCI and GCI in community-dwelling older adults affect the prevalence of FoF in a completely different manner; the prevalence of FoF was highest with MCI and lowest with GCI. Furthermore, GCI was independently associated with a lower prevalence of FoF, even after accounting for confounding factors, such as demographic, physical, and mental factors.

Subjects with GCI might have underestimated their functional deficits and disregarded their risk of falling because they had the lowest prevalence of FoF, despite having the lowest physical function (i.e. slowest TUG and highest rate of users with walking aids). Older adults with dementia are often unable to appreciate or recognize their own deficiencies in motor, behavioral or cognitive functioning, which are evident to clinicians and caregivers [25]. This condition is regarded as "anosognosia" and is described as lack of awareness of impairments in ADL or of neuropsychological deficits [26], particularly in patients with Alzheimer's disease [27]. This impaired awareness is significantly correlated with the severity of global cognitive impairment, as assessed by the MMSE [28]. Therefore, GCI may contribute to insensitivity to FoF and be more likely to lead to adopting dangerous behaviors, and is likely to be observed in Alzheimer's disease [27].

Subjects with MCI had a higher prevalence of FoF and fallers than the cognitive healthy subjects and lower physical function than them. This is in line with a previous study, which found that MCI increases the risk of falling in older adults [12]. Anosognosia (i.e. lack of awareness) is frequent in patients with Alzheimer's

Table 2
Factors associated with FoF in stepwise logistic regression.

Factor	OR	95% CI	p-Value
Age	1.03	1.02–1.05	<0.001
Gender	0.28	0.25–0.32	<0.001
Educational history	0.96	0.93–0.99	0.003
TUG	1.1	1.06–1.16	<0.001
Walking aids usage	2.07	1.33–3.23	0.001
GDS	1.16	1.13–1.19	<0.001
No. of medication	1.08	1.04–1.12	<0.001
GCI	0.63	0.53–0.76	<0.001
Cognitive healthy	–	–	0.26
MCI	–	–	0.26
MMSE	–	–	0.99
Fall history	–	–	0.06

FoF, fear of falling; TUG, timed up & go test; GDS, Geriatric Depression Scale; GCI, global cognitive impairment; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination.

disease but not in those with MCI [25,29]. However, having anxiety is the most frequent behavioral symptom in MCI subjects [30]. Fall experience, decreased physical function, and feeling anxiety may contribute to the increased prevalence of FoF in MCI subjects. Therefore, the feeling of FoF may depend on the severity of cognitive impairment, and there may have been prevalent differences between the MCI and GCI groups in the present study.

GCI has been reported as a major risk factor of fall and serious fall-related injury [10]. GCI subjects might be unable to recognize their risks of falling and select a safety strategy during ambulation and transfer, despite having decreased physical function. This insensitivity to FoF may be one of the characteristics of psychological changes in older adults with GCI and account for an increased risk of falling derived from GCI. However, the design of the current study, as with other cross sectional studies, limits the interpretation of the results with regard to causality between FoF and associated factors. A longitudinal study is necessary to examine whether the insensitivity to FoF in GCI subjects who have decreased physical function leads to an increased incidence of accidental falls. If this hypothesis is verified, education and an exercise program specifically designed to address the cognitive needs and insensitivity to FoF among participants with GCI may be beneficial for preventing falls.

Another limitation of this study is the sub-optimal use of the single-item FoF measure. Further study is needed to examine the relationship between cognitive impairment and fear of falling during various activities of daily living using measures of falls efficacy which has been validated in older people with cognitive impairment [31,32]. However, as it is reported that single item FoF measurement shows good correlation with the Fall Efficacy Scale-International [33], a single question regarding FoF has been found to have high validity with continuous measures of FoF [34]. Thus, we consider that the relevance of our research is not lost by the way of FoF measurement. Finally, the incidence of falling in our subjects was relatively low compared with that in other studies [35], while a recent systematic review estimated that the incidence of falls among older people ranged from 14.7% to 34% [36]. Additionally, Milat and colleague [37] reported that older adults who fell more than twice were only 9.9% of all participants. These differences may be due to differences between races and/or physical function status of the participants. The findings of the present study differ from available comparable studies in which fall history was associated with FoF [5,6]. However, Austin and colleague [3] also reported that fall history was not found to predict FoF. Like this previous study, low rate of fall incidence might have weakened any relationship between falls and FoF. The strengths of the present study include its much larger sample size and that it is the first study to clarify the significant difference in prevalence of FoF between cognitive statuses which were classified strictly based on objective assessment measures.

