ORIGINAL RESEARCH ARTICLE

Prevalence of Fear of Falling and Associated Factors among Community-Dwelling Older Adults in Urban Northeastern Thailand: A Cross-Sectional Study

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ABSTRACT

Background: Fear of falling (FOF) is a major issue for older adults, significantly increasing their risk of falling. Few studies have explored this topic in urban areas of Thailand. This current study was aimed at assessing the prevalence of FOF and identifying factors associated with FOF among community-dwelling older adults.

Methods: A cross-sectional study was conducted among 350 older adults aged ≥ 60 years in Ban Ped Sub-district, Khon Kaen, Thailand. Participants were sampled using systematic sampling. FOF was assessed using the Thai Falls Efficacy Scale-International (Thai FES-I), with FOF defined as a score ≥ 22. Univariable and multivariable logistic regression analyses were performed to identify factors associated with FOF.

Results: FOF prevalence was 54% (95% CI: 48.91-59.59). High frequency items for FOF were walking on a slippery surface and walking up or down a slope. Four factors were found to be significantly associated with FOF: the female gender (AOR=2.88; 95% CI: 1.57-5.31), age ≥ 80 years (AOR=3.57; 95% CI: 1.23-10.37), a history of falls (AOR=2.10; 95% CI: 1.04-4.23), and nocturnal awakenings (AOR=3.37; 95% CI: 1.97-5.76).

Conclusion: More than half of older adults experienced FOF. Female gender, advanced age, a history of falls, and nocturnal awakenings were significantly associated with FOF. Interventions should prioritize high-risk groups, particularly by addressing modifiable factors, such as nocturnal awakenings through sleep hygiene programs, nocturnal toileting management, and referral pathways to see specialist physicians for older adults with sleep disorders.

Keywords: Fear of falling, Accidental falls, Aged, Community-dwelling older adults, Nocturnal awakenings, Sex factors

ARTICLE INFO

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INTRODUCTION

The global population of older adults is growing rapidly, projected to increase from approximately 1 billion in 2020 to 2.1 billion by 2050.[1] Thailand has already transitioned into an aged society, with individuals aged 60 years and older constituting 22% of the population in 2024, a figure expected to exceed 36% by 2050.[2] As this demographic expands, age-related health issues have emerged as significant public health concerns, and an especially important health issue among older adults is the issue of falling.[3] A fear of falling (FOF) is one of the modifiable factors related to falling.[4] FOF prevalence among community-dwelling older adults varies worldwide. The global prevalence of FOF is 49.6%, with higher rates recorded in developing countries (53.4%) compared to developed countries (46.7%).[5] In Southeast Asia, FOF prevalence ranges from 21.6% to 88.2%.[6]

FOF is a crucial health issue among older adults. Persistent FOF can lead to limited activities, even with tasks that older adults are capable of performing. This fear may arise from direct or indirect experiences of falling, resulting in decreased confidence in performing daily activities. Restricted activity levels resulting from FOF can lead to a decline in physical function. In severe cases, FOF can cause a loss of functional independence, social withdrawal, a reduced quality of life, and an increased risk of falling.[7]

A systematic review by Xiong et al.[5] identified multiple factors associated with FOF, such as demographic factors (e.g., female, advanced age, living alone, a history of falls), physical function (e.g., frailty, balance issues, use of walking aids), chronic diseases (e.g., diabetes mellitus, hypertension, taking ≥ 4 types of medications), and psychological factors (e.g., anxiety, depression). Some of these factors are modifiable and can be addressed through targeted interventions. Additionally, environmental factors may contribute to fall risk and FOF.

Several studies conducted in Thailand have used the Thai Geriatric Fear of Falling Questionnaire to examine FOF among individuals in suburban Bangkok. These studies reported a prevalence of FOF at 25.2%. After adjusting for potential confounders, several factors were identified as associated with FOF, including difficulties with performing daily routine activities, balance impairments, a history of falls, and symptoms of depression, anxiety, and stress.[8] Additionally, a study in Northern Thailand that utilized the Short Falls Efficacy Scale-International found that among respondents, 39.3% demonstrated a low concern for FOF, 22.5% a moderate concern, and 38.2% a high concern, and after adjusting for potential confounders, knee osteoarthritis and quality of life were associated with FOF.[9] While the Thai Falls Efficacy Scale-International (Thai FES-I) has been shown to be suitable for assessing FOF among Thai community dwellers, due to variations in measurement tools and community contexts, there are gaps in the research regarding FOF. Additionally, associated factors such as demographic data, living arrangements, and sleep patterns (including sleep duration and nocturnal awakenings) remain unexplored. Moreover, most studies conducted in northeastern Thailand have primarily focused on falls and fall prevention rather than FOF. Therefore, this study aims to identify the prevalence of FOF and factors associated with FOF among community-dwelling older adults. The findings are expected to provide valuable insights for stakeholders and guide the development of interventions aimed at reducing FOF and fall risk among older adults.

