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The Impact of Home Environmental Hazards on Subjective Health Among Healthy Elderly Adults in Thailand

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ABSTRACT

Thailand's aging population includes a growing number of near-centenarians and centenarians living at home. Grounded in Lawton's Ecological Theory of Aging, this study aimed to examine whether an unsafe home environment (outdoor, indoor, and additional hazards) has an indirect negative effect on subjective health among elderly Thai adults. Participants were 141 elderly (ages 80–112) but healthy adults, most of whom were living in well-maintained, single-story homes. Instruments used in the study included the *Self-Rated Health Question*, the *Social Contact Scale*, the *Loneliness Question*, and the *Home Environmental Hazards Checklist*. Findings reveal common indoor hazards such as bathrooms and showers, sleeping areas, laundry areas, stairs, raised floors, and dim lighting. The group of elderly adults rated their health as moderately good, received more visits than they made, and reported little loneliness. Using a serial mediation model, the results demonstrated that raised floors and dim lighting, when combined with limited social contact and much loneliness, significantly lowered self-rated health. The finding extends previous research by showing that reducing home environmental hazards (i.e., enhancing lighting, removing raised flooring) and strengthening social connections (i.e., increasing social contact frequency, reducing feelings of loneliness) as key strategies for promoting self-rated health in this population. Local housing authorities, health promotion agencies, and community stakeholders should prioritize home modifications that reduce environmental hazards in the home and proactively implement social support programs to reduce loneliness for promote healthy longevity among Thailand's elderly population.

Keywords: environmental hazards, raised floor, dim light, social contacts, loneliness, elderly adults

INTRODUCTION

According to the 2024 Survey of Older Persons in Thailand, approximately 14 million older adults, or 20% of the population, are aged 60 and above, with 10.9% of this group aged 80 years or older. The survey also revealed that 8.6% of older adults rated their health as poor. Moreover, 8.8% of older adults aged 80 and above experienced falls more frequently than those aged 70-79 (6.3%) and 60-69 (4.7%), indicating a correlation between age and the frequency of falls (National Statistical Office, 2024). Increased age is strongly linked to a higher likelihood of developing frailty, often accompanied by physical and functional decline (Thinuan et al., 2020). Thai society is aging rapidly, with an increasing number of near-centenarians and centenarians with functional limitations living at home. Tsuchiya-Ito et al. (2019) emphasize that these limitations are particularly common in this oldest of age groups, highlighting the importance of safe home environments for them. Unfortunately, the use of an interdisciplinary approach and a socio-ecological framework to examine the relationships among safe home environments, psychosocial factors, and health outcomes for the oldest within Thailand's aging population remains underexamined.

The topic of health in relation to home environment was addressed at the 1976 Vancouver conference on human settlements. The document released by the conference stated that health is a fundamental component of individual development and that improving environmental health should be a key goal of human settlement policies. The physical and social environment of housing directly affects residents' health, well-being, and quality of life (United Nations, 1976). Jarutach and Lertpradit (2020) reported that housing conditions for the elderly in Thailand were inadequate. They recommended lowering bedroom furniture, installing handrails in bathrooms, shortening stair risers, and creating communal spaces like gazebos, where the elderly can socialize and spend time outdoors. In response, Thailand recently introduced guidelines incorporating the World Health Organization's (WHO) universal design principles to promote healthy housing development. The Thai Green Building Institute developed the SOOK Building Standard, an assessment tool for both residential and non-residential buildings. This standard evaluates physical characteristics, environmental hazards, and resident satisfaction, ensuring that housing projects align with the healthy home concept (Jarutach, 2023).

The WHO defines health as a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity (World Health Organization [WHO], 1948). The health outcomes of older adults are influenced by their interactions with their environments, as outlined in the WHO's International Classification of Functioning, Disability and Health (ICF) framework. According to the ICF, an individual's functioning and health are shaped by both environmental and personal factors (World Health Organization [WHO], 2007).

In line with this, the environmental gerontologist M. Powell Lawton (1977) wrote a paper, "An Ecological Theory of Aging Applied to Elderly Housing," *which* underscores that aging is shaped by both environmental and personal factors. Lawton's ecological theory of aging emphasizes the crucial role of the home environment in supporting the aging process and promoting the health and well-being of older adults (Lawton, 1977; Lawton & Nahemow, 1973). Moore noted that Lawton's framework (1989) identifies five key behavioral competences for older adults: biological health, functional health, cognition, time use, and social behavior. The framework introduces several key concepts. First, the environment can either hinder or enhance adaptive behavior, comfort, or performance, depending on an individual's level of competence. Second, individuals with different levels of competence differ in their ability to respond effectively to environmental demands, aligning with the concept of person and environmental fit. Finally, psychological well-being and perceived quality of life are just as important outcomes of person and environment interactions as functional performance (Moore et al., 2003). In gerontology, aging is often accompanied by increased frailty and declining health, both of which are influenced by social and physical environmental factors.

A growing body of evidence supports Lawton's framework that the physical home environment can directly or indirectly affect individuals' health, especially if they are old or very old adults (Kim,

2021; Lu et al., 2019; Tsuchiya-Ito et al., 2019; Van Bemmel et al., 2005). In Japan, Tsuchiya-Ito et al. (2019) explored the relationships between physical home environments (e.g., safety, health, and amenities) and subjective well-being among 2,225 recipients of home care services who were aged 65 and above. Their findings revealed that factors such as a lack of safety, limited access to emergency assistance, excessively hot or cold indoor temperatures, poor sanitary conditions, and home disrepair were significantly associated with negative health outcomes. Additionally, the impact of these factors varied according to the level of independence in activities of daily living (ADL), with the strongest associations found among those with low ADL independence. Further research emphasizes the need to improve home environments to promote equity and better health outcomes in near-centenarians.

