Factors Associated with Performance-based Physical Function of Older Veterans of the PLAAF: A Pilot Study

DA-WEI CHEN1*, YAN-BIN JIN1, WEI-LIU1, WEN-JIN DU1, HUA-JUN LI1, JIN-WEN CHEN1, WEI XU1

1) Department of Neurology, Geriatric Institute, the General Hospital of the Air Force, PLA (the Chinese People’s Liberation Army): 30 Fucheng Road, Haidian District, Beijing 100142, China

Abstract. [Purpose] This study investigated the factors associated with performance-based physical function of older veterans of the People’s Liberation Army Air Force of China (PLAAF). [Subjects and Methods] A cross-sectional survey of 146 older veterans of the PLAAF was carried out. Their physical function was measured using the Chinese Mini-Physical Performance Testing (CM-PPT). The demographics and health status (including physical measures, blood chemical tests, chronic diseases, and number of morbidities) were collected from health examination reports and computer records of case history. Cognition was measured using the Mini-Mental Status Examination (MMSE). [Results] In multiple linear regressions, age, MMSE, Parkinsonism, and chronic obstructive pulmonary disease were independently associated with CM-PPT, while previous stroke and albumin level reached borderline statistical significance. The association between the number of morbidities and CM-PPT was significant after adjustment for MMSE and demographics. The CM-PPT of low (0 or 1), medium (2 to 4) and high count (5 or more) morbidities were 11.3±3.9, 10.2±4.1, 6.1±3.8 respectively, and the difference among these three groups was significant. [Conclusion] Some modified conditions and the number of chronic diseases might be associated with the physical function of older veterans of the PLAAF.

Key words: Physical function, Physical performance test, Aging

INTRODUCTION

The quality of life of older persons is more determined by their level of physical function and ability to maintain independence than by the specific diseases diagnosed by their physicians9). When physical function declines to the point where older persons cannot fully care for themselves, the burden on their families and the medical care system becomes substantial. With increasing age, there is a noticeable rise in the proportion of the population residing in nursing homes or living at home and needing the help of other people3). In addition, it has been consistently demonstrated that measures of physical function of the elderly can predict major health-related events, such as falls, disability, hospitalization, institutionalization, and mortality3–6). Therefore, it is imperative to understand and realize the determinants of physical functional decline. These determinants can not only be used as an early warning system for identifying persons at great risk of subsequent decline of physical function, but also to suggest therapy strategies to delay or even ameliorate physical function impairment, in order to prevent and postpone adverse health-related events.

A series of studies have reported that the age, cognitive function, life-style, psychosocial factors, and chronic medical conditions, are associated with the physical function of older persons. However, these studies have inconsistent results which may be related to differences in race and geography, in addition to different designs and methods1, 2, 7–11). As such, it is necessary to investigate these associations in populations of different races and countries, but this has not been carried out in China.

Physical function can be assessed by self-report or performance-based measures. Different from the self-report measures, physical performance tests (PPT) provide a multidimensional, objective and standardized assessment of elderly persons, and are less confounded by culture, language, or educational level1, 7, 12). In addition, PPT have been proved to be able to identify more limitations in physical function than self-report measures, and consequently they are more sensitive to changes leading to disability13–15). PPT have more recently been considered as the ‘gold standard’ for the measurement and follow-up of physical function.

Recently, we modified the Mini-Physical Performance Test of Wilkins et al.16) by replacing the 50-ft timed walk with a 20-ft timed walk, and adding one-leg standing to construct the Chinese version of the Mini-PPT (CM-PPT)17). CM-PPT has an unchanged score for the timed walk with the shortened distance, and has a more sensitive assessment of balance. Fitzpatrick et al. found that the tasks...
requiring greater functional reserve appear to be more sensitive at assessing the physical function than the usual tasks, and CM-PPT is required to be completed as quickly as possible\(^{18}\). A pilot study showed that CM-PPT is reliable, and is more sensitive than the Barthel index (BI) at evaluating and monitoring the physical function of elderly Chinese\(^{17}\).

In the present cross-sectional study, we investigated the association of CM-PPT with demographics, cognition and health status in older veterans of The People’s Liberation Army Air Force of China (PLAAF). We found that aging, cognition, some chronic conditions, and a number of morbidities were associated with the physical function of older veterans of the PLAAF.

