Slower maximal walking speed is associated with global cognitive function decline among older adults residing in China (#70851)

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Slower maximal walking speed is associated with global cognitive function decline among older adults residing in China

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Background: Maintaining both walking speed and cognitive function is essential for active, healthy aging. This study investigated age-related differences in walking speed and global cognitive function with aging and the association between them among older adults residing in the developing country of China. **Methods:** This cross-sectional study measured usual (UWS) and maximal walking speed (MWS) of participants for 6 meters. The Chinese version of the Montreal Cognitive Assessment was used to evaluate global cognition through in-person interviews. Analyses of variance were used to compare the differences in UWS, MWS, and global cognition between genders and age groups. Multiple linear regression models were used to determine the association between walking speed and global cognitive function. **Results:** In total, 791Chinese adults (252 men and 539 women) aged 60–89 years were included in this study. Markedly slowed UWS and worse global cognitive function scores were observed for both genders among adults ≥80 years of age. MWS slowed considerably in men ≥85 years of age and in women ≥80 years of age. There was a significant gender difference in MWS—with men walking faster than women—but not in UWS. Linear regression analysis adjusted for the confounding factors of gender, height, weight, years of education, and chronic disease indicated that MWS, but not UWS, was significantly associated with global cognitive function (β = 0.086, [0.177, 1.657], P = 0.015) such that slower maximal walking speed was associated with cognitive decline. This association was statistically significant only for adults aged 75-79 years (β = 0.261 [0.647, 4.592], P =0.010). **Conclusion:** Both UWS and MWS slowed with age in a population of older adults in China. Global cognitive function deteriorated markedly after 80 years of age. After controlling for confounding variables, slower MWS, but not UWS, was associated with global cognitive function decline. MWS may serve as a potential indicator for earlier identification of cognitive decline and motoric cognitive risk syndrome in an older Chinese population.

Slower maximal walking speed is associated with global cognitive function decline among older adults residing in China

Running title: walking speed and cognition

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Abstract

Background: Maintaining both walking speed and cognitive function is essential for active, healthy aging. This study investigated age-related differences in walking speed and global cognitive function with aging and the association between them among older adults residing in the developing country of China.

Methods: This cross-sectional study measured usual (UWS) and maximal walking speed (MWS) of participants for 6 meters. The Chinese version of the Montreal Cognitive Assessment was used to evaluate global cognition through in-person interviews. Analyses of variance were used to compare the differences in UWS, MWS, and global cognition between genders and age groups. Multiple linear regression models were used to determine the association between walking speed and global cognitive function.

Results: In total, 791Chinese adults (252 men and 539 women) aged 60－89 years were included in this study. Markedly slowed UWS and worse global cognitive function scores were observed for both genders among adults ⩾80 years of age. MWS slowed considerably in men ≥85 years of age and in women ≥80 years of age. There was a significant gender difference in MWS—with men walking faster than women—but not in UWS. Linear regression analysis adjusted for the confounding factors of gender, height, weight, years of education, and chronic disease indicated that MWS, but not UWS, was significantly associated with global cognitive function (β = 0.086, [0.177, 1.657], P = 0.015) such that slower maximal walking speed was associated with cognitive decline. This association was statistically significant only for adults aged 75-79 years (β = 0.261 [0.647, 4.592], P =0.010).

Conclusion: Both UWS and MWS slowed with age in a population of older adults in China. Global cognitive function deteriorated markedly after 80 years of age. After controlling for confounding variables, slower MWS, but not UWS, was associated with global cognitive function decline. MWS may serve as a potential indicator for earlier identification of cognitive decline and motoric cognitive risk syndrome in an older Chinese population.

Introduction

The global population is aging, and aging is often accompanied by impaired physical and cognitive functions (Sofi et al., 2011; Clouston et al., 2013) that may lead to decreased abilities to perform activities of daily living. As the most populous developing country in the world, China is poised to have a moderately aged population. Thus, there is an urgent need to study potential indicators for cost-effective and efficient slowing of physical and cognitive decline in older adults in China as well as in other developing countries. Walking, the most basic activity of daily living and an important determinant of the quality of life in later years, requires the coordination of multiple systems. Walking speed is considered the sixth vital sign (Fritz and Lusardi, 2009), after respiration, heartbeat, blood pressure, body temperature, and pain, and is a core indicator of health and functional ability in aging and disease (Montero-Odasso et al., 2019; Stenholm et al., 2019; Rosso et al., 2013; Verghese et al., 2013; Verghese et al., 2019). A slower walking speed may reflect a damaged system, a high energy cost of walking, or diminished motor control (Studenski et al., 2011). Therefore, maintenance of a normal and steady ability to walk for older adults is important for the prevention of adverse events in later life. Both usual walking speed (UWS) and maximal walking speed (MWS) have been used to predict frailty, falls, and mobility impairment in older adults (White et al., 2013).