5. Conclusion

Older adults with GCI have lower prevalence of FoF despite having lower physical function. GCI is independently associated with a lower prevalence of FoF while accounting for confounding factors, such as demographic, physical, and mental factors. However, MCI subjects have a higher prevalence of FoF and fallers than those with GCI and cognitive healthy subjects. GCI may induce disparity between awareness and function, which leads to insensitivity to FoF. Further study is required to determine whether insensitivity to FoF with GCI induces the risk of falling in older adults.

Contributors

Kazuki Uemura, Hiroyuki Shimada, Hyuma Makizako and Takehiko Doi were responsible for study concept and design; Takao Suzuki and Hyuntae Park contributed to study supervision and funding; Kota Tsutsumimoto, Daisuke Yoshida, Yuya Anan, Tadashi Ito and Sangyoon Lee contributed to data analysis, interpretation and draft of the manuscript; all the authors did critical revisions of the manuscript and approved the final manuscript.

Competing interest

The authors declare no conflict of interest.

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Ethical approval

Informed consent was obtained from all participants prior to their inclusion in the study, and the Ethics Committee of the National Center for Gerontology and Geriatrics approved the study protocol.

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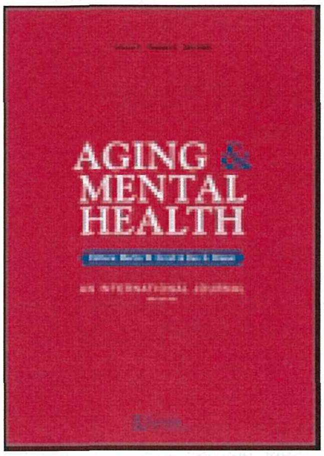

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Subjective physical and cognitive age among community-dwelling older people aged 75 years and older: differences with chronological age and its associated factors

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Subjective physical and cognitive age among community-dwelling older people aged 75 years and older: differences with chronological age and its associated factors

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Objective: The aim of this cross-sectional study was to determine the associations between self-reported subjective physical and cognitive age, and actual physical and cognitive functions among community-dwelling older people aged 75 years and older.
Method: The sample comprised 275 older adults aged 75–91 years. Two questions were asked regarding subjective age: 'How old do you feel physically?' and 'How old do you feel cognitively?' To assess physical functions, we measured handgrip strength, knee extension strength, standing balance and walking speed. Tests of attention, executive function, processing speed and memory were performed to assess actual cognitive function.
Results: Subjective physical and cognitive age was associated with performance on all of the physical and cognitive tests, respectively ($p < 0.01$). We also found that older adults who reported themselves as feeling older than their chronological age had a slower walking speed and lower scores for word-list memory recall than those who did not report themselves as feeling older than their actual age.
Conclusion: These findings suggest that promoting a fast walking speed and good memory function may help to maintain a younger subjective physical and cognitive age in older adults aged 75 years and older.

Keywords: perceived age; memory function; walking speed; aging

Introduction

Subjective age is a multidimensional construct, including subjective health status, physical function and cognitive function, and it indicates how old an individual feels and reflects personal perceptions of age (Montepare, 2009). In general, while adolescents and younger adults often wish to be older than they actually are, middle-aged and older adults tend to report younger subjective ages (Galambos, Turner, & Tilton-Weaver, 2005; Hubley & Hultsch, 1994; Rubin & Barntsen, 2006; Westerhof & Barrett, 2005). Hubley and Hultsch (1994) showed that among participants aged 55–85 years, more than 80% felt younger than their chronological age. In older adults, some studies have found that a self-reported subjective age that was younger than chronological age was associated with good health status (Hubley & Hultsch, 1994; Westerhof & Barrett, 2005), successful aging (Kuper & Marmot, 2003; Levy, 2003) and high levels of well-being (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Westerhof & Barrett, 2005). Additionally, higher subjective age has been shown to potentially predict future morbidity decline and increasing mortality in the aged population (Kotter-Grühn et al., 2009; Uotinen, Rantanen, & Suutama, 2005). Furthermore, cancer patients who felt younger than their chronological age reported better health-related quality of life than those who subjectively felt older (Boehmer, 2006).