**SUBJECTS AND METHODS**

The data used in this study were collected in our previous study, in which 170 Veterans taking part in the 2010 health examination at the General Hospital of Air Force PLA were recruited for a study of the reliability and validity of CM-PPT\(^{17}\). Eligibility criteria were an age of 60 years or older, and the ability to follow a one-step command. Participants were excluded if they were enrolled in a hospice program with anticipated survival of less than 6 months, enrolled in a sub-acute or acute care program, or were unable to follow directions due to severe visual and hearing impairment, or profound dementia. In the present study, we selected only those persons with complete health examination and computer records of case history. Subjects with dementia were also excluded in order to make sure that the participants had completely comprehended their instructions. A cross-sectional survey was carried out of the remaining 146 persons. Information about their demographics, health status, cognitive and physical functions was collected. All procedures were approved by the Institutional Ethical Review Committee, and all participants provided their written informed consent to participation in this study.

The CM-PPT contains 4 physical performance tests: standing static balance, 20-ft timed walk (time of 10-ft forward and back), chair-stand time (time to sit in and rise from a chair with arms folded across the chest 5 times) and picking up a penny from the floor (a penny was placed approximately 12 inches from the subject’s foot on the dominant side, and the time taken to pick up the penny from the floor and stand up). Standing static balance also contains 4 items: feet together (standing still with the feet together), semi-tandem (standing with the heel of one foot placed to the side of the first toe of the opposite foot), tandem (standing with the heel of one foot directly in front of the other foot), and one-leg standing (standing unassisted on one leg with eyes open). Each test is scored from 0 to 4 points and the data of categorical variables as percentage. The associations of CM-PPT with demographics measures, all data of health status, and MMSE were examined using multiple linear regression. In Model 1, only demographic measures were included. In Model 2, all covariates of health status and MMSE were examined in separate demographics-adjusted regression models. In Model 3, the significant variables of Model 2 were simultaneously entered into a summary demographics-adjusted regression model. In Model 4, the number of morbidities was examined in the regression model after adjustment for MMSE and demographics. The correlation between CM-PPT and the number of morbidities is expressed by Pearson’s correlation coefficient. The difference of CM-PPT scores among the low, medium and high counts of morbidities was examined by analysis of variance. Statistical significance was accepted for values of \( p \leq 0.05 \), and all statistical analyses were performed using SPSS version 16.0.
RESULTS

The main characteristics of CM-PPT, demographics measures, health status and MMSE of 146 subjects are shown in Table 1. Except for BMI, there were complete clinical data for all subjects. Most of the participants were male in this study because our sample was comprised of PLA AF veterans. In Model 1, age was significantly associated with CM-PPT (Table 2): CM-PPT declined with age. In separate demographic-adjusted linear regression models, MMSE, albumin level, SAS, COPD, previous stroke, and parkinsonism were significantly associated with CM-PPT, in addition to age (Table 2). In the summary demographics-adjusted linear regression model, age, MMSE, COPD and parkinsonism were significantly associated with CM-PPT, and previous stroke and albumin level reached borderline statistical significance (Table 2). The number of morbidities was negatively associated with CM-PPT (r=0.337, p<0.001). This association still existed after adjusted for MMSE and demographics (p=0.007, Table 2). The CM-PPT of the low, medium and high count morbidities were 11.3±3.9, 10.2±4.1, and 6.1±3.8 respectively, and the difference among the three groups was significant (p=0.002).

DISCUSSION

In the present study, we explored the association of a performance-based physical function assessment with demographics, cognition, and health status in a sample of non-demented and non-institutionalized veterans of the PLA AF who were older than 60 years. Our results show that age, cognitive function, and some medical conditions (such as parkinsonism and COPD) might independently affect physical function, and that previous stroke and low albumin level showed associations that were close to statistical significance. In addition, the number of morbidities was also associated with physical function, and persons with more diseases had poorer physical performance.

Our cross-sectional study show that age was negatively associated with physical function, which is consistent with the results of other studies1, 2, 7–11. The longitudinal studies of Miller et al.9 and Ishizaki et al.20 also showed that age is associated with physical function decline. In addition, Ostir et al. found that 65–74-year-olds had the highest initial PPT scores and the most moderate slope of decline, followed by 75–84-year-olds, and ≥85 year-olds7). Therefore, age is the main risk factor of physical function decline. The mechanism of decline may be that muscle loss due to aging results in declines in motor ability and physical function21, 22.