In the Netherlands, van Bemmel et al. (2005) investigated the relationship between home environmental hazards and the incidence of falls among elderly adults (aged 85 years and over). Home environmental hazards were defined as potentially dangerous conditions within the living environment. These included loose rugs, slippery bathroom surfaces, insufficient lighting, and the absence of appropriately elevated furniture, such as toilets, beds, and chairs. Their findings indicated that elderly people without a record of preceding falls had a 4-fold risk of falls in connection with the presence of six or seven home environmental hazards, compared to those living in hazard-free home environments (van Bemmel et al., 2005). Lu et al. (2019) conducted a systematic review highlighting the link between lighting and older adults' health. Poor lighting can increase fall risks at home, while targeted lighting strategies, for example, pathway illumination from bed to bathroom, enhance safety by improving postural stability. Increased daylight exposure also supports better sleep quality. Additionally, advances in tunable LED lighting offer promising interventions to aid nighttime navigation and regulate circadian rhythms.

Socio-ecological approaches explore how home environments, including home environmental hazards, and psychosocial factors such as social relationships and loneliness, influence health outcomes. Among psychosocial factors, social relationships, including social contacts and loneliness, are frequently mentioned in the literature on aging (Czaja et al., 2021; Shor & Roelfs, 2015). Social contact is defined as the frequency of interactions, making it a relatively objective measure of social relationships. In this study, social contact is assessed by measuring the average frequency of visiting and/or hosting friends and relatives (Shor & Roelfs, 2015). Previous meta-analyses have demonstrated a positive relationship between the frequency of social contact and self-rated physical health (Shor & Roelfs, 2015). However, evidence also suggests that although moderate increases in contact frequency are associated with improved health, further increases, such as engaging in daily interactions, do not yield additional benefits (Stavrova & Ren, 2021).

Loneliness, in contrast, refers to the distress resulting from a perceived gap between desired and actual social relationships (Perlman & Peplau, 1998). Czaja et al. (2021) found a strong association between loneliness and depression and lower self-rated health. Moreover, greater social isolation and reduced social support were linked to higher levels of loneliness, which, in turn, mediated the relationship between social isolation and health outcomes. Older cohorts (80 years and above) reported receiving less social support.

Additionally, loneliness was more pronounced among individuals with smaller social networks, more functional limitations, and fewer opportunities to engage in meaningful activities, all of which contributed to greater social isolation. Bower et al. (2023) found that smaller living spaces were associated with loneliness due to limited opportunities for hosting guests or engaging socially. Inadequate natural light and a lack of common spaces were additional contributing factors to loneliness. Similarly, Zaccaria et al. (2022) studied 94 individuals aged 95–107 and found that social isolation and loneliness are distinct but overlapping experiences among near-centenarians and centenarians. While most participants maintained meaningful relationships, loneliness increased with age, often due to the loss of loved ones. These findings demonstrate that elderly people facing a combination of poor housing conditions, limited social contact, and loneliness experience increased health problems, depressive symptoms, and poor functional health. The results suggest that near-centenarians and

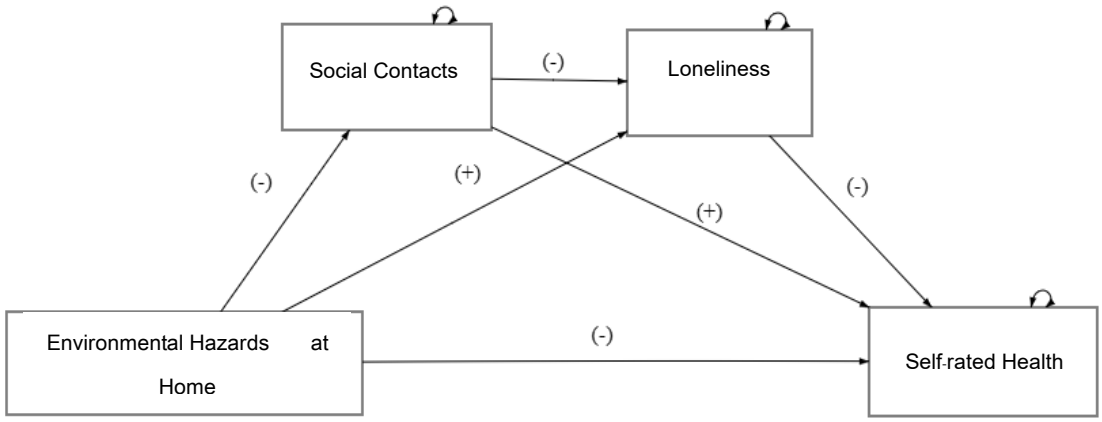
centenarians may be more vulnerable to these challenges than younger older adults, with social contact and loneliness being key mediators in the relationship between home environments and health.

In Thailand, specific home environmental hazards or household hazards linked to fall risks and home modification have been identified as critical factors affecting the health and well-being of older adults. Chindapol (2025) examined fall risks among 205 older adults across five subcultures in Thailand. The study found that health conditions, body size, and sociocultural factors (e.g., family structure and housing features) were significantly associated with the risk of a fall. Regional differences in body dimensions, family dynamics, and housing characteristics were observed. Hazardous vernacular housing, such as steep stairs and poor lighting, increased the risk of a fall. Recommended home modifications include sleeping on the ground floor, using low-seated toilets, placing portable toilets in bedrooms, and adjusting mattress heights. However, sociocultural factors also play a crucial role in mitigating fall risks. Pekalee and Gray (2023) analyzed data from the 2017 National Survey of Older Persons in Thailand (n = 7,829) to examine how in-home modifications (such as sleeping arrangements, bathroom features, handrails, and toilet location) affect happiness among adults aged 75 and above, with a median age of 79. Their findings revealed that happiness is primarily influenced by in-home modifications to reduce environmental hazards, particularly the sleeping arrangements and type of toilet. The study also identified a significant, indirect negative effect of physical disability (e.g., frailty in performing activities of daily living) on the relationship between in-home modification and happiness.

