ปัจจัยเสี่ยงที่สัมพันธ์กับการหกล้มในผู้สูงอายุวัยปลายที่พึ่งพาตนเองได้ในพื้นที่ชนบทของประเทศไทย

Risk Factors Associated with Falls Among Independent Oldest-Old Adults in Rural Thailand

นิพนธ์ต้นฉบับ **Original Article**

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บทคัดย่อ

วัตถุประสงค์: เพื่อทดสอบความสัมพันธ์ระหว่างการหกล้มกับปัจจัยเสี่ยงภายในและภายนอกในผู้สูงอายุชาวไทยที่อายุมากกว่า 80 ปี **วิธีการศึกษา:** ดำเนินการช่วงเมษายนถึงพฤษภาคม 2568 มีผู้เข้าร่วมวิจัยจำนวน 57 คน เป็นผู้สูงอายุที่พึ่งพาตนเองได้และอาศัยอยู่ชุมชนของ อ.ท่าศาลา จ.นครศรีธรรมราช เก็บข้อมูลด้วยแบบสัมภาษณ์โครงสร้างสำหรับ 1-ปัจจัยภายใน ได้แก่ ปัจจัยด้านชีวภาพ เศรษฐานะและสังคม และพฤติกรรม 2—ปัจจัยภายนอกด้านอันตรายทางสิ่งแวดล้อม และ 3-ประวัติการล้ม และการประเมินสิ่งแวดล้อมในบ้าน วิเคราะห์ความสัมพันธ์ด้วยการทดสอบไคสแควร์และการถดถอยโลจิสติกพหุคูณ **ผลการศึกษา:** พบว่าร้อยละ 52.6 ของผู้สูงอายุวัยปลายเคยหกล้มอย่างน้อยหนึ่งครั้งในช่วง 12 เดือนที่ผ่านมา ปัจจัยภายในที่ทำนายการหกล้มได้อย่างมีนัยสำคัญ ได้แก่ ภาวะเสียการทรงตัว (adj. OR = 5.88, 95% CI = 1.55 - 22.21, P-value = 0.009) และการใช้ยาลดความดันโลหิต (adj. OR = 6.82, 95% CI = 1.78 - 26.16, P-value = 0.005) **สรุป:** ความเสี่ยงของการหกล้มสัมพันธ์กับสมรรถภาพทางกายและการใช้ยา การป้องกันการหกล้มในผู้สูงอายุวัยปลายที่พึ่งพาตนเองได้ส่วนหนึ่งควรเน้นการปรับสภาพแวดล้อม การทำกายภาพบำบัด และการทบทวนการใช้ยาโดยเภสัชกร

คำสำคัญ: การหกล้ม; ผู้สูงอายุวัยปลายที่พึ่งพาตนเองได้; ปัจจัยเสี่ยงภายในและภายนอก; ยาลดความดันโลหิต; พื้นที่ชนบท

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Abstract

Objective: To examine associations between falls and internal and external risk factors among Thai older adults over 80 years old. **Methods:** A total of 57 functionally independent adults aged over 80 years, residing in the community of Thasala District, Nakhon Si Thammarat, Thailand, participated in the study from April to May 2025. Data were collected via structured interviews (i.e., 1-intrinsic factors encompassing the biological, socioeconomic, and behavioral domain, 2-extrinsic factors focusing on environmental hazards, and 3-fall history) and home environment assessments. Associations were tested using chi- square tests and multivariate logistic regression. **Results:** It was found that 52.6% of the participants experienced at least one fall in the past 12 months. Significant predictors of falls included balance disorders (adj. OR = 5.88, 95% CI = 1.55 - 22.21, P-value = 0.009) and the use of antihypertensive medications (adj. OR = 6.82, 95% CI = 1.78 - 26.16, P-value = 0.005). **Conclusion:** Falls were associated with physical function and medication use. To prevent falls in independent oldest- old adults, in part, one might promote environmental modification, physical therapy, and pharmacist-led medication review.