Our results also showed that the cognitive function was associated with physical performance, similar to many other studies18, 23, even though we had excluded dementia patients in order to eliminate the confounder of instructions of CM-PPT being not comprehended well. This suggests that cognition is another factor of physical function decline, as well as age. Physical frailty and cognitive impairment may share a common underlying etiopathogenesis (e.g., vascular pathology, inflammation, stress)35; However, the accumulation of Alzheimer’s disease pathology in brain regions that subserve cognition may affect components of frailty through the impairment of neural systems involved in the planning and monitoring of simple movement24.

In our study, some medical conditions affected physical performance, a result which is consistent with those of previous studies1, 2, 7–11. Neurological diseases (such as parkinsonism and previous stroke) have an negative effect on physical function1, 2, 7, 8) since these diseases can cause muscle weakness, abnormal gait, balance impairment, and other movement disorders25, 26). A recent study showed that sustained or unsustained decline in physical performance is also common after an ischemic stroke or transient ischemic attack, even in the absence of a recurrent neurological event27. Some systemic conditions (such as COPD and low albumin level) can also contribute to poor physical function28–31. COPD is being increasingly viewed as a multi-system disease associated with depleted lean mass that results in muscle weakness and physical frailty28). Besides a sedentary lifestyle, the factors that lead to skeletal muscle atrophy include systemic or muscular hypoxia, systemic inflammation, and oxidative stress32, 33). A albumin is a negative acute phase protein that decreases with systemic inflammation and is conventionally viewed as a marker of chronic inflammation30, 31). Since pro-inflammatory cytokines may cause muscle atrophy and are associated with physical frailty, it is very interesting that the common mechanism for the observed association of these two medical conditions with physical function may be chronic inflammation33.

Some other chronic medical conditions (e.g., chronic heart failure, obesity, diabetes, coronary vascular disease, impaired vision, hypertension, cancer, arthritis, depression) have also been reported in other studies to affect physical function1, 2, 7–11, but these were not verified in our study. The reason for this inconsistency may be that different chronic diseases play a role in the decline of physical function in different populations. Some studies have shown that chronic heart failure (CHF), but not COPD, influences physical function in American and European populations1, 6–8). In the past decade, it has become clear that both COPD and CHF have important systemic consequences. Cachexia and muscle weakness are two clearly visible expressions of the systemic consequences associated with both diseases33). Therefore, COPD and CHF may affect the physical function of Chinese and Western populations, respectively. Miller and Troosters found that obesity (BMI≥30 kg/m2), another condition associated with inflammation, is strongly associated with disability in Western populations1, 6–9), but this was not demonstrated in our study. Since the prevalence of obesity (only 4.4% in our study) is lower in China than in Western countries30, it’s no surprise that a low albumin level, but not obesity, may be a biomarker for the decline of physical function in the Chinese population. Finally, many studies have shown that diabetes is associated with physical function1, 6–8), but the reason for the lack of this relationship in our population is not clear.

The inconsistencies between our study results and those of other studies may also arise from chronic conditions exerting an effect on physical function proportionate to their severity31). Therefore, it is understandable that the mere presence or absence of most chronic conditions is not related
Table 1. Demographic measures, health status, MMSE and CM-PPT of the 146 participants