METHODOLOGY

Study design and setting: This cross-sectional study was conducted between July and December 2025 among community-dwelling older adults in four villages within Ban Ped Sub-district, Mueang District, Khon Kaen Province, Northeast Thailand.

Study population and eligibility criteria: The target population was community-dwelling older adults aged 60 years or older who were registered at the Ban Ped Sub-District Health Promotion Hospital. Inclusion criteria were: age 60 years or older, had resided in Ban Ped Sub-district for at least one year, and were able to communicate and respond to questions during the interview. Exclusion criteria were: being bedridden, having severe physical or mental disability, or having known dementia.

Sample size calculation: The sample size was calculated using the single population proportion formula proposed by Cochran,[10] with parameters set as follows: Z=1.96 for a 95% confidence level, P=0.48 based on a previously reported prevalence of FOF,[11] and d=0.048 as the margin of error. After adjustment using a finite population correction factor for the total registered older adult population at Ban Ped Sub-District Health Promotion Hospital (N=993), and accounting for a 20% non-response rate, the total required sample size was 353.

Sampling technique: This study employed systematic sampling using a sampling frame of older adults' name lists obtained from the HOSxP database of Ban Ped Sub-District Health Promotion Hospital. After sorting the name lists by village, a sampling interval of 993/353 ≈ 2.81 was applied. A random start point (the first participant) was selected using a random number generator set between 1 and the interval of 2.81 (1.0 and 2.81). Next, participants were selected by repeatedly adding the fixed interval of 2.81 to the previous selection's position. For example, if the random start point was 1, the subsequent positions would be 3.81 (Position 4), 6.63 (Position 7), 9.44 (Position 9), and so on. The sampling process was conducted proportionally across the four villages based on the older adult population size of each village.

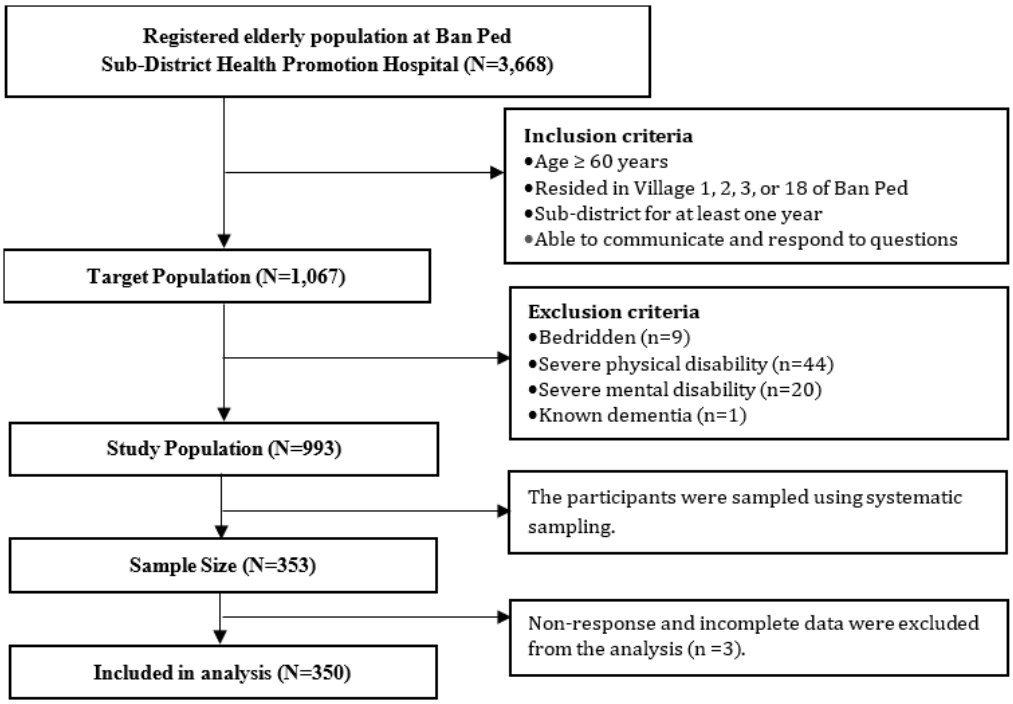

Figure 1: Flowchart of the study participants

Variables and measurements: The study tool used to conduct this research was a questionnaire divided into three parts:

Part I - Demographic Data: This section included information such as gender, age, marital status, education level, occupation, living arrangement, and primary caregiver.