Walking speed has been associated with cognitive function, with cognitive function referring to the process of acquiring or applying knowledge or to information processing (Hunt., 1989), and is the most basic human mental process. Safe and effective walking requires input from higher cognition areas (Hausdorff et al., 2005). Significant reduction in cognitive processing abilities have been shown among people who walk slowly, suggesting that walking speed may serve as a simple, noninvasive biomarker for early identification of cognitive decline (Demnitz et al., 2016; Peel et al., 2019; Hirono et al., 2021). Maintaining walking speed and cognitive function is essential for preventing motoric cognitive risk syndrome, and both walking speed and cognitive function may be useful for identifying cognitive decline. Targeted interventions would effectively improve the quality of life and well-being of older people in developing countries and would greatly reduce the economic burden.

Previous studies have investigated walking speed (Hirono et al., 2021) and global cognitive function with age (Boyle et al.,2021) and gender differences (Callisaya et al., 2008) , and many studies (Fitzpatrick et al., 2007; Hao et al., 2021; Deshpande et al., 2009; Garcia - Pinillos et al., 2016) have evaluated the association between them. However, those studies mostly focused on developed countries and used different measurement methods. In addition, factors such as geographical differences may have affected the results of those studies (Cai et al., 2020). Systematic reviews and meta-analyses (Demnitz et al., 2016; Peel et al., 2018) indicate that most previous studies assessed UWS, only a few examined both UWS and MWS, and fewer still investigated the association of MWS with cognitive function. Those few studies have shown that MWS, which is more physically challenging than UWS (Sheridan et al., 2003), is a better predictor than UWS of cognitive decline with limited cognitive resources (Fitzpatrick et al., 2007).

To date, research on age-related differences in walking speed and cognitive function and their association in older Chinese adults is scarce. Whether UWS, MWS, or both are associated with cognitive function in this population has not been studied. Therefore, the present study aimed to investigate age-related differences in walking speed and global cognitive function and the association between them in older adults residing in the developing country of China. We hypothesized that ~~their~~ walking speed would become slower and global cognitive function begin to decline with older age. We also hypothesized that MWS, but not UWS, would be significantly associated with global cognitive function.

Materials & Methods

Participants

The study population was drawn from older adults in eight communities in Shanghai. The inclusion criteria were being a community-dwelling adult ≥60 years of age with sufficient communication skills to complete the study, having the ability to walk independently without the use of a walking aid, and agreeing to participate in this study. The exclusion criteria included the following:(1) an inability to understand the test; (2) a diagnosis of osteoarthritis, Parkinson's disease, dementia, stroke or a neurological disorder; and (3) declining to participate in the study. This study was approved by the Ethics Committee of Shanghai University of Sport (No. 102772021RT067). All participants provided written informed consent.

Assessment of Walking Speed

The 6-meter walk is a common method for assessing walking speed (Aoyagi et al.,2001). Participants walked 6 m without assistance. Colored marking tape was applied to level ground at the starting position as well as at 2, 8, and 10 m. Before the test, the investigator explained and demonstrated UWS (habitual walking speed) and MWS (walking as fast as possible but not running). After hearing the word ~~for~~ "start," the participant walked from the starting position to the marker at 10-m. All participants completed the test twice at their UWS and then completed the test once more a their MWS. The time needed to walk the middle 6 m was recorded to avoid the influence on the pace of the starting acceleration in the first 2 m and the braking deceleration in the last 2 m. Times were measured with a stopwatch, as Peters et al. (Peters, Fritz and Krotish, 2013) showed that a handheld stopwatch is as reliable as an automatic timer for measuring walking speed. The averaged time for each of the two tests performed at UWS was recorded and was considered accurate to 0.01 s. The final walking speed was calculated by dividing 6 m by the time required to complete the test. Walking speed was accurate to 0.01 $m \cdot s^{-1}$.