While evidence links home environmental hazards to health outcomes among Thailand's older adults, research examining the interplay between home environmental hazards and psychosocial factors, such as social contacts and loneliness, on health outcomes remains limited. This study, therefore, aims to investigate the relationships among home environmental hazards, social contacts, loneliness, and self-rated health among the oldest adults in Thailand. Additionally, this study employs an interdisciplinary approach that integrates architecture, psychology, and allied health sciences to provide a comprehensive understanding of how the physical home environment influences the health of elderly adults. Specifically, the study investigates how environmental hazards in the home affect self-rated health, not only directly but also indirectly through psychosocial mediators. These mediating factors include the frequency of social contact and the experience of loneliness, both of which are known to play an important role in older adults' health (Figure 1). By integrating insights from multiple disciplines, the study offers a holistic perspective on how home environment safety and social interactions together support the aging process and promote healthy longevity in this population.

Figure 1

A Hypothesis Model



METHODOLOGY

This study, part of the research project "CU-CI Index: Development of Centenarian and Older Adult Age-Well Community Index," received approval from Chulalongkorn University's Health Science Ethics Committee (Approval No. 047/67, 20 February 2024).

Study Areas

In this study, provinces were selected using a purposive sampling method. The first criterion, at the provincial level, required provinces to be among the top 20 in Thailand with the highest proportions of individuals aged 80–100 years and 100 years and over (Table 1), reflecting high longevity. The second criterion, at the district and community levels, required areas to have a sufficient number of the oldest adults and to demonstrate strong elderly support systems, such as ongoing elderly care services and active volunteers (e.g., village health volunteers).

Four provinces (Bangkok, Nonthaburi, Nakhon Si Thammarat, and Nakhon Sawan) were chosen for their significant populations aged 80–100 and over 100 years. Up to three districts per province were selected based on elderly population density and active community leadership. The selected provinces and districts were Bangkok (Dusit District), Nonthaburi (Tha It Subdistrict Administrative Organization (SAO)), Nakhon Si Thammarat (Thasala SAO, Klai SAO, and Ban Bon Nern SAO), and Nakhon Sawan (Nakhon Sawan Municipality, Ban Kai To Health Promoting Hospital, Ban Buriram Health Promoting Hospital) (Figure 2). Researchers collaborated with community leaders to schedule home visits, announce the project, and recruit participants, creating a list of eligible individuals prior to data collection.

Table 1

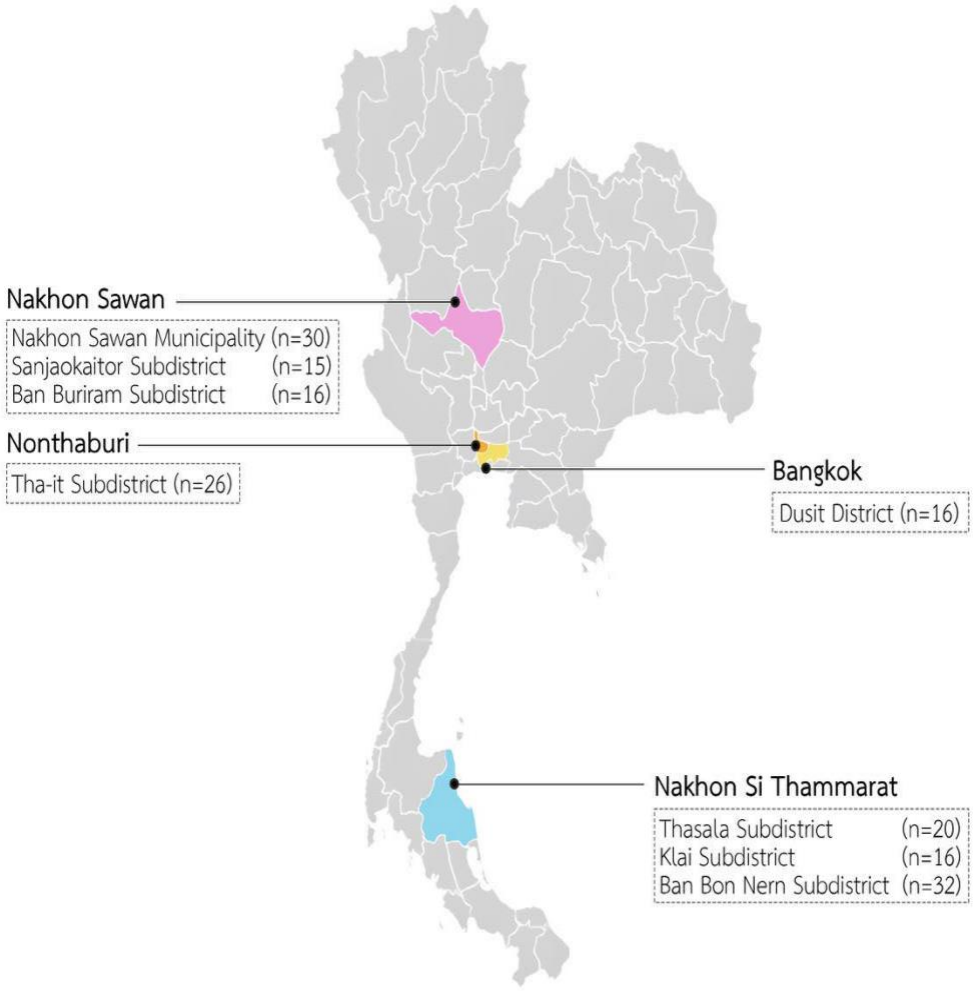
Provinces in Thailand with the Highest Proportions of the Oldest Adults Aged 80–100 Years and 100 Years and Over