Part II - Health Status: This part consisted of (1) Chronic conditions that had been diagnosed by a medical professional; (2) Number of medications, categorized as 0, 1-4, or ≥ 5 medications per day, with ≥ 5 medications defined as polypharmacy;[12] (3) A history of falls defined as the self-reported experience of one or more falls in the previous 12 months; (4) Daily sleep duration, recorded and grouped according to the National Sleep Foundation's established guidelines for older adults,[13] with two groups formed: those who sleep less than 7 hours and those who sleep 7 hours or more; (5) Nocturnal awakenings, assessed using a question asking participants to self-report whether they had experienced waking up during the night (yes/no), consistent with previous epidemiological studies that have used general questions about "waking up often during the night" or a "problem with nightly awakenings" to identify sleep disturbances;[14] (6) Use of walking aids, assessed using a question asking participants to self-report whether they used any walking aids (yes/no); (7) Activities of daily living (ADL), assessed using the Barthel ADL index,[15] which has a total score ranging from 0 to 20, with a cut-off point of above 12 points indicating non-severe disability and 12 points or lower indicating severe disability;[16] (8) Instrumental Activities of Daily Living (IADL), assessed using the Lawton and Brody scale, with a total score ranging from 0 to 8, where female participants scoring below 8 and male participants scoring below 5 were classified as having IADL limitations;[17] (9) A Timed Up and Go (TUG) test, performed according to Podsiadlo and Richardson,[18] where a time of more than 12 seconds indicates a risk of falls, and a time of 12 seconds or less indicates normal mobility.;[19] (10) A Five Times Sit-to-Stand Test (FTSST) used to assess lower extremity muscle strength, where participants who exceeded age-specific normative values were classified as having increased fall risk: 11.4 seconds for those aged 60-69 years, 12.6 seconds for 70-79 years, and 14.8 seconds for 80-89 years.[20]

Part III - FOF: FOF was assessed using Thai FES-I.[21] This scale has been demonstrated to have a high internal consistency with a Cronbach's alpha of 0.95. Each item is rated from 1 (not at all concerned) to 4 (very concerned), with total scores ranging from 16-64. Delbaere et al.[22] proposed cut-points differentiating between low concern with scores of 16-22 and high concern with scores of 23-64. This study adopted cut-off ranges from prior Thai research,[23] with scores of 16-21 indicating no FOF, scores of 22-27 indicating mild to moderate FOF, and scores of 28-64 indicating severe FOF. FOF was defined as a total score of 22 or higher.

Data collection: Data were collected via face-to-face interviews conducted by well-trained research assistants at the homes of the older adults in the study sample. After the interview, participants were invited to the Sub-District Health Promotion Hospital for TUG and FTSST assessments. Each participant was tested individually indoors on a flat, non-slip floor surface by two trained and licensed physiotherapists following standard procedures.[18,20] The first physio-

therapist administered the TUG test, which was followed by a 5-minute rest interval before the second physiotherapist administered the FTSST. The same protocol was applied to all participants.

Ethical considerations: Approval for this study was obtained from the Faculty of Medicine's Review Board at Khon Kaen University (HE681252; Dated: 9 June 2025).

Statistical analysis: Double data entry was used to ensure data quality before transferring to STATA version 16 (KKU Licensed). Descriptive statistics were used to describe the frequency, percentage, mean, and standard deviation (SD) of demographic characteristics. Univariable logistic regression analysis was used to examine associations between the different factors and FOF. FOF was dichotomized into two groups, no FOF (scores 16-21) and FOF (scores 22-64). For multivariable logistic regression analysis, variables with p-value <0.25[24] in univariable analysis were entered into the model to identify factors associated with FOF. Multicollinearity was assessed using the Variance Inflation Factor (VIF), where values >10 were considered indicative of multicollinearity.[25] TUG data were missing for 13 participants (3.7%); therefore, complete case analysis was performed. Subgroup analyses were performed by stratifying by gender and age group. Results were reported as adjusted odds ratio (AOR) with 95% confidence interval (CI), and a significance level of 0.05 was applied.

