RESEARCH ARTICLE

pISSN: 0126-074X | eISSN: 2338-6223
https://doi.org/10.15395/mkb.v57.4361
Majalah Kedokteran Bandung. 2025;57(3):225–233

Majalah Kedokteran Bandung (MKB)

Received: March 25, 2025
Accepted: August 28, 2025
Available online: September 30, 2025

Home Environmental Hazard as Extrinsic Factors For Falls Among Community-Dwelling Elderly

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Abstract

Falls among the elderly are a major concern in both clinical practice and public health. Studies have shown that falls occur more frequently at home than outside home.This study aimed to identify the areas and types of home environmental hazards present in the residences elderly individuals. A quantitative descriptive study was conducted from April to May 2024 accross six primary healthcare centers in Bandung, West Java, Indonesia, selected from having the highest number of elderly patients. A total of 100 elderly respondents were recruited using a multistage purposive convenience sampling method. Data collection was carried out using an instrument consisting of two parts: the first part focused on respondent characteristics and the second part on home environmental hazards.The study variables were respondent characteristics and environmental hazards in the terrace, living room, stairs, bedroom, bathroom, kitchen, and garage. Data were analyzed using Microsoft Excel software and presented in tabular form. Results showed that all areas of the home posed potential hazards, with the presence of scattered items on the floor as the commonly identified risk. In specific areas such as the kitchen, high shelves were found, and in the bathroom, there were slippery floors, squat toilets, absence of handrails, and inward-opening bathroom door. Home can be a source of environmental hazards that increase the fall risk among the elderly. It is essential to provide the elderly with adequate information on these risk to encourage preventive actions and, where necessary, home modifications that improve safety and reduce the risk of falls.

Keywords: Elderly, extrinsic factors, fall, home environmental hazards

Introduction

Falls are a significant public health issue among older adults. Each year, approximately 28–35% of individuals aged 65 and older experience a fall, with this figure rising to 32–42% for those over the age of 70.[1] The prevalence of falls varies across countries. In the Region of the Americas, data showed that the proportion of older adults falling each year spans from 21.6% in Barbados to 34% in Chile (average 27.9%).[1,2] In the South-East Asia Region, studies indicate that the annual fall rate among older adults ranges from 6-31% in China and approximately 20% in Japan.[1,3] A study in Korea revealed 5.9% to 25.1% of community-dwelling elderly Koreans experience falls annually.[4] The incidence of falls in Indonesia is increasing. A report based on the Indonesia Family Life Survey (IFLS-5) from year 2014-2015 found that 12.8% of individuals experienced one or more fall-related injuries within the previous two years, with a higher prevalence among women (14.0%) compared to men (11.5%). Of these, 7.6% reported a single fall, while 5.2% experienced multiple fall-related injuries during the same period.[3] In 2018, the incidence varied from 25.4% among community-dwelling older adults to 32.7% among institutionalized older adults.[5]

Falls and the resulting injuries are significant public health issues that frequently demand medical attention.[1] Falls and fall-related injuries represent a significant healthcare concern due to their link with morbidity, disability, hospitalization, institutionalization, and mortality. [6] In Australia, Canada, and the United Kingdom, hospital admission rates due to falls among individuals aged 60 and older range from 1.6 to 3.0 per 10,000 population. Meanwhile, fall-related injuries leading to emergency department visits in the same age group are higher, with

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rates of 5.5 to 8.9 per 10,000 population in both Western Australia and the United Kingdom. According to the World Health Organization, falls result in 20–30% of mild to severe injuries. The primary reasons for fall-related hospital admissions include hip fractures, traumatic brain injuries, and upper limb injuries. As age and frailty increase, older individuals who suffer fall-related injuries are more likely to remain hospitalized for the remainder of their lives.[1,7]