Overall Rank	Provinces	Total Population	80 years and over			100 years and over		
			Number	Ratio	Rank	Number	Ratio	Rank
1	Nakhon Sawan	1,025,319	35,990	3.51	9	767	0.075	8
2	Samut Songkhram	188,559	7,851	4.16	1	113	0.060	16
3	Nakhon Si Thammarat	1,543,216	55,109	3.57	6	985	0.060	13
4	Bangkok	5,479,953	182,142	3.32	14	4453	0.080	6
5	Nonthaburi	1,300,610	41,281	3.17	19	1375	0.110	5
6	Chumphon	509,053	17,104	3.36	13	296	0.060	21
7	Prachuap Khiri Khan	550,800	15,796	2.87	31	623	0.110	4
8	Phra Nakhon Si Ayutthaya	821,063	26,648	3.25	17	486	0.060	18
9	Suphan Buri	827,798	29,306	3.54	8	420	0.050	27
10	Chachoengsao	728,386	22,298	3.06	26	489	0.070	10

Note. From *Statistics on the Thai elderly population by province and district as of December 31, 2022, based on data from the Department of Provincial Administration, by* Department of Older Persons, 2023) (https://www.dop.go.th/th/know/side/1/1/335). Copyright 2023 by Department of Older Persons.

Figure 2

Geographic Coverage of the Study Areas



Participants

Participants were recruited from the selected provinces and districts. Eligible participants met the following criteria: (a) aged 80 years and older; (b) residing in the study areas across the four target provinces; and (c) not bedridden. Using Cohen's (1992) method for sample size estimation, the adjusted sample size for a population of 2,248,000 older adults aged 80 and above (Economic and Social Commission for Asia and the Pacific, 2022), with an 70% confidence level, a margin of error of 5%, and an estimated proportion of 0.5, was calculated to be approximately 108 individuals. In this study, 171 very old adults participated. However, only the 141 (82.5 %) with complete data were included in the final analysis. Incomplete data were due to older adults either not completing the questionnaire or being absent on the day of the home visit. Their mean age was 87.14 ± 5.09 years (ranging from 80 to 112 years). There were more females than males (65.2% vs. 34.8%).

Measures

The following measures were used to collect data.

1. Self-Rated Health (SRH) Question. The SRH question, a subjective measure of one's health status, strongly correlates with objective physical functioning. Using a single question: "In

general, how would you rate your current health status?", responses are measured on a 5-point Likert scale, categorized as "0 =very bad," "1 = bad," "2 = fair," "3 = good," and "4 = very good," corresponding to scores of 0–4. This widely recommended measure is endorsed by the WHO (de Bruin et al., 1996) and the European Network for Health Expectancies (Robine et al, 2003; Jürges et al., 2008).

2. Social Contact (SC) scale. The SC scale was developed from the Lubben Social Network Scale (LSNS) (Lubben, 1988) to measure the average frequency of interactions with friends and relatives through two modes: visiting and hosting. Older adults were asked about the frequency of their interactions: visiting friends, visiting relatives, being visited by friends, and being visited by relatives. Responses were scored as follows: Never = 0, Sometimes = 1, Often = 2. Total scores ranged from 0 to 8, with higher scores indicating more frequent social contact. The measure showed good internal consistency (Cronbach's alpha = 0.70).

3. Loneliness Question: Loneliness was measured using one item from the Center for Epidemiologic Studies Depression (CES-D-10) scale (Andresen et al., 1994). "In the past week, how often did you feel lonely?" Responses were categorized as almost always (5–7 days) = 3, often (3–4 days) = 2, sometimes (1–2 days) = 1, and very rarely (less than one day) or never = 0. Single-item measures of loneliness have demonstrated good reliability and a strong correlation with multi-item measures (Mund et al., 2022).

4. Home Environmental Hazards Checklist (HEHC). The HEHC was developed by our research team based on the Home Falls and Accidents Screening Tool (HOME FAST) (Mackenzie et al., 2000) and field-tested to ensure its appropriateness for assessing hazards in housing environments in Thailand. The checklist included a total of 15 items related to fall hazards, categorized into three areas: 3 items for outdoor hazards (within the property fence), 12 items for indoor hazards (from the main entrance inward), and two additional hazard items. Each item on the HEHC was assigned one of four hazard levels: 0 = no risk, 1 = slight risk, 2 = moderate risk, and 3 = high risk. The HEHC assessment was conducted by trained researchers and took approximately 5 minutes to complete. Cronbach's alphas for the three subscales were 0.46, 0.69, and 0.44, indicating moderate internal consistency.

Data Collection

Data were collected using questionnaires, which included the *Self-Rated Health Question, the Social Contact Scale, the Loneliness Question, and the Home Environmental Hazards Checklist.* The research team obtained population registry data for individuals aged 80-99 and 100+ from the Department of Provincial Administration to identify communities with the highest elderly population proportions in four provinces: Bangkok, Nonthaburi, Nakhon Si Thammarat, and Nakhon Sawan. Three subdistricts or villages were selected. After receiving ethical approval on February 20, 2024, the team collaborated with local networks to select communities based on the proportion of the oldest adults, availability of basic infrastructure, care policies for the oldest adults, and research interest in this area. Research assistants (i.e., psychology seniors and architecture postgraduates) and researchers completed training workshops on data collection and home hazard evaluations. Guidelines and training videos were developed to standardize the process. Data collection, including interviews and housing environmental evaluations at participants' homes, took place between May and July 2024.