RESULTS

A total of 1,067 older adults met the inclusion criteria. After excluding 74 participants due to bedridden status, severe physical or mental disability, or known dementia, the study population was 993. Using systematic random sampling, 353 participants were selected. Three were subsequently excluded due to item non-response or incomplete data, resulting in a final analytic sample of 350 participants (response rate = 99.15%) (Figure 1).

This study found that most of the older adults were female, aged between 60 and 79 years, had a primary school education, and were living with family (Table 1).

This study found that more than half of older adults had FOF. High frequency items for FOF were walking on a slippery surface, walking up or down a slope, and walking on an uneven surface (Table 2).

Univariable analysis found that 14 variables were significantly associated with FOF. Demographic factors included female gender, advanced age, single/widowed/divorced, primary school level of education, and unemployed. In addition, health-related factors included chronic conditions, polypharmacy, history of falls, sleep duration, nocturnal awakenings, using a walking aid, IADL limitations, risk of falls based on the TUG, and risk of falls based on FTSST (Table 3).

Table 1: Demographic characteristics among community-dwelling older adults (n=350)

Variable	Participants (%)
Gender	
Male	125 (35.71)
Female	225 (64.29)
Age: (mean ± SD)	70.27 ±7.07
60-69 years	181 (51.71)
70-79 years	129 (36.86)
≥80 years	40 (11.43)
Marital status	
Single	21 (6.00)
Married	155 (44.29)
Widowed	166 (47.43)
Divorced	8 (2.29)
Education level	
Primary school	279 (79.71)
Secondary school	33 (9.43)
Bachelor's degree or higher	38 (10.86)
Occupation	
Not employed	167 (47.71)
Agriculture	70 (20.00)
General labor	51 (14.57)
Trade/self-employed	30 (8.57)
Retired civil servant	32 (9.14)
Living arrangement	
Living alone	15 (4.29)
Living with spouse only	27 (7.71)
Living with family	300 (85.71)
Living with relatives	8 (2.29)
Primary caregivers	
No caregiver	15 (4.29)
Spouse	111 (31.71)
Son/daughter	197 (56.29)
Grandchild	17 (4.86)
Relatives	10 (2.86)

Table 2: FOF among community-dwelling older adults (n=350)

Thai FES-I item	Mean±SD	95% CI of mean
Cleaning the house	1.53±0.83	1.44-1.62
Getting dressed/undressed	1.49±0.85	1.40-1.58
Preparing simple meals	1.35±0.75	1.28-1.43
Taking a bath	1.41±0.78	1.33-1.50
Going to the shop	1.45±0.83	1.36-1.54
Getting in or out of a chair	1.46±0.80	1.37-1.54
Going up or down stairs	1.78±0.92	1.68-1.88
Walking around outside	1.38±0.71	1.31-1.45
Reaching for something above your head or on the ground	1.67±0.86	1.58-1.76
Going to answer the telephone before it stops ringing	1.53±0.82	1.44-1.61
Walking on a slippery surface	2.18±0.81	2.09-2.26
Visiting a friend or relative	1.51±0.83	1.43-1.60
Walking in a crowded place	1.61±0.82	1.52-1.70
Walking on an uneven surface	2.04±0.79	1.96-2.13
Walking up or down a slope	2.18±0.84	2.09-2.27
Going out to a social event (e.g. religious service, family gathering, or club meeting)	1.46±0.80	1.37-1.54
Total score	26.0 ±10.22	24.9-27.1
FOF category (n=350)		
No FOF (<22 scores) n(%)	160 (45.7)	40.4-51.1
FOF (≥22 scores) n(%)	190 (54.3)	48.9-59.6

Table 3: Univariable logistic regression analysis of factors associated with FOF among community-dwelling older adults (n=350)