Assessment of Cognitive Function

The Chinese version of the Montreal Cognitive Assessment (MoCA-C) was used to evaluate global cognition through in-person interviews. The MoCA-C was evaluated by uniformly trained psychology researchers. The scale consisted of a tota l of 30 points: visual space and executive function (5 points); attention (6 points); delayed recall, memory (5 points); naming (3 points); language (3 points); abstract reasoning (2 points); and orientation (6 points). The MoCA has been shown to be a reliable tool with high sensitivity and specificity for asessing cognitive function (Nasreddine et al., 2005).

Confounders

Participants were invited to participate in face-to-face interviews to complete a questionnaire that asked about their age (Early 60s: 60-64 yrs, Late 60s: 65-69 yrs; Early 70s: 70-74 yrs, Late 70s: 75-79 yrs; Early 80s: 80-84 yrs, Late 80s: 85-89 yrs; respectively), gender, weight, height, and medical history, which included a history or physician diagnosis of hypertension, diabetes, hyperlipidemia, and heart disease. Those variables were considered confounders.

Statistical Analysis

Continuous variables are presented herein as the mean ± standard deviation, and non-normally distributed continuous variables, such as MoCA-C scores, are expressed herein as medians and quartiles. Baseline UWS, MWS, and MoCA-C scores as well as demographic characteristics were analyzed by independent-samples t-tests, Pearson's chi-square tests, or Mann-Whitney tests. Analysis of covariance was performed to compare the differences in variables between age groups of each gender for the presence of the main effects of age and gender. A Kruskal-Wallis one-way analysis of variance was used to compare the differences in global cognition between the age groups. The Mann-Whitney test was used to compare the differences in variables between genders.

The results of our statistical tests indicated that there was no multicollinearity for the independent variables (variance inflation factors <5) and that the residuals were normally distributed, indicating that the conditions for using linear regression were met. Global cognitive function was used as the dependent variable, and UWS and MWS were the independent variables. Multiple linear regression models were used to determine the association between walking speed and global cognitive function for all participants and for the different age groups.. The main confounders included age, gender, weight, height, years of education, hypertension, diabetes, hyperlipemia, and heart disease. All statistical analyses were performed using SPSS, version 26.0, and $P < 0.05$ was considered statistically significant.

Results

Participant Characteristics

This cross-sectional study included 791 Chinese adults (252 men and 539 women) aged 60–89 years. Their characteristics are given in **Table 1**. No statistically significant differences between genders were detected for either UWS or for MoCA-C total scores, but there was a significant gender difference in MWS, with men walking significantly faster than women.

********TABLE 1 AROUND HERE********

Age-Related Differences in Walking Speed

To control for the effect of confounding variables on walking speed, this study examined the main effects of height, hypertension, and hyperlipidemia on UWS for each gender. Height, BMI and hyperlipidemia were control variables for MWS in both genders. This was carried out to satisfy the conditions required for a covariance analysis. The analysis of covariance revealed no significant interaction between UWS and MWS. However, there were significant main effects of age and gender for MWS and a significant main effect of age, but not gender, for UWS. These results suggested that both UWS and MWS slowed with increasing age but that UWS was not affected by gender. Post-hoc tests assessing age groups of both genders showed that both UWS and MWS for people in their late 80s were significantly slower than for those in the other age groups (**Table 2**). For both genders, UWS and MWS in the early 80s age group were significantly slower than UWS and MWS in the early or late 60s age groups and in the early 70s age group (**Figure 1 and Figure 2**). UWS and MWS in the late 60s and 70s age groups were significantly slower than UWS and MWS in the early 60s age group. UWS in the early 70s age group was significantly slower than UWS in the early 60s age group. MWS for men in the early 80s age group was significantly slower than MWS for men in the early 60s age group. For women, UWS and MWS in the late 80s age group were significantly slower than UWS and MWS in the other age groups. UWS and MWS in the early 80s age group were significantly slower than UWS and MWS in the early and late 60s and in the early 70s age groups. UWS and MWS in the late 70s age group were significantly slower than UWS and MWS in the early 60s age group. Moreover, MWS in the early 80s group was significantly slower than MWS in the late 70s group. Post-hoc independent t-tests to compare the differences in MWS between genders showed significant differences between genders in the early and late 60s age groups and in the early 80s age group.

********FIGURE 1 AROUND HERE****** ******FIGURE 2 AROUND HERE********

Age-Related Differences in Global Cognitive Function

This cross-sectional study found that global cognitive function among older adults in this cohort was significantly lower in people ⩾80 years of age (**Table 2**). The results of Mann-Whitney tests assessing age groups among both genders showed that for men, global cognitive functioning scores in the early 80s age groups were significantly lower than those scores in the other age groups. For women, global cognitive function scores in the early and late 80s age groups were significantly lower than those scores in the early and late 60s age groups and in the early 70s age groups. Additionally, global cognitive function scores in the early 80s age group were significantly lower than those scores in the late 70s group. Gender differences in global cognitive function were not statistically significant.

