Factors Associated with the Functional Status of Community-dwelling Elderly

Dorothy Tan Morala, PT, MS;[1] Taizo Shiomi, PT, PhD;[1] Hitoshi Maruyama, PT, PhD[1]

[1] Department of Physical Therapy, School of Health and Science, International University of Health and Welfare, Tochigi, Japan

ABSTRACT

Purpose: This research sought to answer the following question: To what extent is the functional status of elderly people explained by gender, age, geographical residence, level of cognitive function, and depression? **Method**: Two hundred randomly selected community-dwelling elderly people aged 65 to 80 years old completed the Mini-Mental State Examination (MMSE), Geriatric Depression Scale (GDS), and Physical Performance Test (PPT). **Results**: Correlation analysis and simple linear regression models showed that age, MMSE, GDS, and geographical residence were significantly associated with the functional level, whereas gender was not. In the multiple regression model, MMSE and geographical residence together explained 40% of the variance in functional status; age and GDS did not add to the explanation. **Conclusion**: Since cognitive function had the strongest association with functional performance to an extent greater than the other variables, adding a treatment regimen that stimulates cognitive function might further enhance functional level or prevent decline of functional status compared with an exercise intervention alone.

Key Words: functional status, cognition, age, depression

INTRODUCTION

Population aging, a gradual increase in the average age of a region's population,[1] is a problem in developed nations, particularly Japan and Italy, which are facing substantial growth of the proportions of their elderly. Developing countries, in contrast, have higher child populations as compared with the percentage of elderly people. Nevertheless, the absolute numbers of elderly people in developing nations are also large and continue to increase. In fact, more than 248 million of the roughly 418 million people aged 65 years and older in the world (59%) now live in developing countries. By 2020, this proportion is projected to increase to 67%.[2] Yet, despite this worldwide aging trend, there has been little research on elderly people living in developing countries.

As the number of elderly people continues to increase around the world, physical frailty, cognitive impairment, and depression will emerge as significant components of the global burden of disease. Hence, a deeper understanding of the relationships and precipitating factors affecting these components is important. In this study, we focused on the factors affecting physical frailty. This has an important bearing in the field of physical therapy; specifically, more than any other medical professionals, physical therapists are the medical personnel who are most likely to deal with the physical functional aspects of patients.

Although there is no universally accepted definition of physical frailty, it is generally accepted that frail elderly people have difficulty with fundamental tasks such as dressing, shopping, household work, and ambulation.[3,4] Physical frailty is thought to be due to a number of factors, including decline in strength, loss in range of motion, slowness of movement, poor balance, and limited cardiovascular endurance.[5-7] Recently, specialists have been moving away from the common view of frailty as an inevitable part of old age towards a new view of frailty as an avoidable condition.[8] While specific treatments for frailty are not yet available, being aware of the factors affecting the functional status of the healthy elderly people can lead to treatment that considers individual vulnerabilities to disability.

The primary aim of this study was to determine the factors associated with functional status of the healthy community-dwelling elderly. Specifically, this research sought to answer the following question: To what extent is the functional status of elderly people explained by gender, age, geographical residence, level of cognitive function, and depression? Knowing the factors that strongly associates with functional status is relevant for preventing and delaying functional decline among frail elderly people and may also be used in the future development of physical therapy treatment regimens.

METHODS

Sample

A cross-sectional study design was used among 65 to 80 year old community-dwelling elderly people residing in 2 communities (Talomo and Manuwangan) in Southern Mindanao, Philippines. Talomo, an urban community, is located within the main city of Mindanao (Davao), whereas Manuwangan is an agricultural rural area. Lists of potential subjects were obtained from the local administrative offices. All persons aged 65 to 80 years old at the time of data collection who were registered at the administrative offices were included in the random sampling. From a total list of 637 community-dwelling elderly people, a sample of 200 individuals (100 in each study site) was selected by draw lots (pieces of paper with names written on them were drawn from a box).

Address correspondence to: Dorothy T. Morala, Department of Physical Therapy, School of Health and Science, 2600-1 Kitakanemaru, Otawara City, Tochigi, Japan, 324-8501. Telephone: + 81-287-24-3637 (alarom2001@yahoo.com).