Understanding the association between self-reported subjective age and actual function could provide strategies to maintain the health status of older people. In an effort to understand the association between subjective age and health status, recent studies have focused on whether health behavior is associated with subjective age among older adults. Younger subjective age may translate into better health behaviors (or vice versa) and in turn lead to a better quality of life and well-being. For example, the positive relationship between feeling younger than one's age and engaging in physical activity has been demonstrated in older adults, and self-efficacy played a mediating role in this relationship (Caudroit, Stephan, Chalabaev, & Le Scanff, 2012). Furthermore, another study demonstrated that older individuals showed better physical functioning when they were induced to feel younger after an experimental manipulation (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013).

However, little is known about the relationship between actual function and subjective age in older adults. In particular, none of these studies examined two aspects of subjective age separately, namely the physical and cognitive dimensions, because subjective age might be related

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*Corresponding author. Email: hikaru.ihira@gmail.com not only with physical function but also with specific cognitive skills (Amariglio, Townsend, Grodstein, Sperling, & Rentz, 2011; Stephan, Caudroit, Jaconelli, & Terracciano, 2013). The purpose of this study was to determine the associations between self-reported subjective physical and cognitive age, and actual physical and cognitive function, respectively, among community-dwelling older people aged 75 years and older.

Methods

Subjects

A total of 275 Japanese community-dwelling older adults aged 75 years and older (75–91 years, 111 males) participated in the present study. Table 1 shows demographic descriptions of participant characteristics in the present study. All participants were required to read an information sheet about the survey, and sign a consent form, before data were collected in the present survey. The ethical aspects of the study were approved by the Sapporo Medical University Hospital Ethics Committee.

Procedure

This study is the first wave of the 'Population-based and Inspiring Potential Activity for Old-old Inhabitants (PIPAOI)' study. For this cross-sectional study, the 1312 potential participants were community-dwelling older adults aged 75 years and older. They were recruited from the Basic Register of Residents in Bibai City, and were sent an introductory letter about the health-check survey. Of the original 1312 potential participants who were mailed an introductory letter, 316 older adults (24%) replied that they would participate in the survey. Among the participants who had replied that they would participate in the survey, only 275 older adults actually attended the assessment session. Eligible participants for PIPAOI included men and women aged 75 years and older who were able to walk without any assistance in their home. The participants received face-to-face interviews before commencing with any measurements. They were excluded if they had been hospitalized for longer than 1 week, 3 months prior to the study, owing to high blood pressure, stroke, cardiovascular disease, respiratory disease, diabetes, joint pain and osteoporosis. In the face-to-face interviews, the participants were asked whether they had an existing diagnosis of dementia, depression or schizophrenia. No participants reported that they had these diagnoses. Among these 275 older adults, four of them were excluded from the analysis because they did not complete the subjective age questionnaire fully.

Table 1. Demographic characteristics, physical function and cognitive function of participants ($n = 271$).

	Value	
Demographic characteristics, mean (SD)		
Chronological age (years)	80.0	(4.1)
70s, *n* (%)	150	(55.4)
80s, *n* (%)	115	(42.4)
90s, *n* (%)	6	(2.2)
Subjective physical age (years)	77.1	(6.1)
Subjective cognitive age (years)	76.9	(7.7)
Male, *n* (%)	111	(40.9)
Height (cm)	152.4	(9.2)
Weight (kg)	56.4	(10.0)
BMI	24.2	(3.3)
Years of education (years)	9.7	(2.6)
Physical function, mean (SD)		
Handgrip strength (kg)	25.1	(7.9)
Knee extension power (N m)	58.3	(26.4)
Postural sway area (mm)	232.4	(170.3)
Walking speed (m/min)	96.1	(21.9)
Cognitive function, mean (SD)		
TMT-A (sec)	2.1	(5.5)
TMT-B (sec)	5.2	(5.0)
SDST (score)	30.0	(8.2)
Word-list memory (score)	6.5	(1.5)

Note: SD = standard deviation; BMI = body mass index; TMT = trail making test; SDST = symbol digit substitution task.

Data collection

Data for 271 older adults were collected for demographic information (i.e., chronological age, sex, weight, height, body mass index [BMI] and years of education), physical functions and cognitive functions. For subjective age, the participants were asked about two different types of subjective age including physical and cognitive age using the following questions: 'How old do you feel physically?' and 'How old do you feel cognitively?'