Falls contribute to 40% of all injury-related deaths, with rates vary by country and population group. In the United States, the fall fatality rate for individuals aged 65 and older is 36.8 per 100,000 population (46.2 for men and 31.1 for women). In Canada, the mortality rate for the same age group is 9.4 per 10,000 population. In Finland, for those aged 50 and older, the mortality rate is 55.4 per 100,000 population for men and 43.1 for women.[1] Furthermore, falls can lead to post-fall syndrome, characterized by dependence, loss of autonomy, confusion, immobility, and depression, ultimately resulting in further limitations in daily activities.[1]

A fall is a symptom rather than a condition itself and is often caused by an interaction of multifactorial factors or risks. Fall risk is described as an unforeseen incident where an individual ends up on the ground, floor, or a lower surface.[8] These falls risk encompass intrinsic, situational, and extrinsic factors.[7,8] Intrinsic factors contributing to age-related functional decline include medical conditions and adverse drug reactions.[7] Frequent health conditions, including muscle weakness, vertigo, gait and balance difficulties, visual and hearing impairments, cognitive and sensory deficits, orthostatic hypotension, diabetes, and osteoporosis, play a major role in contributing to falls.[5,9,10] Numerous studies have identified a link between certain medications and an increased risk of falls in older adults, particularly psychotropic drugs like hypnotics, sedatives, antipsychotics, and antidepressants, which may lead to sedation, balance issues, and impaired coordination. Cardiovascular drugs, including diuretics and beta-blockers, may worsen orthostatic hypotension, further raising the risk of falls. Antihistamines and anticholinergic medications can impair cognitive function and cause blurred vision, increasing the likelihood of falling.[9,10] Situational factors are those related to activities being performed, such as walking and talking at the same time, getting distracted by multitasking, rushing to the bathroom, or running to answer a phone call.[7] Extrinsic factors contributing to falls include environmental hazards,[7] unsuitable footwear and clothing, as well as improper walking aids or assistive devices.[11] The extent to which environmental factors influence the risk of falls among older adults remains unclear. According to a systematic review by Kim, Do, and Yim in 2022, environmental factors contribute to more than 20%–22% of falls in the older adult population.[12]

A significant majority of fall-related emergency department visits (71.6%) were due to falls occurring indoors.[13,14] The majority of fall incidents occur at home and in its sorroundings.[13,15] Environmental hazards in elderly homes include uneven flooring, unsecured carpets in the kitchen and bedroom, and a shower area not separated from the toilet. Other factors contributing to falls among the elderly include inadequate lighting in the living room, bathroom, bedroom, and parking garage, as well as clutter and obstacles like wires in the living room and parking area. Additionally, poorly maintained staircases with uneven step heights or slippery surfaces further increase the risk of falls.[16]

Bandung Municipality, the capital of West Java Province, has one of the largest populations of older adults in Indonesia. The presence of environmental hazards in the elderly's residences has not yet been known since studies of the home environmental hazards in elderly residences as a risk factor for falls in Bandung has not yet been conducted. Therefore, a study was carried out to examine the home environmental hazards in the homes of elderly residents in Bandung. The aim of this study was to identify the areas within the residences and the types of environmental hazards that serve as risk factors for falls among the elderly.

Methods

A descriptive quantitative study was conducted in Bandung Municipality, West Java, Indonesia, from April to May 2024. This location was selected because Bandung is one of the cities in Indonesia with the largest elderly population. The study employed a multistage purposive convenience sampling technique. The municipality was divided into six regions, and one region with the highest elderly population was chosen from each region. Within these regions, there were 2–3 Primary Health Centers (*Puskesmas*). The *Puskesmas* with the highest number of elderly individuals in each regions

was selected for the study, resulting in a total of six *Puskesmas*. The minimum sample size based on the calculation for descriptive categorical data was 100 participants. Each *Puskesmas* had a different number of samples, determined by the proportion of its elderly population. Participants were recruited from the selected *Puskesmas* based on the following inclusion criteria: age ≥60 years, seeking treatment or consultation at the *Puskesmas*, male or female, not living in an institution, and if there were multiple elderly individuals living in the same household, only one was chosen to participate as a respondent. Elderly individuals who were not at home during the visit, unwilling to participate, or did not complete the study process were excluded.