Variable	FOF (n=190) (%)	No FOF (n=160) (%)	COR (95% CI)	p-value
Female Gender (Ref Male)	146 (64.89)	79 (35.11)	3.40 (2.15-5.38)	<0.001*
Age group (Ref 60-69 yrs)				
70-79 years	84 (65.12)	45 (34.88)	2.58 (1.62-4.11)	<0.001*
≥ 80 years	30 (75.00)	10 (25.00)	4.14 (1.91-8.99)	<0.001*
Single/Widowed/Divorced (Ref Married)	120 (61.54)	75 (38.46)	1.94 (1.27-2.98)	0.002*
Education level Primary School (Ref ≥ Secondary school**)**	164 (58.78)	115 (41.22)	2.47 (1.44-4.23)	0.001*
Unemployed (Ref Employed**)**	112 (67.07)	55 (32.93)	2.74 (1.77-4.24)	<0.001*
Living arrangement (Ref Living with relatives)				
Living alone	7 (46.67)	8 (53.33)	1.46 (0.25-8.43)	0.673
Living with spouse only	11 (40.74)	16 (59.26)	1.15 (0.23-5.81)	0.870
Living with family	169 (56.33)	131 (43.67)	2.15 (0.50-9.16)	0.301
At least one Chronic condition (Ref None)	126 (60.00)	84 (40.00)	1.78 (1.16-2.74)	0.009*
Number of medications (Ref None)				
1 – 4	104 (58.76)	73 (41.24)	1.66 (1.06-2.57)	0.025*
≥ 5	18 (69.23)	8 (30.77)	2.61 (1.07-6.39)	0.035*
Foot problems (Ref No)	16 (64.00)	9 (36.00)	1.54 (0.66-3.59)	0.315
History of falls (Ref No)	59 (77.63)	17 (22.37)	3.79 (2.10-6.83)	<0.001*
Sleep duration ≥ 7 hours (Ref < 7 hours)	163 (56.99)	123 (43.01)	1.82 (1.05-3.14)	0.033*
Nocturnal awakenings (Ref No)	99 (71.22)	40 (28.78)	3.26 (2.07-5.16)	<0.001*
Use of a walking aid (Ref No)	29 (85.29)	5 (14.71)	5.58 (2.11-14.79)	0.001*
IADL limitations (Ref No IADL limitation)	61 (83.56)	12 (16.44)	5.83 (3.01-11.31)	<0.001*
TUG - Risk of falls (n=337) (Ref Normal)	105 (69.08)	47 (30.92)	3.51 (2.23-5.52)	<0.001*
FTSST - Risk of falls (Ref Normal)	146 (63.48)	84 (36.52)	3.00 (1.90-4.75)	<0.001*

FOF: Fear of falling; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; TUG: Timed Up and Go Test; FTSST: Five Times Sit-to-Stand Test; COR: Crude odds ratio; CI: Confidence interval. *p-value <0.05 was considered statistically significant; ADL disability was excluded from univariable analysis, as all participants were classified as non-severe.

Table 4: Multivariable logistic regression analysis of factors associated with FOF among community-dwelling older adults (n=350)

Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Female Gender (Ref Male)	3.40 (2.15-5.38)	<0.001	2.88 (1.57-5.31)	0.001*
Age group (Ref 60-69 yrs)				
70-79 years	2.58 (1.62-4.11)	<0.001	1.57 (0.86-2.86)	0.146
≥ 80 years	4.14 (1.91-8.99)	<0.001	3.57 (1.23-10.37)	0.019*
Single/Widowed/Divorced (Ref Married)	1.94 (1.27-2.98)	0.002	1.17 (0.66-2.09)	0.593
Education level Primary School (Ref ≥ Secondary school)	2.47 (1.44-4.23)	0.001	0.80 (0.40-1.60)	0.536
Unemployed (Ref Employed)	2.74 (1.77-4.24)	<0.001	1.02 (0.57-1.81)	0.952
At least one Chronic condition (Ref None)	1.78 (1.16-2.74)	0.009	1.14 (0.66-1.94)	0.639
History of falls (Ref No)	3.79 (2.10-6.83)	<0.001	2.10 (1.04-4.23)	0.039*
Sleep duration ≥ 7 hours (Ref < 7 hours)	1.82 (1.05-3.14)	0.033	1.54 (0.78-3.04)	0.218
Nocturnal awakenings (Ref No)	3.26 (2.07-5.16)	<0.001	3.37 (1.97-5.76)	<0.001*
Use of a walking aid (Ref No)	5.58 (2.11-14.79)	0.001	1.11 (0.34-3.57)	0.864
IADL limitations (Ref No IADL limitation)	5.83 (3.01-11.31)	<0.001	2.15 (0.94-4.94)	0.070
TUG - Risk of falls (n=337) (Ref Normal)	3.51 (2.23-5.52)	<0.001	1.35 (0.73-2.51)	0.341
FTSST - Risk of falls (Ref Normal)	3.00 (1.90-4.75)	<0.001	1.78 (0.99-3.19)	0.052