********TABLE 2 AROUND HERE********

Associations between Walking Speed and Global Cognitive Function

Overall, the results of multiple linear regressions indicated no significant association between UWS and global cognitive function ($P > 0.05$) (**Table 3**). By contrast, MWS was significantly associated with global cognitive function in Model 1 (adjusted for gender, age, height, and weight), in Model 2 (adjusted for gender, age, height, weight and years of education) and in Model 3 (adjusted for gender, age, height, weight, years of education, hypertension, diabetes, hyperlipemia, and heart disease) ($\beta = 0.086$, [0.177, 1.657], $P = 0.015$). These results suggested that faster MWS was associated with higher global cognitive function. Further analysis by age groups revealed that MWS and global cognitive function were significantly correlated only in the late 70s age group ($\beta = 0.261$, [0.647, 4.592], $P = 0.010$).

********TABLE 3 AROUND HERE********

Discussion

Our findings supported our hypothesis that both UWS and MWS slowed with age in adults ⩾60 years of age. Markedly slower UWS and MWS were observed for both genders among people ⩾80 years of age. Compared with those in other groups, UWS and MWS were significantly slower after the late 80s for men and after the early 80s for women. Our results showing that walking speed slowed with age were consistent with those found worldwide (Tolea et al., 2010; Bohannon, 1997; Busch et al., 2015). However, the UWS of the older adults in our study population was significantly faster than that of the elderly in some other countries (1.08 $m \cdot s^{-1}$) (Cai et al.,2020) but slower than that among older Japanese adults (men, 1.39 $m \cdot s^{-1}$; women, 1.31 $m \cdot s^{-1}$) (Tanimoto et al., 2012), despite the adults in the latter study being older than our cohort. That study by Tanimoto and colleagues included community-dwelling participants aged ⩾65 years whose health status was unknown and assessed UWS using at distance of 5 m. The participants in our study were community-dwelling adults aged ⩾60 years with known chronic disease status (Table 1) and UWS assessed at distance of 6 m. Thus, factors such as the baseline health of the study participants and the distance tested for walking speed may affect the results. In addition, UWS may vary by the population studied and the methodology used to assess it (Busch et al., 2015). No gender differences in UWS were found in our study. Previous studies have shown that MWS among older Japanese adults is markedly slower after the age of 70 years (Peters et al., 2013). In the present study, compared with the participants in the early 60s age group, the MWS of men was significantly slower in the early 80s age group, and the MWS of women in the late 70s groups was significantly slower. In addition, there were gender differences in MWS, mainly in the early and late 60s age groups and in the early 80s age group. Previous study (Hunt D,1989) has shown markedly slower walking speeds in women than in men, consistent with our study. The walking speed of women in the present study was slower at a younger age than that of men. One study (Guadagnin et al., 2019) showed that changes in walking speed are strongly associated with the aging process and that this association is most significant in older women. In that study, walking speed in men was predicted by brain white matter hyperintensity volume rather than by the degree of brain atrophy or magnetization transfer ratio peak height (adjusted for age and brain size). However, in women, slower walking speed was associated with lower magnetization transfer ratio peak height (suggestive of microstructure cerebral changes), increased white matter hyperintensity, and greater brain atrophy (Rosano et al., 2010).

There were no significant differences in global cognitive function among older adults for the groups encompassing 60 to 79 years of age. However, global cognitive function was poorer for participants ≥80 years of age. This result is in line with our hypothesis. The trend for lower global cognitive function in older adults was essentially the same for both genders, consistent with the results of a previous study (Chinese Cooperative Group of Guidelines for Diagnosis and Treatment of Dementia and Cognitive Impairment., 2018). The present study showed that global cognitive function remained stable until 80 years of age, which is consistent with previous studies (Boyle et al., 2021).

