SURVEY OF PERSONAL AND HOME ENVIRONMENTAL FACTORS AFFECTING FALLS AMONG OLDER ADULTS AGED ≥60 YEARS IN NORTHERN THAILAND

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Abstract. Falls among older people may increase their risk for morbidity and mortality. In this study, we aimed to determine personal and home environmental factors affecting falls among adults aged ≥60 years in Phitsanulok Province, northern Thailand, in order to inform programs to reduce the risk of falls in the study population. Subjects were recruited by multi-stage sampling technique. Inclusion criteria for subjects were: 1) being aged ≥60 years, 2) being able to read and write Thai, 3) living in the same area for at least 1 year and 4) being willing to participate in the study. Exclusion criteria for subjects were: 1) having an illness on the date of data collection and 2) being unable to complete the questionnaire. The minimum number of subjects calculated to be needed for the study was 328. Each subject was asked to complete a self-administered questionnaire. Frequencies, means and standard deviations (SD) were used to describe subjects and studied factors. Binary logistic regression analysis was used to determine significant associations between studied factors and falls. A total of 328 subjects were included in the study: 56.4% male. The mean (±SD) age of study subjects was 72 (±8) (range: 60-97) years. The number (%) of subjects who had a history of a fall was 58 (17.7%). On multivariate analysis the factors significantly associated with falls were: female sex (adjusted odds ratio (aOR) = 3.53; 95% confidence interval (CI): 1.20-8.34, $p<0.001$), being aged ≥80 years (aOR = 7.09; 95% CI: 2.97-16.90, $p<0.001$), not having sufficient light on the stairs, in the rest room and at doors (aOR = 5.40; 95% CI: 1.56-18.96, $p = 0.008$), not keeping the corridors of the house clear of objects (aOR = 4.59; 95% CI: 1.41-14.90, $p = 0.011$) and having different floor levels between the inside and the outside the house (aOR = 3.77; 95% CI: 1.31-10.82, $p = 0.014$). In summary, a large proportion of study subjects had a history of a fall and the factors significantly associated with falls were being female, being aged ≥80 years, having insufficient lighting in high fall-risk areas, having cluttered corridors and having different floor

levels inside and outside the house. We conclude there were modifiable fall risks in the study population. Further studies are needed on how to educate the public regarding these factors and if modifying these factors will result in a decrease in the number of falls in the study population.

Keywords: home environmental management, falls, older adults, lower northern Thailand

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INTRODUCTION

The average age of the world population is increasing (UN, 2019). It is estimated the worldwide number of people aged ≥65 years will double by 2050 but the number of children aged ≤12 years will remain the same (UN, 2022). Although the number of older people is increasing, the number of deaths is decreasing (UNFPA, 2022). The number of people aged ≥60 years worldwide has been predicted to increase from 1 billion in 2020 to 1.4 billion in 2050 (WHO, 2022). The ageing of the world's population is the result of declining fertility and increasing life expectancy (Weeks, 2016). This demographic change has resulted in increasing numbers and proportions of people who are over age 60 (WHO, 2010).

In 2022, the number of people aged ≥60 years in Thailand was estimated to be around 12 million or about 18.3% of the 66,208,737 total population (conditions specified for the data requested were by gender, as of June 2022 and for the whole country) (Bureau of Registration Administration, 2022). In 2020, Thai women had a life expectancy of 80.4 years and Thai men of 73.2 years (Royal Thai Government, 2021). The National Economic and Social Development Council for Thailand estimated in 2022 the proportion of Thai adults aged ≥60 years will increase from 18% in 2022 to 30% in 2037 (Department of Disease Control, 2022b). Of these, 30% will live alone or live with another elderly person.

Chronic diseases become more common with increasing age, some of

which increase fall risk, such as stroke, osteoporosis, hypertension, diabetes and obesity (Zhao *et al*, 2019; Lecktip *et al*, 2019). The previous studies reported the factors influencing falls among those aged ≥60 years include: age, sex, health, physical impairments and factors related to the home environment such as having no handrails in the restroom and using a squat toilet (Tanaka *et al*, 2018; Luang-ubol *et al*, 2020; Chaono and Khunkongme, 2022; Nicklett *et al*, 2017; Wongsawang *et al*, 2021; Smith *et al*, 2017). Other studies reported other factors associated with falls in the elderly to be: type of house, medication use, physical activity level and physical weakness (Yoo *et al*, 2016; Romli *et al*, 2018).

Falls in older adults can cause severe injuries such as hip fractures, lacerations, sprains, and intracerebral hemorrhages, resulting in long term health problems and even death (CDC, 2021). The Department of Disease Control, for Thailand, in 2022 reported there were 3 million cases of falls, of which 60,000 occurred among those aged ≥60 years and 4 died every day (Department of Disease Control, 2022a).

In this study, we aimed to determine personal and home environmental factors affecting falls among adults aged ≥60 years living in Phitsanulok, northern Thailand, in order to inform programs to reduce the risk of falls in the study population.

