

# APPLICATION OF THE HIRARC METHOD TO ASSESS HOME ENVIRONMENTAL HAZARDS AMONG ELDERLY: THE ROLE OF FUNCTIONAL INDEPENDENCE AND NUTRITIONAL STATUS

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## ABSTRACT

**Background:** The increasing elderly population is associated with an increased risk of injury due to declining physical function and hazards within the home environment. Home safety is influenced by both environmental and individual factors, including independence level and nutritional status. The Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method can be used to identify and assess home environmental hazards systematically

**Purpose:** This study aimed to analyze the relationship between independence level and nutritional status with home environmental hazard levels among older adults based on the HIRARC method.

**Methods:** A cross-sectional analytical study was conducted among 30 alderly selected through total sampling. Independence level was measured using the Barthel Index, nutritional status was assessed using Body Mass Index (BMI), and home environmental hazards were evaluated using the HIRARC method. Data were analyzed using descriptive statistics and Spearman rank correlation tests with a significance level of 0.05.

**Results:** Most respondents were female (56.7%) and aged 60–69 years (66.7%). Nearly half had normal nutritional status (46.7%) and were categorized as independent (46.7%). Home hazard assessment indicated that 53.3% of homes were at moderate risk. The most common hazards were slippery bathroom floors (60.0%), inadequate lighting (46.7%), and the absence of handrails (40.0%). Significant relationships were found between independence level and home environmental hazards ( $p=0.004$ ), between nutritional status and home environmental hazards ( $p=0.028$ )

**Conclusion:** Independence level and nutritional status are significantly associated with home environmental hazard levels among elderly. Improving home safety, maintaining functional independence, and promoting optimal nutritional status are important strategies to prevent injuries and support healthy aging.

**Keywords:** Elderly, HIRARC, Nutrision Status, Barthel Index, Nutritional Status, Home Environmental Hazards

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## **BACKGROUND**

Rising life expectancy has led to a sustained increase in the number of elderly people (seniors) year after year. The Central Statistics Agency (BPS) reports that the number of elderly people in Indonesia will reach approximately 33.94 million by 2025, or 11.93% of the total population, indicating that Indonesia has entered an aging society (BPS, 2025). The increasing number of elderly presents challenges because the aging process is accompanied by various physiological changes, such as decreased muscle strength, balance, mobility, and sensory function, which can increase susceptibility to injury and reduce the ability to perform daily activities (Mauk, 2018).

Level of independence and nutritional status are two important factors influencing the quality of life of elderly. Independence reflects the ability of elderly to independently perform daily activities, such as moving, transferring, eating, and bathing. This is generally measured using the Barthel Index (Mahoney & Barthel, 1965). On the other hand, poor nutritional status can lead to decreased muscle mass, physical weakness, and impaired balance, while being overweight can limit mobility and increase the burden on the musculoskeletal system. These conditions can potentially reduce the ability of elderly to adapt to various risks in their living environment (WHO, 2021).

From an occupational health and safety (OHS) perspective, accidents are influenced by the interaction between human and environmental factors (ILO, 2022). This concept applies not only to the workplace but is also relevant to the home environment of elderly. Various conditions such as slippery floors, inadequate lighting, stairs without handrails, cluttered electrical cords, and unsafe furniture layout can be sources of hazards that increase the risk of injury. To identify and control these risks, the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method can be used as a systematic approach to assess the risk level of the home environment.

The condition of the home environment contributes to the safety of elderly. Research by Mackenzie, Byles, and Higginbotham (2000) found that slippery floors, obstructions in walkways, inadequate lighting, and a lack of handrails are factors associated with an increased risk of injury in elderly. Furthermore, research by Ziebart et al. (2021) also showed that most senior homes still have various potential hazards that have not been optimally identified. However, most studies have focused on fall risk factors or health conditions of elderly, while research combining nutritional status, level of independence, and level of home environmental risk using the HIRARC approach is relatively limited.

Based on this description, nutritional status and independence level are suspected to be associated with the level of home environmental risk faced by elderly. Elderly individuals with poor nutritional status and low independence levels are potentially more vulnerable to hazards in their living environment than elderly with good nutritional status and the ability to function independently. Therefore, this study was conducted to analyze the relationship between independence level, nutritional status, and home environmental risk levels in elderly using the HIRARC method. The results of this study are expected to provide a basis for developing health promotion programs, injury prevention programs, and developing a safe and friendly home environment for the elderly.