After adjusting for confounders in the present study, only MWS, not UWS, was significantly associated with global cognitive function in adults 60–89 years of age, which is also in line with our hypothesis. Notably, this association was statistically significant in the late 70s age group. Years of education and chronic diseases may affect walking speed and cognition in older adults. One study showed that compared with UWS, MWS was a more sensitive indicator of neuromuscular function (Annweiler et al., 2010). A previous longitudinal study of older Italian adults (Deshpande et al., 2009) and a cross-sectional study of older Japanese adults (Fitzpatrick et al., 2007) both showed that MWS was more associated with cognitive function than UWS was. In addition, some studies (Deshpande et al., 2009) have shown that MWS is a better predictor than UWS of cognitive decline. Postural control decreases with age. In addition to the involvement of the sensory system and the musculoskeletal system during postural control, cognitive function is critical for postural stability. The higher demands placed on the balance control system at MWS necessitate much higher conscious control and cortical activity in older adults than is required for usual walking (Deshpande et al., 2009). Thus, the ability to maintain good performance during rapid walking may be closely related to the integrity of cortical function, which is associated with good cognitive performance (Deshpande et al., 2009). The associations between walking speed and executive function, memory, and processing speed have been summarized in the literature (Demnitz, et al., 2016). Numerous mechanisms may underlie slower walking speed in older people. For example, magnetic resonance imaging has shown that slower walking speed in older adults is associated with an increased proportion of subcortical white matter hyperintensities and periventricular (Murray et al., 2010) and hippocampal atrophy (Callisaya et al., 2013). However, executive function, a major domain of cognitive function, is also influenced by white matter hyperintensities. That is, the association between walking speed and cognitive function may be based in part on the involvement of common neural networks (Murray et al., 2010).

The results of the present study suggested that MWS was significantly associated with global cognitive function in older adults, particularly for people in their late 70s age group. This finding suggests that MWS may be used as a potential indicator for early identification of cognitive decline or motoric cognitive risk syndrome. Furthermore, MWS may also provide a basis for a sensitive time period for mobility and cognitive functional reduction interventions in older Chinese adults. This study also identified numerous confounding factors associated with walking speed and the association between walking speed and global cognition that are modifiable, including weight, hypertension, hyperlipidemia, and diabetes. Community health managers may prevent or delay declines in walking speed and cognitive function in older adults by helping them to regulate some of these modifiable factors. The results of this study also reinforce the clinicians' perception of walking speed as a sixth vital sign. Early recognition of motoric cognitive risk syndrome (Verghese et al, 2014), a pre-dementia syndrome characterized by both walking speed slowing and cognitive concerns, has led to an increased interest in preventing and delaying both walking speed and cognitive decline. This would provide a valuable approach to health management for healthy aging in developing countries, such as China.

The strengths of the present study were that we assessed the differences in walking speed and global cognitive function with age divided into 5-year intervals among adults aged 60–89 years and residing in China, a developing country. Thus, this study assessed both wide and narrow age ranges. MWS was found to be significantly associated with global cognitive function among older adults, especially those in the late 70s age group, in the Chinese community. Our results provide a reference for other relevant studies, especially in developing countries. This study also has limitations. Because this was a cross-sectional study, we could not explore the causal relationship between walking speed and global cognition. The small sample of participants in the late 80s age group may have biased the interpretation of the association. We studied only the associations between walking speeds and global cognitive function. Future studies should be conducted to analyze the associations of UWS and of MWS with subdomains of cognitive function. In addition to the assessed factors affecting the association between walking speed and cognition in this study, other factors may affect UWS, MWS, and global cognitive function. Thus, future studies should consider increasing the sample size of oldest adults, controlling for additional confounding factors, and assessing the associations of UWS and of MWS with cognitive function subdomains using broad neuropsychological test batteries in longitudinal studies.

Conclusions

The results of this cross-sectional study indicated that both UWS and MWS slowed with age. The slowing of walking speed was most pronounced in the oldest age groups assessed. The present study also showed that global cognitive function remained stable until 80 years of age but deteriorated markedly after that. There were gender differences for MWS, but not for UWS or for global cognitive function, among older adults. After controlling for gender, age, height, weight, years of education and common chronic diseases, we found that MWS was significantly associated with global cognitive function, whereas UWS was not. These results suggest that MWS may serve as a potential indicator for earlier identification of cognitive decline and motoric cognitive risk syndrome in an older Chinese population.

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Table 1(on next page)

Characteristics of the study population

Note: Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups. BMI, body mass index; UWS, usual walking speed; MWS, maximal walking speed; MoCA-C, Chinese version of Montreal Cognitive Assessment. [1] Values are expressed as mean ±standard deviation; [2] Values are expressed as median and quartiles [a] independent-samples t-test; [b] chi-square test; [c] Mann-Whitney test; *P < 0.05, **P < 0.01.

