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Women and stroke patients are more at risk for fall-related injury among older persons

Sulistyowati Tuminah*, Woro Riyadina*, and Aprildah Nur Sapardin**

ABSTRACT

BACKGROUND
In Indonesia, the prevalence of injury has increased from 7.9% in 2007 to 8.2% in 2013. Among older persons, falls were the main cause of injury. The objective of this study was to determine the major risk factors and the magnitude of the risk for fall-related injury in older persons.

METHODS
A study of cross-sectional design was conducted on 4,222 respondents aged 60 years and over. Injury was defined as fall-related injury occurring in the previous 12 months that disturbed activity daily living (ADL). Data collection was done by: 1) interview about sociodemographics and health (including hearing impairment, non-communicable diseases and injury) using a questionnaire, 2) measurement of blood pressure and anthropometry (body mass index), 3) examination of vision in the right and left eyes using tumbling E cards and pinhole eye covers. Data were analyzed using the chi square test and multiple logistic regression with 0.05 significance level.

RESULTS
After controlling for age, occupation, vision disorder, educational level and economic status, older women had a 2.0-fold increased risk for fall-related injury compared to men ([a]OR=2.3; 95% CI: 1.93-2.73; p=0.000); subjects with a history of stroke had a 2.1-fold increased risk for fall-related injury compared to those without a history of stroke ([a]OR=2.07; 95% CI: 1.38-3.09; p=0.000). Educational level was a confounding factor.

CONCLUSION
Women and stroke sufferers were at higher risk of fall-related injury among older persons. Prevention of fall-related injury should be done by older persons through periodic control of their health condition.

Keywords: Injury, stroke, fall, older persons

*Research and Development Center of Community Health Efforts
**Health Resource and Services Center, Health Research and Development Agency, Ministry of Health, Repubic of Indonesia

Correspondence address
Sulistyowati Tuminah
Jl. Percetakan Negara 29,
Jakarta Pusat
Email: sdarjoko@yahoo.com / watidarjoko@gmail.com

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INTRODUCTION

The prevalence falls dan fall-related injuryin populasi lanjut usia (lansia) semakin meningkat. Falls are one of the causes of death from injury among older persons. Around 20-30% of older persons with moderate and severe injury may suffer from loss of independence, decrease in quality of life and eventually death.[1] In Indonesia, the prevalence of injury showed a slightly increasing trend from 7.9 percent in *Riskesdas 2007* to 8.2 percent in *Riskesdas 2013*.[2,3] Of the percentage of injured respondents, the proportion of falls (40.9%) was the second greatest cause of injury after land transport accidents (47.7%).[3]

The risk factors of falls are categorized as internal and external. Internal factors comprise age, gender, problems of balance associated with walking style, functional and cognitive impairment, visual problems, and comorbidities such as depression, stroke, parkinsonism, and arthritis. External factors are closely associated with home hazards, such as slipping, stumbling, and falling from loss of balance, e.g. wet floors, slippery floors, uneven floor surfaces, inadequate lighting, absence of handholds, absence of walking aids, and others.[4-7] The study results of Rodriguez et al.[8] showed that falls were more frequently experienced by female older persons and older persons aged 80 years and above. According to Jalayondeja,[9] falls are common occurrences in healthy older persons and are more frequently experienced by stroke patients. In individuals with stroke, the incidence of first-time falls ranged from 3.8 to 22%, whereas the incidence of falls was around 1.3-6.5 times in the year following a stroke event.

Data on fall-related injury in Riskesdas 2007 and 2013 were respectively representative of data from the national level down to the district level in Indonesia. However in Riskesdas 2007, data on fall-related injury comprised all types of fall-related injury, including slight injury, so that its prevalence was greater.[10] This is in contrast with the data obtained in Riskesdas 2013, which were focussed exclusively on fall-related injury that impaired the activities of daily living (ADL), and which constitute the novelty of the present study. The objective of the present study was to determine the most dominant risk factors of fall-related injury among older persons in Indonesia and the magnitude of the risk.

METHODS

Design of the study

This advanced analysis of a subset of the Riskesdas 2013 data was of cross sectional design. The complete advanced analysis consisting of the writing of the proposal, protocol, and a request for data to the data management laboratory (Lab mandat), data analysis, and writing of the report, was conducted from January to December 2014.