After subjects were identified, 2 social workers from the respective communities were requested to contact the selected subjects and inform them about the purpose and research protocol of the study. They were also instructed to ask the participants' consent to participate in the study, which was approved by the Human Studies Committee of the International University of Health and Welfare. If however, subjects had severe stroke, congestive heart failure, coma, alcohol or drug abuse, were experiencing acute terminal illness, could not walk more than 50 feet without an assistive device other than a cane, had severe dementia and psychiatric disorders, or refused to participate in the research, the social workers were asked to report this to the researchers so that a new subject could be drawn from the list. Selected and eligible subjects who agreed to participate were interviewed at home in their preferred language (English or the local language) by bilingual raters (2 physical therapists and a nurse) who had been thoroughly trained in the administration and scoring of assessment measurements by the first author (Morala) prior to the data collection.

Assessment Measures

Functional status was measured using the 7-item Physical Performance Test (PPT). The 7-item and 9-item PPT measures, developed by Reuben and Siu in 1990, are commonly used to test the overall functional ability of elderly people.[9] The 7-item PPT includes writing a sentence, simulating eating, lifting a book and placing it on a shelf, donning and removing a jacket, picking up a penny from the floor, turning 360° while standing, and walking 50 feet.[10] The total score ranges from 0 (worst performance) to 28 (best performance). The PPT was administered with a standardized set of tools.

The cognitive test used in this research was the Mini-Mental State Examination (MMSE). The MMSE includes 11 sub-items that assess abilities of orientation (time and place), registration, attention, recall, naming, repetition, command, reading, writing, and copying.[11]

Symptoms of depression were assessed using the Geriatric Depression Scale (GDS), a 30-item scale that has been shown to be useful in distinguishing elderly depressed subjects from nondepressed subjects. The GDS correlates well with the number of research diagnostic criteria for depressive symptoms. According to Yesavage et al, a score of 0 to 10 should be considered normal, and a score of ≥11 is indicative of depression.[12] On the other hand, Burke et al recommend a cut-off point of ≥14 for possible depression.[13]

Procedures

Having previously described the research protocol and the evaluation technique to the raters in detail, the first author held 2 meeting sessions with the raters prior to the interviews. The first was a 2-hour session focused on demonstrating and practicing the measurement method and answering any of their questions. Second, raters were asked to administer and score the PPT, GDS, and MMSE for 10 community-dwelling elderly people who were not part of the study sample. After administering the tests, the rater's doubts and difficulties were addressed. In addition to PPT, GDS, and MMSE, the subjects were asked about their sociodemographic characteristics, such as gender and age.

Data Analysis

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) software version 12. Descriptive statistics were calculated to determine the mean and distribution of values for each of the variables. Relationships among variables were examined using the Spearman correlation coefficient. Multivariate regression models, as primary statistical analysis, were applied to test the research questions of the study. Simple- and multiple-regression analyses were examined with the PPT score as dependent variables. For each regression analysis, the variables were entered into the regression equation in the following order: age as a continuous variable; level of cognitive function as measured by MMSE; level of depression using GDS; geographical residence (0 = rural; 1 = urban); and gender (0 = female; 1 = male).

Preliminary Data Screening

Prior to running the statistical analysis, the data were screened for both missing data (1 subject) and outliers (12 subjects). Missing data were excluded. Subjects who were outliers on the dependent variable were not eliminated from the analysis. The residuals of regression analysis were also checked to test the assumption of multiple regressions (ie, normality, multicollinearity, and homoscedasticity). Normality was assessed by examining the distributions and histogram of the standardized residuals. Linearity and homoscedasticity were assessed through scatter plots of residuals.

RESULTS

Descriptive and Inferential Characteristics

Table 1 reports descriptive statistics for the independent variables and functional status. Study samples were aged 65 to 80 years old (mean = 70.3; SD = 4.5) and were predominantly female (61.5%). The average MMSE score was 24.0 (SD = 4.2), which lies in the range of no cognitive impairment. More than half of the subjects (59%) scored in the no cognitive impairment range (24-30); 33% scored in the mild cognitive impairment range (18-23); and 8% scored in the severe cognitive impairment range (0-17). Thus, 41% of our subjects had cognitive impairment. The mean score for GDS was 17.1 (SD = 3.3). Using the recommended cut-off score of Burke et al,[13] 84.5% of the subjects had possible depression and 15% had none. On the other hand, grouping our subjects based on the cut-off score of Yesage et al,[12] 95.5% of the subjects were likely to be depressed and 4% were not. In conclusion, more than 80% of the subjects were depressed. The PPT mean score of this population was 19.3 (SD= 3.9). The mean score in this study sample was higher than that reported among the male population of Pittsburgh University Drive Veteran Affairs Medical Center[14] and lower than the population studied by Brach et al[15] and Lusardi et al.[9]