Data Analysis

Descriptive statistics, including frequency, percentage, mean, standard deviation, and Pearson product-moment correlations, were used to analyze the data. Multiple regression and serial mediation analyses were conducted using the SPSS macro PROCESS Model 6 (Hayes, 2017) to determine the impact of home hazards and related health variables.

RESULTS

House Characteristics

House characteristics, including housing types, structural condition, and usable areas, are presented. Among the housing types, 54.9% were single-story or row houses; 41.5% were two-story or row houses; and 3.6 % fell into other categories, such as elevated houses on stilts or single-story houses with separate kitchen or sleeping areas. In terms of structural condition, 69.4% of the homes were in "good condition, structurally sound." However, 22.4% were described as "partially decayed, structurally stable," indicating some deterioration with minor damage. Among these, 8.2% were classified as "partially decayed, stable (with some sagging floors)" and "decayed, unstable structure," showing significant damage and structural instability. In terms of usable areas, 66.9% of the houses utilized only the ground floor or raised platform area, 14.3% used both the ground floor and upper floors (all levels), and 18.8% used all levels within a single-story structure.

Home Environmental Hazards

We assessed environmental hazards in the homes of very old adults using a 15-item HEHC. The assessment was conducted by trained researchers. Each item was rated on one of four levels: 0 = no risk, 1 = slight risk, 2 = moderate risk, and 3 = high risk. The home environmental hazards include three items related to outdoor hazards (within the property fence), ten items related to indoor hazards (from the main entrance inward), and two additional hazard items. Figures 3 and 4 provide examples of home environmental hazards among the most elderly Thai adults.

Results show that 12 out of 15 home environmental hazards were present in over 70% of homes occupied by elderly adults (Table 2).

The most commonly presented potential hazards were (1) additional hazards, such as raised floors or stairs and dim lighting; (2) indoor hazards, including the sleeping area and indoor walkways; and (3) outdoor hazards, like the pathway to the house. However, the most identified risks were indoor hazards: (1) bathroom: doors that don't close, slanted floors, and no roof (M = 2.13, SD = 0.68); (2) sleeping area: the mattress was on the floor, and insufficient lighting (M = 2.00, SD = 0.83); (3) stair position (M = 1.91, SD = 0.43); (4) laundry area: problems such as a lack of proper seating (have to squat or bend over to wash clothes), raised platforms, and no handrails (M = 1.90, SD = 0.76); and (5) shower area: problems such as a lack of shower seat (have to squat while showering), no grab bars, and low faucets (M = 1.89, SD = 0.76).

Home Environmental Hazards and Their Relations to Health-Related Outcomes

The oldest adults generally rated their health between fair and good (M = 2.56, SD = 0.97, range = 0–4). Among them, 10.6% reported bad or very bad health; 39% rated their health as fair; and 50.3% described it as good or very good. They received more visits from relatives and friends than they made. The mean social contact score was 4.20 (SD = 2.55, range 0-8), indicating moderately frequent social interactions with relatives and friends. The participants also reported a low level of loneliness, with a mean score of 0.57 (SD = 0.87, range 0-3). Using correlational analysis, the relationships between home environmental hazards (3 outdoor hazards, 10 indoor hazards, and 2 additional hazards) and health-related variables (self-rated health, frailty, loneliness, and social contacts) were examined (Table 3). The analysis revealed a significant negative correlation between home environmental hazards, particularly additional hazards, and both social contact and loneliness. A positive correlation was also found between self-rated health, loneliness, and social contacts.

Figure 3

Examples of Hazardous Environments in the Homes of Elderly Thai Adults (High Hazards)

High Hazards: Pathway to the House

Uneven ground, damaged pavement, and a bumpy surface pose significant risks for tripping and falling, particularly for very old adults, making it difficult to navigate safely to the house's main entrance.

High Hazards: Sleeping Area

Sleeping on the floor, combined with poor lighting and obstructed space, creates a hazardous environment, increasing the risk of falls and difficulty moving.

High Hazards: Squatting Toilet

A squatting toilet with no grab bars and a slippery floor increases the risk of falls and accidents.

High Hazards: Raised Wooden Stairs with No Handrails

These stairs are unstable and unsafe due to deterioration, and the absence of handrails significantly increases the risk of falls.

Figure 4

Examples of Hazardous Environments in the Homes of Elderly Thai Adults (Low Hazards)

Low Outdoor Hazards: Pathway to the House
A smooth and wide pathway with sufficient lighting and a resting bench for social interactions.

Low Hazards: Sleeping Areas
A comfortable bed height, adequate lighting, and no obstacles blocking movement around the bed.

Slightly Low Hazards: Bathroom and Washing Areas
Adequate lighting and unobstructed pathways to ensure safe movement, though improvements may still be needed in some areas.

Low Hazards: Living Area
Sufficient day lighting and clear, unobstructed pathways, ensuring a safe and comfortable environment for movement and social activities.

