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Does the Wealthier Elderly Show Better Standing Balance? Socioeconomical Factors and Standing Balance of the Elderly Living in Rural and Urban Areas in South Korea

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Abstract

Background: South Korea is one of fastest aging countries in the world. Poor balance and falls of the elderly are main health issues.

Objects: The goal of this study was to understand the association between the socioeconomical factors and the standing balance of elderly living in the rural and urban area.

Methods: One hundred sixty-six elderly participants who were older than 65 and were able to walk without an assistive device were recruited in the city of Gwangju and in the rural area of Jeonnam, South Korea. All participants performed the static and dynamic standing balance tests. Static standing balance was measured with chronometer in seconds while standing on one leg. Dynamic balance was tested with the timed up and go test (TUG), measured in seconds while getting up from a chair and walking 3 meters and back to sit. The static and dynamic standing balance was analyzed using analysis of variance and the Fisher's Least Significant Difference post hoc test.

Results: Male participants from both areas had no difference in one leg standing and TUG. The female elderly living in rural area took shorter in TUG than females living in urban area. Age decreased the one leg standing time in both areas while did not affect the TUG significantly. As the monthly income increased, both of one leg standing and TUG increased in urban area, while the medium monthly income showed best performance (it was not statistically significant) in both of one leg standing and TUG in rural area.

Conclusion: Socioeconomical factors affects differently the standing balance of the elderly living in rural and urban South Korea. Female living alone in urban area with low monthly income demonstrated worst standing balance in this study.

Key Words: Elderly; Falls; One leg standing; Socioeconomical factors; Timed up and go test.

Introduction

Aging is a wide-spread trend in the world and South Korea is one of fastest aging countries in the world (OECD, 2008). Aging process is much faster in the rural areas in South Korea (SGIS, 2012) since younger people gathers in the urban area for better education and employment. The elderly in the rural area has somewhat different life style in South Korea: living in a private house without an elevator, doing manual labor in the field, staying in relatively limited boundary with insufficient public transportation, and having difficulty in joining the leisure activities. The elderly in the urban areas are living more in apartment (condo or co-op style in a tall building), more active in social activities with well-connected public transportation (subway is free for those who are older than 65), enjoying leisure activity more often, and usually not working.

Poor balance and falls in the elderly are common, incapacitating, and occasionally deadly event all over the world. About one third of those over 65 years of

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age fall at least once a year (Voermans et al, 2007). Having more than two falls in a year was associated with all-cause mortality among people who are older than 65 (Bowling et al, 2013). The predisposing factors for the falling included lower extremity impairment, decreased arm strength, decreased vision and hearing, and affective impairment (Tinetti et al, 1995). These fall risk factors can be classified as either intrinsic (e.g., lower extremity weakness, poor grip strength, balance disorders, functional and cognitive impairment, visual deficits) or extrinsic (e.g., four or more prescription medications, poor lighting, loose carpets, and lack of bathroom safety equipment) and probable synergism between factors needs to be considered (AGS et al, 2001).

Poor balance and falls of the elderly is also the main health issues in South Korea. Injury-related deaths were the third most common cause of death followed by cancer and circulatory disease (Choi et al, 2014). Average number of falls in a year was 2.3 in 2014. 63.4% of fallen elderly sent to a hospital or clinic and 47.4% had residual complications (KOSIS, 2014). Females (30.5%) had far more falls experiences than male (17.5%) and the elderlies living in rural area (26.2%) experienced falls slightly more often than those in urban area (24.8%) of Korea (KOSIS, 2014). Since each fall has different characteristics (i.e., outdoor vs. indoor, type and severity of injury), more specific approach for each sub-group of elderly is important to prevent falls and reduce the fall related injuries (Kim, 2016).

Assessing the static and dynamic standing balances of the community-dwelling elderly is one of the fundamental data to screen the elderly at risk of falls and implementing a preventive intervention. A special panel on falls prevention (AGS et al, 2001) suggested a research agendum in their guideline, "Can fall-prone individuals be risk stratified in terms of whom will most benefit from assessment and interventions?" Since the falling patterns and the influencing factors between the urban and rural areas can be different, it is worthy to compare the static and dynamic standing balance of the elderlies living in both areas. The goal of this study was to understand the association between the socioeconomical factors and the standing balance of elderly living in the Korean urban and rural areas. The hypothesis is that the elderly living in the rural area would show better standing balance than those living in the urban area in Korea because they have more physical work at the field.