Correlations between independent variables and functional status are reported in Table 2. Performance on the PPT was positively correlated with MMSE ($r = 0.61$; $p < 0.005$), which implies that the elderly with higher levels of cognitive function had higher levels of functional status. Conversely, GDS was negatively correlated to PPT ($r = -0.16$; $p = 0.02$), such that those subjects with higher levels of depression had lower functional levels. The Spearman correlation coefficient also showed that PPT was negatively correlated with age ($r = - 0.28$; $p < 0.005$), such that the older the subject, the lower was his or her functional level. Difference in geographical residence was also significantly correlated with PPT ($r = 0.14$; $p = 0.05$), whereas gender was not ($r = 0.23$; $p = 0.28$). Although the relationships of age, GDS, and geographical residence with PPT were significant, according to Cohen's criterion of effect size, the strength of the relationship between PPT and geographical residence ($r = 0.14$) had a small effect size, whereas that of age ($r = - 0.28$) and GDS ($r = -0.16$) had a medium effect size. Only the relationship between PPT and MMSE ($r = 0.61$) had a large effect size.[16]

Multivariate Regression Analyses

Table 3 shows the association of functional status with independent variables when entered individually in the linear regression models. Simple linear regression models showed that MMSE ($R^2 = 0.36$; $\beta = 0.60$; $t = 10.6$; $df = 198$; $p < 0.001$), age ($R^2 = 0.06$; $\beta = -0.25$; $t = - 3.6$; $df = 198$; $p < 0.001$), GDS ($R^2 = 0.04$; $\beta = -0.20$; $t = - 2.9$; $df = 197$; $p = 0.004$) and geographical residence ($R^2 = 0.02$; $\beta = 0.14$; $t = 2.1$; $df = 198$; $p = 0.042$) were significantly associated with functional level, whereas gender was not ($R^2 = 0.05$; $\beta = 0.07$; $t = 1.0$; $df = 198$; $p = 0.32$). In the multiple regression model, gender was excluded and only the

Table 1. Baseline Characteristics of the Sample (N= 200)

Variables	N (%)	Mean ± SD	95% CI
Geriatric Depression Scale	200 (100%)	17.1 ± 3.3	16.7 – 17.6
Gender			
male	77 (38.5%)	16.0 ± 3.5	15.2 – 16.8
female	123 (61.5%)	17.8 ± 2.9	17.3 – 18.3
Residence			
urban	100 (50%)	16.7 ± 3.2	16.1 – 17.3
rural	100 (50%)	17.5 ± 3.3	16.9 – 18.2
Mini Mental State Examination	200 (100%)	24.0 ± 4.2	23.4 – 24.6
Gender			
male	77 (38.5%)	25.5 ± 3.7	24.6 – 26.3
female	123 (61.5%)	23.1 ± 4.33	22.3 – 23.9
Residence			
urban	100 (50%)	23.9 ± 4.0	23.1 – 24.7
rural	100 (50%)	24.1 ± 4.5	23.3 – 25.0
Physical Performance Test	200 (100%)	19.3 ± 3.9	18.7 – 19.8
Gender			
male	77 (38.5%)	19.6 ± 3.8	18.8 – 20.5
female	123 (61.5%)	19.1 ± 3.9	18.4 – 19.7
Residence			
urban	100 (50%)	19.8 ± 3.6	19.1 – 20.5
rural	100 (50%)	18.7 ± 4.0	17.9 – 19.5

Table 2. Correlations between Functional Status and Other Dependent Variables

Variables	PPT*	GDS	MMSE	Age	Sex
- Geriatric Depression Scale (GDS)	-.16**				
- Mini Mental State Examination (MMSE)	.61**	-.28**			
- Age	-.28**	.15*	-.31**		
- Sex	.08	-.23**	.28**	.06	
- Residence	.14**	-.10	-.06	.09	.03

* PPT= Physical Performance Test, **Correlation is significant at the 0.05 level (2-tailed

combined effect of the significant independent variables on the functional status was examined. In this model, MMSE (β = 0.59; t = 9.6; df = 194; p < 0.001) and geographical residence (β = 0.17; t = 3.0; df = 194; p = 0.004) together explained 40% of the variance in functional status, but age (β = -0.08; t = -1.3; df = 194; p = 0.21) and GDS (β = 0.01; t = 0.11; df = 194; p = 0.91) did not add to the explanation. Table 4 outlines the characteristics of the multiple regression analysis.