Physical function

For the assessment of physical performance, we measured handgrip strength, knee extension strength, standing balance and walking speed. Handgrip strength in the dominant hand was tested twice using a Smedley-type handheld dynamometer (Matsumiya Medical Industry, Tokyo, Japan) (Nordenskiöld & Grimby, 1993), and the best performance on these two measurements was used in the analysis. Isometric knee extension strength was tested once using a dynamometer (μTas F-1; Anima Corp., Tokyo, Japan). Knee extension strength was measured while the participant was sitting on a chair without a backrest and the knee was flexed to 90°. A dynamometer pad was attached to the front lower leg of the participant and strapped to the leg of the chair (Makizako, Shimada, Doi, et al., 2013). The participants were instructed to push the pad with maximal strength. Isometric knee extension torque was normalized against arm moment (N m) in the data analysis. For assessment of postural stability, postural sway during standing was measured with a force plate (ECG-1500A, Kyowa, Japan). Signals were sampled at 50 Hz and registered for a period of 20 sec. Subjects were instructed to open their eyes and stand as symmetrically as possible. The root mean square (RMS) was calculated for the test trial as the deviation from the average center of pressure; higher RMS values have been traditionally interpreted as greater postural instability (Anand, Buckley, Scally, & Elliott, 2003). Walking speed was measured over a 5 m distance: between 3 and 8 m from the start of the 11-m walkway. For maximum walking speed, we measured walking speed twice for each participant and used the faster walking speed in the analysis (Shinkai et al., 2000).

Cognitive function

We used the computerized multidimensional neurocognitive task battery to assess the cognitive function. This battery assessed cognitive function using the tablet personal computer that has been described in detail previously by Makizako and Shimada, and has demonstrated its reliability and validity as a task battery to assess cognitive function (Makizako, Shimada, Park, et al., 2013; Shimada et al., 2013). Using this task battery, we assessed cognitive function, including attention, executive function, processing speed and memory function. The participants were given approximately 40–50 minutes to complete this task battery. In the tablet version of TMT-A (trail making test A), the participants were required to touch the target numbers shown randomly on the panel as rapidly as possible, in consecutive order (1–15). In the tablet version of TMT-B, the participants were required to touch the target numbers or letters alternately between consecutive numbers and letters (Japanese Kana characters). We recorded the time (in seconds) taken to complete each task and we calculated the time taken to touch one target number and one target letter. We used the Symbol Digit Substitution Task (SDST) to assess processing speed. For this task, nine pairs of numbers and symbols were provided at the top of the display. The participants chose a number corresponding to a target symbol at the bottom of the display as rapidly as possible. The score was the number of correct numbers chosen within 90 sec. To assess the memory function, the participants were instructed to memorize 10 words that were shown on the tablet personal computer. In this word-list memory task, the participants were asked to choose the 10 memorized target words among 30 words after an approximately 30-minute delay. An operator assisted each participant in setting up the tablet personal computer, understanding the task protocols and recording their data.

Data analysis

Spearman's correlations were conducted to examine the associations between each of the age categories (i.e., chronological age, subjective physical age and subjective cognitive age) and physical and cognitive functions, respectively. Two logistic regression models for subjective physical age and cognitive age were used to examine the relationship between feeling older than one's chronological age and actual function. In the model for subjective physical age, the independent variables were handgrip strength, knee extension power, postural sway area and walking speed, and the dependent variable was feeling that one's subjective physical age was older than one's chronological age. In the model on subjective cognitive age, the independent variables were TMT-A, TMT-B, SDST and word-list memory, and the dependent variable was feeling that one's subjective cognitive age was older than one's chronological age. Age, sex and BMI were included as covariates in the subjective physical age model, and age, sex and education were included as covariates in the subjective cognitive age model, respectively. We calculated odds ratios (ORs) with 95% confidence intervals (CIs). The threshold for statistical significance was defined as $p < 0.05$. Statistical analysis was performed using SPSS (version 19.0, IBM Japan Ltd., Tokyo, Japan).

Results

The demographic characteristics and the data regarding physical and cognitive function are presented in Table 1. Chronological age was associated with handgrip strength ($r = -0.20$, $p < 0.01$), knee extension power ($r = -0.23$, $p < 0.01$), walking speed ($r = -0.34$, $p < 0.01$), TMT-A ($r = 0.26$, $p < 0.01$), TMT-B ($r = 0.21$, $p < 0.01$), SDST score ($r = -0.36$, $p < 0.01$) and word-list memory ($r = -0.20$, $p < 0.01$). Subjective physical age was associated with all of the physical performance tests

Table 2. Correlation coefficients between chronological age, subjective physical age and subjective cognitive age, and physical and cognitive function.