| Characteristics               | Mean±SD | Range  | Number (%) |
|-------------------------------|---------|--------|------------|
| **Demographic measures**      |         |        |            |
| Age (year)                    | 80.8±6.8| 60–94  |            |
| Sex (male)                    |         |        | 136 (93.2) |
| Marital Status (married)      |         |        | 129 (88.4) |
| Educational levels            |         |        |            |
| Illiteracy                    | 1 (0.7) |        |            |
| ≤6 years                      | 10 (6.8)|        |            |
| ≤12 years                     | 63 (43.2)|       |            |
| >12 years                     | 72 (49.3)|       |            |
| **Physical measures**         |         |        |            |
| Systolic BP (mmHg)            | 130.1±15.4| 90–180 |            |
| Diastolic BP (mmHg)           | 73.3±9.3| 58–110 |            |
| BMI (kg/m²)                   |         |        |            |
| <18.5                         | 3 (2.1) |        |            |
| 18.5–25                       | 70 (47.9)|       |            |
| >25                            | 60 (41.1)|       |            |
| Unknown                        | 13 (8.9) |      |            |
| Hearing (normal)              | 127 (87.0)|      |            |
| Vision (normal)               | 81 (55.5)|      |            |
| **Blood chemistry**           |         |        |            |
| Fasting blood sugar (mmol/L)  | 5.5±1.3 | 3.6–11.9|            |
| Total cholesterol (mmol/L)    | 4.0±0.8 | 2.0–8.1 |            |
| Triglyceride (mmol/L)         | 1.4±0.8 | 0.5–6.8 |            |
| LDL (mmol/L)                  | 2.6±0.7 | 0.4–6.2 |            |
| HDL (mmol/L)                  | 1.1±0.3 | 0.6–1.9 |            |
| Creatine (umol/L)             | 108.2±102.2| 48.0–795.0|        |
| Urea nitrogen (mmol/L)        | 6.6±3.2 | 2.0–23.4|            |
| Uric acid (umol/L)            | 344.6±95.1| 129.0–667.0|        |
| Haematin (g/L)                | 124.0±19.0| 69.0–163.0|        |
| Albumin (g/L)                 | 40.5±3.2| 33.0–49.0|            |
| **Chronic diseases**          |         |        |            |
| Coronary disease              | 22 (15.1)|      |            |
| Chronic heart failure         | 13 (8.9) |      |            |
| Hypertension                  | 92 (63.0)|      |            |
| Hyperlipidemia                | 20 (13.7)|      |            |
| Diabetes                      | 44 (30.1)|      |            |
| SAS                           | 3 (2.1) |        |            |
| COPD                          | 9 (6.2) |        |            |
| Neoplasm                      | 33 (22.6)|      |            |
| Arthritis                     | 7 (4.8) |        |            |
| Chronic renal failure         | 15 (10.3)|      |            |
| Anemia                        | 61 (41.8)|      |            |
| Previous stroke               | 21 (14.4)|      |            |
| Parkinsonism                  | 10 (6.8) |      |            |
| **Number of morbidities**     |         |        |            |
| ≤1                            | 38 (26.0)|      |            |
| 2–4                           | 98 (67.2)|      |            |
| ≥5                            | 10 (6.8) |      |            |
| **MMSE**                      | 27.0±2.6| 20–30 |            |
| **CM-PPT**                    | 10.2±4.2| 0–16  |            |

SD = standard deviation; BP = blood pressure; BMI = body mass index; LDL = low density lipoproteins; HDL = high density lipoproteins; SAS = sleep apnea syndrome; COPD = chronic obstructive pulmonary disease; MMSE = Mini-Mental State Examination; CM-PPT = Chinese version Mini-Physical Performance Test
to physical performance measures in our population. Moreover, lifestyle can influence the effect of chronic diseases on physical performance and function, but such associations were not confirmed in our sample due to the absence of information on physical activity and training programs. In addition, the limited data of some conditions in our study (such as arthritis) reduced its power to confirm their association with physical function. Lastly, the single effect of these medical conditions on physical function was low, but the combined effect may be significant, since our results show that multi-morbidity (two or more morbidities in one individual) rather than single or zero morbidity, was associated with lower physical function. This association between the number of morbidities (multi-morbidity) and physical