Study subjects

The respondents who were selected for the Riskesdas 2013 sample came from 33 provinces. The inclusion criteria were: 1) male and female respondents, 2) aged 60 years and above (older persons), 3) respondents who in the previous 12 months experienced fall-related injury that impaired their ADL. The number of respondents meeting the inclusion criteria was 4,222 persons.

Interviews

The interviews were conducted on elderly respondents aged 60 years and above. The age of the respondents was the difference in years between the last birthday and the birth date. These data were of ordinal scale and were divided into 3 categories, i.e. 60-69 years, 70-79 years, 80 years, and above. The dependent (outcome) variable was fall-related injury and was obtained through 2 questions: "Within the last 12 months, did the respondent experience events that resulted in injuries?" and "What were the causes of these injuries?".[11] The injuries referred to were injuries that impaired ADL. The responses to the experiencing of injuries were divided into 2 categories, i.e. "Yes" (experienced injuries) and

"No", while the cause of injury that was the focus of the present study was falls. In this case falls were causes of unintentional injury and resulted in the person falling to the ground, e.g. gliding, stumbling, falling from heights.[12] The causes of injuries were grouped into 2 categories, i.e. "Due to falls" and "Not due to falls" (land transport accidents, injuries from sharp/blunt objects, burns/scalds, animal attacks/bites, etc.). The study sample consisted of the respondents who answered "Yes" (had experienced injuries) and "Falls" as the cause.

Other independent variables that were collected comprised socio-economic factors (education, occupation, and economic status), biological factors (gender, history of illness, health status, and physical condition). The education of the respondents was the final completed educational stage of the respondents who received diplomas. The education of the respondents were grouped into 3 categories, i.e. low (no schooling/never went to school, did not finish primary school and finished primary school), middle (finished junior high school and finished senior high school), and high (finished D1/D2/D3 and finished tertiary education). The occupation of the respondents was a composite of their occupational status and the type of their main occupation. The main occupation of the respondents was grouped into 5 categories, i.e. non-employed, employee, entrepreneur, farmer/fisher/laborer and others. The economic status was determined according to the quintile of ownership index, which was calculated from several variables of ownership of durable goods. The economic status was grouped into 5 categories, i.e. lowest, lower middle, middle, upper middle, and upper.

What was meant by "History of illness of the respondents" in this case were the diseases suffered by the respondents based on the diagnosis established by health personnel (physicians/nurses/midwifes). For example, diagnosis of hypertension, or consumption of anti-hypertensive medications, coronary heart disease (CHD) or heart failure, renal disease, diseases of the joints/rheumatism or stroke. Respondents were said to have a history of hypertension if they were diagnosed as having hypertension by health personnel or had never been diagnosed as having hypertension by health personnel but consumed anti-hypertensive medications.[3] The responses for history of illness was divided into 2 categories, i.e "Yes" and "No".

What was meant by "Health status of respondents**"** in this analysis was the health condition of the respondents at the time of data collection, e.g. presence of high blood pressure (hypertension), visual or hearing impairment. The information on blood pressure and visual impairment was obtained by measurement or examination, whereas the information on hearing impairment was obtained from the interviews based on the report of the respondents. The response options were 1) Yes, in one ear; 2) Yes, in both ears; 3) Yes, fluctuating hearing impairment; 4) No hearing impairment; 8) Do not know. In this analysis, hearing impairment was grouped into 2 categories, i.e. "Yes" (response code 1, 2, or 3) or "No" (response code 4 or 8).[13]

Measurements

Blood pressure was determined using an Omron IA1 digital tensimeter on the left arm, and performed twice with a 2-3 minute interval. If the results of the two determinations differed ≥10 mm/Hg for systolic or diastolic blood pressure, a third measurement was done after a rest of 2-3 minutes. High blood pressure (hypertension) was grouped according to the guidelines of the 8th Joint National Committee (JNC) for 2014.[14] However, in this study blood pressure was categorized into 2, i.e. high (hypertension stage 1 and 2) and normal (normotension and prehypertension). For hypertension associated with health status, the respondents were said to have hypertension if they had a history of hypertension or had hypertension at the time of examination or if the blood pressure at the time of measurement was

not high because they had previously taken anti-hypertensive medications. If at the time of measurement the blood pressure of the respondents was not high but the respondents had previously consumed anti-hypertensive medications, this was called controlled hypertension. The physical condition in this case was seen from the body mass index (IMT) status that was obtained from the anthropometric measurements (weight and height). Weight was measured using Camry digital scales with a capacity of 150 kg and precision of 100 g. The respondents were recommended to wear thin or the lightest clothing, and were weighed in the standing position without footwear. Height was measured in the upright position using a multifunctional height measuring instrument with a capacity of 2 meters and precision of 0.1 cm. The body mass index was obtained by first measuring weight and height, then calculating with the formula:

