Comparison of Factors Influencing Fall Recurrence in the Young-old and Old-old: a Cross-sectional Nationwide Study in South Korea

Mi Young Kim

Hanyang University

Yujeong Kim (✉ yujeongkim@knu.ac.kr)

Kyungpook National University

Research Article

Keywords: Accidental falls, Aged, Frail elderly, Old-old, Young-old

Posted Date: January 25th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1186822/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Background: Elderly recurrent falls are a significant problem. Most elderlies experience injuries after falls, and elderlies over 65 years old who fall often require medical treatment for severe fall-related injuries, and the financial costs of fall-related injuries are significant. This study aimed to identify factors related to recurrent falls in community-dwelling young-old (65–74 years old) and old-old (>75 years) elderlies in South Korea.

Methods: This study used a cross-sectional, correlation design. Data from the 2017 National Survey of Older Koreans were used, and 5,838 young-old and 4,205 old-old elderly were included in the analysis. The questionnaire included general characteristics, fall experience, physical status, mental status, chronic disease characteristics items. A X^2 test, ANOVA, and logistic regression were performed for data analysis.

Results: In the young-old elderlies, limitations in activities of daily living ($p<.001$), visual aids ($p=.002$), cognitive function ($p<.001$), suicidal ideations ($p=.005$), number of chronic diseases ($p<.001$), and number of prescribed medications ($p=.006$) affected fall recurrence. In the old-old elderlies, spouse ($p=.034$), national basic livelihood security system ($p=.025$), exercise ($p=.003$), limitations in activities of daily living ($p<.001$), visual aids ($p=.002$), suicidal ideations ($p=.015$), number of chronic diseases ($p<.001$), and Parkinson's disease ($p<.001$) affected fall recurrence.

Conclusions: This study identified differences in factors related to fall recurrence between young-old and old-old elderlies. Based on the findings, a risk assessment tool that can screen the recurrent falls that reflects the characteristics of each age group. In addition, appropriate interventions must be developed to prevent recurrent falls risk according to age group.

Background

In Korea, 15.7% of the total population of 8,125,000 people is older than 65 years; this proportion is expected to increase to 20.3% by 2025 as Korea is a super-aged society [1]. The elderly comprise a vulnerable age group with many health problems that threaten their safety and quality of life. According to the World Health Organization (WHO), falls are a major public health problem worldwide [2]. Approximately 646,000 fatal falls occur annually, and falls are the second leading cause of death from unintended injuries, following road traffic injuries [2]. In an aged society, elderly falls are a very significant problem. Most elderlies experience injuries after falls, and elderlies over 65 years old who fall often require medical treatment for severe fall-related injuries, and the financial costs of fall-related injuries are significant [2].

To prevent falls, studies have evaluated various related predictive factors. To date, risk factors for falls reported in different studies, include age [3], gender [4], income level, and spouse [5]. Additionally, muscle strength, balance ability, sensory deficits [6], number of chronic diseases [3]; comorbid conditions and certain categories of medications [6] have been reported as risk factors.

Falls may occur repeatedly in individuals. In fact, 50% of the elderly population experience recurrent falls [7]. Those who experience fall recurrence suffer from greater morbidity than those who do not [8]. Thus, the consequences of recurrent falls are serious. However, few studies have evaluated fall recurrence. Studies of the elderly, group together individuals who differ by 20–30 years in age for comprehensive assessment; however, such classification may overlook the differences in health conditions and problems of young-old and old-old elderlies [9]. Therefore, Neugarten et al [10] suggested dividing the elderly into young-old and old-old groups under and over the age of 75, respectively.

To predict and prevent fall recurrence in the elderly, we must understand the risk factors of recurrent falls and identify predictive factors of falls with detailed standards that consider the characteristics of the elderly by age. Therefore, this study evaluated the demographic structure and health characteristics of the elderly and assessed the predictive factors of fall recurrence in young-old and old-old elderlies.

Methods

Study sample

This cross-sectional study identified factors related to recurrent falls in the young-old (65–74 years old) and old-old (>75 years). This study used raw data from the 2017 National Survey of Older Koreans by the Korea Institute for Health and Social Affairs through interviews of individuals over 65 years old. Among the 10,299 subjects over 65 years old, those with missing values in related measured items were excluded, and 5,838 and 4,205 young-old and old-old elderly were analyzed in this study.

Measures

Fall experience

The item “Have you experienced falls (falling, slipping, or collapsing) in the past year? If yes, how many times?” was used to assess fall experience and was answered as yes, no, and the number of times, if any.

General characteristics

Gender, education level, spouse, National Basic Livelihood Security System (NBLSS) beneficiaries, smoking, problematic drinking, and exercise were assessed. The NBLSS is a government-supported benefit to guarantee minimum living and self-support for those with difficulties in living. Current smoking status was evaluated, and problematic drinking was defined as more than three drinks every day for the last month. Exercise was assessed by answering “yes” or “no” to exercising more than once a week for 10 minutes or more each time.