The prospective respondents were elderly patients who were present at the Puskesmas at the time of data collection, and if they met the inclusion criteria, the researcher provided information about the study and requested their willingness to be visited at home. If the respondents understood and agreed to participate, they signed an informed consent form, and the researcher, together with the selected respondents, arranged a schedule for the home visit.

Data collection was carried out using an instrument. The development of the instrument to assess the home environment hazards in each room was adapted from the American Association of Retired Persons (AARP) Home Fit Guide, which categorizes elderly homes by room, several statements from HOMEFAST for the observed items, as well as findings from several related publications. The instrument consisted of two sections. The first section of the instrument gathered information on respondent characteristics, such as age (60–70, 70–80, ≥80 years), gender (male, female), education level (no education, elementary school, junior high school, senior high school, higher education), occupation (working, not working), health status (hypertension, diabetes mellitus, or other conditions), and medications used. It also included details of the areas in the home (terrace, living room, stairs, kitchen, bathroom, bedroom, garage), home ownership (owned, rented, or other), length of stay at the current residence (< one year, one to five years, > five years), household companions (none, family, others), total number of floors (single floor, multiple floors), and the floor level of the bedroom. The second section collected data on the environmental hazards present in various areas of the home: on the terrace (7 items), living room (6 items), stairs (7 items), kitchen (5 items), bathroom (7 items), bedroom (9 items), and garage (3 items).

Data were collected through direct observation and interviews during home visits. During the home visits, the researcher conducted observations to identify potential hazards present in each household area, including the terrace, living room, stairs, bedroom, bathroom, kitchen, and garage. Data processing and analysis were performed using Microsoft Excel software. The study was approved by the Health Research Ethics Committee of the National Eye Center Cicendo Hospital in Bandung, with approval number DP.04.03/D.XXIV.16/4311/2024.

Results

The study discovered that the number of female elderly nearly doubled the number of male elderly. The majority of elderly were between 60 and 70 years old. A large proportion had low levels of education, though 13 had higher education. Most elderly were unemployed. Many reported having hypertension and diabetes mellitus, while a smaller group had a history of asthma. Commonly used medications included amlodipine, an antihypertensive drug, and metformin, an antidiabetic drug. Additionally, a smaller subset of elderly used other antihypertensive and antidiabetic drugs, as well as anticoagulants and anti-arrhythmic medications, often in combination with amlodipine or metformin (Table 1).

Most participants lived in their own homes, had resided there for more than five years, and lived with family members. However, some elderly rented their homes and lived alone. The majority of homes were two-story houses, however most elderly having their bedrooms on the first floor. All residences were equipped with bathrooms. The study revealed that one elderly did not have a private bedroom. (Table 1).

The study identified environmental hazards in every part of the residence, some of which could be harmful and posed potential fall risks for the elderly. Table 2 outlines the most frequently observed hazards in different areas of the home. Clutter with items was recognized as a significant hazard in several spaces, including the terrace, living room, and garage. In the bathroom, the lack of a handrail near the toilet was a prominent hazard. Another notable observation was that bedroom doors opened inward, which could pose additional risks.

