



Original Article

Comparison of older adults' visual perceptual skills, cognitive function, and fall efficacy according to fall risk in the elderly

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Abstract. [Purpose] This research aims to identify the relationships among visual perceptual skills, cognitive functioning, and fall efficacy of older adults based on whether they are at risk for falls. [Subjects and Methods] Subjects included 116 older adults over 65 years of age who use D Seniors Welfare Center and Y Senior Citizen Center in Busan Metropolitan City. All research subjects were classified based on balance maintenance ability evaluation and whether or not they had experienced falls more than once. Those with scores below the cut-off standard were selected as a group of older adults at risk for falls. An MVPT-3 test was used to assess visual perceptual skill, MMSE-KC, and MoCA-K tests to assess cognitive function, and the FES-K falls efficacy test to classify subjects as either at risk for falls or not. [Results] After comparing scores for visual perceptual skills, cognitive functioning, and fall efficacy, subjects at risk for falls showed significantly lower scores than did those not at risk. [Conclusion] The study found that there are significant differences in balance ability, visual perceptual skill, cognitive functioning, and fall efficacy between older adults at risk for falls and those not at risk.

Key words: Elderly, Falls, Falls efficacy

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INTRODUCTION

In the case of older adults over 65 years of age, physiological changes caused by aging lead to much greater vulnerability with regard to safety issues compared to younger age groups¹⁾. Due to physiological changes resulting from aging, elders face a 10 times greater risk of falls than those in other age groups⁶⁾. Falls can happen in all age groups, but they especially occur in 1/3 of elders aged 65 or above, and about 50% of elders who have experienced falls experience recurrences^{2, 3)}. In more severe cases, elders lose independence in daily living because of aftereffects and declines in physical body functions⁴⁾. It has been reported that the fear of such experiences influences daily living activities and mobility and that 40–70% of elders face limitation in daily living due to this fear⁵⁾.

Safely participating in meaningful daily living activities requires high-level, appropriate visual processing. Although the visual perceptual skills of elders have a large impact on their daily living activities, there are still inadequacies in medical prevention systems and organized healthcare systems for elders, such as the early diagnosis and treatment of visual perceptual disorder⁶⁾.

Position balance ability and most behaviors that occur in daily living are associated with visual perception⁷⁾, and impairments in cognitive functioning affect the balance maintenance ability and physical body integration of elders, acting as a

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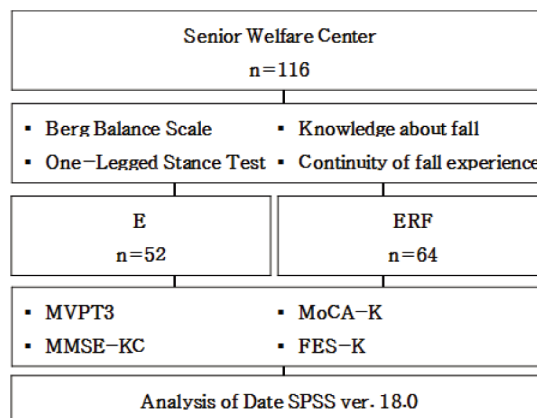


Fig. 1. Flow chart of study
ERF: elderly at risk of falls, n=64
E: elderly, n=52

risk factor for falls⁸). Balance is an essential element of functional activity, and balance ability is regarded as a critical factor involved in elders' daily living⁹). Therefore, this study selected a group of older adults at risk for falls and another of those not at risk for falls and evaluated their visual perceptual and cognitive functioning to check for a mild visual perceptual disorder unnoticed by them or their guardians. Next, the study aimed to compare the elders' balance maintenance ability, cognitive functioning, fall efficacy, and visual perceptual functioning, and to examine how these were correlated.

SUBJECTS AND METHODS

This study was conducted from September 1, 2014, to March 30, 2015. In order to carry out the research using survey contents and assessment report measurements, all details of this study's procedures were submitted to the Science Research Council of Inje University, which approved the study protocol.

This research was carried out on 116 elders aged 65 or above who use D Seniors Welfare Center and Y Senior Citizen Center in Busan. Subjects were divided into a group of 64 elders at risk for falls and a group of 52 elders not at risk for falls using balance maintenance ability evaluation tools—the Berg Balance Scale and the One-Legged Stance Test—as well as a measurement tool on their knowledge of falls and whether or not they had experienced falls more than once over the past year.

For the group at risk for falls, elders who could act in accordance with instructions, stand on their own, and walk for more than 10 m without outside help were selected from those capable of independent daily living¹⁰). Before beginning the research, its overall content and expected effects were explained carefully to the elders, and only those who voluntarily consented participated.