$BMI = weight (kg) / height (m)^2$

In general, obesity was divided into 5 categories obtained from the BMI classification for Asians according to the International Obesity Task Force (IOTF).[15] These obesity categories were underweight (BMI <18.5), normal (BMI 18.5-22.9), overweight (BMI 23.0-24.9), obese 1 (BMI 25.0-29.9) and obese 2 (BMI 30 or higher). In this study the BMI was grouped into 2 categories only, i.e. obese (BMI 25 or higher) and non-obese (BMI less than 25).

Visual examination

Visual impairment may be determined by visual acuity testing on both eyes. The instruments used were a 6-m measuring tape, one set of tumbling E cards (of great, medium, and small sizes), and eye-shields with a pinhole. The eye examination was started on the right eye of the respondent, without a pinhole. The response options for the visual examination results were as follows: 1) capable of seeing small E cards (at a distance of 6m); 2) not capable of seeing small E cards, but capable of seeing medium E cards (at a distance of 6m); 3) not capable of seeing medium E cards, but capable of seeing large E cards (at a distance of 6m); 4) not capable of seeing large E cards (at a distance of 6m), but capable of seeing large E cards (at a distance of 3m); 5) not capable of seeing large E cards at a distance of 3m; 6) cannot be examined.

If there is slight visual impairment (code 2), low vision (code 3 and 4) or blindness (code 5), then it is recommended to perform a pinhole examination. After the columns for examination without and with pinhole of the right eye have been completely filled in, this is followed by examination of the left eye. Visual impairment was grouped into 2 categories, i.e. yes and no. Respondents were said to have visual impairment (yes) if both eyes had codes 2, 3, 4, or 5. Respondents were said not to have visual impairment if either one of the eyes had code 1.[13]

Data analysis

The data were analyzed using: 1) bivariate analysis (chi square) to determine differences between the proportions of the dependent and independent variables; 2) multiple logistic regression analysis to determine the relationship between females and stroke patients with regard to fall-related injury in older persons, after controlling for confounding variables.

Ethical clearance

This protocol of the Basic Health Research (Riset Kesehatan Dasar, Riskesdas) for the year 2013 has been accorded ethical clearance from the Ethics Commission of the Health Research and Development Agency, Ministry of Health, Repubic of Indonesia.

RESULTS

The data on fall-related injury in older persons that could be analyzed comprised 4,222 cases (65.4%). Based on biological factors (Table 1), the proportion of older persons with fall-related injury was increased with increasing age. There were more female elderly with fall-

Table 1. Frequency distribution of fall-related injury in older persons by biological factors

Biological factors	Injured elderly (n)	Injured elderly		p
		Falls	Non-falls	
		%	%	
Age (years)				0.000
80 and above	817	80.2	19.8	
70 – 79	2,101	72.4	27.6	
60 – 69	3,542	57.7	42.3	
Gender				0,000
Male	2,790	51.6	48.4	
Female	3,671	75.8	24.2	
Obese				0.487
Yes	1,131	62.6	37.4	
No	4,766	64.3	35.7	
Hypertension (diagnosed) / medications				0.000
Yes	2,172	70.7	29.3	
No	4,288	62.6	37.4	
Coronary heart disease				0.371
Yes	130	71.1	28.9	
No	6,330	65.2	34.8	
Heart failure				0.016
Yes	26	85.3	14.7	
No	6,434	65.3	34.7	
Renal disease				0.191
Yes	70	76.8	23.2	
No	6,391	65.2	34.8	
Joint disease/rheumatism				0.019
Yes	2,414	68.1	31.9	
No	4,047	63.7	36.3	
Stroke				0.000
Yes	341	79.8	20.2	
No	6,119	64.5	35.5	
Hypertension				0.005
Yes	4,162	67.2	32.8	
No	2,298	62.0	38.0	
Visual impairment				0.000
Present	4,579	69.5	30.5	
Absent	1,881	55.2	44.8	
Hearing impairment				0.000
Present	1,706	72.3	27.7	
Absent	4,754	62.9	37.1	

related injury (75.8%) than male elderly. With regard to physical condition, there were no significant differences between the proportion of obese older persons with fall-related injury and that of the non-obese.