Table 1 Characteristics of the study population

Characteristic	Total		Men		Women		*P* value
	n=791		n=252		n=539		
Age, (years) [1]	70.40	6.95	71.79	7.33	69.75	6.68	<0.001**
Early 60s (n, %) [b]	174	22.0	47	18.7	127	23.6	
Late 60s (n, %) [b]	246	31.1	67	26.6	179	33.2	
Early 70s (n, %) [b]	172	21.7	59	23.4	113	21.0	
Late 70s (n, %) [b]	95	12.0	31	12.3	64	11.9	
Early 80s (n, %) [b]	70	8.8	31	12.3	39	7.2	
Late 80s (n, %) [b]	34	4.3	17	6.7	17	3.2	
Height (m)[a] [1]	1.61	0.08	1.69	0.06	1.57	0.06	<0.001**
Weight(kg)[a] [1]	62.43	10.24	69.36	9.49	59.19	8.89	<0.001**
BMI ($kg \cdot m^{-2}$) [a] [1]	24.08	3.28	24.37	2.98	23.95	3.40	0.072
≥12 years of education [b] (n, %)	499	63.08	174	69.05	325	60.30	<0.001**
Walking speed ($m \cdot s^{-1}$) [1]							
UWS[a]	1.22	0.26	1.23	0.27	1.22	0.26	0.640
MWS[a]	1.62	0.36	1.67	0.37	1.59	0.34	0.004**
History of disease (n, %)							
hypertension[b]	395	49.9	130	51.6	265	49.2	0.526
diabetes[b]	155	19.6	51	20.2	104	19.3	0.756
hyperlipemia[b]	147	18.6	32	12.7	115	21.3	0.004**
heart disease[b]	200	25.3	60	23.8	140	26.0	0.514
MoCA-C[c] [2]	26	(24-28)	26	(24-28)	26	(24-28)	0.580

Note: Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups.

BMI, body mass index; UWS, usual walking speed; MWS, maximal walking speed; MoCA-C, Chinese version of Montreal Cognitive Assessment.

[1] Values are expressed as mean ±standard deviation;

[2] Values are expressed as median and quartiles

[a] independent-samples t-test; [b] chi-square test; [c] Mann-Whitney test; *$P < 0.05$, **$P < 0.01$.

Table 2 (on next page)

Age-related differences in walking speeds and cognitive performance in men and women

Note: MoCA-C, Chinese version of Montreal Cognitive Assessment; Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups. ① Control variable: height. ② Control variable: hypertension. ③ Control variables: height and hyperlipidemia. ④ Control variables: height, BMI and hyperlipidemia. *Significant difference compared with the early 60s group (*P < 0.05, ** P < 0.01). †Significant difference compared with the late 60s group (††P < 0.01). §Significant difference compared with the early 70s group (§§P < 0.01). ♦Significant difference compared with the late 70s group (♦P < 0.05, ♦♦P < 0.01). ※Significant difference compared with the late 70s group (※P < 0.05, ※※P < 0.01). ▲Significant difference compared with women (▲P < 0.05, ▲▲P < 0.01).

Table 2 Age-related differences in walking speeds and cognitive performance in men and women

	Early 60s N=174/47/127	Late 60s N=246/67/179	Early 70s N=172/59/113	Late 70s N=95/31/64	Early 80s N=70/31/39	Late 80s N=34/17/17
Walking speeds, mean (standard deviation)						
UWS($m \cdot s^{-1}$)						
Both genders①	1.32(0.02)	1.25(0.02) *	1.23(0.02) **	1.18(0.03) **	1.12(0.03) **††§	0.86(0.04) **††§§♦♦※※
Men②	1.33(0.04)	1.28(0.03)	1.21(0.03)	1.23(0.04)	1.20(0.04)	0.89(0.06) **††§§♦♦※※
Women③	1.29(0.02)	1.21(0.02)	1.22(0.02)	1.15(0.03) **	1.04(0.04) **††§§	0.84(0.06) **††§§♦♦
MWS($m \cdot s^{-1}$)						
Both genders ④	1.71(0.02)	1.62(0.02) *	1.64(0.03)	1.54(0.03) **	1.40(0.04) **††§§	1.15(0.06) **††§§♦♦※※
Men	1.85(0.35) ▲	1.71(0.34) ▲	1.66(0.35)	1.64(0.39)	1.59(0.29) *▲▲	1.25(0.39) **††§§♦♦※
Women④	1.67(0.03)	1.58(0.03)	1.63(0.03)	1.51(0.04) *	1.29(0.05) **††§§♦♦	1.10(0.08) **††§§♦♦
MoCA-C total score, median (quartiles)						
Both genders	27 (25, 28)	27 (25, 28)	26 (25, 28)	26 (24, 28)	23 (20, 26) **††§§♦♦	23 (17, 26) **††§§♦♦
Men	27 (25, 28)	27 (25, 28)	26 (25, 28)	27 (26, 29)	24(21, 27) *††♦	24 (17, 26.5) *††♦
Women	27 (24, 29)	27 (25, 28)	26 (25, 29)	26 (23, 28)	21(19, 26) **††§§♦	23 (17, 25) **††§§