Physical status

Factors including limitations in activities of daily living (ADL) and instrumental activities of daily living (IADL), visual aids, and body mass index (BMI) were measured to evaluate the subjects’ physical status. Limitations in ADL were measured using the Korean version of the daily life activity measurement tool [11]. Complete independence, partial dependence, and complete dependence on seven items in the last seven days were assessed, and partial or complete dependence for one or more items was considered limitations in ADL.

Limitations in IADL were measured using the Korean version of the IDAL (K-IADL) measurement tool [11]. Complete independence, partial dependence, and complete dependence on 10 items and partial and complete dependence for one or more items were considered limitations in IADL. In our study, Cronbach’s alphas for the K-ADL and K-IADL were 0.78 and 0.89.

Vision aid was assessed using data on whether the elderly used glasses, lenses, or magnifying glasses, and BMI was calculated using height and weight.

Mental status

Factors including cognitive function, depression, and suicidal ideations were measured to assess mental state. Cognitive function was measured using the Korean Version of the Mini Mental Status Examination for Dementia Screening (MMSE-DS) [12]. The MMSE-DS contains 19 items for a total of 30 points. In the study by Kim et al [12] Cronbach’s alpha was 0.83; this value was 0.81 in our study. Depression was assessed using data on whether the subjects had suffered from depression for more than three months after diagnosis (yes or no), and suicidal ideations was assessed using data on the item “Have you ever considered committing a suicide after the age of 60?” (yes or no).

Chronic disease characteristics

Chronic disease characteristics were assessed as the number of chronic diseases the subjects were suffering from for more than three months (based on doctor’s diagnosis). Chronic diseases included hypertension, stroke, angina/myocardial infarction, diabetes, arthritis, osteoporosis, lumbodynia, sciatic neuralgia, cataract, glaucoma, cancer, chronic kidney disease, prostatic hypertrophy, urinary incontinence, anemia, dementia, insomnia, and Parkinson’s disease; these diseases were

surveyed by the medical team. The number of prescribed medications taken daily for more than three months was also assessed.

Statistical analysis

Differences in fall frequency according to general characteristics, physical and mental states, and chronic disease characteristics were analyzed as the frequency, percentage, mean, and standard deviation (SD) using the X^2 test, ANOVA, and Scheffe test. Factors that affect single and recurrent falls were analyzed with a logistic regression.

Results

Differences in fall frequency according to general characteristics

The single fall group included 516 (8.8%) and 516 (12.3%) young-old and old-old elderlies, respectively, whereas the recurrent fall group included 263 (4.5%) young-old and 283 (6.7%) old-old elderlies, respectively.

In the young-old, those who were females, had less than an elementary school education, had no spouse, were NBLSS beneficiaries, did not smoke, were not problematic drinkers, and exercise had significantly increased experiences of recurrent falls. In the old-old, those who were females, had no spouse, were NBLSS beneficiaries, did not exercise and had increased experiences of recurrent falls (Table 1).

Table 1
Differences in fall frequency according to general characteristics (N=10,043)

Variables	Category	Young-old (n = 5,838)				Old-old (n = 4,205)			
		No fall (n = 5,060)	Single fall (n = 516)	Recurrent fall (n = 263)	χ^2 , F(p) Scheffe	No fall (n = 3,406)	Single fall (n = 516)	Recurrent fall (n = 283)	χ^2 , F(p) Scheffe
Gender	Male	2,303 (91.1)	137 (5.4)	89 (3.5)	78.17 ($<.001$)	1,499 (86.0)	158 (9.1)	86 (4.9)	48.08 ($<.001$)
	Female	2,757 (83.3)	378 (11.4)	174 (5.3)		1,907 (77.5)	358 (14.5)	196 (8.0)	
Education level	$\leq$ Elementary school	2,506 (84.6)	295 (10.0)	162 (5.5)	25.87 ($<.001$)	2,271 (79.4)	380 (13.3)	209 (7.3)	17.01 (.009)
	Middle school	1,077 (88.6)	97 (8.0)	41 (3.4)		414 (83.8)	50 (10.1)	30 (6.1)	
	High school	1,075 (88.4)	91 (7.5)	50 (4.1)		444 (83.6)	58 (10.9)	29 (5.5)	
	$\geq$ College	402 (90.1)	33 (7.4)	11 (2.5)		277 (86.8)	28 (8.8)	14 (4.4)	
Spouse	No	1,324 (82.1)	201 (12.5)	87 (5.4)	42.40 ($<.001$)	1,546 (76.2)	318 (15.7)	165 (8.1)	59.49 ($<.001$)
	Yes	3,735 (88.4)	315 (7.5)	176 (4.2)		1,859 (85.5)	198 (9.1)	118 (5.4)	
NBLSS* beneficiary	No	4,779 (87.1)	468 (8.5)	241 (4.4)	14.35 (.001)	3,160 (81.7)	468 (12.1)	240 (6.2)	23.85 ($<.001$)
	Yes	281 (80.1)	48 (13.7)	22 (6.3)		246 (73.0)	48 (14.2)	43 (12.8)	
Smoking	No	4,414 (86.1)	479 (9.3)	234 (4.6)	13.87 (.001)	3,148 (80.9)	478 (12.3)	263 (6.8)	0.28 (.870)
	Yes	646 (90.6)	37 (5.2)	30 (4.2)		258 (81.9)	38 (12.1)	19 (6.0)	
Problematic drinking	No	4,766 (86.2)	504 (9.1)	256 (4.6)	15.16 (.001)	3,277 (80.9)	500 (12.3)	275 (6.8)	1.10 (.577)
	Yes	294 (93.9)	12 (3.8)	7 (2.2)		128 (84.2)	16 (10.5)	8 (5.3)	