DISCUSSION

The analyses presented in this paper indicate that in a representative sample of healthy community-dwelling elderly men and women aged 65 to 80 years old, cognitive function, and geographical residence had the strongest association with functional status. The variance in functional status explained by age (6.1%), cognitive function (36%), depression (4.1%), and geographical residence (2%) was significant whereas that explained by gender was not.

Although men perform better than women in functional performance measure,[17,18] our result showed that gender difference was not associated with functional status. This finding corroborates those of previous research.[9,17] On the other hand, geographical residence was associated with functional status, with urban-dwelling elderly having higher functional performance than their rural counterparts. A study conducted in the US by the Centers for Disease Control and Prevention found that physical inactivity was highest in rural areas (37%) and lowest in metropolitan areas (27%).[19] In China, elderly living in rural areas was reported to have the highest disability rate.[20] Because few studies compare functional status between rural and urban elderly and, as far as we know, this is the first research that used physical performance measure, we presumed that diet, lifestyle, and other socio-economic factors may be contributory factors for such a difference. Furthermore, functional status of the rural dwellers especially in developing countries may be affected by poor accessibility to health care.

Previous studies have shown negative correlation between age and functional status.[9,21,22] Though our reported variance (R^2 = 0.06) is lower than those reported by Binder et al (R^2 = 0.30) and Lusardi et al (R^2 = 0.55), age distribution and administration of the PPT may partially account for these different rates.

In this population, cognitive function explained 36% of the variance in functional status. Our variance was higher than that reported by Binder et al.[21] Comijs et al observed that people with cognitive decline were still able to perform daily activities but had some problems concerning the slowing down of motor activities.[23] Tabbarah et al explained that interrelated changes in cognitive function and physical performance suggest that cognition plays an integral role in the execution of most physical tasks.[24] Though cognitive-impaired individuals may be able to accomplish a given task, their efficiency in performing the task appears to be diminished.

As the level of depression increased among the community dwellers, functional status also decreased. This finding is consistent with the growing literature on the negative outcomes of depressive symptoms. Clinical data on depressed patients indicate that major depression increases the risk of mortality and impaired psychosocial functioning.[25-27] In the MacArthur community study, Bruce et al explained that the persistent somatic symptoms of depression (eg, fatigue) affect physical disability over time.[28]

We extended our study by analyzing the simultaneous effect of significant independent variables on functional status. Interestingly, when the combined effects of significant variables were examined, age and level of depression did not account for significant unique variance; only cognitive function and geographical residence explained the variance of functional status. According to past research studies, normal aging in humans is accompanied by sarcopenia or muscle loss that inevitably leads to functional decline.[29-31] One may think that age would provide a higher variance in explaining functional status than geographical factors. However, our results suggest that this is not the case. There are 2 possible explanations for this result. First, PPT may not entirely account for age-related decline in functioning for this population; second, the level of cognitive function may be more powerful in explaining functional status than age and depression. The lack of associa-

Table 3. Simple Linear Regression Models between Independent Variables and Physical Performance Test

Variables	B	SE B	β	R^2
- Constant	34.3	4.2		
Age	-0.2	0.1	- 0.25**	0.06
- Constant	6.1	1.3		
Mini-Mental State Examination	0.6	0.1	0.60**	0.36
- Constant	23.4	1.4		
Geriatric Depression Scale	-0.2	0.1	-0.20*	0.04
- Constant	18.7	0.4		
Residence	1.1	0.5	0.14*	0.02
- Constant	19.1	0.4		
Gender	.6	0.6	0.1	0.01

** p < 0.001; * p < 0.005.

Table 4. Multiple Regression Model between Independent Variables and Physical Performance Test

Variables	B	SE B	β
Constant	10.2	4.4	
Age	-0.1	0.1	-0.08
Mini-Mental State Examination	0.5	0.1	0.59**
Geriatric Depression Scale	0.01	0.1	0.01
Residence	1.3	0.4	0.17*

$R^2 = 0.40$; ** $p < 0.001$;* $p < 0.005$

tion between PPT and depression was also observed by other researchers.[32-34] In particular, Rozzini et al suggest that physical performance measures are scarcely influenced by psychosocial factors.[32]

In conclusion, functional status was strongly associated with cognitive function and geographical residence among the healthy community dwelling elderly. Although the level of depression and age appears to have had a very weak systematic effect on functional level among community dwellers in the populations studied, this finding does not rule out that age and level of depression might affect specific aspects of physical function.