Note: MoCA-C, Chinese version of Montreal Cognitive Assessment; Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups.① Control variable: height. ② Control variable: hypertension.

③ Control variables: height and hyperlipidemia. ④ Control variables: height, BMI and hyperlipidemia.

Significant difference compared with the early 60s group ($P < 0.05$, **$P < 0.01$). †Significant difference compared with the late 60s group (††$P < 0.01$).

§Significant difference compared with the early 70s group (§§$P < 0.01$). ♦Significant difference compared with the late 70s group (♦$P < 0.05$, ♦♦$P < 0.01$).

※Significant difference compared with the late 70s group (※$P < 0.05$, ※※$P < 0.01$). ▲ Significant difference compared with women (▲$P < 0.05$, ▲▲$P < 0.01$).

Table 3 (on next page)

Cross-sectional associations between walking speed and global cognitive function in the population

Note: UWS, usual walking speed; MWS, maximal walking speed. Model 1 adjusted for age, gender, weight, height; Model 2 adjusted for age, gender, weight, height, and years of education; Model 3 adjusted for age, gender, weight, height, years of education, hypertension, diabetes, hyperlipemia, and heart disease. * $P < 0.05$, ** $P < 0.01$

Table 3 Cross-sectional associations between walking speed and global cognitive function in the population

Walking speed	Model 1				Model 2				Model 3			
($m \cdot s^{-1}$)	β	Wald 95% Confidence limits		*P*	β	Wald 95% Confidence limits		*P*	β	Wald 95% Confidence limits		*P*
UWS												
total	-0.019	-0.752	1.292	0.605	0.007	-0.879	1.070	0.848	0.006	-0.890	1.069	0.858
Early 60s (n=174)	-0.130	-3.543	0.287	0.095	-0.120	-3.381	0.374	0.116	-0.107	-3.231	0.554	0.164
Late 60s (n=246)	-0.065	-2.491	0.819	0.321	-0.084	-2.688	0.524	0.187	-0.093	-2.818	0.445	0.153
Early 70s (n=172)	0.096	-0.855	3.633	0.224	0.092	-0.890	3.544	0.239	0.078	-1.151	3.396	0.331
Late 70s (n=95)	0.042	-2.323	3.496	0.690	0.088	-1.597	4.078	0.387	0.122	-1.217	4.656	0.248
Early 80s (n=70)	-0.048	-4.869	3.270	0.696	-0.069	-4.558	2.265	0.504	-0.061	-4.481	2.450	0.560
Late 80s (n=34)	0.149	-5.866	13.900	0.412	0.073	-7.492	11.411	0.674	0.100	-7.339	12.691	0.586
MWS												
total	0.109	0.392	1.937	0.003**	0.088	0.204	1.681	0.012*	0.086	0.177	1.657	0.015*
Early 60s (n=174)	-0.047	-1.870	1.007	0.554	-0.041	-1.791	1.025	0.592	-0.023	-1.640	1.207	0.765
Late 60s (n=246)	0.027	0.690	-1.062	1.603	0.006	0.142	0.373	0.929	0.004	-1.264	1.353	0.947
Early 70s (n=172)	0.152	-0.009	3.098	0.051	0.1440	-0.121	2.959	0.071	0.126	-0.315	2.877	0.115
Late 70s (n=95)	0.203	0.025	4.057	0.047*	0.223	0.303	4.180	0.024*	0.261	0.647	4.592	0.010*
Early 80s (n=70)	-0.017	-4.096	3.600	0.898	-0.108	-4.776	1.711	0.349	-0.104	-4.721	1.772	0.367
Late 80s (n=34)	0.110	-4.723	8.550	0.560	0.076	-4.879	7.525	0.665	0.105	-4.703	8.374	0.567

Note: UWS, usual walking speed; MWS, maximal walking speed.