Cluttered furniture and items, slippery mats

Table 1 Respondent Characteristics

Characteristics (n = 100)	n	Percentage (%)
Age (years)		
60-70	70	70.0
71-80	24	24.0
>8	6	6.0
Gender		
Male	39	39.0
Female	61	61.0
Education		
No education	1	1.0
Elementary School	34	34.0
Junior High School	28	28.0
Senior High School	24	24.0
Higher Educatio	13	13.0
Occupation		
Yes	14	14.0
No	86	86.0
Chronic Diseases		
None	12	12.0
Hypertension	58	58.0
Diabetes Mellitus	15	15.0
Hypertension and Diabetes Mellitus	12	12.0
Asthma	1	1.0
Hypertension or Diabetes Mellitus and Asthma	2	2.0
Medication Used (n=88)		
Amlodipin	59	64.1
Metformin	19	20.7
Candesartan	4	4.3
Ascardia	2	2.2
Others (Bisoprolol, Nifedipin, Ascarbose)	8	8.7
Ownership		
Owned by her/himself	77	77.0
Rent	17	17.0
Others	6	6.0
Length of stay at the current residence		
<one year	1	1.0
one to five years	2	2.0
>five years	97	97.0
Areas in the home		
Terrace	75	75.0
Living room	91	91.0
Stairs	64	64.0
Kitchen	95	95.0
Bathroom	100	100.0
Bedroom	99	99.0
Garage	25	25.0

Table 1 Continued

Characteristics (n = 100)	n	Percentage (%)
Total number of floors		
One	36	36.0
Two	63	63.0
More than two	1	1.0
The floor level of the elderly's bedroom:		
First floor	99	99.0
Second floor	1	1.0

Table 2 Frequent Environmental Hazards In Elderly Homes

Area	Home Environmental Hazards	Percentage (%)
Terrace	Clutters with items	84.0
Living room	Clutters with items or furniture	94.6
Stairs	The step width is less than 30 cm.	95.3
Kitchen	Kitchen items were stored on high shelves.	63.2
Bathroom	No handrail	94.0
Bedroom	The bedroom door opens inward.	72.7
Garage	Clutters with items	88.0

or floors, uneven surfaces or steps, and poor lighting were common hazards found in nearly all areas of the home. An intriguing observation from this study was the presence of pets, such as cats or dogs, both indoors and outdoors (Table 3). Another notable finding was that terraces are frequently used as parking areas, mainly for two-wheeled vehicles. Additionally, steps connecting the terrace to the living room were a safety concern (Figure 1). The discovery of an LPG gas cylinder in the kitchen raises additional concerns. This study showed that 64% of homes had stairs, with many having step dimensions that failed to meet safety standards. Moreover, some stairs were equipped with a handrail on only one side (64.1%), while others lack handrails entirely (37.5%).

In this study, the kitchen, as the main cooking area, was found to have cooking items stored at high positions (Figure 1). To access these items, individuals had to fully extend their arms, stand on tiptoes, or used a chair. The bathroom,

Figure 1 Front Terrace, Bathroom/Toilet, and Kitchen

Table 3 Environmental Hazards in Elderly Homes by Area

Environmental Hazards	n	Percentage (%)
Front terrace (n=75)		
Slippery doormat	44	58.7
Slippery floor	22	29.3
Uneven floor	32	42.7
Terrace cluttered with items	63	84.0
Parked vehicles	27	36.0
Presence of steps/outdoor stairs leading to the terrace	51	68.0
Presence of pets	10	13.3
Living room (n=92)		
Need/have to walk around furniture to pass through the room	14	15.2
Presence of a carpet	36	39.1
Cluttered with items or furniture	87	94.6
Items scattered on the floor	45	48.9
Poor lighting/dark	4	4.3
Presence of pets	9	9.8
Indoor Stairs (n=64)		
Cluttered with items on the steps	25	39.1
Damaged or uneven steps	13	29.3
Poor lighting/dark	35	54.7
No handrails on the stairs	24	37.5
Step width less than 30 cm	61	95.3
Step height greater than 20 cm	50	78.1
Handrails only on one side of the stairs	41	64.1
Kitchen (n=95)		
Kitchen items were stored on high shelves	60	63.2
Using a stool to reach kitchen items	18	18.9
Low lighting/dark	4	4.2
Presence of pets	8	8.4
LPG Gas cylinder for cooking	83	87.4
Bathroom (n=100)		
Slippery floor	54	54.0
No handrails/support bars in the bathroom	94	94.0
Wet floor	61	61.0
Squat toilet	60	60.0
Cluttered with items	48	48.0
Bathroom door swung inwards	82	82.0
Poor lighting/dark	2	2.0
Bedroom (n=99)		
Poor lighting/dark	2	2.1
Area less than 9 m^2	63	63.6
Items scattered on the floor	46	46.4
Cables crossing the middle of the bedroom	2	2.1
Slippery carpet	67	67.6
Bedroom door swung inwards	72	72.7
Uneven floor	3	3.3
Slippery floor	33	33.3
Presence of pets	8	8.8