On the other hand, with regard to history of illness, the proportion of older persons with fall-related injury was larger in respondents who had been diagnosed by health personnel as having hypertension/consumed anti-hypertensive medications, heart failure, renal disease, diseases of the joints/rheumatism or stroke. Similarly with respondents who had coronary heart disease, although the differences in proportion were not significant. While according to the health status of the respondents at the time of data collection, there were more older persons with fall-related injury among the respondents with hypertension, and with visual or hearing impairment.

From the results of the bivariate analysis, the variables that could be included in the multivariate analysis were age, gender, history

of illness (hypertension/medications, heart failure, renal disease, diseases of the joints/ rheumatism and stroke, health status (hypertension, visual impairment and hearing impairment), education, occupation and economic status. The highest proportion of older persons with fall-related injury was found among the respondents with low educational level, unemployed, with lowest econmoic status (Table 2).

The results of multivariate analysis showed that the risk of older persons for being injured by falls increased with increasing age, with the magnitude of the risk ([a]OR=1.94;95% CI: 1.46-2.58; p=0.000) for the age group of 80 years and older. Female older persons had a 2.3-fold increased risk for fall-related injury ([a]OR=2.30;95% CI: 1.93-2.73; p=0.000) in comparison with male older persons. Older persons with a history of stroke had a 2.1-fold increased chance of fall-related injury ([a]OR=2.07;95% CI: 1.38-3.09; p=0.000) in comparison with older persons without stroke. Older persons with visual impairment had a 1.4-fold increased chance of suffering from fall-related injury ([a]OR=1.36; 95% CI: 1.14-1.64; p=0.001) in comparison with older persons without impaired vision (Table 3).

DISCUSSION

Falls in older persons are the main cause of morbidity and mortality from unintentional injury in the United States in 2006, accounting for 45.4%.[16] This figure is lower than the prevalence of fall-related injury in older persons (aged ≥60 years) in the year 2013 in Indonesia (65.4%). This may be caused by the relative low socio-economic conditions of the Indonesian community so that an advanced age older persons must still be more actively working to meet their necessities of life.

From the aspect of age, the risk of older persons to experience fall-related injury increases with advancing age. This agrees with the study by Pi et al.[17] in China, who found that in the majority of cases falls occurred in individuals who were over 80 years of age. However, in the study conducted by Orces [18] the investigators found different results. This may be because in Indonesia many older persons have low educational level and lower-middle economic status, so that in their old age they have to continue working hard. In general, persons with low educational level perform more physical work. With increasing age, the body becomes physically weaker through exhaustion. Therefore

Table 2. Associations between socio-economic factors and fall-related injury in older persons

Socioeconomic factors	n Injured elderly	Injured elderly		p
		Falls %	Non-falls %	
Education				0.000
Low	5,536	67.5	32.5	
Middle	763	53.0	47.0	
High	162	48.6	51.4	
Occupation				0.000
No work	3,493	74.3	25.7	
Employee	123	44.5	55.5	
Entrepreneur	509	51.8	48.2	
Farmer/fisher/laborer	2151	56.0	44.0	
Others	184	55.6	44.4	
Economic status				0.000
Lowest	1,394	70.0	30.0	
Lower-middle	1,606	65.7	34.3	
Middle	1,481	67.3	32.7	
Upper-middle	1,220	62.6	37.4	
Upper	760	56.6	43.4	

Table 3. Multiple logistic regression analysis of risk factors for fall-related injury in older persons

Risk factors	N Injured elderly	Injured elderly Falls %	Injured elderly Non-falls %	Adjusted Odds Ratio	95% Confidence Interval	p
Age (years)						0.000
80 and above	817	80.2	19.8	1.94	1.46-2.58	
70 – 79	2,101	72.4	27.6	1.47	1.22-1.77	
60 – 69	3,542	57.7	42.3	1.00	Reference	
Gender						0.000
Female	3,671	75.8	24.2	2.30	1.93-2.73	
Male	2,790	51.6	48.4	1.00	Reference	
Stroke						0.000
Yes	341	79.8	20.2	2.07	1.38-3.09	
No	6,119	64.5	35.5	1.00	Reference	
Visual impairment						0.001
Present	4,579	69.5	30.5	1.36	1.14-1.64	
Absent	1,881	55.2	44.8	1.00	Reference	
Education*						0.085
Low	5,536	67.5	32.5	1.57	0.92-2.69	
Middle	763	53.0	47.0	1.26	0.72-2.20	
High	162	48.6	51.4	1.00	Reference	
Occupation						0.001
No work	3,493	74.3	25.7	1.59	1.06-2.38	
Employee	123	44.5	55.5	1.05	0.56-1.97	
Entrepreneur	509	51.8	48.2	1.12	0.69-1.82	
Farmer/fisher/laborer	2151	56.0	44.0	1.08	0.71-1.62	
Lainnya	184	55.6	44.4	1.00	Reference	
Economic status						0.036
Lowest	1,394	70.0	30.0	1.58	1.15-2.16	
Lower-middle	1,606	65.7	34.3	1.28	0.95-1.71	
Middle	1,481	67.3	32.7	1.44	1.08-1.93	
Upper-middle	1,220	62.6	37.4	1.17	0.87-1.58	
Upper	760	56.6	43.4	1.00	Reference	

