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Intrinsic and Extrinsic Risk Factor for Fall among Community Dwelling Indonesian Elderly

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Abstract

BACKGROUND: Fall-related injuries are identified as a public health problem that has major consequences in affecting the lives of elderly people. Recent studies showed that one out of four elderly people suffers from this condition annually.

AIM: This study aims at identification of fall risk factors that involve intrinsic and extrinsic factor to predict the future fall.

MATERIALS AND METHODS: This study uses an observational design and a descriptive-analytic approach with a cross-sectional method which was used to identify risk factors for falls. This study targeted 60 years and above who live in West Java region. Afterward, a total of 420 people were obtained and divided into two regions, 215 people in Bandung Regency and 205 people in Bandung City. Furthermore, the sampling technique used was for cluster random sampling.

RESULTS: The elderly who experienced incontinence in controlling urination had the potential of falling by 4 times compared to those who did not AOR = 3.73; 95% CI (1.038–13.428). Furthermore, those who had history of falling in the past 12 months were 2.4 times exposed compared to those who had not fallen AOR = 2.438; 95% CI (1.219–4.875). Balance disorders also contributed in increasing the risk of fall by 2 times with a value of AOR = 1.703; 95% CI (1.018–2.849). An extrinsic factor, namely, unsafe home environment has higher possibility to increase the risk of falling 2.6 times compared to those in safer environment (AOR = 2.603; 95% CI [1.331–5.087]).

CONCLUSION: This study succeeded in identifying the risk factors for falls among the elderly in intrinsic and extrinsic approach. This finding can be used as a reference in planning health promotion programs for elderly people, specifically in the primary prevention of morbidity and mortality that occur due to falls.

Introduction

The process of aging is associated with a gradual increase in molecular and cellular damage which cause a decrease in functional abilities [1]. This is characterized by decreased muscle mass and strength, vision, hearing and cognition, loss of bone density, and multi-morbidity, as well as a weakness [2]. Furthermore, these conditions have an impact on the disruption of daily life activities, increased susceptibility to disease, frailty, and even balance disorders that cause the elderly to become vulnerable to falling [3], [4], [5].

Fall-related injuries among the elderly have been identified as a public health problem that has major consequences of affecting their quality of life [6], [7]. It was found that the prevalence of falls reached about 30–50%, with the incidence of repeated scenarios of about 40% [8]. Furthermore, more than 80% of fall-related deaths among elderly people occurred in low- and middle-income countries [9]. The National Basic Health Survey, data in 2018, showed that the proportion of injuries due to falls caused by mild to total dependence within the age group of 60 years and above was 8.2%, while 67% occurred in the home environment [10]. Former study conducted by Susilowati *et al*. (2020) identified that the prevalence of fall in among community dwelling elderly was 24.5% [11], one out of four elderly experience fall.

The incidence of falls among the elderly is affected by a decrease in functional ability. In this case, it consists of individual intrinsic capacity and extrinsic environmental characteristics [12]. Previous studies identified various risk factors for falls originating from intrinsic factors such as earlier occurrence [13], [14], the decline in physical function [15], the presence of chronic diseases [5], [16], balance disorders [17], [18], and decreased sensory abilities such as vision and hearing [19], [20], [21] as well as depression. Meanwhile, the extrinsic factors include the use of drugs that reduce consciousness, antihypertensive, antidiabetic, diuretic, anti-depressant, and environmental factors [22], [23]. The interaction between elderly people and the environment, as well as a wider scope such as administrative regions in rural or urban areas allows them to have different behavior and living habits. Their

habits and lifestyles in these areas have implications for their functional abilities [24] which make them vulnerable to fall-related injuries.

This study aims at identification of fall risk factors that involve intrinsic and extrinsic factor to predict future fall in longitudinal study. Fall risk identification is expected to reduce the morbidity and mortality that occur significantly in elderly people. In addition, fall prevention efforts can be carried out that focus on the main risk factors that are affected.

Methods

Design

This study using longitudinal observational study that involves repeated observations of the same variables over 6 month. A baseline assessment was carried out, which included recalling history of falls within the past 12 months and risk factor of fall. All subject were observed for 6 months using a monitoring book to record the incidence of falls.

Instrument and variables

One set of questionnaires were distributed in baseline data collection.

Fall is the major outcome of this study. The definition of fall is in accordance with the WHO definition of fall as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level [8]. History of fall in this study was assessed with the following questions “Have you fell in the past 12 months?” and “How many times have you fallen?” Fall incidence is measured based on the incidence of falls recorded in the monitoring book for 6 months.