Table 3 Continued

Environmental Hazards	n	Percentage (%)
Garage (n=25)		
Uneven floor	15	60.0
Slippery floor	2	8.0
Cluttered with items	22	88.0

a frequently used space for the elderly, also contained various hazards. These included the absence of handrails near the toilet, limited space that restricted movement, and the frequent presence of wet floors. Additionally, inward-opening bathroom doors, a common feature in Indonesian homes, were identified as a potential issue for future safety concerns.

The bedroom, where elderly spent most of their time, was found to be particularly hazardous. Risks included cramped spaces, cluttered or scattered items, carpets, slippery floors, cables crossing the room, and inward-opening doors (Table 3).

Discussion

Studies on home environmental hazards among the elderly in Indonesia remain limited. Home environmental hazards are one of the risk factors for falls in the elderly. A study conducted in the United States discovered that most emergency department visits due to falls among community-dwelling elderly took place at home.[13] A similar finding was reported in a study conducted in Yogyakarta, Indonesia, which found that elderly individuals who had experienced falls most often fell at home.[16] The majority of older adults fall due to slipping, tripping, and stumbling.[7] Every area in the home can contribute to fall risk. A study revealed that the primary locations where elderly individuals most frequently fall, in order, were the bedroom, stairs, and bathroom.[13] Another study found different results, indicating that the primary locations where elderly individuals most frequently fall, in order, were the bathroom, kitchen, bedroom, and living room.[17] The specific areas in the house where falls occur vary across studies, as they are influenced by the home's condition and other contributing factors. This study discovered that every area, such as the front terrace, living room, bedroom, indoors/outdoors stairs, kitchen, bathroom, and garage, in elderly's homes contain potential risks for falls. In general, a significant fall risk for the elderly is the presence of excessive clutters obstructing their pathways, which was observed in nearly all areas of their homes, including indoor stairs and the bathroom. This condition makes it challenging for the elderly to move from the front terrace to various areas inside the house, increasing the risk of tripping or stumbling over object. A similar finding was also observed in a study conducted in Australia, where only 32% of elderly homes were found to have home clutters free.[18]

Elderly homes with outdoors and indoors stairs can be a risk to fall. A study found that both indoor and outdoor stairs contribute to the risk of falling in the elderly, with non-safe stairs significantly affecting the fall rate.[19] This study discovered that more than 50% elderly's home had outdoors stairs. These stairs were always used by the elderly when entering or leaving the house. These stairs can pose a fall risk due to their uneven surfaces. Indoor stairs are also found in elderly homes, however, nearly all elderly individuals have their bedrooms on the first floor, with only one home where the elderly person's bedroom is on the second floor. This arrangement is highly beneficial, as it prevents the elderly from having to frequently use the stairs to reach their bedroom. This is especially important considering that many staircases do not meet safety standards, such as having step widths of less than 30 cm, step heights exceeding 20 cm, poor lighting, and excessive clutter.

Carpets or indoor/outdoor mats, especially slippery ones, can cause elderly individuals to slip and fall.[7] This study revealed that carpets were present in certain areas of the home, such as the front terrace, the living room and bedroom. Based on the results of the study, it is recommended that elderly individuals should choose carpets or indoors/outdoors mats that are attached to the floor to prevent slipping.