	Chronological age	Subjective physical age	Subjective cognitive age
Physical function			
Handgrip strength	-0.20^{**}	-0.35^{**}	-0.28^{**}
Knee extension power	-0.23^{**}	-0.27^{**}	-0.25^{**}
Postural sway area	0.10	0.16^{**}	0.08
Walking speed	-0.34^{**}	-0.44^{**}	-0.24^{**}
Cognitive function			
TMT-A	0.26^{**}	0.04	0.12^{**}
TMT-B	0.21^{**}	0.10	0.18^{**}
SDST	-0.36^{**}	-0.25^{**}	-0.29^{**}
Word-list memory	-0.20^{**}	-0.12	-0.25^{**}

Note: TMT = trail making test; SDST = symbol digit substitution task.
$^{**}p < 0.01$.

(all, $p < 0.01$). Subjective cognitive age was also correlated with all of the cognitive performance tests (all, $p < 0.01$) (see Table 2).

A minority of older adults reported older subjective age than chronological age for both physical (18%, $n = 43$) and cognitive age (21%, $n = 50$) (see Tables 3 and 4). In the subjective physical age model, including physical performance tests, age, sex and BMI, high chronological age (OR = 1.11, 95% CI = 1.00−1.24, $p = 0.04$) and slow walking speed (OR = 1.04, 95% CI = 1.01−1.06, $p < 0.01$) were associated with feeling older than their chronological age (e.g., see Table 3 for details). In the subjective cognitive age model, including cognitive performance tests, age, sex and years of education, high chronological age (OR = 1.16, 95% CI = 1.04−1.29, $p < 0.01$), females (OR = 0.33, 95% CI = 0.15−0.72, $p < 0.01$) and low word-list memory score (OR = 1.26, 95% CI = 1.02−1.54, $p = 0.03$) were associated with feeling older than their chronological age (see Table 4 for details).

Discussion

The present study examined the relationship between subjective ages of physical and cognitive domains and actual physical and cognitive functions in community-dwelling older adults aged 75 years and older.

Results of correlation analyses are in line with previous studies of older adults that have demonstrated that older adults had enhanced physical functioning when they were induced to feel younger (Stephan, Chalabaev, et al., 2013), and that self-efficacy played a mediating role between subjective age and physical activity intention among older adults (Caudroit, Stephan, & Le Scanff, 2011). In particular, slower walking speed was found to be more closely associated with older subjective age compared with other aspects of physical functioning after adjusting for chronological age, sex and BMI. In general, walking speed is a typical indicator of physical functioning in older adults (Studenski et al., 2011). Walking speed is widely used in comprehensive geriatric assessments (Cruz-Jentoft et al., 2010; Shinkai et al., 2000), and it is an independent health indicator after controlling for various confounding factors in older adults aged 75 years and older (Anand et al., 2003). Moreover, it has also been reported that faster walking speed is associated with better psychological status such as confidence in one's performance (Portegijs et al., 2012) and depression status (Iwasa et al., 2009) in older adults. Thus, the present results suggest that older adults with slower walking speed perceived themselves as being older than their chronological age.

Table 3. Associations between subjective physical age and actual physical function.

	Subjective physical age	
	Other^a ($n = 198$) vs. Older^b ($n = 43$)	
Factor	OR (95% CI)	p-value
Age	1.11 (1.00−1.24)	0.04
Sex	0.31 (0.09−1.12)	0.07
BMI	0.98 (0.87−1.10)	0.79
Handgrip strength	1.00 (0.92−1.09)	0.94
Knee extension power	0.98 (0.95−1.00)	0.09
Postural sway area	1.00 (0.99−1.00)	0.84
Walking speed	1.04 (1.01−1.06)	<0.01

Note: OR = odds ratio; CI = confidence interval; BMI = body mass index.
^{a}Other: subjective physical age ≤ chronological age.
^{b}Older: subjective physical age > chronological age.

Table 4. Association between subjective cognitive age and actual cognitive function.