Data were analyzed using the SPSS WIN 18.0 statistical program (Fig. 1). Frequency analysis was performed using descriptive statistics for the general characteristics of the two subject groups, and t-tests were applied to analyze differences in balance maintenance ability, cognitive ability, fall efficacy, and visual perceptual functioning. In addition, Pearson correlation analysis was applied to examine the relationships among balance maintenance ability, cognitive ability, fall efficacy, and visual perceptual functioning. The significance level was set at 0.05.

RESULTS

To classify elders based on whether or not they were at risk for falls, subjects scoring less than 22 out of 30 on the falls knowledge measurement tool, 45 out of 56 on the Berg Balance Scale, and 5 seconds on the One-Legged Stance Test, were classified as being at risk for falls. The results are in Table 1.

The cognitive functioning scores of the two groups as measured by the MMSE-KC and MoCA-K are in Table 2, and the fall efficacy scores of the two groups measured by the FES-K are shown in Table 3. Finally, the visual perceptual function scores of the two groups are in Table 4.

Furthermore, the correlations among Berg Balance Scale, One-Legged Test, MMSE-KC, MoCA-K, FES-K, and MVPT-3 scores are shown in Table 5.

Table 1. Knowledge of falls, berg balance scale, one-legged stance test

Categories	Elderly at risk of falls (n=64)	Elderly (n=52)
	M ± SD	M ± SD
Knowledge of fall	18.8 ± 2.6*	22.8 ± 1.6*
Berg balance scale	39.7 ± 2.3*	42.9 ± 4.3*
One-legged stance test: open(s)	2.0 ± 0.9*	5.3 ± 2.1*
One-legged stance test: off(s)	0.8 ± 0.8*	2.8 ± 0.9*

Values are mean ± SD, *Significant difference (p<0.05)

Table 2. MMSE-KC, MoCA-K score

Categories	Item	Elderly at risk of falls (n=64)	Elderly (n=52)
		M ± SD	M ± SD
MMSE-KC	Time orientation	3.5 ± 1.5	3.7 ± 0.8
	Place orientation	3.2 ± 0.7*	4.0 ± 1.1*
	Registration (three words)	2.8 ± 0.4	2.9 ± 0.1
	Attention and calculation (sam cheon ri gang san)	1.2 ± 1.3*	3.0 ± 1.1*
	Recall (three words)	0.7 ± 0.9*	1.4 ± 1.2*
	Naming	1.3 ± 0.8*	2.3 ± 0.7*
	Three-stage command	1.8 ± 1.0	2.3 ± 0.9
	Copying interlocking pentagons	0.6 ± 0.4	0.5 ± 0.5
	Abstract thinking	1.5 ± 0.5	1.5 ± 0.4
	Total score	17.2 ± 5.3*	22.1 ± 3.8*
MoCA-K	Visuospatial / executive	1.9 ± 0.8*	2.8 ± 0.7*
	Naming	2.5 ± 0.6	2.2 ± 0.8
	Attention	2.4 ± 1.1	3.7 ± 1.1
	Language	2.2 ± 0.7	2.3 ± 0.5
	Delayed recall	1.7 ± 1.3	3.8 ± 1.2
	Orientation	3.2 ± 1.5	3.8 ± 1.2
	Total score	14.0 ± 4.3	19.3 ± 2.3

Values are mean ± SD, *Significant difference (p<0.05)

Table 3. FES-K Score

	M ± SD
Elderly at risk of falls (n=64)	27.5 ± 7.2*
Elderly (n=52)	39.6 ± 3.8*

Values are mean ± SD, *Significant difference (p<0.05)

Table 4. MVPT-3 Score

	Elderly at risk of falls (n=64)	Elderly (n=52)
	M ± SD	M ± SD
Visual short term memory 1	2.9 ± 0.9*	4.9 ± 1.1*
Visual closure 1	4.0 ± 1.0*	6.5 ± 2.1*
Spatial orientation	1.4 ± 0.8*	3.0 ± 0.7*
Figure ground	1.1 ± 0.7*	2.2 ± 0.9*
Visual closure 2	1.6 ± 0.9*	2.4 ± 0.8*
Visual short term memory 2	1.3 ± 0.8	1.5 ± 1.1
Raw score	26.5 ± 2.7*	34.8 ± 5.4*
Standard score	55.0 ± 0.0*	62.3 ± 6.7*

Values are mean ± SD, *Significant difference (p<0.05)

Table 5. Correlations among balance maintenance ability, cognitive function, falls efficacy, and visual perceptual skill

	BBS	OLST (open)	OLST (close)	MMSE -KC	MoCA -K	FES -K	MVPT -3
BBS							
OLST (open)	0.432**						
OLST (close)	0.205*	0.588**					
MMSE-K	0.207*	0.459**	0.512**				
MoCA-K	0.366**	0.522**	0.568**	0.762**			
FES-K	0.298**	0.575**	0.585**	0.549**	0.632**		
MVPT-3	0.349**	0.624**	0.485**	0.442**	0.518**	0.506**	