| Table 2. Associations of CM-PPT with demographics, physical health state, and MMSE by multiple linear regressions |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Model 1 | Model 2 | Model 3 | Model 4 |
| Age | $-0.352$ | $-0.576$ | $<0.001$ | $-0.283$ | $-0.463$ | $<0.001$ | $-0.281$ | $-0.460$ | $<0.001$ |
| Sex | 0.055 | 0.003 | 0.963 | 0.300 | 0.018 | 0.777 | 0.301 | 0.018 | 0.786 |
| Marital Status | $-0.282$ | $-0.044$ | 0.547 | $-0.320$ | $-0.050$ | 0.450 | $-0.143$ | $-0.022$ | 0.745 |
| Educational levels | $-0.343$ | $-0.054$ | 0.484 | $-0.575$ | $-0.090$ | 0.194 | $-0.552$ | $-0.086$ | 0.231 |
| SBP (mmHg) | 0.010 | 0.036 | 0.614 | 0.010 | 0.023 | 0.748 |
| DBP (mmHg) | 0.010 | 0.023 | 0.748 |
| BMI (kg/m²) | 0.243 | 0.048 | 0.497 |
| Heart rate | 0.243 | 0.048 | 0.497 |
| Triglyceride (mmol/L) | $-0.545$ | $-0.099$ | 0.157 | 0.243 | 0.040 | 0.568 |
| LDL (mmol/L) | 0.634 | 0.041 | 0.562 |
| HDL (mmol/L) | $-0.003$ | $-0.068$ | 0.339 | 0.243 | 0.040 | 0.568 |
| Creatine (umol/L) | $-0.059$ | $-0.045$ | 0.539 |
| Urea nitrogen (mmol/L) | $-0.002$ | $-0.044$ | 0.531 |
| Uric acid (umol/L) | 0.022 | 0.102 | 0.166 |
| Haematin (g/L) | 0.022 | 0.102 | 0.166 |
| Albumin (g/L) | $0.263$ | $0.204$ | 0.004 | $0.162$ | 0.125 | 0.062* |
| Previous stroke | $-1.743$ | $-0.148$ | 0.036 | $-1.353$ | $-0.115$ | 0.077* |
| Coronary disease | $-0.959$ | $-0.083$ | 0.237 |
| Chronic heart failure | $-1.033$ | $-0.071$ | 0.321 |
| Hypertension | $-0.597$ | $-0.070$ | 0.326 |
| Hyperlipidemia | $-0.134$ | $-0.011$ | 0.875 |
| Diabetes | $-0.930$ | $-0.103$ | 0.149 |
| SAS | $-4.067$ | $-0.139$ | 0.045 | $-3.073$ | $-0.105$ | 0.098 |
| COPD | $-3.129$ | $-0.182$ | 0.010 | $-3.121$ | $-0.181$ | 0.005 |
| Neoplasms | $-0.010$ | $-0.001$ | 0.988 |
| Arthritis | $-1.039$ | $-0.054$ | 0.449 |
| Parkinsonism | $-3.634$ | $-0.222$ | 0.001 | $-3.004$ | $-0.183$ | 0.005 |
| Chronic renal failure | $-1.307$ | $-0.096$ | 0.183 |
| Anemia | $-0.277$ | $-0.033$ | 0.662 |
| MMSE | $0.437$ | $0.273$ | $<0.001$ | $0.293$ | $0.183$ | $0.010$ | $0.387$ | $0.242$ | $<0.001$ |
| Number of morbidities | $-0.568$ | $-0.188$ | 0.007 |

SBP = systolic blood pressure; DBP = diastolic blood pressure; BMI = body mass index; LDL = low density lipoproteins; HDL = high density lipoproteins; SAS = sleep apnea syndrome; COPD = chronic obstructive pulmonary disease; MMSE = Mini-Mental State Examination; CM-PPT = Chinese version Mini-Physical Performance Test.

Model 1: analysis of demographics; Model 2: analysis of physical health state and MMSE after adjustment for demographics; Model 3: analysis using the significant variables of Model 2 after adjustment for demographics; Model 4: analysis of the number of morbidities after adjustment for both MMSE and demographics. Bold and italic p <0.05; *p close to 0.05.
function has also been demonstrated in other studies, Our study had several important strengths. First, chronic diseases were collected from computer records of case history, not self-report by the participants, so the accuracy of the information is higher. Second, CM-PPT has the characteristics of being brief and easy to implement and is well-suited to the clinical environment, so the results can be used to guide clinical practice.

This study also had a few limitations. The sample size was not large enough, and the study design was cross-sectional, which reduces its statistical power. However, this study was a pilot one. The good reliability and validity of CM-PPT as well as its ease of implementation will ensure a wide range of surveys evaluating and monitoring the physical function of elderly Chinese will be undertaken. A further limitation is that most participants were male, because our sample was of retired veterans, which limits the generalization of our results. However, our results still provide some important information about male subjects.

In summary, our study showed that the age, cognitive impairment, parkinsonism, COPD, and the number of morbidities might be independently associated with the physical function of elderly Chinese and that previous stroke and low albumin level also showed association that were close to statistical significance. In addition, the number of chronic diseases was also associated with the physical function. In the future, we need to study the relationship between these conditions and physical function in large samples or in a longitudinal study. Our findings also suggest that the prevention and intervention of some specific conditions or the comprehensive management of multi-morbidity might retard the decline of physical function.