	Subjective cognitive age	
	Other^a ($n = 209$) vs. Older^b ($n = 50$)	
Factor	OR (95% CI)	p-value
Age	1.16 (1.04−1.29)	<0.01
Sex	0.33 (0.15−0.72)	<0.01
Years of education	1.01 (0.88−1.16)	0.85
TMT-A	1.94 (0.90−4.18)	0.09
TMT-B	0.94 (0.88−1.01)	0.12
SDST	1.02 (0.97−1.08)	0.34
Word-list memory	1.26 (1.02−1.54)	0.03

Note: OR = odds ratio; CI = confidence interval; TMT = trail making test; SDST = symbol digit substitution task.
^{a}Other: subjective cognitive age ≤ chronological age.
^{b}Older: subjective cognitive age > chronological age.

We observed that memory score, as opposed to processing speed or executive function, was particularly strong in its association to older subjective age, even after adjusting for chronological age, gender and education. This finding is consistent with previous research that found that younger subjective age was prospectively associated with better episodic memory function (Stephan, Caudroit, et al., 2013) and that subjective age indirectly contributed to life satisfaction through subjective health and memory self-efficacy (Stephan, Caudroit, & Chalabaev, 2011). Memory function is an important domain of cognitive function in older adults and is a significant predictor of subjective cognitive decline in early dementia, such as mild cognitive impairment (Clément, Belleville, & Gauthier, 2008; Studer, Donati, Popp, & von Gunten, 2014). One population-based study found that a poorer performance on cognitive tests was related to more subjective memory complaints (SMCs) among older adults aged 70−81 years (Amariglio et al., 2011). SMC is one potential area of exploration regarding memory deficits. In fact, several studies have suggested SMC as a diagnosis criterion of mild cognitive impairment (MCI; Clément et al., 2008; Petersen, 2004; Winblad et al., 2004), because SMC reflects objective cognitive performance in older adults with MCI. It was also found that worse performance on cognitive tests was related to more SMC in older adults without MCI and dementia. Results of the present logistic analyses are consistent with these previous studies, which have reported associations between SMC and objective cognitive performance. Feeling that oneself is younger cognitively than one's chronological age is associated with a higher confidence in one's memory ability (Schafer & Shippee, 2010).

Older adults who report that they feel older than their chronological age might also feel less confident about their memory function.

Ficker, Lysack, Hanna, and Lichtenberg (2013) have found strong associations between perceptions of cognitive impairment and other quality of life indicators such as depression and mobility. Although no older adults in the present study reported having a diagnosis of depression, it was expected that some of these older adults may have had symptoms of depression; there is a reported prevalence of depression of 10% in Japanese women aged 75 years and older (Seino et al., 2013). We interpreted that mobility might contribute to subjective cognitive age, because we confirmed that subjective cognitive age was associated with physical functions, including handgrip strength, knee extension power and walking speed. Therefore, this study expands existing knowledge that feeling oneself to be younger cognitively than one's chronological age is associated with actual memory function, when various potentially confounding factors were controlled. Both subjective memory complaint and objective memory problem could be contributing factors to older subjective cognitive age than chronological age. This is certainly an important topic that requires further exploration.

This study has several limitations that should be considered. We cannot draw any conclusions regarding the causal change of relationships between subjective age and actual functioning because of the cross-sectional design of this study. In addition, although older adults who reported themselves as being older than their chronological age had significantly slower walking speed and memory loss after adjusting for demographic characteristics; other factors might be related to subjective physical and cognitive age. For example, it has been confirmed that personality may be a predictor of subjective age among older adults (Canada, Stephan, Caudroit, & Jaconelli, 2013). Particularly, it has been shown that conscientiousness, neuroticism and agreeableness are not related to subjective age in older adults, and it has been suggested that with aging, self-rated health and personality traits become increasingly important for subjective age. Future research should incorporate personality as a potentially related factor when examining the associations between subjective age and actual function in older adults.

Conclusion

Overall, the present study has expanded the existing literature in this field. It is the first cross-sectional investigation of older adults aged 75 years and older to determine two types of subjective age separately, namely physical and cognitive age. It also examined the associations between subjective physical and cognitive age and each of these in relation to actual functioning. We found that slow walking speed and decreased memory function are associated with the feeling that one's subjective physical and cognitive age is older than one's chronological age, respectively. We suggest that promoting a fast walking speed and good memory function may help to maintain a younger subjective physical and cognitive age in older adults aged 75 years and older.

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