*NBLSS = National Basic Livelihood Security System

Exercise	No	1,369 (84.7)	164 (10.1)	84 (5.2)	7.70 (.021)	1,237 (77.8)	209 (13.1)	144 (9.1)	25.39 (<.001)
	Yes	3,691 (87.4)	351 (8.3)	180 (4.3)		2,169 (82.9)	307 (11.7)	139 (5.3)	
*NBLSS = National Basic Livelihood Security System									

Differences in fall frequency according to physical and mental states

Significant differences in fall frequency were observed in the young–old with recurrent falls occurring significantly more frequently in those who did not have limitations in ADL and IADL, had visual aids, had high BMI, low cognitive function, no depression, and no suicidal ideations. There were differences in the fall frequency in the old–old according to all factors except BMI with recurrent falls significantly more frequent in those with no limitations in ADL, limitations in IADL, visual aids, low cognitive function, no depression, and no suicidal ideations (Table 2).

Table 2
Differences in fall frequency according to physical and mental States (N=10,043)

Variables	Category	Young-old (n = 5,838)				Old-old (n = 4,205)			
		No fall (n = 5,060)	Single fall (n = 516)	Recurrent fall (n = 263)	χ^2 , F(p) Scheffe	No fall (n = 3,406)	Single fall (n = 516)	Recurrent fall (n = 283)	χ^2 , F(p) Scheffe
Limitations in ADL*	No	4,938 (87.3)	482 (8.5)	234 (4.1)	82.08 ($<.001$)	3,063 (82.8)	428 (11.6)	207 (5.6)	81.62 ($<.001$)
	Yes	122 (65.9)	34 (18.4)	29 (15.7)		342 (67.7)	88 (17.4)	75 (14.9)	
Limitations in IADL**	No	4,526 (88.0)	424 (8.2)	193 (3.8)	82.78 ($<.001$)	2,235 (85.3)	255 (9.7)	129 (4.9)	86.10 ($<.001$)
	Yes	533 (76.6)	92 (13.2)	71 (10.2)		1,171 (73.8)	261 (16.5)	154 (9.7)	
Visual aid	No	1,959 (88.4)	183 (8.3)	75 (3.4)	12.55 (.002)	1,337 (83.5)	180 (11.2)	84 (5.2)	12.69 (.002)
	Yes	3,101 (85.6)	333 (9.2)	188 (5.2)		2,069 (79.5)	336 (12.9)	199 (7.6)	
BMI***		23.91 $\pm$	24.29 $\pm$	24.20 $\pm$	4.80(.008) a<b	23.06 $\pm$	23.18 $\pm$	22.95 $\pm$	0.53 (.590)
		2.93 ^a	3.18 ^b	3.37 ^c		3.06	3.27	3.09	
Cognitive function		26.31 $\pm$	26.04 $\pm$	25.20 $\pm$	17.23($<.001$) a>b,c	23.94	23.15 $\pm$	23.49 $\pm$	8.46($<.001$) a>b,c
		3.04 ^a	3.07 ^b	3.89 ^c		$\pm$ 4.26 ^a	4.37 ^b	4.52 ^c	
Depression	No	4,939 (87.0)	492 (8.7)	244 (4.3)	28.43 ($<.001$)	3,309 (81.4)	495 (12.2)	263 (6.5)	14.08 (.001)
	Yes	121 (73.8)	24 (14.6)	19 (11.6)		96 (70.6)	21 (15.4)	19 (14.0)	
Suicidal ideations	No	4,755 (87.6)	452 (8.3)	222 (4.1)	60.12 ($<.001$)	3,236 (82.1)	462 (11.7)	245 (6.2)	47.86 ($<.001$)
	Yes	305 (74.4)	64 (15.6)	41 (10.0)		170 (65.1)	54 (20.7)	37 (14.2)	
* ADL = activities of daily living, ** IADL = instrumental activities of daily living, ***BMI = body mass index									

Differences in fall frequency according to chronic disease characteristics

In both young-old and old-old elderlies, the number of recurrent falls increased as the number of chronic diseases and prescribed medications increased. In the young-old, those with hypertension, stroke, angina and myocardial infarction, diabetes, arthritis, osteoporosis, lumbodysnia, sciatic neuralgia, cataract, glaucoma, chronic kidney diseases, urinary incontinence, anemia, insomnia, and Parkinson's disease had more recurrent falls. In the old-old, recurrent falls were significantly more frequent in those with hypertension, arthritis, osteoporosis, lumbodysnia, sciatic neuralgia, glaucoma, urinary incontinence, anemia, dementia, insomnia, and Parkinson's disease (Table 3).