Certain limitations to the present study should be noted. Firstly, the 7-item PPT test assesses functional status by measuring the time required to perform a task and using predetermined scoring rules.[10] Since subjects in our study might have moved more quickly than their usual pace, the tests may not have accurately captured their true functional ability. However, our subjects were healthy community dwellers, using self-reported measurements might result in a ceiling effect. Additionally, self-reported measurements are incapable of capturing preclinical disability, which is common among healthy elderly people.[15,32] Secondly, this study did not include socio-demographic and environmental factors, which can directly or indirectly affect functional status. In this study, we were able to observe only 40% of the variance in functional status. Incorporating socio-demographic and environmental factors might explain the other 60% variance. Finally, the study sample represents only healthy, highly functioning elderly adults aged 65-80 years old; thus, the results cannot be generally applied to all community-dwelling elderly people. Nevertheless, it was useful for our purpose in disentangling the factors associated with functional status. The assessment of functional performance within these relatively healthy, highly functioning elderly people allows for more vigorous control of the confounding effects of physical health status (ie, medical conditions and health behaviors). Furthermore, our results were based on random sampling.

SUMMARY

In this randomly selected community-based study, cognitive function had the strongest association with functional performance. As such, researchers assessing the functional status of elderly people, by implementing performance-based measures, should pay particular attention to the cognitive capacities of their subjects and how they might influence the measurement. Additionally, knowing the factors that influence physical function provides not only secondary and tertiary prevention but also an effective treatment regimen for rehabilitation.

The general treatment for frailty in clinical rehabilitation is physical exercise.[8,35] The interrelated nature of cognitive function and functional status found in the present study highlights the importance of cognitive impairment on functional decline. Since cognitive function had the strongest association with functional performance to an extent greater than the other variables, adding a treatment regimen that stimulates cognitive function might further enhance functional level or prevent decline of functional status compared with an exercise intervention alone. Experimental research to test this theory might be a good start to investigate further how the level of cognitive function can influence the functional status of elderly people.

ACKNOWLEDGEMENT

This work was completed as part of a doctoral dissertation by one of the authors (DTM) at the International University of Health and Welfare. Part of the research was supported by the Japanese Ministry of Education. We thank our colleagues and the 2 anonymous reviewers for their helpful comments during the preparation of this manuscript and acknowledge the support of the Hon. Salvador Claud, the Hon. Bernardo C. Ballenas, and the Hon. Artemio S. Jimenez.

REFERENCES

1. Gavrilov LA, Heuveline P. Aging of Population. In: Demeny P, McNicoll G, eds. *The Encyclopedia of Population.* New York, NY: Macmillan Reference USA; 2003;1:32-37. Available at http://longevity-science.org/papers.htm. Accessed on November 4, 2005.
2. Shrestha L. Population aging in the developing countries. *Health Affairs.* 2000;19:204-212.
3. Rockwood K, Fox R, Stolee P, Robertson D, Beattie BL. Frailty in elderly people: an evolving concept. *CMAJ*.1994;150:489-495.
4. Brown I, Renwick R, Raphael D. Frailty: constructing a common meaning, definition, and conceptual framework. *Int J Rehabil Res*. 1995;18:93-102.
5. Schenkman M, Hughes M, Samsa G, Studenski S. The rela-

tive importance of strength and balance in chair rise by functionally impaired older individuals. *J Am Geriatr Soc*. 1996;44:1441-1446.