Keywords: falls; independent oldest- old adults; intrinsic and extrinsic risk factors; antihypertensive drugs; rural area

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Introduction

The phenomenon of global aging has accelerated in recent decades, with people living longer due to advances in public health, medicine, and socioeconomic development. According to the World Health Organization,[1] the population aged 80 and above will triple to 426 million by 2050. In Thailand, this demographic group currently represents 10.9% of the elderly population and continues to grow rapidly.[2] While increased longevity is a significant achievement, it also brings complex health challenges, such as age- related sensory and mobility loss as well as a higher prevalence of chronic diseases like heart disease, stroke, cancer, and dementia,[3] one of which is an increased risk of falls among the elderly. Falls are among the leading causes of injury-related morbidity and mortality in older adults, with the risk increasing with age and frailty, particularly among those over 80 years old.[4] In Thailand, the incidence of falls is highest among the oldest-old (80+ years), exceeding that observed in early-old adults (60 - 69 year) and middle-old adults (70 - 79 years).[5] This indicates that both the incidence and frequency of falls increase progressively with advancing age. Falls can result in fractures, head trauma, loss of independence, long- term disability, institutionalization, and death. In addition to physical

injuries, falls carry significant psychological and economic burdens, both for individuals and for the healthcare system. According to Thailand's National Statistical Office, 16.9% of adults aged 80 years and older experienced a fall, and 29.0% suffered fall-related injuries requiring either outpatient treatment or inpatient hospitalization, which resulted in limitations in performing daily activities, as reported in Thailand.[5]

The multifactorial nature of falls encompasses intrinsic factors and extrinsic factors.[6] Intrinsic factors such as chronic disease, physical decline, and medication use,[7,8] while extrinsic factors like environmental hazards,[9] particularly in the home. As older adults spend most of their time at home,[10,11] which becomes the anchor of daily life with age,[12] housing conditions and their surroundings are integral to fall prevention. However, most studies have examined falls among the oldest dependent adults in settings such as nursing homes,[13] hospitals,[14-16] and community studies.[17] Although much research has focused on frail or institutionalized elderly individuals, limited attention has been paid to functionally independent adults aged 80 and older who still maintain autonomy in basic daily living (ADLs),[18] such as dressing, bathing, toileting, transferring and eating without assistance. Research on falls among independent oldest-old adults is critically important for developing fall-prevention strategies that address socioeconomic, lifestyle or behavioral, and environmental factors to maintain independence and enhance quality of life. In southern Thailand, falls pose a major health issue for older adults. For example, lower education level and unsafe house flooring were identified as significant risk factors in the southern border provinces of Pattani, Yala, and Narathiwat.[19] A broader survey across seven southern Thai provinces identified independent risk factors for falls, including female gender, employment status, cognitive impairment, semi-dependent functional ability, balance problems, visual and hearing impairments, polypharmacy, reliance on assistive devices, and outdoor toilet use.[20] Although fall risk is multifactorial, the relative importance of these factors varies by sociodemographic, behavioral, and rural context of southern Thailand. Nakhon Si Thammarat has the highest proportion of the oldest-old adults in this region[21]; however, research on fall risk within this demographic remains limited.

This omission creates a critical knowledge gap, especially in rural areas where inadequate healthcare resources and unsafe housing conditions may contribute to elevated fall risk among the oldest-old. Moreover, the rising prevalence of hypertension among older adults, along with the use of antihypertensive drugs, is increasingly recognized as a modifiable risk factor for falls in this age group. This study aimed to identify both intrinsic and extrinsic risk factors associated with falls among functionally independent oldest-old adults living in a rural Thai community. By examining intrinsic factors, including biological, socioeconomic, and behavioral domains, alongside extrinsic risk factors such as environmental domains,[6,22] the study could contribute to a more holistic understanding of fall risk in this growing population and provide evidence to inform multidisciplinary prevention strategies.

Methods

This community-based cross-sectional study was conducted in Thasala District, Nakhon Si Thammarat Province, southern Thailand, between April and May 2025. This cross-sectional survey study was conducted between April and May 2025. The study aimed to investigate falls risk factors among functionally independent oldest-old adults living in the community.