## **OBJECTIVE**

The Objective from this research is to analyze the relationship between the level of independence and nutritional status with the level of environmental hazards in the home in the elderly based on the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method. In addition, this study also aims to identify potential hazards in the elderly's home environment and assess the level of risk as an effort to prevent injuries and improve the safety of the elderly in their residential environment.

## **METHODS**

This research is a quantitative study with an analytical observational design using a cross-sectional approach. The research was conducted in January 2025 at one of the Elderly Posts in Bluru Kidul District, Sidoarjo Regency. The research population was all elderly people registered at the Elderly Posyandu, a total of 30 people. Considering the relatively small population, the sampling technique used was total sampling, the entire population was used as research respondents. Inclusion criteria included elderly aged  $\geq 60$  years, able to communicate well, and willing to participate in this research. While elderly with severe cognitive impairment or not at home at the time of observation were excluded from the research.

The independent variables in this study were the level of independence and nutritional status of the elderly, while the dependent variable was the level of risk in the home environment. Independence was measured using the Barthel Index, which consists of 10 components of Activities of Daily Living (ADL), including eating, bathing, dressing, moving, using the toilet, and transferring. Nutritional status was measured using Body Mass Index (BMI), obtained from respondents' weight and height measurements, then categorized based on the Asian BMI classification. The level of risk in the home environment was assessed using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method through direct observation of the home, including the yard, living room, bedroom, bathroom, kitchen, and stairs. Observed potential hazards included slippery floors, inadequate lighting, lack of handrails, cluttered electrical wiring, obstructed walkways, and uneven floors. Each identified potential hazard was then rated based on its likelihood and severity to determine the level of risk.

Data were collected through structured interviews, anthropometric measurements, and observations of the home environment. Univariate analyses were conducted to describe respondent characteristics, nutritional status, level of independence, and level of risk in the home environment, using frequency distributions, percentages, means, and standard deviations. Bivariate analyses were conducted using Spearman's rank sum test to determine the relationship between level of independence and nutritional status and level of risk in the home environment at a 95% confidence level ( $\alpha = 0.05$ ).

## **RESULTS**

### **Respondent Characteristics**

This study involved 30 elderly people registered as participants of the Elderly Posyandu in Village X. Based on gender, most of the respondents were female, namely 17 people (56.7%), while 13 respondents were male (43.3%). Based on age group, the majority of

respondents were in the age range of 60–69 years, namely 20 people (66.7%), followed by the age group of 70–79 years, namely 7 people (23.3%) and  $\geq 80$  years, namely 3 people (10.0%).

Table 1. Respondent Characteristics Based on Gender and Age

Gender	n	%
Male	13	43.3
Female	17	56.7
Total	30	100
Age group (Year)		
60-69	20	66.7
70-79	7	23.3
$\geq 80$	3	10.0
Total	30	100

### Nutritional Status of the Elderly

Based on Body Mass Index (BMI) measurements, the majority of respondents (14) had normal nutritional status. Eight (26.7%) were overweight, four (13.3%), and four (13.3%) were obese. These findings indicate that the majority of elderly individuals had a nutritional status within the normal range, although some respondents were found to be underweight or overweight.

Table 2. Distribution of Nutritional Status of the Elderly Based on BMI

Nutritional status (IMT)	n	%
Underweight	4	13.3
Normal	14	46.7
Overweight	8	26.7
Obesitas	4	13.3
Total	30	100

### Elderly Independence Level

Based on the Barthel Index, the majority of respondents (14) were classified as independent. Nine (30.0%) experienced mild dependence, four (13.3%), and three (10.0%) experienced moderate dependence. No respondents were completely dependent. These results indicate that most elderly individuals are still able to perform daily activities independently, although some require assistance with certain activities.

Table 3. Distribution of Elderly Independence Levels Based on the Barthel Index

Independence Level	n	%
Independent	14	46.7
Light Dependence	9	30.0
Moderate Dependence	4	13.3
Heavy Dependence	3	10.0
Total	30	100

### Home Environmental Risk Level Based

The results of hazard identification and risk assessment using the HIRARC method for each house showed that the majority of respondents' houses were in the medium risk category (15 houses (50.0%). Eight houses (26.7%) were in the low risk category, and seven houses

(23.3%) were in the high risk category. The most commonly identified potential hazards were slippery bathroom floors (18 houses (60.0%), inadequate lighting (14 houses (46.7%), lack of handrails in bathrooms or stairs (12 houses). (40.0%), electrical cables crossing footpaths (8 houses (26.7%), and furniture layout that hinders the mobility of the elderly (7 houses (23.3%).