Table 2

Mean, Standard Deviation, Percentage of Home Environmental Hazards (N = 141)

Home Environmental Hazards		Availability		M	SD
		n	%s		
A. Outdoor areas outside the main house (but within the property fence), 3 items					
1	Pathway to the house (outside) (e.g., uneven ground, elevated, narrow, or no lighting)	127	83.60	1.50	0.93
2	Stairs, position 1 (e.g., step height >15 cm, narrow treads, no grab bars)	68	39.76	1.73	0.65
3	Main entrance door (e.g., door is damaged, raised floor, has a threshold).	131	76.61	1.50	0.84
B. Indoor areas within the house (starting from the main entrance), 12 items					
4	Indoor walkway (e.g., uneven levels, unstable floor, dark)	135	78.94	1.78	0.92
5	Rest area (e.g., sitting on the floor, insufficient lighting, obstructed path)	134	78.36	0.83	0.86
6	Kitchen and dining area (e.g., dark kitchen, stove placed on the floor, eating while sitting on the floor)	126	73.68	1.55	0.76
7	Overall bathroom (e.g., bathroom door cannot close, sloped floor, no roof)	132	77.19	2.13	0.68
8	Toilet area (e.g., squatting toilet, raised floor, no grab bars)	132	77.19	1.82	1.04
9	Shower area (e.g., squatting to shower, no grab bars, only low faucet)	132	77.19	1.89	0.76
10	Sleeping area (e.g., sleeping on the floor, insufficient lighting, obstructed space)	135	78.94	2.00	0.83
11	Stairs, position 2 (if applicable)	134	78.36	1.91	0.43
12	Laundry area (e.g., squatting to wash clothes, raised floor, no grab bars)	74	43.27	1.90	0.76
13	Others (e.g., the walkway is dark at night and dangerous, no door that making it accessible to outsiders)	36	21.05	1.87	0.53
C. Additional hazards, 2 items					
14	The house has a raised floor of 1.5 meters or more, or is a two-story house that requires stairs to access	135	78.94	0.24	0.42
15	Insufficient lighting	135	78.94	0.53	0.49

Based on prior research, a regression model was developed to examine mediation effects, exploring how home environmental hazards (outdoor hazards, indoor hazards, and additional hazards) influence self-rated health through social contacts and loneliness. Using a serial mediation model, the study tested how home hazards relate to self-rated health, with social contacts and loneliness as mediators. Mediation analysis was conducted using the bootstrapping method with the SPSS PROCESS macro (Model 6) to test these relationships. The findings revealed that social contacts and loneliness fully mediated the relationship between additional hazards and self-rated health. However, no mediation effects were observed for indoor or outdoor hazards. Detailed results are presented in Table 4 and Figure 5 (a-c).

Table 3

Bivariate Correlations Between Modeled Variables (N=140)

	Variables	1	2	3	4	5	6
1	Self-rated Health	-					
2	Outdoor Hazards	.05 (.27)	-				
3	Indoor Hazards	-.04 (.31)	.37** (<.01)	-			
4	Additional Hazards	-.06 (.24)	.048 (.29)	.26** (<.001)	-		
5	Social Contacts	-.29** (<.01)	-.01 (.45)	-.02 (.42)	-.15* (.04)	-	
6	Loneliness	-.40** (<.01)	.10 (.13)	.04 (.34)	.19* (.01)	-.20** (<.01)	-
	M	2.56	4.90	17.80	.75	4.20	.57
	SD	.97	1.60	3.78	.63	2.55	.87
	Skewness	-.19	.15	.04	.34	.07	1.44
	Kurtosis	-.26	.08	.64	-.49	-1.18	1.13
	Possible range	0-4	0-9	0-30	0-2	0-8	0-3

Note. * p< .05 ** p<.01 One-tailed

Table 4

Coefficients and Standard Errors for the Mediation Models (N = 140)

Model	Coefficients	SE	LLCI	ULCI
(a) Outdoor Hazard → Self-Rated Health				
Total Effect	.03	.08	-.12	.18
Direct Effect	.06	.05	-.04	.15
Total Indirect Effect	-.02	.03	-.08	.04
Indirect Effect 1: Outdoor Hazard → Social Contacts → Self-Rated Health	-.00	.01	-.03	.02
Indirect Effect 2: Outdoor Hazard → Loneliness → Self-Rated Health	-.02	.02	-.07	.02
Indirect Effect 3: Outdoor Hazard → Social Contacts → Loneliness →Self-Rated Health	.00	.00	-.01	.01

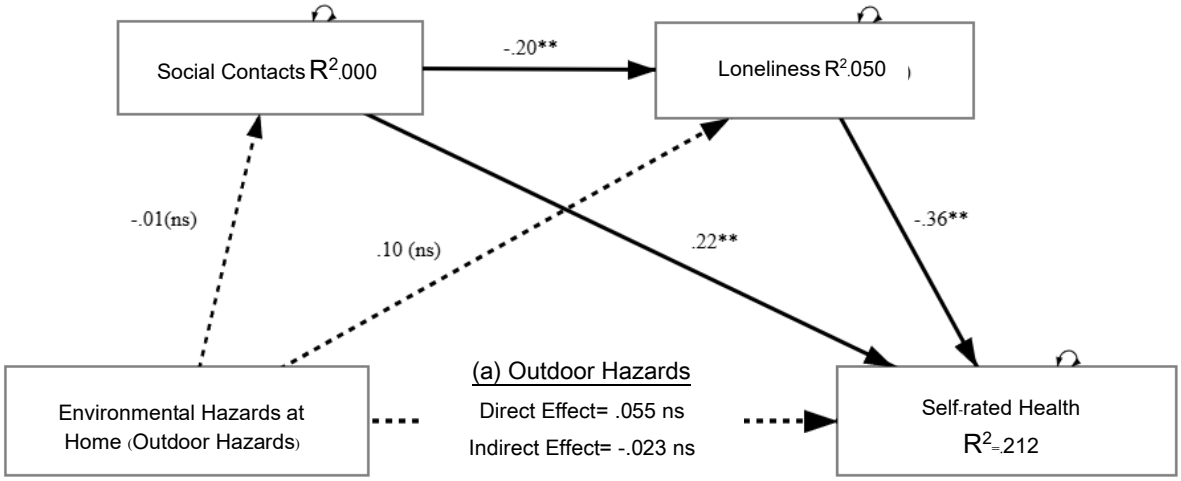
Table 4 (Continued)