According to the available census records from Thasala District, Nakhon Si Thammarat Province, approximately 350 individuals were identified as functionally independent. This subgroup constituted the target population of the study. Sample size estimation was conducted using G*Power 3.1 for chi-square tests of independence. With an alpha level of 0.05, a power of 0.80, and a medium effect size of 0.30, a minimum of 52 participants were required.[23] Ultimately, 57 participants were successfully recruited through multistage cluster sampling, representing approximately 16% of the functionally independent oldest-old population in the district. While this sample size may not allow broad generalization to the national or international population, it was considered statistically sufficient and contextually representative for this specific rural setting, and provided meaningful insights into fall risk among this hard-to-reach subgroup. Participants were selected using multistage sampling. First, Thasala District was randomly chosen from districts with high proportions of independent older adults. Then, three subdistricts were selected using simple random sampling. Within these subdistricts,

proportional stratified random sampling was employed. Finally, one eligible participant per household was selected using simple random sampling, guided by household rosters from community health volunteers. Inclusion criteria were age ≥ 80 years, living in the study area for ≥ 1 year, being able to perform activities of daily living (ADLs) independently,[18] being able to communicate clearly, and willing to provide informed consent. Individuals with cognitive impairment or dependency were excluded.

Research instruments and data collection procedure

Data were collected through face-to-face interviews conducted by trained interviewers under principal investigator's supervision. The structured questionnaire consisted of three sections namely (1) intrinsic factors encompassing the biological, socioeconomic, and behavioral domain, (2) extrinsic factors focusing on environmental hazards, and (3) fall history. The intrinsic and extrinsic factors for falls were adopted from the CDC and WHO framework.[6,22]

For biological domain of the intrinsic factors, we collected the participant's age, sex, BMI, chronic disease (e.g., hypertension, diabetes), health problems (e.g., balance disorders, vision impairment, sleep disturbance), and medication use (antihypertensives, sedatives, hypnotics, analgesics, diuretics). For socioeconomic domain, we collected religion, education level, employment status, living arrangement, and income adequacy. For behavioral domain, we assessed the participant's physical activity (exercise more than 30 min for < 3 times per week or ≥ 3 times per week), activity engagement classified as social grouping (village committee, elderly club, and others), and no social grouping. Functional ability in daily activities was evaluated using ADL (yes (dressing, bathing, toileting, transferring and eating) and no) and Instrumental Activities of Daily Living (IADL) classified as "no perform" and "perform" (cleaning, cooking, shopping, and other).

For extrinsic factors, environmental hazards in the home were assessed using a checklist adapted from WHO guidelines, including split-level surfaces (yes and no), slippery floors (yes and no), obstacles (yes and no), and cleanliness (yes and no).

In the last section, fall history was assessed with questions about fall occurrence in the past 12 months, including frequency (no fall and single /recurrent fall), fall time (morning, during the day, nighttime), fall location (bathroom, living room, bedroom, kitchen, stairs, around the home), types of falls (tripping over obstacle, slip, faint, misstep, other), and injury (bruises/abrasions/broken bones/head injury, non-injurious).[24] Falls were defined as "an event which results in a person coming to rest inadvertently on the ground or lower level."22

Research instrument quality assurance

To test for internal consistency reliability, 30 individuals with characteristics comparable to the participants were asked to complete the questionnaire. Internal consistency reliability was high with a Cronbach's alpha coefficient of 0.83. Based on two raters, inter-rater reliability was also high with a Cohen's kappa coefficient of 0.78.

Ethical protection for participants

The study was approved by the Human Research Ethics Committee of Walailak University (WUEC-23-195-02), and informed consent was obtained from all participants.

Data analysis

Descriptive statistics were used to summarize participant characteristics and fall-related variables. Chi-square tests were applied to identify associations between risk factors and fall incidence. Multivariate logistic regression was conducted to determine independent predictors of falls. Adjusted odds ratios (adj. ORs) and 95% confidence intervals (CIs) were reported. Statistical significance was set at a type I error of 5%. Data were analyzed using SPSS version 29.0 (IBM Corp., Armonk, NY, USA).