MATHERIALS AND METHODS

Study design, setting and participants

We conducted this cross-sectional survey during March-June 2022. The sample size was calculated using a formula for the estimation of population proportion (Daniel, 1995). A total of 328 subjects were recruited by multi-stage sampling technique. We randomly selected one district out of 9 from Phitsanulok Province, 7 sub-districts from the study district and finally 7 villages from each of the studied sub-districts. The subjects in each village were randomly selected from the population of each village. The inclusion criteria for the study subjects were: 1) being aged ≥60 years, 2) being able to read and write Thai, 3) living in the study area for at least 1 year, and 4) being willing to participate in the study. The exclusion criteria for the study subjects were: 1) having an illness at the time of data collection and 2) being unwilling or unable to complete the questionnaire.

Research tool

Each subject was asked to complete

a self-administered questionnaire with 3 parts: 1) personal factors, 2) home environmental factors, and 3) falls in the past one year. Personal factors included: age, sex, health, physical impairments, and type of house. Home environmental factors were obtained from the home environmental management guideline for the elderly (Bureau of Environmental Health, 2015). This consisted of 20 yes or no questions where a "yes" answer was given 1 point and a "no" was given 0 points. Falls was assessed by the questionnaire where an answer of "yes" was given 1 point and "no" was given 0 points. All questions with an item objective congruence (IOC) index >0.5 were considered to meet standard criteria of the validity test. The reliability of the questionnaire was determined by a pilot test among 30 subjects not included in the study. The reliability test for home environmental factors was assessed by KR-20 and was determined to be 0.76.

Statistical analysis

Categorical data were described using frequencies and percentages. Continuous data were described using mean, standard deviations, minimums and maximums. Binary logistic regression analysis was used to determine factors significantly associated with falls. An adjusted odds ratio (aOR), 95% confidence interval (CI) and *p*-value were calculated for each factor. A *p*-value <0.05 was considered statistically significant.

Ethical considerations

Informed consent was obtained from each subject prior to inclusion in the study. This study was approved by Human Research and Ethics Committee of Naresuan University, Thailand (Ref No. P3-0178/2021).

RESULTS

Personal factors

A total of 328 subjects were included in the study; 56.4% male. 40.9%of subjects were aged 70-79 years. The mean (± standard deviation (SD)) age for subjects was 72 (±8) (range: 60-97) years. 60.1% of subjects had an underlying health condition; 84.4% had no physical impairments. 42.2% of subjects lived in a house with 2 floors. 17.7% of subjects had a history of a fall (Table 1).

Home environment

93.7% of subjects had a conveniently placed light switch in the house and 93.3% had sufficient light on the stairs, in the rest room and at doors. 51.2% of subjects had handrails between the bedroom and the bathroom (Table 2).

Personal factor associated with falls

On binary logistic regression analysis, factors significantly associated with falls were: female sex (aOR = 3.53; 95% CI: 1-20.834, p<0.001) and being aged 80 years and over (aOR = 7.09; 95% CI: 2.97-16.90, p<0.001) (Table 3).

Table 1

Factors potentially associated with fall risk in study subjects (N = 328)

Factors	Frequency *n* (%)
Sex	
Male	185 (56.4)
Female	143 (43.6)
Age groups in years	
60-69	123 (37.5)
70-79	134 (40.9)
≥80	71 (21.6)
History of underlying health conditions	
No	131 (39.9)
Yes	197 (60.1)
Physical impairment	
No	278 (84.8)
Yes	50 (15.2)
Type of house	
Single story house	108 (32.9)
Single-story house with a basement	81 (24.7)
Two-story house	139 (42.4)
History of a fall	
No	270 (82.3)
Yes	58 (17.7)

Table 2

Home environmental factors potentially associated with a fall (N = 328)

	Factors	Frequency *n* (%)
1.	Having enough light on stairs, in the rest room and at doors	306 (93.3)
2.	Having a conveniently located light switch	307 (93.7)
3.	Flat, unpolished floor in the house	261 (79.6)
4.	Flat, unpolished floor in the bathroom	258 (78.7)
5.	Having a bathroom close to the bedroom	217 (66.2)
6.	Having separate wet and dry floor areas in the bathroom	192 (58.5)
7.	Having a flush toilet	244 (74.4)
8.	Having the same floor level inside and outside the bathroom	239 (72.9)
9.	Having bathroom grab bars	174 (53.0)
10.	Having handrails on stairs	285 (86.9)
11.	Having appropriate bed height	285 (86.9)
12.	Having bedside handrails	186 (56.7)
13.	Having handrails from the bedroom to the bathroom	168 (51.2)
14.	Having clear home corridors	290 (88.4)
15.	Having a shower chair	203 (61.9)
16.	Having a shower instead of bathing by scooping water	195 (59.5)
17.	Using reflective colors in the house	194 (59.1)
18.	Having enough light outside the house	299 (91.2)
19.	Having the same floor levels inside and outside the house	285 (86.9)
20.	Having the threshold at the same level as the floor level	272 (82.9)