Methods

Subjects

Inclusion criteria were to be older than 65 years, community-dwelling, and able to walk at home without an assistive device. Exclusion criteria were present of any activity-limiting pain, history of neurological, cardiovascular, or vestibular disorders, recent (<3 months) surgery. The 221 elderly were contacted for this study and the 166 elderly participants living in the city of Gwangju (47 males and 42 females) or in the rural area of Jeonnam (31 males and 46 females), South Korea were participated in this study.

Procedures

Eleven physical therapy students were trained to assess the static and dynamic standing balances and visited all participants at their home. All participants completed a questionnaire asking their health, work, income, and residential status. Static and dynamic standing balances were measured in a randomized order after an instruction session with demonstration and a couple of familiarization trials. Static standing balance was measured with chronometer in seconds up to 30 seconds while standing on one leg (dominant side) as in the stork test ('one leg standing'). Dynamic balance was tested using the timed up and go (TUG) test. The TUG test measures the time in second while a subject to stand up from an armchair, walk a distance of 3 m, turn around, walk back to the chair, and sit down on the chair.

In a study with community-living volunteers older

Table 1. Characteristics of participants (N=166)

		Urban (n_1=89)		Rural (n_2=77)	
		Male (47)	Female (42)	Male (31)	Female (46)
Age	60's	25	23	15	14
	70's	16	15	10	25
	80's and up	6	4	6	7
	Mean (year)	71.8	71.3	71.7	73.3
	SD[a] (year)	6.2	5.8	6.3	6.0
Monthly income (persons)	>₩1,000,000	15	11	10	10
	₩500,000~₩1,000,000	22	18	16	19
	<₩500,000	10	13	5	17
Living with (persons)	Alone	8	10	4	15
	Spouse	31	14	19	23
	Family	8	18	8	8
Falls in a year (occurrences)		9	18	15	29
Use of eye glasses (persons)		41	41	26	39
Use of hearing aids (persons)		9	1	5	3
Owning a house (persons)		37	24	26	31
Owning a car (persons)		15	11	18	10

[a]standard deviation.

than age 60 (Vellas et al, 1997), less than 5 seconds of one-leg balance was the only significant independent predictor of injurious falls (relative risk: 2.13; 95% confidence interval: 1.04, 4.34; p=.03). In addition, the one-leg stand was reliable (reliability coefficient=.69) and able to discriminate between functional levels (Curb et al, 2006). TUG test use as a short test of mobility skills for community-dwelling elderly was proposed (Podsiadlo and Richardson, 1991). A descriptive meta-analysis (Bohannon, 2006) reported the reference TUG values of 8.1 (7.1~9.0) seconds for 60 to 69 year olds, 9.2 (8.2~10.2) seconds for 70 to 79 years, and 11.3 (10.0~12.7) seconds for 80 to 99 years. The TUG measurement showed high test-retest reliability [intra-correlation coefficient (2,1)=.97] in a previous study (Steffen et al, 2002).

Statistical analysis

The characteristics of the urban and rural participants were compared using the chi-square test and Student's t-test. The relationship between the living area and gender, between the living area and age, and between the living area and income level on the one leg standing and TUG tests were analyzed with two-way analysis of variance. When interaction with the living area is significant, the effect of gender, age, and income level on the one leg standing and TUG tests was separately analyzed in the urban and rural areas. The level of significance was set at α=.05.

Results

All 166 participants were all older than 65 (mean: 72.1, standard deviation (SD): 6.1, range: 65~88) and able to walk at home without an assistive device. There was no significant difference (p=.135) in the age between the participants living in urban and rural areas. The characteristics of participants are displayed in Table 1. There was no significant difference in 'monthly income', 'living with', 'use of eye glasses', 'owing a house', 'owning a car' and 'use of