The kitchen is an area of the home commonly used by the elderly. This study discovered that cooking items were often stored in high shelves, a finding supported by Kim.[20] Reaching for items in high shelves can cause balance issues, leading to falls in the elderly.

Most fall incidents in bathroom/toilets are

linked to the fact that this is where individuals exercise the most independence and are often alone due to the need for privacy. A study revealed that, among all areas in a home, the bathroom/toilets poses the highest fall risk for elderly.[18,19] Elderly individuals often fall due to wet, slippery, and unclean bathroom conditions, as well as the absence of handrails or support bars.[21]these problems are poorly understood in Vietnam. A cross-sectional study was performed at seven hospitals in Thai Binh province, Vietnam, to investigate the individual and environmental factors associated with recurrent falls among elderly patients hospitalized due to fall injuries in Vietnam. A history of recurrent falls within the last 12 months, sociodemographic, health, and clinical characteristics, as well as environmental conditions, were obtained via self-reported interviews. Multivariate logistic and Poisson regression models were used to identify associated factors. Overall, the mean fall episodes in the last 12 months were 1.8 (Standard deviation-SD = 1.2 This study yielded similar findings, revealing that most bathrooms/toilets in elderly homes had slippery, wet floors and lacked essential safety features such as handrails or support bars. Slippery bathroom floors or unsecured mats can heighten the risk of falls for older adults. A floor can become slippery if non-slip resistant materials are exposed to water, cleaning agents, or other substances that compromise their slip resistance.[22] As such, the best bathroom flooring should feature a dry surface, a non-slip surface, and mats that are securely attached, if present. Additionally, many of these homes had squat toilets and doors swung inwards which can further increase the risk of falls. Squat-style toilets have been widely used since ancient times in various Asian regions, including India, Japan, China, and Indonesia. As a result, they are commonly referred to as 'Asian-style toilets' or 'Eastern-style toilets.[23] The use of squat toilets is often considered more hygienic than sitting toilets, as the body does not come into direct contact with the toilet surface, which may serve as a potential source of germ contamination. Moreover, squat toilets are perceived to be healthier, as the squatting posture during defecation aligns more closely with the natural ergonomics of the human body. However, such perceptions are largely shaped by cultural norms.[23] Toileting includes squatting, standing, and using the hands and arms. Both activities demand strong body coordination, balance, and sensory abilities.[24] Squat toilets can pose physical challenges for certain populations. For elderly, the act of squatting and standing may lead to increased risk of falls. Therefore, it is recommended that squat toilets intended for older adults be equipped with handrails or other assistive devices to enhance safety and accessibility.[18] Inward-swinging bathroom/toilet doors can present significant barriers for elderly, particularly when space is limited and caregiver assistance is required to enter the bathroom. This design also poses substantial difficulties for older adults who use wheelchairs.[25] Moreover, inward-swinging doors could pose a hazard in case of an emergency,[18] because the door cannot be opened due to being blocked by the elderly person's body.

This study has several limitations. Firstly, the respondents were only selected from those who visited the *Puskesmas*, which may not provide a comprehensive representation of elderly individuals in the community. Future study should include elderly individuals from the community. Secondly, the study focused solely on the extrinsic factors contributing to fall risk and did not gather information on whether participants had experienced falls previously or the specific locations where these falls occurred. Therefore, additional studies are necessary to explore the relationship between hazards in the home environment and fall incidents, as well as to determine the most frequent fall locations in elderly households. Despite these limitations, the study successfully identified various areas and items in the homes of elderly individuals that contribute to fall hazards.

In conclusion, every area of the home may contain potential hazards that increase the risk of falls in elderly individuals. Common problems include excessive clutter, unsafe stairs, high kitchen shelves, slippery floor coverings, squat toilets without handrails, and bathrooms lacking safety features. Preventive strategies should focus on identifying hazards and implementing simple modifications to improve safety in the home environment.

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