Model	Coefficients	SE	LLCI	ULCI
(b) Indoor Hazard → Self-Rated Health				
Total Effect	-.01	.03	-.07	.05
Direct Effect	-.01	.02	-.05	.03
Total Indirect Effect	-.00	.01	-.03	.01
Indirect Effect 1: Outdoor Hazard → Social Contacts → Self-Rated Health	-.00	.01	-.01	.01
Indirect Effect 2: Outdoor Hazard → Loneliness → Self-Rated Health	-.00	.01	-.02	.01
Indirect Effect 3: Outdoor Hazard → Social Contacts → Loneliness →Self-Rated Health	-.00	.00	-.00	.00
(c) Additional Hazard → Self-Rated Health				
Total Effect	-.09	.19	-.49	-.26
Direct Effect	.06	.12	-.18	.30
Total Indirect Effect	-.16*	.07	-.31	-.04
Indirect Effect 1: Outdoor Hazard → Social Contacts → Self-Rated Health	-.05	.03	-.13	.00
Indirect Effect 2: Outdoor Hazard → Loneliness → Self-Rated Health	-.09	.06	-.24	.01
Indirect Effect 3: Outdoor Hazard → Social Contacts → Loneliness →Self-Rated Health	-.02	.01	-.05	.00

Note. * p< .05 ** p<.01 (one tailed)

Figure 5 (a)

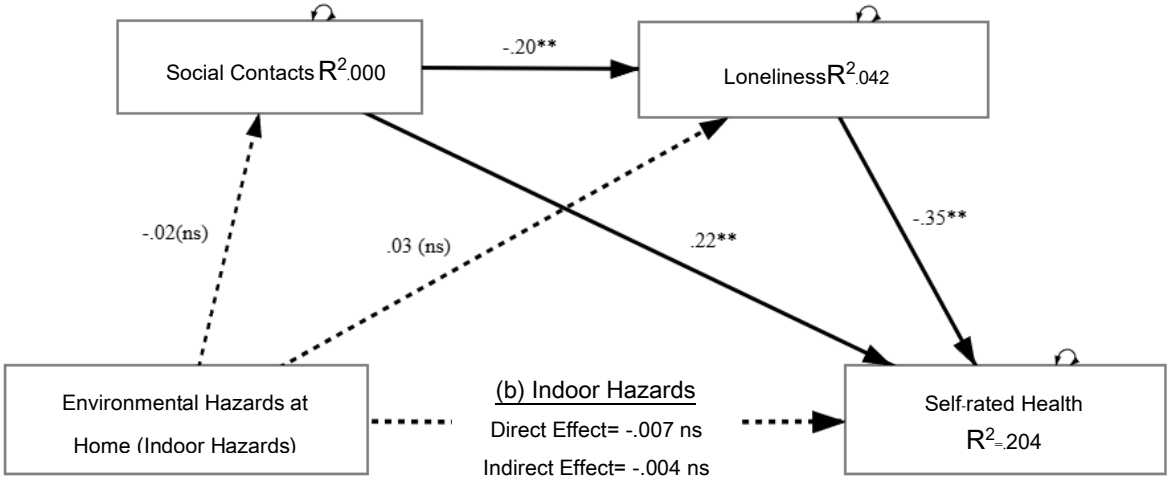
Standardized Coefficients in a Mediating Model of Social Contact and Loneliness in the Relationship Between Outdoor Hazards and Self-Rated Health



Note. *p< .05, ** p<.01 (one tailed); ns = not statistically significant. Solid lines indicate significant effects; dashed lines represent non-significant effects.

Figure 5 (b)

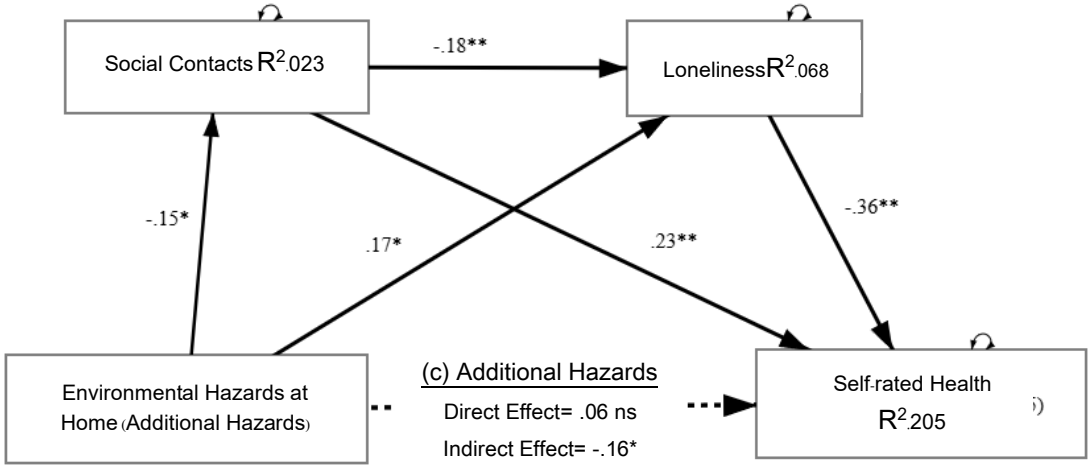
Standardized Coefficients in a Mediating Model of Social Contact and Loneliness in the Relationship Between Indoor Hazards and Self-Rated Health



Note. *p< .05, ** p<.01 (one tailed); ns = not statistically significant. Solid lines indicate significant effects; dashed lines represent non-significant effects.

Figure 5 (c)

Standardized Coefficients in a Mediating Model of Social Contact and Loneliness in the Relationship Between Additional Hazards and Self-Rated Health



Note. *p< .05, ** p<.01 (one tailed); ns = not statistically significant. Solid lines indicate significant effects; dashed lines represent non-significant effects.