6. Whipple RH, Wolfson LI, Amerman PM. The relationship of knee and ankle weakness to falls in nursing home residents: an isokinetic study. *J Am Geriatr Soc*. 1987;35:13-20.
7. Era P, Avlund K, Jokela J, et al. Postural balance and self-reported functional ability in 75-year-old men and women: a cross-national comparative study. *J Am Geriatr Soc*. 1997;45:21-29.
8. Wilson JF. Frailty--and its dangerous effects--might be preventable. *Ann Intern Med*. 2004;141:489-492.
9. Lusardi M, Pellecchia G, Schulman M. Functional performance in community living older adults. *J Geriatr Phys Ther.* 2003;26:14-22.
10. Reuben D, Siu A. An objective measure of physical function of elderly outpatients. The Physical Performance Test. *J Am Geriatr Soc*. 1990;38:1105-1112.
11. 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.
12. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: a preliminary report. *J Psychiatr Res*. 1982-83;17:37-49.
13. Burke WJ, Nitcher RL, Roccaforte WH, Wengel SP. A prospective evaluation of the Geriatric Depression Scale in an outpatient geriatric assessment center. *J Am Geriatr Soc*. 1992;40:1227-1230.
14. Brach J, Van Swearingen J. Physical impairment and disability: relationship to performance of activities of daily living in community-dwelling older men. *Phys Ther*. 2002;82:752-761.
15. Brach JS, Van Swearingen JM, NewmanAB, KriskaAM. Identifying early decline of physical function in community-dwelling older women: performance-based and self-report measures. *Phys Ther*. 2002;82:320-328.
16. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. New York, NY: Academic Press; 1992.
17. Murtagh K, Hubert H. Gender differences in physical disability among an elderly cohort. *Am J Public Health*. 2004;94:1406-1411.
18. Merrill SS, Seeman TE, Berkman LF. Gender differences in the comparison of self-reported disability and performance measures. *J Gerontol A Biol Sci Med Sci*. 1997;52:M19-M26.
19. Centers for Disease Control and Prevention (CDCP). Self-reported physical inactivity by degree of urbanization-United States, 1996. *MMWR*. 1998;47:1097-1100.
20. Tang Z, Wang HX, Meng C, et al. The prevalence of functional disability in activities of daily living and instrumental activities of daily living among elderly Beijing Chinese. *Arch Gerontol Geriatr*. 1999;29:115-125.
21. Binder E, Storandt M, Birge S. The relation between psychometric test performance and physical performance in older adults. *J Gerontol A Biol Sci Med Sci*. 1999;54:M428-M432.
22. Jette AM, Branch LG. Impairment and disability in the aged. *J Chronic Dis*. 1985;38:59-65.
23. Comijs HC, Dik MG, Aartsen M, Deeg DJ, Jonker C. The impact of change in cognitive functioning and cognitive decline on disability, well-being, and the use of healthcare services in older persons. Results of Longitudinal Aging Study Amsterdam. *Dement Geriatr Cogn Disord*. 2005;19:316-323.
24. Tabbarah M, Crimmins E, Seeman T. The relationship between cognitive and physical performance: MacArthur Studies of Successful Aging. *J Gerontol A Biol Sci Med Sci*. 2002;57:M228-M235.
25. Mintz J, Mintz LI, Arruda MJ, Hwang SS. Treatments of depression and the functional capacity to work. *Arch Gen Psychiatry*. 1992;49:761-768.
26. Coryell W, Scheftner W, Keller M, Endicott J, Maser J, Klerman GL. The enduring psychosocial consequences of mania and depression. *Am J Psychiatry*. 1993;150:720-727.
27. Koenig HG, Blazer DG. Epidemiology of geriatric affective disorders. *Clin Geriatr Med*. 1992;8:235-251.
28. Bruce M, Seeman T, Merrill S, Blazer DG. The impact of depressive symptomatology on physical disability: MacArthur Studies of Successful Aging. *Am J Public Health*. 1994;84:1796-1799.
29. Kinney JM. Nutritional frailty, sarcopenia and falls in the elderly. *Curr Opin Clin Nutr Metab Care*. 2004;7:15-20.
30. Carter CS, Onder G, Kritchevsky SB, Pahor M. Angiotensin-converting enzyme inhibition intervention in elderly persons: effects on body composition and physical performance. *J Gerontol A Biol Sci Med Sci*. 2005;60:1437-1446.
31. Nikolic M, Bajek S, Bobinac D, Vranic TS, Jerkovic R. Aging of human skeletal muscles. *Coll Antropol*. 2005;29:67-70.
32. Rozzini R, Frisoni G, 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.
33. Rozzini R, Frisoni GB, Bianchetti A, et al. Physical Performance Test and activities of daily living scales in the assessment of health status in elderly people. *J Am Geriatr Soc*. 1993;41:1109-1113.
34. Guralnik JM, Branch LG, Cummings SR, et al. Physical performance measures in aging research. *J Gerontol*. 1989;44:M141-M146.
35. Taylor L, Whittington F, Hollingsworth C. A comparison of functional outcomes following a physical activity intervention for frail older adults in personal care homes. *J Geriatr Phys Ther.* 2003;26:7-11.