their risk of experiencing fall-related injury also increases. According to gender, female older persons have a 2.3-fold greater risk of fall-related injury than do males. This is in agreement with the study results of Kuang et al.[19] showing that females have a 2.3 fold greater risk of falls. This is because female older persons are at higher risk for osteoporosis than are males. The presence of osteoporosis increases the risk for fractures after falls.[10,20] On the other hand, our results differ from the study results of Grundstrom et al.[16] who found a higher risk of fall-related injury in males than in females.

With regard to history of illness, older persons who ever had stroke had a 2.1-fold increased risk of experiencing injury from falls. Similar results were obtained by Thurman et al.[21] and Orces [18] who found that subjects with stroke had a greater risk of falls in comparison with subjects without stroke. This is because in general stroke attacks decrease the functions of the patient's extremities and disturb the body balance so increasing the risk of falls. Older persons with visual impairment have a 1.4-fold higher risk of fall-related injury in comparison with older persons without impaired vision. This is in accordance with the study results of Kuang et al.[19] who found that visual impairment increases the risk of falls almost 2-fold in comparison with normal subjects. This is because at their age (60 years and above), the older respondents usually have visual impairment and move less actively, thus decreasing their strength and balance, which increases their risk of falls.

Our study results showed that educational level was not a risk factor for falls, which differs

from the study results of Hayashi et al.[22] in Japan and Qader et al.[23] in Iraq. These investigators found that the risk of injury from falls was significantly higher in older persons with low educational level in comparison with those of older persons with high educational level. In contrast, with regard to the lowest ownership index (socio-economic status), our study showed similar results with those of the studies by Hayashi et al[22] and Qader et al,[23] in that the risk of falls in older persons with low socio-economic status was significantly greater than in older persons with high socio-economic status. This is because the respondents with high socio-economic status have better welfare, nutrition, and health services. Non-working older persons have a 1.6-fold greater risk of fall-related injury in comparison with working older persons. These results agree with those of the Iraqi study, in that the risk of fall-related injury in non-working older persons is significantly greater in comparison with older persons of working status. Psychological factors, especially depression, as a result of having no occupation, which is caused by age and health conditions, are important risk factors for the occurrence of falls.[23]

One limitation of this study is the lack of data on impairment of balance so that it cannot explain the role of balance in the risk of falls in older persons. In addition, the lack of information on the conditions of the site of injury, e.g. multistory buildings, slippery floors, roads with potholes or uneven surfaces and others, so that these cannot be used as further information on the role of environmental factors on the risk of falls. There is a need for further studies to determine the role of environmental conditions on fall-related injury.

To reduce the resulting morbidity and mortality, internal preventive measures need to be taken, i.e. behavioral changes for a healthy life style, such as consumption of healthy foods to avoid diseases such as stroke, limiting salty foods to avoid hypertension, managing emotions to avoid stress, sufficient rest and routine physical exercise.[23] It is important for older persons to control their health status by routine blood pressure measurements, periodic ophthalmologic examinations, positive socializing such as participating in health gymnastics or religious studies (pengajian) to prevent boredom, and using walking aids if necessary. Based on the results of this study, the Ministry of Health and the Regional Government should cooperate in increasing community health services by maximizing the functioning of community health centers *(puskesmas)* in monitoring and guiding the community, particularly those families at high risk of poor health (both healthy older persons and those with chronic diseases).

CONCLUSION

Older women and those with a history of stroke are at greater risk for fall-related injury.

CONFLICT OF INTEREST

There was no conflict of interest in this study.

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