Table 4. Distribution Table of Home Environmental Hazard Levels

Risk Level	n	%
Low	8	26.7
Medium	15	50.0
High	7	23.3
Total	30	100

### The relationship between Independence Level and Home Environmental Risk Level

Based on the Spearman Rank Test, the p-value was 0.004 ( $p < 0.05$ ) with a correlation coefficient (r) of -0.512. These results indicate a significant relationship between the elderly's independence level and the level of home environmental risk. The negative correlation coefficient indicates that the higher the elderly's independence level, the lower the level of home environmental risk they face.

Table 6. Relationship between Level of Independence and Level of Danger in the Home Environment

Variabel	r	p-Value
Level of Independence (Barthel) with Level of Danger of Home Environment	-0.512	0.004

Description: Spearman Rank Test,  $\alpha = 0.05$ .

### The relationship between nutritional status and home environmental risk levels

Based on the Spearman Rank test showed a p-value of 0.028 ( $p < 0.05$ ) with a correlation coefficient (r) of -0.401. These results indicate a significant relationship between nutritional status and the level of home environmental risk. Elderly people with better nutritional status tend to have better physical ability to perform activities and adapt to home environmental conditions, potentially facing lower risks than elderly people with poor nutritional status.

Table 7. Relationship between Nutritional Status and the Level of risk in the Home Environment

Variabel	r	p-Value
Nutritional Status (BMI) with Home Environmental Hazard Level	-0.401	0.028

Description: Spearman Rank Test,  $\alpha = 0.05$ .

## DISCUSSION

### Home Environmental Hazard Levels

During the aging process, the elderly experience a decline in physical function such as reduced muscle strength, body balance, reflexes, and visual acuity. This condition makes the elderly more vulnerable to various hazards in the home environment compared to productive age groups. Based on the results of hazard identification using the Hazard Identification, Risk

Assessment and Risk Control (HIRARC) method, it shows that most elderly homes are in the medium risk category with the most common potential hazards found including slippery bathroom floors, inadequate lighting, and the lack of handrails in the bathroom area and stairs. These findings indicate that the home environment still has various conditions that have the potential to cause injury to the elderly, especially when carrying out daily activities that involve mobility and changing body positions. The findings of this study align with those of Mackenzie et al. (2000) showed that various home environmental conditions, such as slippery floors, obstacles on walking paths, and the lack of handrails, are factors that contribute to the increased risk of injury in the elderly. Research by Ziebart et al. (2021) also found that most elderly homes still have various potential hazards that have not been identified or optimally controlled. These results indicate that modifying the home environment is an important strategy for preventing injuries in the elderly. Hazards that might be considered minor to adults, such as wet floors or poor lighting, can be triggers for injuries in the elderly. Therefore, a safe home environment is an important factor in supporting the quality of life and independence of the elderly.

The application of the HIRARC method in this study provides a more systematic overview of potential hazards in the home environment. Through the hazard identification and risk assessment process, various conditions that have the potential to cause injury can be identified early, allowing for appropriate control measures. This approach aligns with occupational safety and health (OHS) principles, which emphasize the importance of controlling risks before accidents or injuries occur

### **Relationship between Independence Level and Home Environmental Danger Level**

The analysis results show a significant relationship between the level of independence of the elderly and the level of danger in the home environment. Elderly people with higher levels of independence tend to live in homes with lower levels of risk than elderly people with moderate to severe dependency. These findings show that the ability of the elderly to carry out daily activities is related to the safety conditions of their residential environment.

A good level of independence allows the elderly to mobilize more safely, be able to adapt to environmental conditions, and be able to recognize various potential hazards that can cause injury. Conversely, elderly with limitations in daily activities tend to be more vulnerable to hazards in their home environment due to their limited ability to avoid or cope with risky situations. The results of the study show that limitations in daily living activities (ADL) play an important role in increasing the vulnerability of the elderly to falls and injuries in their living environment. An unsafe home environment can exacerbate the impact of functional limitations, increasing the risk of accidents in elderly.