DISCUSSION

The research findings have shown that common environmental hazards in the homes of the oldest Thai adults include raised floors or stairs, dim lighting, unsafe sleeping areas, and poorly maintained indoor walkways and pathways. Although raised floors or stairs are common, they were not the riskiest among the elderly adults in this study, likely due to nearly 50% of participants living in single-story homes, with about 47% reporting their homes as structurally sound. Previous research in Thailand, such as Chindapol (2025), similarly found that elevated houses and dim lighting were identified as hazardous home environments associated with fall risks for older adults. In particular, elevated or two-story houses with steep stairs are common, with regional variations in elevation: 1.5–2.0 m in the north and central regions for storage, 1.0–2.0 m in the northeast to avoid reptiles, and 1.0–1.5 m in the south for boat storage and bird nests. The space under these houses is often used for living quarters, and half-timber, half-cement houses are increasingly popular in rural areas of Thailand.

This study demonstrated that the most hazardous environments identified in the homes of the oldest adults were the bathroom, sleeping area, laundry area, toilet, and shower area. These findings are consistent with previous studies in Thailand and worldwide (Carter et al., 1997; Chindapol, 2025; Sattin et al., 1998), which also identified the bathroom as the most unsafe area. A unique finding of this study was that many of the oldest adults usually squat or sit without proper support in the laundry, shower, and toilet. Without adequate seating or stability features, such as handrails, these actions can result in falls and difficulty completing daily tasks. These environmental conditions not only make it challenging for the elderly to perform essential activities safely but also increase their vulnerability to injury, ultimately reducing their independence.

Through an interdisciplinary approach combining architecture, psychology, and health science, this study builds upon and extends previous research by demonstrating that certain home environmental hazards, such as raised floors and dim lighting, when combined with limited social contact and increased loneliness, can significantly worsen self-reported health among very old adults. This finding is consistent with Lawton's framework, which posits that home environmental factors can indirectly influence the health of very old adults (Lawton, 1977; Lawton & Nahemow, 1973). However, this study found no significant association between outdoor and indoor home environmental hazards and self-rated health. One possible explanation is that 50.3% of the participants rated their health as good or very good. This aligns with findings by Pengpid and Peltzer (2023), who reported that 53.3% of Thai adults aged 80 and older rated their physical health as good. It is possible that for those in better health, environmental hazards in the home may not have an immediate or noticeable impact on their perceived health because they are physically more capable of navigating potential risks, such as uneven flooring or poor lighting, without experiencing adverse effects. Their higher functional capacity and better mobility may allow them to adapt to or compensate for minor environmental challenges. As a result, they may not perceive these hazards as significant threats to their daily functioning or subjective health outcomes, unlike individuals with declining health who may be more vulnerable to environmental risks.

The findings have implications for local housing authorities, health promotion agencies, and community stakeholders to cope with the trend that the advanced age population is rapidly accelerating in Thailand. Targeted health promotion interventions for this group should address both the physical and social environments. Specifically, efforts could focus on enhancing lighting strategies to improve safety, reduce feelings of loneliness, and facilitate social interaction. As suggested by Lu et al. (2019), implementing targeted lighting solutions, such as pathway illumination from the bedroom to the bathroom, can significantly improve safety and mobility for the oldest adults within their homes. Adequate lighting along pathways leading to social gathering areas can also reduce the risk of trips and falls, especially among individuals with impaired vision. Additionally, increasing exposure to natural daylight during the day not only supports physical health but also promotes greater engagement in social activities, helping to strengthen social networks and overall health.

Another important implication relates to home modifications based on the World Health Organization's universal design principles (Jarutach, 2023). Homes can be redesigned to eliminate raised steps and uneven surfaces, which pose significant risks to individuals with limited mobility or vision impairments. As recommended by Jarutach and Lertpradit (2020) and Chindapol (2025), assessing housing conditions and modifying homes, such as shortening stair risers, can greatly improve accessibility, taking into account both the physical abilities and cultural characteristics of elderly adults' living environments. It is also recommended to create common areas, such as gazebos, to promote outdoor social interaction. At the same time, social support initiatives aimed at improving the overall health of the oldest adults are crucial. Local government authorities, health promotion agencies, and community stakeholders may consider social support programs to improve the overall health of the oldest adults. Community-based initiatives, such as social engagement programs and encouraging visits from friends and relatives, are crucial in reducing loneliness and enhancing subjective health among older adults. When combined with safe and well-maintained housing conditions, these efforts become even more effective. A secure and accessible home environment allows the oldest adults to engage with their community more confidently, reducing mobility-related barriers that might otherwise limit social interactions. Ultimately, integrating safe housing with community-driven support systems enhances the overall health of older adults, enabling them to remain independent, socially active, and mentally engaged in their later years.

CONCLUSION

The study identified several common environmental hazards in the homes of the oldest Thai adults, including raised floors, dim lighting, and unsafe bathrooms and sleeping spaces. While raised floors were prevalent, they posed a lower risk because many participants resided in single-story homes, minimizing the likelihood of severe falls due to stair-related hazards. However, other home hazards significantly limited mobility, safety, and social engagement. Poor lighting increased the risk of trips and falls, particularly at night, while unsafe bathroom and sleeping areas heightened the chances of injuries, further restricting daily activities. These challenges often led to decreased confidence in moving around the home, which resulted in fewer social interactions and increased feelings of loneliness. This lack of engagement indirectly affected self-rated health, highlighting the critical role of a safe and supportive home environment in maintaining overall health. Addressing both environmental and social factors is essential for creating a safer, more connected living environment. By improving home safety and fostering social engagement, the quality of life and overall health outcomes for Thailand's oldest adults can be significantly enhanced.

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