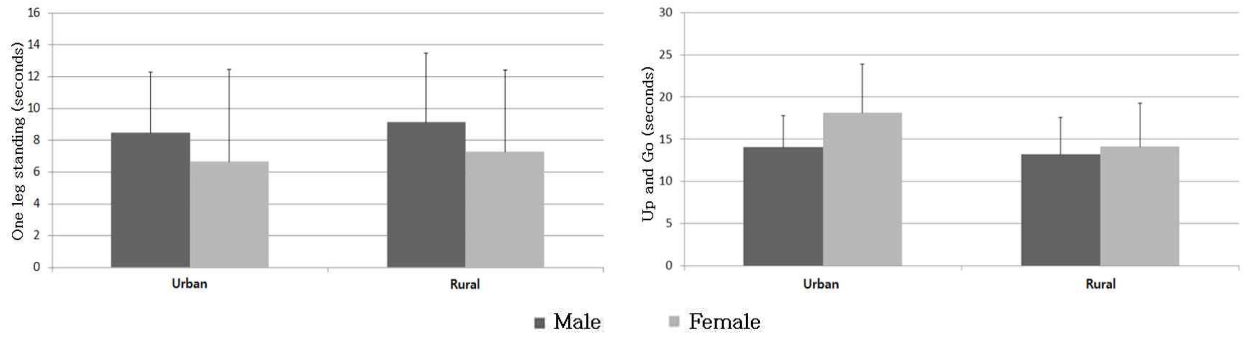

Figure 1. The one leg standing and TUG tests by gender in urban and rural areas.

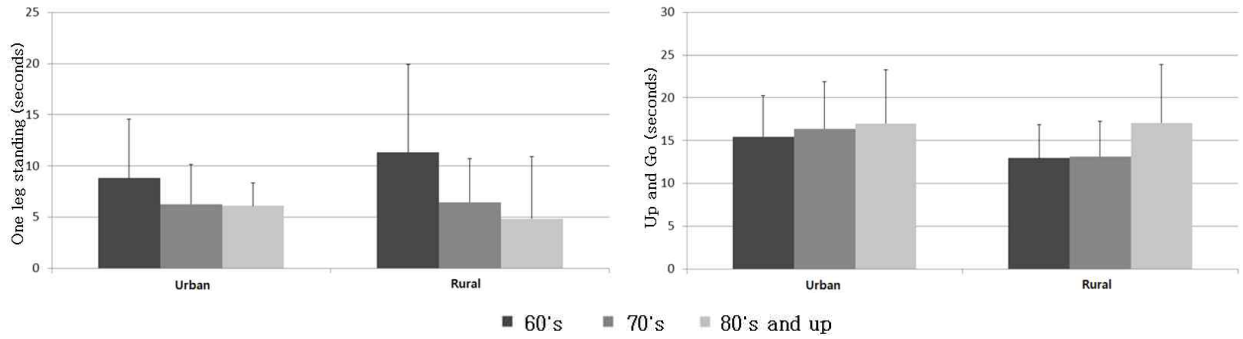

Figure 2. The one leg standing and TUG tests by age in 10 years in urban and rural areas.

hearing aids' between urban and rural areas. Monthy income level was categorized based on the basic living expense per individual in the news (Jung, 2016). Falls in one year was greater in rural area (t=-2.279, p=.024).

Balance by gender

There was no significant difference (p=.503) in one leg standing between living areas (Figure 1). Male participants in both areas stand longer on one leg than the females but not statistically significantly (p=.057). The interaction between living area and gender on one leg standing was not significant (p=.981). There was a significant interaction in the TUG result between living area and gender (p=.040). In males, there was no difference in TUG test between urban and rural area (p=.412). However, the female elderly living in rural area took 3.9 second shorter for TUG test (p=.001).

Balance by age

Aging decreased the one leg (p<.001) standings in both areas (Figure 2) while it did not significantly affect the TUG test (p=.071). There was no significant interaction between age and living area, which means that the effect of age was not different in both living areas.

Balance by income level

The one leg standing and the TUG test were improved as monthly income increased in urban area (Figure 3), but did not reach to statistical level of significance (p=.190 and p=.082). Highest monthly income group took second place in rural area, however, the effect of monthly income was not significant (for one leg standing p=.281 and for TUG p=.134).