Table 3
Differences in fall frequency according to chronic disease characteristics (N=10,043)

Variables	Category	Young-old (n = 5,838)				Old-old (n = 4,205)			
		No fall (n = 5,060)	Single fall (n = 516)	Recurrent fall (n = 263)	χ^2 , F(p) Scheffe	No fall (n = 3,406)	Single fall (n = 516)	Recurrent fall (n = 283)	χ^2 , F(p) Scheffe
Number of chronic diseases		2.37±	3.01±	3.74±	98.29	2.91±	3.48±	3.92±	58.95
		1.74	1.91	2.25	(<.001)	1.76	1.86	2.01	(<.001)
Number of prescribed medications		3.33±	4.42±	5.62±	83.06	4.20±	4.94±	5.68±	33.89
		3.16	3.57	4.25	(<.001)	3.23	3.56	3.85	(<.001)
Hypertension	No	2,363 (88.7)	203 (7.6)	97 (3.6)	18.71	1,210 (83.3)	166 (11.4)	76 (5.2)	10.14
	Yes	2,696 (84.9)	313 (9.9)	166 (5.2)	(<.001)	2,196 (79.8)	350 (12.7)	207 (7.5)	(.006)
Stroke	No	4,787 (87.0)	482 (8.8)	231 (4.2)	21.80	3,116 (81.3)	464 (12.1)	252 (6.6)	2.84
	Yes	272 (80.5)	34 (10.1)	32 (9.5)	(<.001)	290 (77.7)	53 (14.2)	30 (8.0)	(.241)
Angina and myocardial infarction	No	4,750 (86.9)	479 (8.8)	236 (4.3)	7.70	3,151 (81.3)	474 (12.2)	251 (6.5)	5.47
	Yes	310 (82.9)	37 (9.9)	27 (7.2)	(.021)	254 (77.4)	42 (12.8)	32 (9.8)	(.065)
Diabetes	No	3,963 (87.9)	371 (8.2)	174 (3.9)	30.17	2,596 (81.2)	393 (12.3)	209 (6.5)	0.81
	Yes	1,096 (82.4)	145 (10.9)	89 (6.7)	(<.001)	810 (80.4)	123 (12.2)	74 (7.3)	(.668)
Arthritis	No	3,688 (88.6)	324 (7.8)	149 (3.6)	52.00	2,135 (83.5)	284 (11.1)	138 (5.4)	29.02
	Yes	1,372 (81.8)	192 (11.4)	114 (6.8)	(<.001)	1,270 (77.2)	232 (14.1)	144 (8.7)	(<.001)
Osteoporosis	No	4,528 (87.9)	420 (8.2)	201 (3.9)	65.95	2,963 (82.7)	408 (11.4)	213 (5.9)	46.15
	Yes	532 (77.1)	96 (13.9)	62 (9.0)	(<.001)	442 (71.3)	109 (17.6)	69 (11.1)	(<.001)
Lumbodynia and sciatic neuralgia	No	4,127 (88.3)	371 (7.9)	174 (3.7)	61.63	2,459 (83.3)	322 (10.9)	172 (5.8)	33.08
	Yes	933 (79.9)	145 (12.4)	90 (7.7)	(<.001)	946 (75.7)	194 (15.5)	110 (8.8)	(<.001)
Cataract	No	4,775 (87.2)	468 (8.5)	236 (4.3)	18.91	3,131 (81.3)	468 (12.2)	250 (6.5)	4.17
	Yes	285 (79.2)	48 (13.3)	27 (7.5)	(<.001)	275 (77.5)	48 (13.5)	32 (9.0)	(.124)
Glaucoma	No	4,968 (86.8)	500 (8.7)	253 (4.4)	10.14	3,314 (81.2)	500 (12.3)	266 (6.5)	9.93
					(.006)				(.007)