AOR: Adjusted odds ratio; CI: Confidence interval; Hosmer-Lemeshow goodness-of-fit test: p = 0.386; Area under the ROC curve = 0.800. All variables with univariable p-value <0.25 were entered into the multivariable analysis, with the exception of ADL disability and number of medications. ADL disability was excluded, as all participants were classified as non-severe. Number of medications was excluded due to collinearity with chronic conditions.

All 14 variables with a univariable p-value <0.25 were entered into the multivariable analysis. Prior to analysis, collinearity diagnostics were performed, and number of medications was excluded due to multicollinearity with chronic conditions. No other concerns with multicollinearity were found among the remaining variables (VIF ranged from 1.06-1.70). The final model showed that after adjusting for confounding variables, female gender, age ≥ 80 years, a history of falls, and nocturnal awakenings were significantly associated with FOF (Table 4). The model demonstrated good discriminative ability with an area under the ROC curve of 0.800 (Figure 2).

Subgroup analyses: When stratified by gender, nocturnal awakenings and a history of falls were associated with FOF in both males and females, with a stronger association found in males (Table 5). Stratified analysis by age group revealed that nocturnal awakenings were associated with FOF across all age groups, whereas a history of falls was significantly associated with FOF only among those aged 60-69 years. However, among participants aged ≥ 80 years,

the confidence intervals were considerably wider, and the association with a history of falls could not be estimated, possibly attributable to the small number of participants in this subgroup (Table 5).

Table 5: Subgroup analysis stratified by gender and age group for factors associated with FOF among community-dwelling older adults (n=350)

Subgroup	Nocturnal awakenings (vs No)		History of falls (vs No fall)	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Gender*				
Male	3.62 (1.48–8.84)	0.005	6.54 (2.11–20.27)	0.001
Female	2.81 (1.52–5.19)	0.001*	2.38 (1.11–5.10)	0.025*
Age Group#				
60-69 years	2.35(1.195-4.615)	0.013	3.72(1.555-8.895)	0.003
70-79 years	3.84(1.635-9.015)	0.002	2.27(0.843-6.12)	0.105
≥ 80 years	10.26(1.09-96.50)	0.042	Not estimated	-

AOR: Adjusted odds ratio; CI: Confidence interval.
*Models were stratified by gender and adjusted for age group.
Models were stratified by age group and adjusted for gender.
The association between a history of falls and FOF in the age≥ 80 years subgroup could not be estimated, as all participants with a history of falls demonstrated FOF.

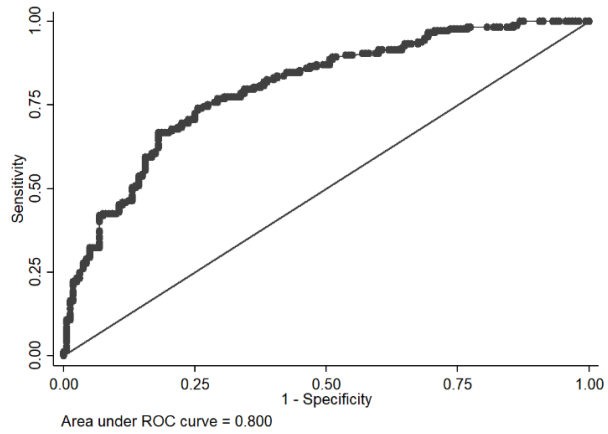

Figure 2: Area under the ROC curve for the multivariable logistic regression model

DISCUSSION

FOF among community-dwelling older adults: This study found that half of older adults had FOF. This finding is similar to previous studies, such as Auais M et al.,[26] which found a high proportion of FOF among older adults due to similar characteristics. In contrast, the prevalence of FOF in this study was lower than that reported by Vitorino LM et al.,[27] who studied older adults in Brazil and Portugal. This finding may vary due to demographic characteristics of the different study samples, especially as their study sample was older, with a higher proportion of females, and higher prevalence of a history of falls in the previous year, all factors identified as influencing factors for FOF. The current study also found a lower FOF prevalence than that reported by Silangirn et al.[9] in Northern Thailand, which may be explained by differences in the tool used to assess FOF.