These findings align with those of Das Gupta et al. (2024) stated that unsafe home environmental conditions are associated with an increased incidence of falls in the elderly, and this relationship is partly mediated by limitations in daily activities (ADL/IADL). In other words, elderly people who have lower functional abilities tend to be more vulnerable to the negative impacts of various hazards in the home environment. In addition to individual factors, the characteristics of the home environment also play a role in maintaining the independence of elderly. Research conducted by Lee (2021) showed that exposure to environmental hazards

in the home is associated with an increased risk of falls in community-dwelling elderly. Hazards such as slippery floors, inadequate lighting, obstructions in walkways, and the lack of handrails can reduce the ability of elderly to safely perform daily activities.

These research findings are further supported by a systematic review by Kim et al. (2023), who concluded that the home environment is an important factor in preventing injuries and maintaining the functional abilities of elderly community-dwelling. A safe home environment allows elderly to perform activities independently, while an environment with numerous hazards can accelerate functional decline and dependence. Therefore, efforts to prevent injuries in the elderly need to be carried out not only through modifying the home environment, but also through interventions aimed at maintaining the functional abilities and independence of the elderly (Mahoney & Barthel, 1965, In Rani *et al.*, 2025).

The study results showed a significant relationship between nutritional status and the level of hazards in the home environment. Elderly individuals with normal nutritional status tended to have lower levels of home environmental risks than those with malnutrition or obesity. This finding suggests that nutritional status also plays an important role in supporting the physical ability of elderly to perform activities and adapt to their living environment. Good nutritional status contributes to maintaining physical function, balance, and mobility, necessary for safely performing daily activities (Dent et al., 2021).

### **The Relationship Between Nutritional Status and the Level of Hazard in the Home Environment**

This finding aligns with the findings of Wang et al. (2022) which showed that poor nutritional status is associated with decreased functional ability and increased risk of falls in the elderly. Another study by Yeung et al. (2023) also found that malnutrition and the risk of malnutrition are associated with decreased physical performance, impaired balance, and increased dependence in daily activities. This condition makes it more difficult for the elderly to adapt to various potential dangers in the home environment. This finding is reinforced by the recent findings of Wang et al. (2024) which showed that sarcopenia and suboptimal nutritional status are factors that contribute to the increased incidence of falls in elderly people living in the community. Decreased muscle strength and mobility make the elderly more susceptible to injury when faced with various environmental hazards such as slippery floors, stairs without handrails, or inadequate lighting. Poor nutritional status can lead to decreased muscle mass and strength, reduced balance, and increased fatigue during daily activities. These conditions can increase the elderly's vulnerability to various hazards in the home environment. Conversely, being overweight and obese can also impair physical function by increasing the load on the musculoskeletal system, reducing mobility, and limiting mobility, potentially increasing the risk of injury if the elderly are exposed to unsafe environmental conditions (Cruz-Jentoft & Sayer, 2023).

The results of this study also support the concept of healthy aging developed by the World Health Organization (WHO), which places intrinsic capacity and functional ability as the main components in maintaining the quality of life of the elderly. Good nutritional status plays an important role in maintaining muscle strength, balance, and mobility, enabling elderly to perform activities more safely and independently (WHO, 2022). Therefore, efforts to

improve the safety of elderly should not only be carried out through improving the home environment and controlling hazards using the HIRARC approach, but also through ongoing nutritional monitoring and interventions to maintain functional capacity.

## CONCLUSION

Based on the research results, it shows that most elderly people have normal nutritional status, an independent level of independence, and live in a home environment with a moderate level of hazard risk based on the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method. The most frequently encountered hazards include slippery bathroom floors, inadequate lighting, and the lack of handrails in risky areas. The analysis shows a significant relationship between the level of independence and nutritional status and the level of hazards in the home environment, where elderly people who are more independent and have better nutritional status tend to live in a home environment with a lower risk level. These findings indicate that the safety of the elderly is not only influenced by physical environmental conditions, but also by individual factors related to functional ability and nutritional status. Therefore, efforts to prevent injuries in the elderly need to be carried out comprehensively through controlling home environmental hazards, increasing independence, and maintaining optimal nutritional status to support the creation of a safe, healthy, and elderly-friendly home environment.

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## CONFLICTS OF INTEREST

There were no obstacles in implementing the research

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