Independent variables identified as risk factors for this condition in elderly people include (1) demographic characteristics consisting of age, gender, and area of residence, (2) intrinsic factors such as history of falls and illness, visual impairment, hearing loss, depression status, urinary incontinence, and balance disorders, and (3) extrinsic factors include consumption of drugs that cause drowsiness, reduce awareness, and disrupt balance as well as safety factors in the living environment.

All measurements on both assessment and monitoring were undertaken by trained assessors.

Population and subjects

The target population was elderly people aged 60 years and above who live in West Java region. This was conducted in the West Java Province, which has a wide aging population followed by Bandung Regency and City with 10.5% which describes rural and urban areas. Bandung Regency was selected to represent the rural areas with a total population of 221,061 people aged 60 years and above, while Bandung City was used to represent the urban area with a population of 166,539 people.

Table 1: Fall prevalence

Description	Frequency	Proportion
Prevalence of Falls in the past 1 year		
Never	332	80%
Ever	83	20%
Incidence of falls after 6 months of monitoring		
Never	363	87.5%
Ever	52	12.5%
Number of falls during monitoring		
1 time	38	73%%
2 times	11	21.2%
3 times	2	3.8%
4 times	1	0.2%

The inclusion criteria were elderly people aged 60 years and above, independent, can communicate well and are willing to be respondents in this study. The exclusion criteria include the elderly that are bed-ridden and those with moderate-severe dementia. In addition, those with impaired cognitive function were not included as subjects. The time required to carry out this study was 18 months starting from the proposal submission in April 2020 to the completion of the results in October 2021.

Sample size and sampling technique

The number of subjects was calculated using the cross-sectional method by taking the fall proportion in a population of 12.8%. Afterward, a total of 420 people were obtained and divided into two regions, 215 people in Bandung Regency and 205 people in Bandung City. Furthermore, the sampling technique used was for cluster random sampling.

Ethics

This study has obeyed and complied with the ethics committee rules of the University of Indonesia. It was carried out after obtaining written approval from the University of Indonesia Ethics Commission as evidenced by the ethical approval letter number: Ket-326/UN2.F10.D11/PPM.00.02/2020 (letter attached). Moreover, this study adheres to the ethical principles, namely, confidentiality, consent, respect for the rights of respondents, and upholds the justice principles related to equality and fairness in obtaining the risks and benefits of the study.

Statistical analysis

The data were analyzed using statistical IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Chicago, IL, USA). A descriptive analysis was performed to describe the sociodemographic profile

Table 2: Characteristics of respondents

Variable	Urban	Rural	p-value
	n (%)	n (%)	
Intrinsic Factor			
Age			0.001
60–69 years	135 (66.80%)	140 (65.70%)	
70–79 years	61 (30.20%)	51 (23.90%)	
More than 80 years	6 (3.00%)	22 (10.30%)	
Gender			0.005
Male	37 (18.30%)	64 (30%)	
Female	165 (81,7%	149 (70%)	
History of chronic illness			0.001
Have a chronic disease	67 (33.20%)	25 (11.70%)	
Have no chronic disease	135 (66.80%)	188 (88.30%)	
Balance disorders			0.001
Yes	20 (9.90%)	48 (22.50%)	
No (ref)	182 (90.10%)	165 (77.50%)	
Depression			0.542
Yes (>4)	30 (14.90%)	30 (14.10%)	
No (<4)	172 (85.10%)	183 (85.90%)	
Visual impairment			0.001
Yes	52 (25.70%)	125 (58.70%)	
No (ref)	150 (74.30%)	88 (41.30%)	
Hearing disorders			0.005
Yes	28 (13.90%)	53 (24.90%)	
No (ref)	174 (86.10%)	160 (75.10%)	
Incontinence			0.005
Yes	4 (2.00%)	11 (5.20%)	
No	198 (98.00%)	202 (94.80%)	
History of fall in past 12 months			0.556
Yes	38 (18.80%)	45 (21.10%)	
No	164 (81.20%)	168 (78.90%)	
Falls during monitoring			0.014
Yes	17 (8.4%)	35 (16.4%)	
No	185 (91.6%)	178 (83.6%	
Environmental risk			
Squat toilet	128 (63.40%)	206 (96.70%)	0.001
The contoured and uneven floor of the house	25 (12.40%)	90 (42.30%)	0.001
The floor in the bathroom is slippery	18 (8.90%)	24 (11.30%)	0.426
There is no handrail in the bathroom	183 (90.60%)	207 (97.20%)	0.006
The house uses stairs for daily activities	112 (55.40%)	119 (55.90%)	0.931
Drug consumption			0.001
Yes	83 (41.10%)	52 (24.40%)	
No (ref)	119 (58.90%)	161 (75.60%)	