Model 1 adjusted for age, gender, weight, height; Model 2 adjusted for age, gender, weight, height, and years of education; Model 3 adjusted for age, gender, weight, height, years of education, hypertension, diabetes, hyperlipemia, and heart disease. * $P < 0.05$, ** $P < 0.01$

Figure 1

Usual walking speed (UWS) differences with age among older men and women.

Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups.

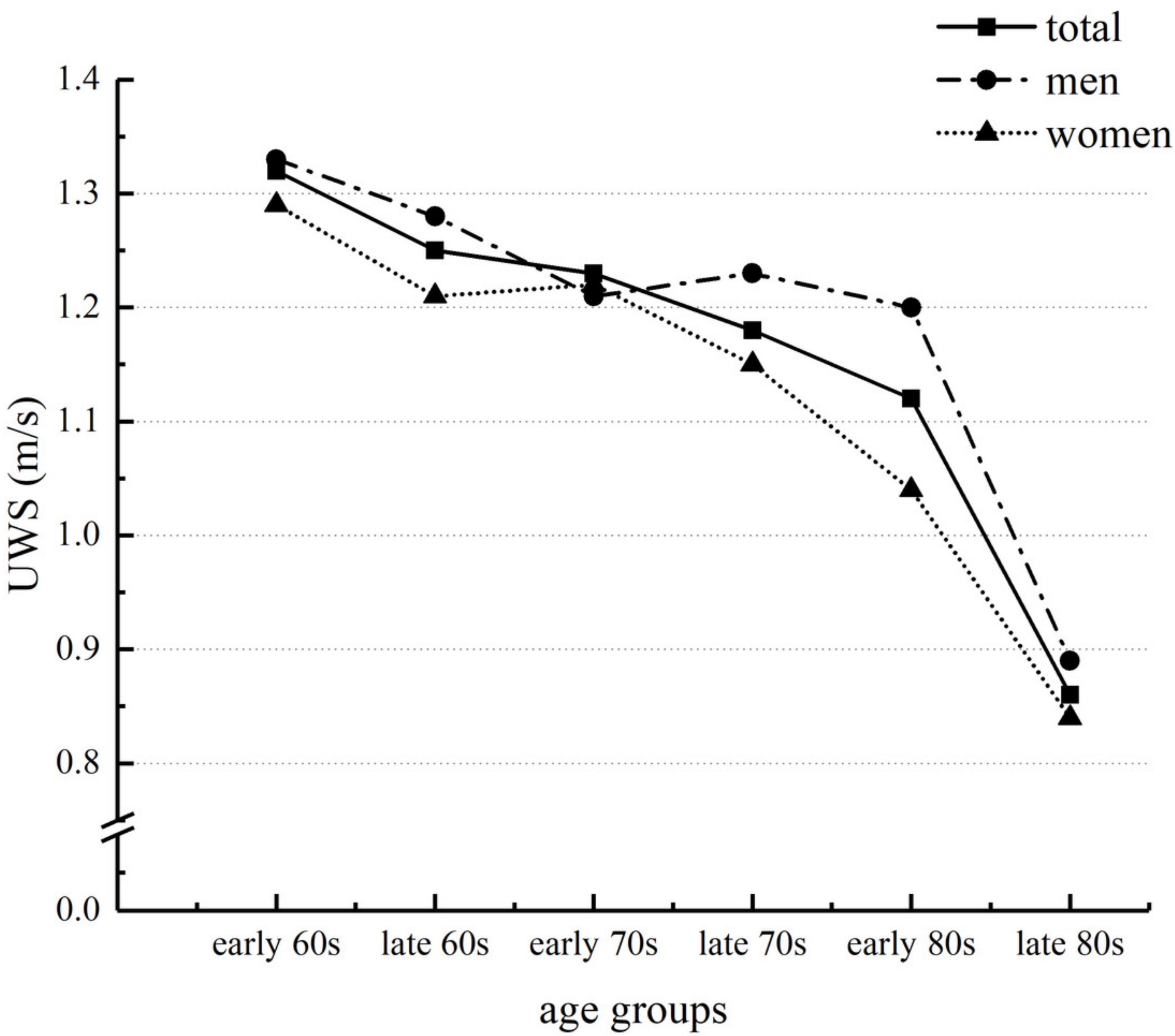

Figure 2

Maximal walking speed (MWS) differences with age among older men and women.

Early 60s represents ages between 60 and 64 years; late 60s represents ages between 65 and 69 years; early and late years are similarly separated for the 70s and 80s age groups.