Variables	Category	Young-old (n = 5,838)				Old-old (n = 4,205)			
		No fall (n = 5,060)	Single fall (n = 516)	Recurrent fall (n = 263)	χ^2 , F(p) Scheffe	No fall (n = 3,406)	Single fall (n = 516)	Recurrent fall (n = 283)	χ^2 , F(p) Scheffe
Cancer	Yes	92 (77.3)	16 (13.4)	11 (9.2)	1.13 (.568)	92 (73.6)	16 (12.8)	17 (13.6)	0.01 (.998)
	No	4,862 (86.7)	491 (8.8)	252 (4.5)		3,288 (81.0)	498 (12.3)	273 (6.7)	
	Yes	197 (84.5)	25 (10.7)	11 (4.7)		118 (80.8)	18 (12.3)	10 (6.8)	
Chronic kidney diseases	No	4,982 (86.8)	508 (8.8)	251 (4.4)	14.28 (.001)	3,335 (81.1)	506 (12.3)	272 (6.6)	4.14 (.126)
	Yes	78 (80.4)	7 (7.2)	12 (12.4)		71 (77.2)	10 (10.9)	11 (12.0)	
Prostatic hypertrophy	No	4,727 (86.8)	482 (8.8)	239 (4.4)	2.60 (.272)	2,998 (80.9)	460 (12.4)	247 (6.7)	0.74 (.690)
	Yes	333 (85.2)	34 (8.7)	24 (6.1)		408 (81.6)	56 (11.2)	36 (7.2)	
Urinary incontinence	No	4,981 (86.9)	499 (8.7)	253 (4.4)	13.99 (.001)	3,310 (81.5)	495 (12.2)	258 (6.3)	29.84 ($<.001$)
	Yes	79 (74.5)	17 (16.0)	10 (9.4)		96 (67.6)	21 (14.8)	25 (17.6)	
Anemia	No	5,001 (86.8)	503 (8.7)	256 (4.4)	9.96 (.007)	3,309 (81.3)	495 (12.2)	265 (6.5)	11.61 (.003)
	Yes	59 (74.7)	13 (16.5)	7 (8.9)		97 (71.3)	21 (15.4)	18 (13.2)	
Dementia	No	5,026 (86.7)	508 (8.8)	260 (4.5)	5.22 (.074)	3,330 (81.2)	499 (12.2)	270 (6.6)	7.37 (.025)
	Yes	34 (75.6)	8 (17.8)	3 (6.7)		76 (71.7)	17 (16.0)	13 (12.3)	
Insomnia	No	4,918 (86.9)	498 (8.8)	243 (4.3)	19.86 ($<.001$)	3,280 (81.4)	486 (12.1)	264 (6.6)	10.26 (.006)
	Yes	141 (78.8)	18 (10.1)	20 (11.2)		125 (71.8)	30 (17.2)	19 (10.9)	
Parkinson's disease	No	5,037 (86.9)	506 (8.7)	255 (4.4)	42.45 ($<.001$)	3,376 (81.3)	505 (12.2)	269 (6.5)	36.56 ($<.001$)
	Yes	23 (54.8)	10 (23.8)	9 (21.4)		30 (54.5)	11 (20.0)	14 (25.5)	

Factors affecting recurrent falls

The Hosmer–Lemeshow test showed that the fitness of the extracted models for young–old and old–old elderlies were 0.77 and 0.32, respectively, indicating that the estimated models were a statistically good fit.

In the young–old, those with limitations in ADL and visual aids were 2.25 and 1.56 times more likely to experience recurrent falls, respectively, compared to those without such limitations. When the cognitive function score increased by 1 point, the

odds of recurrent falls increased by 0.93 times, and those with suicidal ideations experienced recurrent falls 1.69 times more than those without suicidal ideations. As the number of chronic diseases and prescribed medications increased by 1, the odds of recurrent falls increased by 1.22 and 1.06 times, respectively (Table 4).

Table 4
Factors that affect recurrent falls in the young-old elderly

Variables	Young-old					
	B	SE	Wald	p	OR	95% CI
Intercept	-2.53	0.50	25.76	<.001	0.08	-
Limitations in ADL * (ref=none)	0.81	0.23	12.48	<.001	2.25	1.44–3.54
Visual aids (ref=none)	0.45	0.14	9.56	.002	1.56	1.18–20.7
Cognitive function	-0.07	0.02	13.98	<.001	0.93	0.90–0.97
Suicidal ideations (ref=none)	0.53	0.19	7.84	.005	1.69	1.17–2.45
Number of chronic diseases	1.20	0.04	23.67	<.001	1.22	1.13–1.32
Number of prescribed medications	0.06	0.02	7.67	.006	1.06	1.02–1.11
* ADL = activities of daily living						

In the old–old those who had no spouse, were NBLSS beneficiaries, did not exercise, had limitations in ADL, visual aids, and suicidal ideations were 0.76, 1.53, 1.48, 1.96, 1.54, and 1.63 times more likely to experience recurrent falls, respectively. As the number of chronic diseases increased by one, the odds of recurrent falls increased by 1.18 times, and those with Parkinson's disease had 3.53 times increased odds of experiencing recurrent falls (Table 5).