Results

Of the total of 57 oldest-old adults participating in the study. the majority were aged 80 years and older, with ไนที่ comprising 70.2% of the sample (Table 1). Within the domain of intrinsic factors, several dimensions were assessed, including biological, socioeconomic, and behavioral dimensions. Regarding health status, hypertension (64.9%), dyslipidemia (54.4%), and diabetes (29.8%) were the most common chronic diseases. Functional impairments such as balance disorders (59.6%), knee degeneration (57.9%), and visual impairment (59.6%) were also prevalent. Notably, 61.4% of participants used antihypertensive medications. In terms of socioeconomic factors, most participants lived with others (86.0%) and had some form of conventional education

(96.5%). The majority were unemployed (89.5%) and also had insufficient income (56.1%). In the behavioral dimension, participants (98.2%) were not involved in any social groups, and the majority exercised less than three times per week (80.7%). As part of the extrinsic factors, environmental hazards in the participants' homes were assessed, revealing low levels of environmental risk among participants. A small percentage of participants had split-level surfaces (28.1%), slippery floors (1.7%), obstacles in their environment (19.3%), and unclean environments (17.5%). The majority of fallers were female (70.2%) and younger than 90 years old (91.2%). Among functionally independent oldest-old adults, 30 of 57 participants (52.6%) reported experiencing at least one fall within the past 12 months (i.e., fallers) (Table 1).

Table 1 Demographic and clinical characteristics of the participants (N = 57).

Characteristic	N (%)		
	Total (N = 57)	Fallers (n = 30)	Non-fallers (n = 27)
1. Biological domain			
Age (years)			
80 – 89	52 (91.2)	27 (51.9)	25 (48.1)
≥ 90	5 (8.8)	3 (60.0)	2 (40.0)
Sex			
Men	17 (29.8)	9 (52.9)	8 (47.1)
Women	40 (70.2)	21 (52.5)	19 (47.5)
Chronic illnesses/impairments			
Hypertension	37 (64.9)	24 (64.9)	13 (35.1)
Dyslipidemia	31 (54.4)	18 (58.1)	13 (41.9)
Diabetes	17 (29.8)	11 (64.7)	6 (35.5)
Balance disorder	34 (59.6)	22 (64.7)	12 (35.3)
Knee degeneration	32 (57.9)	19 (59.4)	13 (40.6)
Vision impairment	34 (59.6)	16 (47.1)	18 (52.9)
Antihypertensive use	35 (61.4)	23 (65.7)	12 (34.3)
2. Socioeconomic domain			
Living with others	49 (86.0)	26 (53.1)	23 (46.9)
literate	55 (96.5)	30 (54.5)	25 (45.5)
Unemployment	51 (89.5)	26 (51.0)	25 (49.0)
Insufficient income	32 (56.1)	16 (50.0)	15 (50.0)
3. Behavioral domain			
No social grouping	56 (98.2)	30 (53.6)	26 (46.4)
Exercise < 3 times / week	46 (80.7)	25 (54.3)	21 (45.7)
Environmental hazard			
Split-level surfaces	16 (28.1)	11 (68.8)	5 (31.3)
Slippery floor	3 (1.7)	3 (100.0)	0 (0.0)
Obstacles	11 (19.3)	6 (54.5)	5 (45.5)
Cleanliness	10 (17.5)	5 (50.0)	5 (50.0)

Among fallers, most falls occurred while walking, with slipping (33.3%), tripping (26.7%), and fainting (23.3%) being the primary causes (Table 2). Injuries included bruises (46.7%), abrasions (30.0%), and fractures (23.3%), with fractures being more common among females. Most incidents occurred around the home (56.7%) and during the daytime (70.0%) (Table 2).

Table 2 Characteristics of falls among fallers (N = 30).

Characteristics	N (%)
Types of falls	
Slipping	10 (33.3%)
Tripping	8 (26.7%)
Fainting	7 (23.3%)
Misstep	4 (13.3%)
Others	1 (3.3%)
Fall location	
Around the Home	17 (56.7%)
Kitchen	4 (13.3%)
Bathroom	4 (13.3%)
Living Room	3 (10.0%)
Others	2 (6.6%)
Fall time	
During the day	21 (70.0%)
Morning	8 (26.7%)
Nighttime	1 (3.3%)
Injury	
Bruising	14 (46.7%)
Abrasions	9 (30.0%)
Fracture	7 (23.3%)

Factors associated with falls

There were significant associations between fall incidence and three variables within the biological domain including hypertension, balance disorder, and antihypertensive medication use (P-value = 0.012, 0.026 and 0.013, respectively) (Table 3).