Table 3: Results of multiple logistic regression risk factors on fall history and incidence

Variable	Fall history 12 months			Incidence of falls 6 months of monitoring		
	p-value	AOR	95% C.I.	p-value	AOR	95% C.I.
Age						
60–69 years	0.979	0.987	(0.368–2.648)	0.922	1.061	(0.326–3.452)
70–79 years	0.638	0.779	(0.275–2.209)	0.594	0.707	(0.197–2.534)
More than 80 years (ref)		1			1	
Gender						
Female	0.431	1.295	(0.681–2.462)	0.74	0.884	(0.426–1.832)
Male		1			1	
More than 80 years						
Rural (1)	0.38	0.776	(0.44–1.367)	0.105	1.794	(0.885–3.635)
Urban		1			1	
Balance disorders						
Yes	0.002	1.972	(1.29–3.014)**	0.042	1.703	(1.018–2.849)*
No		1				1
Subjective depression status						
Yes (1)	0.932	1.032	(0.5–2.133)	0.771	1.142	(0.466–2.797)
No		1			1	
Visual impairment						
Yes (1)	0.044	1.777	(1.015–3.112)*	0.062	0.518	(0.26–1.033)
No		1			1	
Hearing disorders						
Yes	0.884	0.95	(0.495 – 1.833)	0.108	0.45	(0.175–1.192)
No		1			1	
History of chronic disease						
Yes	0.022*	1.495	(1.061–2.109)*	0.576	1.129	(0.738–1.727)
No		1			1	
Urinary incontinence						
Yes (1)	0.452	1.587	(0.477–5.281)	0.044	3.734	(1.038–13.428)*
No		1			1	
Fall history						
Yes	n/a	-	n/a	0.012	2.438	(1.219–4.875)*
No					1	
Drug consumption						
Yes	0.121	0.626	(0.347–1.131)	0.233	0.637	(0.303–1.338)
No		1			1	
Unsafe home environment						
Yes (1)	0.588	0.867	(0.516–1.455)	0.005	2.603	(1.331–5.087)*
No		1			1	

of the participants and Chi-square test was analyzed the different risk factor between urban and rural elderly. Subsequently, binary multiple logistic regression analysis was performed to identify the association between falls and risk factors.

Results

This study was carried out in two stages first, about 420 elderly people were recruited according to the sample quota calculations. This consists of 200 elderly people from the Bandung City representing urban areas and 220 people from Bandung Regency representing rural areas.

Initial data collection was carried out from July 1, 2020, to September 2020, in Bandung Regency. In this stage, an assessment of fall risk factors was carried out using the modified IFRAT instrument and a questionnaire to identify its occurrence among the elderly. The second stage includes monitoring the incidence of falls for the following 6 months.

At the time of initial data collection, there were 205 elderly people from Bandung City and 215 from Bandung Regency. However, at the time of follow-up monitoring, the number decreased to 202 people from urban and 213 from rural areas. The drop-out respondents were five people with a 0.12% or 98.8% response rate.

As shown in Table 1, the prevalence of falls identified in two consecutive way, namely, history of fall and incident of fall. The history of fall that recalled from the fall experience in the past 12 months was recorded at 20%. Furthermore, the fall incidence that was recorded during 6 month monitoring shows prevalence of 12.5%. This is almost the same as the previous study conducted by Susilowati *et al*., (2018) [25] and higher than study prevalence of fall reported by Indonesian Family Life Survey (2015) that reported a fall prevalence of 12.8% [26]. Among all incidence of falls during monitoring, 73% occurred once, while 27% had two or more falls.

Table 2, describes the demographic characteristics of study participants. A total of 415 elderly people participated in this study, with an average age of 67.6 years ± 7 standard deviations. Furthermore, the youngest and oldest age was 60 and 116 years. About 75.87% (314 people) were female, while the males were mostly found in rural areas. The elderly living in rural areas had an older age than those in the urban.

Based on the region, the elderly in rural areas who had a history of fall incidence in the past 1 year were higher (21%) than those in urban areas (11%). Environmental risk factors also made those who live in rural areas to be more at risk for falling.

The result from multivariate logistic regression analysis as shown in Table 3, indicated that that

there was no significant relationship between the demographic characteristics of the elderly such as age, gender, residence, and the incidence of falls assessed in the past 12 months or after 6 months of monitoring. It was concluded that age, gender, and residence were not related to the incidence of falls among the elderly.