Table 5
Factors that affect recurrent falls in the old–old elderly

Variables	Old-old					
	B	SE	Wald	p	OR	95% CI
Intercept	-3.76	0.18	423.50	<.001	0.02	-
spouse (ref=none)	-0.28	0.13	4.48	.034	0.76	0.59–0.98
NBLSS beneficiary (ref=none)	0.42	0.19	5.00	.025	1.53	1.05–2.20
exercise (ref=none)	0.39	0.13	8.91	.003	1.48	1.14–1.91
limitations in ADL * (ref=none)	0.68	0.16	19.17	<.001	1.98	1.46–2.69
Visual aids (ref=none)	0.43	0.14	9.63	.002	1.54	1.17–2.02
Suicidal ideations (ref=none)	0.49	0.20	5.88	.015	1.63	1.10–2.43
Number of chronic diseases	0.17	0.03	25.03	<.001	1.18	1.11–1.26
Parkinson's disease (ref=none)	1.26	0.33	14.26	<.001	3.53	1.83–6.79
* NBLSS = National Basic Livelihood Security System, ** ADL = activities of daily living						

Discussion

This study assessed predictive factors of recurrent falls by age group in young-old and old-old elderlies. First, 8.8% and 12.3% of young-old and old-old elderlies fell only once in the past year, respectively, whereas 4.5% of young-old and 6.7% of old-old elderlies fell more than twice. Thus, both single and recurrent fall rates were higher in the old-old elderly, which was consistent with a previous study reporting an increased rate of falls with age [3]. Additionally, half of those who experienced a single fall also experienced recurrent falls, which was consistent with the results reported by Kabeshova et al [7].

In both young-old and old-old elderlies, factors that affected recurrent falls were limitations in ADL, visual aid, suicidal ideations, and the number of chronic diseases. The young-old and old-old elderlies with limitations in ADL were 2.25 and 1.98 times more likely to experience recurrent falls, respectively, which is consistent with the results of a previous study [13] showing that the risk of falls increased as the ability to perform ADL decreased. The elderly have difficulties in balance with sitting to standing and surface-to-surface transfer [6]. Decreased body function likely leads to an increase in the rate of falls; thus, the physical functions of the elderly must be assessed to propose measures to prevent falls.

The young-old and old-old elderlies with visual aids experienced 1.56 and 1.54 times more recurrent falls, respectively, than those without visual aids. The WHO also suggested poor balance and limited vision as risk factors of falls. Therefore, creating an appropriate environment and developing auxiliary devices to complement for decreased sensory functions may be necessary [2].

The young-old and old-old elderlies with suicidal ideations experienced recurrent falls 1.69 and 1.63 times more than those without suicidal ideations, respectively. In a study using large-scale national data [14], depression, along with the fear of falling, was identified as a risk factor for falls in the elderly. However, although both depression and suicidal ideations were assessed in our study, only suicidal ideations were shown to significantly affect falls. A previous study noted that depression affected single falls whereas recurrent falls were affected not only by depression but by multiple factors including sleep disturbance and subjective stress [15]. Since suicidal ideations reflect both family structures and social activities, multi-dimensional approaches at individual, family, and community levels are necessary to prevent recurrent falls.

In our study, young-old and old-old elderlies were 1.22 and 1.18 times more likely to experience recurrent falls, respectively, as the number of chronic diseases increased by one. This was consistent with the findings of studies showing that the number of chronic diseases was related to falls [3]. In a previous study [16], the elderly with chronic diseases believed that their subjective health was bad, which led to a vicious cycle of increased fear and falls. Therefore, interventions that consider the physical health and psychological aspects in the elderly are necessary.

There were some differences in the factors that affected recurrent falls in young-old and old-old elderlies. In the young-old, cognitive function and number of prescribed medications were predictors of recurrent falls. It was consistent with the finding that decreased cognitive function increased the risk of falls [17]. In young-old elderlies, as cognitive function starts to decline, there are also differences in the level of decrease in cognitive function, which are believed to have affected the differences observed in the results of this study.

As the number of prescribed medications increased by 1, the odds of recurrent falls increased by 1.06 times, which was consistent with the finding that medications increase the risk of falls in the elderly [18]. Since medications increase the likelihood of adverse drug reactions and drug interactions in the elderly, more medications can cause greater side effects from drug interactions [19]. Therefore, physicians must provide explanations for medications that greatly increase the risk of falls to the elderly, and education on behavior guidelines may be necessary to prevent falls.

Unique predictive factors of recurrent falls in the old-old were spouse status, NBLSS beneficiaries, exercise, and Parkinson's disease. As noted in a study reporting that spouse is a factor affecting falls [5], our finding suggests that having a spouse affects both single and recurrent falls. The old-old are less influenced by their spouse at home because they participate less in work or social life. Thus, support systems that can continue to provide support, such as spouses, can prevent recurrent falls in those with reduced body functions.

Furthermore, NBLSS beneficiaries were 1.53 times more likely to experience recurrent falls, which supported a WHO report that included socioeconomic factors, such as poverty, as risk factors for falls [2]. This finding suggests that NBLSS beneficiaries are socially and economically vulnerable, which may also indicate that the risk of falls in the residential environment is high. In the elderly, the risks of fall-related injuries and death are high because of aging-related physical, sensory, and cognitive changes and unsafe environments [2]. Since forming a safe environment is an important factor for preventing falls, NBLSS beneficiaries would require support for assessment and improvement of the residential environment for a safe living environment.