The results of logistic regression showed the use of antihypertensive medications was associated with a 6.82-fold increased risk of falling (adj. OR = 6.82, 95% CI = 1.78 - 26.16, P-value = 0.005) (Table 4). Similarly, individuals with a balance disorder have a 5.88-fold greater likelihood of experiencing a fall (adj. OR = 5.88, 95% CI = 1.55 - 22.21, P-value = 0.009). Overall, the finding suggested that biological factors, particularly use of antihypertensive and balance disorder, were more strongly associated with fall risk in the oldest-old adults than sociodemographic or environmental factors.

Table 3 Associations between falls and selected risk factors (N = 57).

Variable	Fallers (n = 30)	Non-fallers (n = 27)	P-value*
Hypertension	24 (24.9%)	13 (35.1%)	0.012
Balance disorder	22 (64.7)	12 (35.3)	0.026
Antihypertensive use	23 (65.7)	12 (34.3)	0.013

* Chi-square test.

Table 4 Multivariate logistic regression analysis of fall risk factors (N = 57).

Variables	Adjusted OR	95% CI	P-value
Antihypertensives use	6.82	1.78 - 26.16	0.005
Balance disorder	5.88	1.55 - 22.21	0.009

Discussions and Conclusion

The findings of this study highlight that, while multiple factors were considered, only two factors emerged as significant predictors of fall risk among functionally independent oldest-old adults living in rural settings of Thailand. The integration of descriptive, bivariate, and multivariate analyses supports a comprehensive understanding of the risk profile. As shown in Table 1, the distribution of key demographic and clinical variables differed between fallers and non-fallers. Although most participants were female and aged 80 to 89 years, those with hypertension, balance disorders, and antihypertensive use were more prevalent in the faller group. These differences provide essential context for interpreting subsequent statistical findings.

Table 2 further elaborates on the nature and consequences of falls in this population. Slipping, tripping, and fainting emerged as the leading causes, and most incidents occurred during the daytime and within the home. Bruises and abrasions were common injuries, underscoring the severity and functional impact of falls even among those who are otherwise independent. This study affirms the high prevalence of falls (52.6%) among functionally independent oldest-old adults in a rural Thai community. Consistent with prior literature, majority of the incidents occurred at home during daytime activities.[14,25]

Bivariate analysis (Table 3) demonstrated significant associations between fall occurrence and three variables, namely hypertension, balance disorder, and antihypertensive medication use. This aligns with previous literature suggesting that physiological decline and medication side effects are critical contributors to fall risk in advanced age. The multivariate logistic regression model (Table 4) confirmed that balance disorders (Adj. OR = 5.88) and antihypertensive medication use (Adj. OR = 6.82) were independent and statistically significant predictors of falls. These findings validate the hypothesis that both physical instability[26] and medication-related factors[27] contribute to fall risk among the oldest-old, even in the absence of functional dependence.

The association between antihypertensive use and falls is of particular clinical relevance. Antihypertensive drugs, while essential for managing hypertension and preventing cardiovascular events, may contribute to fall risk through mechanisms such as orthostatic hypotension or dizziness, particularly in older adults with reduced baroreceptor sensitivity.[8,28] The observed nearly sevenfold increase in fall risk among antihypertensive users underscores the need for cautious prescribing, regular medication reviews, and individualized blood pressure targets, especially in this vulnerable age group. This highlights the important role of pharmacists in fall prevention. Pharmacists can support older adults through medication reconciliation, screening for high-risk medications, particularly antihypertensive, as well as, diuretics, sedatives, and providing counseling on proper administration and postural changes. Integrating pharmacists into multidisciplinary fall prevention teams may enhance medication safety and reduce adverse outcomes. Clinical pharmacists should be integrated into primary care and fall-prevention programs to assist with medication reconciliation, assess pharmacokinetic changes in aging, and recommend deprescribing where appropriate. Education on proper medication timing, hydration, and posture changes can help minimize risk.