Model 1 represents the multiple logistic regression analysis of all fall risk factors and occurrence as reported by the respondents in the past 12 months. The results show that after being combined with other risk factors, there was a significant relationship between the variables of balance disorders, visual sensory disturbances, and a history of chronic disease with the incidence of falls. The elderly with balance disorders were at risk of 2 times greater than those who were not with AOR = 1.972; 95% CI (1.29–3.014). Meanwhile, the elderly with visual sensory impairment experienced incidents of falls by 1.8 times compared to those without AOR = 1.777, 95% CI (1.015–3.112). In addition, the respondents with a history of chronic disease were 1.5 times 1.495; 95% CI (1.061–2.109) fall risk incidence.

Model 2 identifies all risk factor variables associated with falls during 6 months of monitoring. This study identifies four variables that are risk factors including urinary incontinence, history of falls, balance disorders, and environmental risk factors. The elderly who experienced incontinence in controlling urination had the potential of falling by 4 times compared to those who did not AOR = 3.73; 95% CI (1.038–13.428). Furthermore, those who had history of falling in the past 12 months were 2.4 times exposed compared to those who had not fallen AOR = 2.438; 95% CI (1.219–4.875). Balance disorders also contributed in increasing the risk of experiencing this condition by 2 times with a value of AOR = 1.703; 95% CI (1.018–2.849). It was concluded that elderly people living in an unsafe home environment have higher possibility of falling by 2.6 times compared to those in safer regions (AOR = 2.603; 95%CI [1.331–5.087]).

Discussion

The history of falls in this study was identified by “recalling” incidence in the past 12 months and it was found that about 20% of the respondents had experienced this condition. The multiple logistic regression analysis also showed that distant history increased the risk of falling by 3 times for elderly people living in the community. The results are in line with previous studies which identified a history of falls as a major risk factor in the future [3], [23], [27], [28]. Most incidents do not result in serious injury, but can trigger a loss of confidence and lead to a prolonged fear of falling. This limits their movement and reduces their activity, which results in weak muscles. Weakening of the movement muscle’s function can reduce the ability of the lower extremities in supporting the body, thereby causing a decrease in posture stability which will disrupt balance function and increase the fall risk incidence.

This study identified balance disorders which consistently increased the risk of falls in elderly people both independently and in multivariate analysis. This condition was also found in previous incidence during the 6 months monitoring. It was found that those with balance disorders had the possibility of falling 3 times compared to those who do not. Balance is a complex process that involves receiving and integrating sensory input as well as planning and executing movements to achieve goals that require an upright posture [29]. To maintain this process, the body constantly changes and corrects the position of the center of gravity concerning the base of support. It was concluded that the presence of balance disorders can increase the risk of falls among the elderly [5], [30].

This study shows that urinary incontinence increases the risk of fall among the elderly by 5 times (OR = 4.9; 95% CI (1.410–17.008). During the 6 months of monitoring, it was found that this disorder is one of the main factors that significantly contributed to falls incidence. This condition occurs when the aging process causes a decrease in the ability to control urine independently. Urinary incontinence is defined as “a complaint on unintentional leakage of urine” (Medical Advisory Secretariat, 2008). It is identified as one of the main predictors in the transition of the elderly from being independent in the community to long-term care institutions. Urinary urgency incontinence (detrusor hyperactivity and bladder strain) is the most commonly seen in middle to old age [31]. This disorder can be caused by weakness or malposition of somatically innervated pelvic floor and urethral muscles, specifically the external sphincter due to aging [32]. Furthermore, it indicates a decrease in the functional capacity of organs that can independently increase the occurrence of fall incidence [33]. The fall risk due to incontinence increases along with impaired functional domains [34] specifically when the functional impairment requires elderly people to take certain types of drugs. Incontinence is also triggered by the use of diuretic or spasmolytic drugs.

Environmental risk factors are one of the dominant variables that cause falls among the elderly. This study identifies independent and multivariate environmental risk factors associated with falls during 6 months monitoring. It was found that elderly people living in an unsafe home environment were 2 times, which are at risk of experiencing fall incidents than those in a safer home environment.

According to the WHO healthy aging concept (2020), functional ability is an interaction between intrinsic capacity and external factors originating from the environment. Intrinsic capacity is weakened due to the aging process, resulting in decreased balance response.

Previous studies identified the home environment as a risk factor for falls among the elderly [35], [36]. The threat of minor hazards in the environment that is easily overcome by healthy individuals can also be a big challenge for elderly people with impaired mobility and balance, thereby endangering their safety. This incidence is mostly common in the bathroom, bedroom, and stairs.

Conclusion

This study succeeded in identifying the risk factors for falls among the elderly. The intrinsic risk factors that are statistically associated with fall include history of falls, balance disorders, and urinary incontinence, while the extrinsic risk factor includes an unsafe environment. This finding can be used as a reference in planning health promotion programs for elderly people, specifically in the primary prevention of morbidity and mortality that occur due to falls.

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