Those who did not exercise were 1.48 times more likely to experience recurrent falls. This finding was not consistent with the results of a previous study indicating that lack of exercise was a main risk factor of falls in the elderly over the age of 80 [3]. Our study defined exercise as 10 minutes or more once a week whereas the definitions and classifications of exercise varied in previous studies, and mixed results were reported. One previous study reported exercise time as a risk factor for falls in those over the age of 85. The risk of falls was higher in those who exercised for a short period of 10–20 minutes than in those who exercised for 30 minutes or more [20], suggesting that the type, intensity, and duration of exercise affect the risk of falls. Therefore, safety must be prioritized in exercise programs for the elderly, particularly the old–old. Because exercise is important for the elderly with weak physical functions, interventions that are safe for the elderly must be created.

Lastly, those with Parkinson's disease were more likely to experience recurrent falls than those without, which is consistent with previous results indicating that Parkinson's disease is closely related to falls since it affects motor function [21]. Moreover, falls are the most important factor causing disability in Parkinson's patients [22]. Therefore, those with Parkinson's disease must be considered a high-risk group, and appropriate measures to prevent falls are necessary.

This study observed differences in factors related to recurrent falls between young–old and old–old elderlies. Risk assessments that reflect the characteristics of different age groups of the elderly must be developed to screen for recurrent falls in the community. Additionally, further studies that evaluate the effects of interventions and strategies that can prevent re-falls in high-risk groups are required. However, the cross-sectional design of this study limits the assessment of causality of the relationship between the variables. Longitudinal studies that include causal variables to assess the cause-and-effect relationship should be conducted in the future.

Conclusions

In conclusion, this study was found that there is a difference in the factors related to recurrent falls between young–old and old–old elderlies. Based on the results of this study, it is necessary to develop a risk assessment tool that can screen the recurrent falls that reflects the characteristics of each age group. In addition, a study to confirm the effectiveness of interventions and strategies to prevent recurrent falls by age group will be needed.

Declarations

Ethical approval and consent to participate

The 2017 National Survey of Older Koreans is a legal survey that were approved by the Institutional Review Board of the Korea Institute for Health and Social Affairs (2017-11). This study was approved by the university's Institutional Review Board (no. KNU-2020-0131). All participants provided written informed consent. When collecting data from the Korea Institute for Health and Social Affairs, it was notified in advance that the questionnaire data could be accomplished to secondary analysis in the explanation and consent provided to the subject. Since the information that can identify the subject is coded, the subject's anonymity and confidentiality are guaranteed, so re-identification is impossible. All methods were carried out in accordance with the relevant guidelines and regulations (Declaration of Helsinki).

Consent to publication

Not applicable

Availability of data and materials

The datasets analysed during the current study are available from the Health and Welfare Data Portal and open to all researchers. The full dataset are available from the authors upon request on the Health and Welfare Data Portal repository (<https://data.kihasa.re.kr/microdata/apply/list>), [accession number: 5_National Survey of Older Koreans; accession year: 2017]. The English dataset used and/or during the current study are included in supplementary information files.

Competing interests

The authors declare no conflict of interest

Funding

No funding source for this work.

Author's contributions

YK designed the study and performed the statistical analyses and description of the study methods and results. MK reviewed the literature and wrote the manuscript. All authors read and approved the final manuscript for publication.

Acknowledgments

The Korea Institute for Health and Social Affairs provided the data for this study.

References

1. Statistics Korea. 2020 Elderly statistics. Statistics Korea. 2021. http://kostat.go.kr/portal/korea/kor_nw/1/1/index.board?bmode=read&aSeq=385322 Accessed 28 Sept 2021.
2. World Health Organization. Falls. World Health Organization. 2021. <https://www.who.int/news-room/fact-sheets/detail/falls> Accessed 31 Sept 2021.
3. Lukaszyk C, Harvey L, Sherrington C, Keay L, Tiedemann A, Coombes J, et al. Risk factors, incidence, consequences and prevention strategies for falls and fall-injury within older indigenous populations: A systematic review. *Aust N Z J Public Health*. 2016; 40: 564–568. <https://doi.org/10.1111/1753-6405.12585>
4. Nam IS, Yoon HS. An analysis of the interrelationship between depression and falls in Korean older people. *J Korean Gerontol Soc*. 2014; 34: 523–537.
5. Kim YH, Yang KH, Park KS. Fall experience and risk factors for falls among the community-dwelling elderly. *J Muscle Joint Health*. 2013; 20: 91–101. <https://doi.org/10.5953/JMJH.2013.20.2.91>
6. Sharif SI, Al-Harbi AB, Al-Shihabi AM, Al-Daour DS, Sharif RS. Falls in the elderly: assessment of prevalence and risk factors. *Pharm Pract (Granada)*. 2018; 16: 1206. <https://doi.org/10.18549/PharmPract.2018.03.1206>
7. Kabeshova A, Launay CP, Gromov VA, Fantino B, Levinoff EJ, Allali G, et al. Falling in the elderly: do statistical models matter for performance criteria of fall prediction? Results from two large population-based studies. *Eur J Intern Med*. 2016; 27: 48–56. <https://doi.org/10.1016/j.ejim.2015.11.019>
8. Kelsey JL, Procter-Gray E, Berry SD, Hannan MT, Kiel DP, Lipsitz LA, et al. Reevaluating the implications of recurrent falls in older adults: location changes the inference. *J Am Geriatr Soc*. 2012; 60: 517–524. <https://doi.org/10.1111/j.1532-5415.2011.03834.x>
9. Lee IS, Ko Y, Lee KO, Yim ES. Evaluation of the effects of a frailty preventing multi-factorial program concentrated on local communities for high-risk younger and older elderly people. *J Korean Acad Commun Health Nurs*. 2012; 23: 201–211. <https://doi.org/10.12799/jkachn.2012.23.2.201>