Balance disorders are a major contributor to falls in older adults, often leading to injury, disability, loss of independence, and reduced quality of life.[29] In this study, more than half of the participants had balance disorders, which were associated with a sixfold increase in the risk of falls in the multivariate analysis. Maintaining balance is a complex process involving the musculoskeletal, central nervous, and sensory systems, requiring rapid and coordinated responses to prevent falls. From a previous study, age-related decline significantly impairs balance, with adults aged 85 and older facing a threefold higher fall risk than those aged 65 – 74 years. The World Health Organization recommends that adults aged 65 years and older engage in at least 150 minutes of moderate-intensity aerobic activity per week, perform muscle-strengthening exercises on at least two days, and practice multicomponent activities incorporating balance training on three or more days each week to help reduce physical decline and prevent falls.[30,31] Therefore, promoting physical activity earlier in the aging process and developing fall prevention programs that meet the specific vulnerabilities of the oldest-old population.[32] These initiatives not only support overall health but also help maintain musculoskeletal strength, balance, and coordination into advanced age. Furthermore, early detection of individuals at high risk of falling can improve more effective fall prevention strategies.[14]

Although hypertension was the most common chronic illness in this study and showed significance in the univariate analysis, it did not retain statistical significance in the multivariate model. This finding suggests that effects of medication, rather than the condition itself, may play a more direct role in fall causation. This contrasts with previous studies that identified hypertension as a significant risk factor for falls among older adults. The risk of falls is increased in older persons with hypertension because it affects their ability to control their postural balance. Rapid fluctuations in blood pressure and sudden reductions in blood flow seen in hypertension can disrupt the body's mechanisms for maintaining balance. Age-related decline in sensory and motor control of postural balance significantly contributes to fall risk. Postural balance maintenance is one of the most significant abilities necessary for the avoidance of falls in the elderly population.[14] Consistent with prior findings, balance disorders also independently predicted fall risk, reaffirming the importance of early detection and intervention in physical therapy and fall prevention programming.[33] Nevertheless, effective hypertension management may still contribute to reducing fall risk.[34] Based on the study findings, it is essential to recognize the importance of a multidisciplinary approach. Collaboration among medical and public health professionals can help develop comprehensive strategies to prevent falls and quality of life of older adults.

This study has some limitations. Its cross-sectional design limits the ability to draw causal relationships between identified risk factors and fall incidence. Additionally, the study did not differentiate between classes or dosages of antihypertensive medications, which may influence fall risk. However, these findings suggest the urgent need for tailored, multidisciplinary fall-prevention strategies that include clinical pharmacists and physical therapists among the oldest old adults. Accordingly, the following evidence-based recommendations are advanced for practice. First, pharmacists should be integrated in fall-prevention teams for medication review and risk reduction. Second, healthcare providers and caregivers should be educated about the risks of antihypertensive medications in the elderly. Third, regular balance and strength training exercises in community health programs should be promoted. Finally, environmental modifications and home safety checks in rural elderly households should be implemented. Future studies should incorporate larger and more diverse sample populations to enhance the generalizability of the findings and conduct longitudinal studies to explore causal relationships and drug-specific effects on fall risk. In addition, diet, sleep quality, and anxiety should be added to the studied factors of musculoskeletal balance, as these factors may significantly influence balance control and contribute to fall risk.

In conclusion, falls are highly prevalent among functionally independent oldest-old adults (aged 80 years and above) in Nakhon Si Thammarat, a rural province in southern Thailand, with nearly half reporting a fall within the previous year. The risk of falling was significantly associated with intrinsic factors such as hypertension, balance disorders, and the use of antihypertensive medications. Balance disorders and the use of antihypertensive medications were the most significant risk factors. The findings emphasize the multifactorial nature of falls and the critical contribution of medication-related factors in the oldest-old population. Targeted fall prevention strategies must incorporate clinical assessments of both physical stability and pharmacological risks.

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