Table 3

Personal factors associated with falls on binary logistic regression analysis

Factors	aOR (95% CI)	*p*-value
Sex		
Male	Reference	
Female	3.53 (1.20-8.34)	<0.001
Age groups in years		
60-69	Reference	
70-79	1.49 (0.67-3.34)	0.329
≥80	7.09 (2.97-16.90)	<0.001
Presence of an underlying health condition		
No	Reference	
Yes	1.57 (0.78-3.19)	0.209
Physical impairment		
No	Reference	
Yes	0.68 (0.27-1.71)	0.412
Type of house		
One story house	Reference	
One-story house with a basement	0.42 (0.17-1.06)	0.066
Two-story house	1.27 (0.62-2.62)	0.516

CI: confidence interval; aOR: adjusted odds ratio

Home environmental factors associated with falls

On multivariate logistic regression analysis factors significantly associated with falls were: not having enough light on the stairs, in the rest room or at doors (aOR = 5.40; 95% CI: 1.56-18.96, p = 0.008), not keeping the corridors of the house clear of objects (aOR = 4.59; 95% CI: 1.41-14.90, p = 0.011) and having different floor levels between the inside and the outside of the house (aOR = 3.77; 95% CI: 1.31-10.82, p = 0.014) (Table 4).

Table 4

Home environmental factors associated with falls on binary logistic regression analysis

Factors	aOR (95% CI)	p-value
1. Having enough light on stairs, in the rest room and at doors	5.40 (1.56-18.96)	0.008
2. Having a conveniently located light switch	1.48 (0.37-5.90)	0.583
3. Flat, unpolished floor in the house	1.10 (0.38-3.19)	0.866
4. Flat, unpolished floor in the bathroom	0.64 (0.21-2.12)	0.489
5. Having a bathroom close to the bedroom	1.57 (0.29-2.06)	0.612

DISCUSSION

In our study, 17.7 % of subjects had falls, greater than the 15.3% reported by a previous study of Thais aged ≥60 years (Aekplakorn *et al*, 2021).

In our study, being female was associated with falls. Females are more likely to have osteopenia and osteoporosis which can affect leg weight and movement (Kumkwan *et al*, 2018). Females have a different gait than males, walking more with a waddle, short, narrow-based gait (Chaono and Khunkongme, 2022). For whatever reason, females have greater fall risk than males (Thiamwong and Suwanno, 2014).

In our study, being aged ≥80 years

Table 4 (cont)

Factors	aOR (95% CI)	*p*-value
6. Having separate wet and dry floor areas in the bathroom	1.50 (0.63-3.55)	0.362
7. Having a flush toilet	0.75 (0.28-2.01)	0.568
8. Having the same floor level inside and outside the bathroom	1.19 (0.52-2.71)	0.688
9. Having bathroom grab bars	1.22 (0.50-3.01)	0.659
10. Having handrails on stairs	1.70 (0.61-4.79)	0.313
11. Having an appropriate bed height	2.49 (0.88-7.05)	0.087
12. Having bedside handrails	0.88 (0.32-2.42)	0.812
13. Having handrails from the bedroom to the bathroom	1.02 (0.37-2.70)	0.997
14. Having clear home corridors	4.59 (1.41-14.90)	0.011
15. Having a shower chair	0.50 (0.18-1.41)	0.188
16. Having a shower instead of bathing by scooping water	0.97 (0.40-2.35)	0.942
17. Using reflective colors in the house	0.73 (0.33-1.60)	0.430
18. Having enough light outside the house	0.49 (0.14-1.71)	0.264
19. Having the same floor levels inside and outside the house	3.77 (1.31-10.82)	0.014
20. Having the threshold at the same level as the floor level	1.31 (0.44-3.90)	0.631

Note: Answering "Yes" is a reference in every item.

CI: confidence interval; aOR: adjusted odds ratio

was associated with fall risk, similar to the results of a previous study (Baurangthienthong and Yindee, 2021). The elderly tends to be frailer (Rongmuang *et al*, 2016) and have more skeletomuscular and balance problems (Grundstrom *et al*, 2012). All these increase fall risk

In our study, having inadequate lighting in key areas was significantly associated with falls, similar to the results of a previous study from Thailand (Rodseeda, 2018). This could be due to vision problems which increase risk of stumbling and slipping (Wongsawang *et al*, 2017).

In our study, cluttered corridors were significantly associated with fall risk, similar to the findings of previous studies (Rodseeda, 2018; Rongmuang *et al*, 2016; Kumkwan *et al*, 2018).

In our study, having different floor levels between the inside and outside the house was significantly associated with fall risk. Vision and balance problems are more common among the elderly (Sorysang *et al*, 2014) making it more likely for them to misstep when floor levels were not the same (Department of Older Persons, 2021).

In summary, a fairly large percentage of our subjects gave a history of a fall and the factors significantly associated with falls were being female, being aged ≥80 years, having insufficient lighting in high fall-risk areas, having cluttered corridors and having different floor levels inside and outside the house. We conclude there were modifiable factors significantly associated with falls in our study population. Further studies are needed to determine how to educate the study population regarding these factors and if modifying these factors will result in a decrease in the number of falls in the study population.

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CONFLICT OF INTEREST DISCLOSURE

All authors declare no conflict of interest.

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