The prevalence of FOF identified in this study's findings may be explained by its environmental and urban context, including uneven roads, uneven surfaces, and slippery floors. Moreover, this study found that 21.71% of older adults in the sample had a history of falling in the last year, a higher prevalence than that reported by Ubonsutvanich N et al.[28] A previous fall experience may result in reduced confidence in mobility and increased FOF.[7] Furthermore, the mean age of the sample was 70.27 years, reflecting a stage in life of increasing physical decline, which may also influence FOF.

Factors related to FOF among community-dwelling older adults: This study found that four factors were statistically significant to FOF among community-dwelling older adults, including female gender, advanced age, a history of falls, and nocturnal awakenings.

Females were at 2.88 times higher risk for FOF compared to males, which can be explained by the onset of physiological differences that occurs during menopausal transition, including decreased bone density and accelerated muscle mass loss due to declining estradiol levels. These changes increase the risk of sarcopenia,[29] leading to imbalance and an increase in FOF. This finding is consistent with Xiong W et al.[5] and Birhanie G et al.[30] but differs from Izadi-Avanji FS et al.,[31] who found no association between female sex and FOF among Iranian older adults. This is likely due to differences in the study population, as the Iranian study was focused on older adult patients hospitalized after injury. In general, findings indicate that older adult females should be considered a target group for intervention in order to reduce FOF.

Advanced age (≥ 80 years) was also statistically relevant to FOF, a finding consistent with Xiong W et al.[5] and Birhanie G et al.[30] This can be explained by age-related decline in physiological functions,[32] along with increasing multiple co-morbidities and polypharmacy,[33] which may contribute to a high risk of falls and FOF. Therefore, targeted strategies to reduce FOF should address this factor.

This study found that participants with a history of falls were at 2.10 times higher risk for FOF compared to those who reported no history. The relationship between a history of falls and FOF can be explained

by the fact that older adults with a history of falls tend to perceive a higher risk of falling and its resulting severity, as described by the Health Belief Model.[34] This model further explains that when older adults perceive a high likelihood of falling and its resulting severity, they become overly anxious and cautious, leading to FOF. This is consistent with Xiong et al.,[5] who confirm that a history of falls is one of the most important determinants of FOF. Furthermore, Li Y et al.,[4] also state that FOF is a risk factor related to falls, as FOF causes older adults to avoid activities they are capable of performing, leading to immobility, muscle weakness, and decreased balance, which increases the risk of falls.[7] Therefore, older adults with a history of falls should also be a key target group when aiming to reduce FOF.

A nocturnal awakening is defined as waking up during nighttime sleep and was assessed in this study by self-reporting of frequent awakenings or interrupted sleep. It was found that older adults who experienced nocturnal awakenings were at 3.37 times higher risk for FOF compared to those who did not report nocturnal awakenings. This result may be explained by the effects of nocturnal awakenings on daytime fatigue, cognitive dysfunction, and mood disturbance,[35] all of which may contribute to increased FOF. Although few studies have examined the relationship between nocturnal awakenings and FOF, previous findings have shown that sleep disturbance can impair gait and balance among older adults.[36] The current study's finding is also consistent with Chen TY et al.,[37] who found that poor sleep predicted the occurrence of FOF among community-dwelling older adults over one year. Badrasawi M et al.,[38] however, found no significant relationship between sleep quality and FOF, possibly because in that study, sleep duration and sleep problems were combined into a single variable, while the current study assessed nocturnal awakenings and sleep duration separately, potentially allowing for a more accurate estimation of the relationship. The findings of this study have important public health implications for reducing FOF among Thai community-dwelling older adults. Sub-district health promotion hospitals should implement sleep hygiene programs, including activities to reduce caffeine consumption, promotion of consistent sleep schedules, and nocturnal toileting management, to reduce nocturnal awakenings. Additionally, referral pathways to specialist physicians should be established for older adults with sleep disorders, as addressing sleep problems may serve as a key mechanism for reducing the risk of FOF in the long term.