Balance by other factors

Owning a house was related to greater one leg standing (p=.002) and shorter TUG (p=.002) in both areas. Owning a car did not affect either of one leg standing (p=.068) and TUG (p=.274) in both areas. Living with somebody found to be better in both of

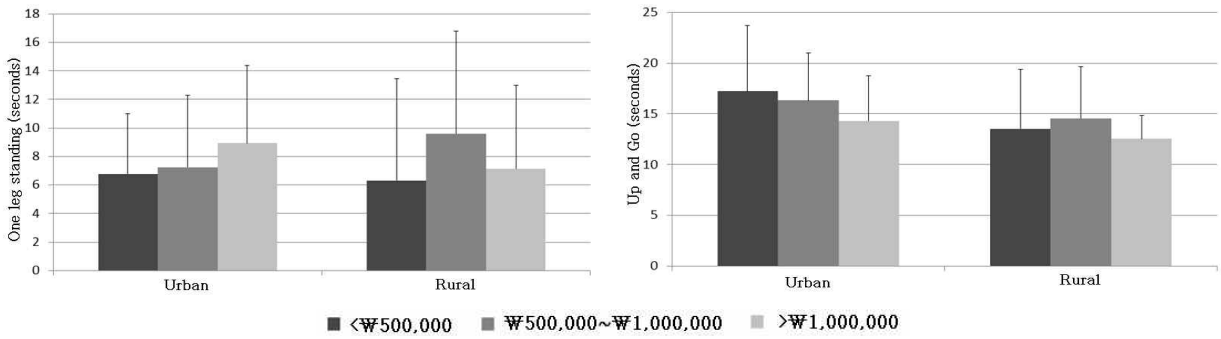

Figure 3. The one leg standing and TUG tests by monthly income in urban and rural areas.

the one leg standing (p=.001) and the TUG (p=.031) in both areas. Living alone showed worst result in both of the one leg standing and the TUG results in both areas. Elderly living with spouse and children had best static standing balance and the TUG score in both areas.

Elderly who are at danger

The elderly unable to perform the one-leg stand for at least 5 seconds is considered at increased risk for injurious fall (Steffen TM et al, 2002). In this study, participants whose one leg standing was less than 5 seconds were more frequent in female and in rural area (Table 2). Aging increased the frequency in rural area but not in urban area. Monthly income did not affect the frequency in urban area while the participants in middle income (₩500,000～₩1,000,000) did better in one leg standing in rural area. In both areas, more than half of participants who live alone could not able to sustain the one leg standing more than 5 seconds.

In this study, participants whose TUG test was more than 12 seconds (Bischoff et al, 2003) were more frequent in female and in urban area (Table 3). Aging increased the frequency in rural area but not in urban area. Monthly income did not affect much the frequency in urban area while the participants in middle income (₩500,000～₩1,000,000) had increased in TUG test longer than 12 seconds in rural area. In

Table 2. The percentage of participants whose one leg standing was less than 5 seconds (N=166)

		Urban (n_1=89)	Rural (n_2=77)
Gender	Male	26%	48%
	Female	38%	50%
Age	60's	29%	38%
	70's	35%	49%
	80's and up	30%	77%
Monthly income	>₩1,000,000	27%	60%
	₩500,000～₩1,000,000	33%	29%
	<₩500,000	35%	73%
Living with (person)	Alone	51%	63%
	Spouse	22%	43%
	Family	35%	50%

Table 3. The percentage of participants whose timed up and go test was more than 12 seconds (N=166)

		Urban (n_1=89)	Rural (n_2=77)
Gender	Male	62%	48%
	Female	81%	54%
Age	60's	69%	45%
	70's	74%	49%
	80's and up	70%	77%
Monthly income	<₩1,000,000	62%	40%
	₩500,000～₩1,000,000	75%	66%
	>₩500,000	74%	41%
Living with (person)	Alone	78%	53%
	Spouse	67%	55%
	Family	73%	44%

Korea, the basic pension for a single familied elderly is ₩600,000 per month (Jung, 2016). Participants who live alone did as well as other participants living with spouse or family in both areas but participants living in urban area showed higher frequency in TUG test took longer than those who lives in rural area.

Discussion

Falls in the elderly are the increasing but modifiable problem when the mechanism and influencing factors are thoroughly investigated and a sound risk management program is set. In this study, there was no difference in one leg standing and TUG in male participants. Age decreased the one leg standing time in both areas while did not affect the TUG significantly. Relationship with the monthly income was not statistically significant in both of one leg standing and TUG in rural area. Living alone decreased both of one leg standing and TUG in both areas. Elderly living with spouse and children performed best in both of one leg standing and TUG in both areas. Owning a house was related to greater one leg standing and shorter TUG in both areas. Owning a car did not affect either of one leg standing and TUG in both areas.