ACKNOWLEDGEMENTS

This work was supported by grants from Ministry of Sciences and Technology of the General Hospital of Air Force PLA (KZ20100019). We also thank the officers of healthcare management for retired cadres at the General Hospital of Air Force PLA.

REFERENCES

1) Cesari M, Onder G, Russo A, et al.: Comorbidity and physical function: results from the aging and longevity study in the Sirente geographic area (iISIRENTE study). Gerontology, 2006, 52: 24–32. [Medline] [CrossRef]
2) Wang L, van Belle G, Kukull WB, et al.: Predictors of functional change: a longitudinal study of nondemented people aged 65 and older. J Am Geriatr Soc, 2002, 50: 1525–1534. [Medline] [CrossRef]
3) Cesari M, Kritchevsky SB, Newman AB, et al.: Added value of physical performance measures in predicting adverse health-related events: results from the health, aging and body composition study. J Am Geriatr Soc, 2009, 57: 251–259. [Medline] [CrossRef]
4) Delbaere K, Van den Noortgate N, Bourgeois J, et al.: The physical performance test as a predictor of frequent fallers: a prospective community-based cohort study. Clin Rehabil, 2006, 20: 83–90. [Medline] [CrossRef]
5) Volpato S, Cavaletti M, Sentiis F, et al.: Predictive value of the short physical performance battery following hospitalization in older patients. J Gerontol A Biol Sci Med Sci, 2011, 66: 89–96. [Medline] [CrossRef]
6) Miller DK, Wolinsky FD, Andreassen EM, et al.: Adverse outcomes and correlates of change in the short physical performance battery over 16 months in the African American health project. J Gerontol A Biol Sci Med Sci, 2008, 63: 487–494. [Medline] [CrossRef]
7) Ostir GV, Volpato S, Fried LP, et al.: Reliability and sensitivity to change assessed for a summary measure of lower body function: results from the Women’s Health and Aging Study. J Clin Epidemiol, 2002, 55: 916–921. [Medline] [CrossRef]
8) Rizzato R, Frisoni GB, Ferrucci L, et al.: The effect of chronic diseases on physical function. Comparison between activities of daily living scales and the physical performance test. Age Ageing, 1997, 26: 281–287. [Medline] [CrossRef]
9) Morala DT, Shiomi T, Maruyama H: Factors associated with the functional status of community-dwelling elderly. J Geriatr Phys Ther, 2006, 29: 101–106. [Medline] [CrossRef]
10) Arias-Merino ED, Mendoza-Ruvalcaba NM, Ortiz GG, et al.: Physical function and associated factors in community-dwelling elderly people in Jalisco, Mexico. Arch Gerontol Geriatr, 2012, 54: e271–e278. [Medline] [CrossRef]
11) Kadam UT, Croft PR: Clinical multimorbidity and physical function in older adults: a record and health status linkage study in general practice. Fam Pract, 2007, 24: 412–419. [Medline] [CrossRef]
12) Morala D, Shiomi T: Assessing reliability and validity of physical performance test for the Japanese elderly. J Phys Ther Sci, 2004, 16: 15–20. [CrossRef]
13) Louie GH, Ward MM: Association of measured physical performance and demographic and health characteristics with self-reported physical function: implications for the interpretation of self-reported limitations. Health Qual Life Outcomes, 2010, 8: 84. [Medline] [CrossRef]
14) Bean JF, Olveczky DD, Kiely DK, et al.: Performance-based versus patient-reported physical function: what are the underlying predictors? Phys Ther, 2011, 91: 1804–1811. [Medline] [CrossRef]
15) van Weely SF, van Denderen JC, Steultjens MP, et al.: Moving instead of asking? Performance-based tests and BASFI-questionnaire measure different aspects of physical function in ankylosing spondylitis. Arthritis Res Ther, 2012, 14: R52. [Medline] [CrossRef]
16) Wilkins CH, Roe CM, Morris JC: A brief clinical tool to assess physical function: the mini-physical performance test. Arch Gerontol Geriatr, 2010, 50: 96–100. [Medline] [CrossRef]