10. Neugarten BL, Moore JW, Lowe JC. Age norms, age constraints, and adult socialization. *Am J Sociol.* 1965; 70: 710–717. <http://www.jstor.org/stable/2774397>
11. Won CW, Rho YG, SunWoo D, Lee YS. The validity and reliability of Korean Instrumental Activities of Daily Living (K-IADL) scale. *J Korean Geriatr Soc.* 2002; 6: 273–280.
12. Kim TH, Jhoo JH, Park JH, Kim JL, Ryu SH, Moon SW, et al. Korean version of mini mental status examination for dementia screening and its' short form. *Psychiatry Investig.* 2010; 7: 102–108. <https://doi.org/10.4306/pi.2010.7.2.102>
13. Tsai YJ, Yang PY, Yang YC, Lin MR, Wang YW. Prevalence and risk factors of falls among community-dwelling older people: results from three consecutive waves of the national health interview survey in Taiwan. *BMC Geriatr.* 2020; 20: 1-11. <https://doi.org/10.1186/s12877-020-01922-z>
14. Park Y, Paik NJ, Kim KW, Jang HC, Lim JY. Depressive symptoms, falls, and fear of falling in old Korean adults: the Korean longitudinal study on health and aging (KLoSHA). *J Frailty Aging.* 2017; 6: 144–147. <https://doi.org/10.14283/jfa.2017.21>
15. Jo KH, Park J, Ryu SY. The effects of mental health on recurrent falls among elderly adults, based on Korean Community Health Survey data. *Epidemiol Health.* 2020; 42: e2020005. <https://doi.org/10.4178/epih.e2020005>
16. Byeon K, Nam Y. The Relationship between status of chronic disease and fall experience in Korean elderly: Based on 2015 community health survey. *The Journal of Korean Society for School & Community Health Education.* 2019; 20: 113-126. <https://doi.org/10.35133/kssche.20190430.09>
17. Graveson J, Bauermeister S, McKeown D, Bunce D. Intraindividual reaction time variability, falls, and gait in old age: A systematic review. *J Gerontol B Psychol Sci Soc Sci.* 2016; 71:857-864. <https://doi.org/10.1093/geronb/gbv027>
18. Lim LM, McStea M, Chung WW, Nor Azmi N, Abdul Aziz SA, Alwi S, et al. Prevalence, risk factors and health outcomes associated with polypharmacy among urban community-dwelling older adults in multi-ethnic Malaysia. *PLoS one.* 2017; 12: e0173466. <https://doi.org/10.1371/journal.pone.0173466>
19. Davies EA, O'mahony MS. Adverse drug reactions in special populations—the elderly. *Br J Clin Pharmacol.* 2015; 80: 796-807. <https://doi.org/10.1111/bcp.12596>
20. Park NJ, Shin YS. Predictors of accidental falls in the community-dwelling elderly by age. *J Korean Acad Commun Health Nurs.* 2019; 30: 141–149. <https://doi.org/10.12799/jkachn.2019.30.2.141>
21. Weaver TB, Robinovitch SN, Laing AC, Yang Y. Falls and Parkinson's disease: evidence from video recordings of actual fall events. *J Am Geriatr Soc.* 2016; 64: 96-101. <https://doi.org/10.1111/jgs.13878>
22. Heinzel S, Maechtel M, Hasmann SE, Hobert MA, Heger T, Berg D, et al. Motor dual-tasking deficits predict falls in Parkinson's disease: a prospective study. *Parkinsonism Relat Disord.* 2016; 26, 73-77. <https://doi.org/10.1016/j.parkreldis.2016.03.007>

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [2017NationalSurveyofOlderKoreansFALL.pdf](#)
- [2017NationalSurveyofOlderKoreansFALL.xlsx](#)