Most of falls are typically a multifactorial problem, where multiple risk factors jointly contribute to falls in each individual patient (Voermans et al, 2007). Gait and balance tests are key elements of fall assessment of the elderly who is at high risk. Timed tests such as TUG and one leg standing test have the advantage of providing quantitative information, and scores beyond established cut-off values may help to predict the risk of falls (Berg et al, 1992; Podsiadlo and Richardson, 1991; Sourdet et al, 2012). In the age 65-and-over population as a whole, approximately 35% to 40% of community-dwelling, generally healthy older persons fall annually (Rubenstein and Josephson, 2002). Both of the incidence and the severity of fall related complications rise steadily after age of 60 (AGS et al, 2001). The velocity of center of pressure during one leg standing found to be affected with stimulating the visual and tactile systems (Kim et al, 2015).

In males, there was no difference in TUG test between urban and rural area (14.02 seconds and 13.19 seconds, p=.412). However, the female elderly living in rural area took 3.9 second shorter for TUG test (14.13 seconds and 18.14 seconds, p=.001). In a previous study with the elderlies who go to the welfare center (Jeon et al, 2014), the TUG score of the non-faller group was 10.00 seconds and the faller group was 8.59 seconds. This difference can be from the inclusion criteria of the study. Their participants were more active since they were recruited at the welfare center. The 10th-90th percentiles for TUG test performance were 6.0~11.2 seconds for community-dwelling and 12.7~50.1 seconds for institutionalized elderly women (Bischoff et al, 2003).

The TUG test was recommended as a screening tool to determine whether an in-depth mobility assessment and early intervention, such as prescription of a walking aid, home visit or physiotherapy, is necessary (Bischoff et al, 2003). Community-dwelling elderly women between 65 and 85 years of age should be able to perform TUG test in 12 seconds or less (Bischoff et al, 2003). In this study, participants whose TUG test was more than 12 seconds were more frequent in female and in urban area. Male and female had no significant difference in the TUG test as in a previous study (Steffen et al, 2002). Aging increased the frequency in rural area but not in urban area. Monthly income did not affect much the frequency in urban area while the participants in middle income had the TUG test longer than 12 seconds in rural area. Participants who live alone did as well as other participants living with spouse or family in both areas but participants living in urban area showed higher frequency in TUG test took longer than those who lives in rural area. Further investigation is needed to focus on the elderly at high risk of fall, such as a female living alone in urban

area with low monthly income.

Living with somebody found to be better in both of the one leg standing and the TUG in both areas. Living alone showed worst result in both of the one leg standing and the TUG results in both areas. These findings support the results of the survey on the actual conditions of older person by the Korean Ministry of Health, Welfare and Family Affairs (KOSIS, 2014). Elderly living with spouse or children had better performance in this study and reported less falls than one living alone (KOSIS, 2014). It seems be affected by the phenomenon of 'healthy worker effect', in this case a elderly with better health and function stays more with family. The fall experience increases with age (from 65 to 85 and more) and decreases with level of education and family income (KOSIS, 2014).

Even the static and dynamic standing balances are closely related to the prevalence of falls in elderly, insufficient balance is not the only cause of all falls. Findings of this study provide cross-sectional information of static and dynamic standing balance of elderly living in rural and urban areas. Participants were not randomly contacted. Power analysis was not performed prior to data collection. Further investigation is needed to focus for the elderly at high risk of fall, such as a female living alone in rural area with low monthly income.

Conclusion

The goal of this study was to understand the association between the socioeconomical factors and the standing balance of elderly living in the rural and urban area. The hypothesis was that the elderlies living in the rural area would show better standing balance than those living in the urban area in Korea, however, socioeconomical factors affects differently the standing balance of the elderly living in rural and urban South Korea. Relationship with the monthly income was not statistically significant in both of one leg standing and TUG in rural area. Living alone decreased both of one leg standing and TUG in both areas. Elderly living with spouse and children performed best in both of one leg standing and TUG in both areas.

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