17) Chen DW, Chen JW, Xu W, et al.: A pilot study for reliability and validity of mini-physical performance test for Chinese male elders. Int J Gerontol, 2012, 6: 16–19. [CrossRef]
18) Fitzpatrick AL, Buchanan CK, Nahin RL, et al.: Associations of gait speed and other measures of physical function with cognition in a healthy cohort of elderly persons. J Gerontol A Biol Sci Med Sci, 2007, 62: 1244–1251. [Medline] [CrossRef]
19) Folstein MF, Folstein SE, McHugh PR: “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res, 1975, 12: 189–198. [Medline] [CrossRef]
20) Ishizaki T, Furuma T, Yoshida Y, et al.: Declines in physical performance by sex and age among nondisabled community-dwelling older Japanese during a 6-year period. J Epidemiol, 2011, 21: 176–183. [Medline] [CrossRef]
21) Nikolić M, Bajek S, Bobincad D, et al.: Aging of human skeletal muscles. Coll Antropol, 2005, 29: 67–70. [Medline]
22) Buford TW, Lott DJ, Marzetti E, et al.: Age-related differences in lower extremity tissue compartments and associations with physical function in older adults. Exp Gerontol, 2012, 47: 38–44. [Medline] [CrossRef]
23) Eggermont LH, Gavett BE, Volkers KM, et al.: Lower-extremity function in cognitively healthy aging, mild cognitive impairment, and Alzheimer’s disease. Arch Phys Med Rehabil, 2010, 91: 584–588. [Medline] [CrossRef]
24) Buchman AS, Schneider JA, Leurgans S, et al.: Physical frailty in older persons is associated with Alzheimer disease pathology. Neurology, 2008, 71: 499–504. [Medline] [CrossRef]
25) Brusse KJ, Zimdars S, Zalewski KR, et al.: Testing functional performance in people with Parkinson disease. Phys Ther, 2005, 85: 134–141. [Medline]
26) Young JA, Tolentino M: Stroke evaluation and treatment. Top Stroke Rehabil, 2009, 16: 389–410. [Medline] [CrossRef]
27) Keanan WN, Viscoli CM, Brass LM, et al.: Decline in physical performance among women with a recent transient ischemic attack or ischemic stroke: opportunities for functional preservation a report of the women’s estrogen stroke trial. Stroke, 2005, 36: 630–634. [Medline] [CrossRef]
28) Eisner MD, Blanc PD, Yelin EH, et al.: COPD as a systemic disease: impact on physical functional limitations. Am J Med, 2008, 121: 789–796. [Medline] [CrossRef]
29) Taspinar B, Gursoy S, Baser S, et al.: Comparison of pulmonary function, physical function, quality of life, depressive symptoms and cognitive abilities between patients with chronic obstructive pulmonary disease and healthy subjects. J Med Sci, 2010, 10: 71–79. [CrossRef]
30) Visser M, Kritchevsky SB, Newman AB, et al.: Lower serum albumin concentration and change in muscle mass: the health, aging and body composition study. Am J Clin Nutr, 2005, 82: 531–537. [Medline]

31) Aung KC, Feng L, Yap KB, et al.: Serum albumin and hemoglobin are associated with physical function in community-living older persons in Singapore. J Nutr Health Aging, 2011, 15: 877–882. [Medline] [CrossRef]

32) Cesari M, Pedone C, Chiurco D, et al.: Physical performance, sarcopenia and respiratory function in older patients with chronic obstructive pulmonary disease. Age Ageing, 2012, 41: 237–241. [Medline] [CrossRef]

33) Troosters T, Gosselink R, Decramer M: Chronic obstructive pulmonary disease and chronic heart failure: two muscle diseases? J Cardiopulm Rehabil, 2004, 24: 137–145. [Medline] [CrossRef]

34) Wu Y: Overweight and obesity in China. BMJ, 2006, 333: 362–363. [Medline] [CrossRef]

35) Toto PE, Raina KD, Holm MB, et al.: Outcomes of a multicomponent physical activity program for sedentary, community-dwelling older adults. J Aging Phys Act, 2012, 20: 363–378. [Medline]

36) Gennuso KP, Gangnon RE, Matthews CE, et al.: Sedentary behavior, physical activity, and markers of health in older adults. Med Sci Sports Exerc, 2013, 45: 1493–1500. [Medline] [CrossRef]