Although a sleep duration of ≥ 7 hours was associated with FOF in the univariable analysis, this association was not statistically significant in the multivariable analysis. This paradoxical finding may be explained by reverse causality, as older adults with FOF tend to limit their activities and reduce mobility, leading to more time spent in bed.[7] Such activity limitations may stem from age-related physiological decline, including decreased muscle mass, strength, and mobility,[32] and depressive symptoms, which have been associated with activity-limiting anxiety over falling in older adults.[39] This non-significant finding from the multivariable analysis may be explained by adjusting for other related confounding variables, particularly nocturnal awakenings, which measures a related aspect of sleep with a stronger influence on FOF and reduces the effect of sleep duration on FOF.

TUG and FTSST were also significantly associated with FOF in the univariable analysis and were both shown to be non-significant in the multivariable analysis. Although collinearity diagnostics showed no multicollinearity concern, this finding may be explained by the influence of other variables in the model that reduced the associations of TUG and FTSST with FOF. This is consistent with Xiong W et al.,[5] who reported that FOF is associated with factors across multiple domains, including demographic characteristics, physical function, chronic disease, and mental problems, suggesting that physical performance alone may not fully explain FOF. Regarding TUG, its effect may have been explained by age, as older age is associated with declining TUG performance,[40] resulting in a reduced effect of TUG on FOF in the multivariable model. FTSST performance, on the other hand, showed a trend towards significance (AOR=1.78, p-value=0.052), indicating potential clinical relevance that requires further study.

When stratified by sex, nocturnal awakenings and a history of falls were associated with FOF in both males and females, with the stronger association found in males. This may suggest that older men who experience nocturnal awakenings or a history of falls tend to experience greater anxiety about falling and reduced confidence in movement. Chang HT et al.[41] similarly found that insomnia and history of falls were significantly associated with FOF in both older men and women. Stratified analysis by age group showed that nocturnal awakenings were associated with FOF across all age groups, particularly among those aged ≥80 years, suggesting that sleep problems may be an important factor related to FOF in older adults, regardless of age.

The strengths of the current study were its community-based data collection process and its high response rate. However, several limitations should be considered: (a) the study was conducted at a single site, specifically among community-dwelling older adults residing in four villages within Ban Ped Subdistrict. This may limit the generalizability of the findings across older adult populations in different contexts; (b) FOF, nocturnal awakenings, and sleep duration were assessed using self-reporting, which may introduce recall bias and response bias; (c) cognitive status and depression were not formally assessed in the study. While only older adults who were able to communicate effectively were included, and those with known dementia or severe mental disabilities were excluded, this remains a limitation that may have influenced the study outcome, as both cognitive impairment and depression are recognized

confounders for FOF; (d) nocturnal awakenings were measured using a single dichotomous item (yes/no), which may not fully capture the frequency, duration, timing, cause, severity, or ability to return to sleep following awakening. Although single-item questions about nocturnal awakenings have been supported for use in epidemiological studies, such measures may present reliability concerns; and (e) due to its cross-sectional design, this study's findings should be interpreted with caution in terms of determining any temporal relationship; (f) the prevalence estimate used for sample size calculation was obtained from a study conducted in Brazil (48%), whereas the prevalence in the current study was 54% (95% CI: 48.91-59.59). This difference may reflect variations in demographic characteristics and cultural context between study populations. However, the prevalence in the current study was reasonably close to the estimated value, and the latter fell within the confidence interval of the study estimate, indicating that the impact on sample size adequacy was likely minimal.

Future longitudinal studies are needed to establish the causal relationship between nocturnal awakenings and FOF among older adults. Additionally, randomized controlled trials examining the effects of sleep-improvement interventions, such as sleep hygiene programs and nocturnal toileting management, on FOF outcomes in Thai community-dwelling older adults would provide stronger evidence for developing effective prevention strategies. Finally, since the sample size in this study was calculated based on its primary objectives, it was insufficient for subgroup analyses. Future studies should therefore incorporate sample size calculations that account for subgroup analyses.

Conclusion

The study found that the prevalence of FOF was 54% (95% CI: 48.91-59.59). After adjusting for confounding variables, the female gender, age ≥80 years, a history of falls, and nocturnal awakenings were significantly associated with FOF. These findings highlight the importance of prioritizing care for high-risk groups, including older female adults, those advanced in age, and older adults with a history of falling. Moreover, nocturnal awakenings are a modifiable factor associated with FOF. Therefore, to reduce FOF and promote quality of life among community-dwelling older adults, sub-district health promotion hospitals and policy makers should develop community-based interventions focused on improving sleep quality, such as sleep hygiene programs and nocturnal toileting management, as well as establish referral pathways to specialist physicians for older adults with sleep disorders.

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