Values are mean \pm SD, *Significant difference ($p < 0.05$), ** Significant difference ($p < 0.01$)
 BBS: Berg Balance Scale; OLST: One-Legged Stance Test; MMSE-KC: MMSE in the Korea version of the CERED assessment packet; MoCA-K: Korean version of the Montreal Cognitive Assessment; FES-K: Korea Falls Efficacy Scale; MVPT: Motor-free Visual Perception Test

DISCUSSION

Falls in older adults are closely related to balance maintenance ability, cognitive functioning, and visual perceptual functioning. However, there are not enough studies examining the visual perception of elders or examining the correlations between falls or balance and visual perception.

On the Berg Balance Scale, both groups of older adults at risk for falls and those not at risk for falls had low scores (below 45), and both groups also scored low with 5 seconds on the One-Legged Stance Test; both of these results indicate that they were at risk for falls. Such results show that there are many problems related to balance in community elders.

Park's research compared score differences between two groups of stroke patients, one with and one without fear of falls. There were significant differences between the two groups in the Berg Balance Test and the One-Legged Stance Test, but there was no significant difference in the fall efficacy criterion. The results of this paper support those of the present study regarding the balance maintenance ability test carried out to classify older adults regarding their fall risk but do not agree with the results of the present study regarding the falls efficacy criterion¹¹.

In this research, both groups showed a significant correlation of $r=0.349$ between their scores on the Berg Balance Scale and the MVPT-3 test. There were significant correlations between the scores on the One-Legged Stance Test with eyes open and the MVPT-3 test ($r=0.624$) and between the scores on the One-Legged Stance Test with eyes closed and the MVPT-3 test ($r=0.485$).

Measuring the balance maintenance ability of elders helps to evaluate their ability to lead a safe life in their given environment, and physical stability and visual perceptual skills are important for this¹².

This research used the MVPT-3 test to evaluate the elders' visual perceptual functioning. According to the results, all subjects at risk for falls demonstrated very low-level visual perceptual functioning with an average raw score of $M=26.53$ ($SD=2.7$) and standard score of $M=55.00$ ($SD=0.0$). Although subjects not at risk for falls had higher scores than those at risk for falls, these scores also showed their weak functioning. This indicates that community elders not at risk for falls also had a decline in visual perception due to normal aging processes.

According to Kim's research that analyzed MVPT raw scores to look into the overall visual perception conditions of community elders, elders in their 50s and 80s were all within the normal range, but elders in their 60s and 70s had lower scores than the normal range¹³. This means that healthy elders who have never received hospital treatments for visual perceptual disorder may have a visual perceptual disorder or decline in visual perceptual skills due to aging that they or their guardians have not noticed. The MVPT-3 raw scores of this study were low for both older adults at risk for falls and those not at risk for falls; this result supports the present study, providing further evidence that even healthy elders may have a visual perceptual disorder or decline in visual perceptual ability that they or their guardians may not have noticed, as in previous research.

Cognitive functioning in this research was measured using the MMSE-KC and the MoCA-K, and subjects had low scores in both tests, indicating severe cognitive disorder and mild cognitive disorder, respectively. This shows that there is a severe decline in the community elders' cognitive functioning, which can also influence falls.

The MMSE-KC and MVPT-3 test scores had a significant correlation at $r=0.442$, and the MoCA-K and MVPT-3 test scores had a significant correlation at $r=0.518$. Visual perception can be defined as an entire process of accepting and recognizing visual simulation¹⁴, and with a visual perception disorder, it is difficult to perceive objects and identify the mutual relation between objects in a space.

Moreover, this research measured fall efficacy using the FES-K. The average fall efficacy scores ($M=25.57$, $SD=7.2$) of subjects at risk for falls were relatively low while of those not at risk for falls had higher average scores ($M=39.69$, $SD=3.8$).

These results support those of Resnick, Luisi, and Vogel's research, which was conducted on elders residing in facilities and demonstrated that fall efficacy of subjects who experienced falls was significantly lower than in those who did not experience falls, showing that older adults at risk for falls have a great fear of falls⁹⁾. Such fear of falls causes a lack of confidence, decreases physical activities, and reduces the independent daily living of elders¹⁰⁾.

For the Korean fall efficacy test, this research demonstrated significant correlations between balance maintenance ability, cognitive functioning, and visual perceptual function of elders. The falls efficacy test can be used clinically as a tool to predict elders' fall risk in advance, thereby preventing falls. In addition, visual perceptual functions training should be reviewed to check whether it can improve visual perceptual function, balance maintenance ability, and cognitive functioning.

The limitations of this research are that it recruited study subjects of high age groups from a local community senior citizen center, and it is difficult to generalize the results to elders living in an active community.

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