Abstract

Background: The 44-question Thai Home Fall Hazard Assessment Tool (Thai-HFHAT) was developed to assist healthcare professionals in identifying the risk of falls among community-dwelling older adults from their home environment. However, the reliability of this tool has not been studied. This study aimed to examine the reliability of the 44-question Thai-HFHAT and determine the demographic characteristics associated with home hazards.

Methods: A descriptive cross-sectional study design was used to evaluate inter-rater reliability. The participants in this study were 51 older people from various types of Thai houses: a one-story elevated house, a one-story non-elevated house, and a house with two or more floors, 51 caregivers of older patients, and 5 village health volunteers (VHV). A prospective design was used to evaluate test-retest reliability with older people at different times in their homes. All participants answered 44 Thai-HFHAT questions to determine inter-rater and test-retest reliabilities. The reliabilities were analyzed using an intra-class correlation coefficient (ICC). Demographic characteristics including sex, occupation, and education were used to identify the factors affecting home hazards, and linear regression was used to analyze.

Results: The ICC of inter-rater reliability of the 44-question Thai-HFHAT was 0.74 (95% CI: 0.57-0.84) and the test-retest reliability was 0.80 (95% CI: 0.64-0.88) for the older adults, 0.80 (95% CI: 0.65-0.89) for the caregivers, and 0.72 (95% CI: 0.56-0.84) for the VHV.
for the caregivers and 0.70 (95% CI: 0.477-0.83) for the VHV. In demographic variables, personal business career and education level (grades 1-3) had significant relations with the total number of home hazards in the 44-questions Thai-HFHAT.

**Conclusions:** The 44-question Thai-HFHAT is suitable for home hazard assessment among older adults in Thailand. Further studies are needed to investigate changes in the house environment after using the 44-question Thai-HFHAT to determine which changes can reduce fall risk.

**Keywords**
elderly, falling, hazard control, prevention, reliability

This article is included in the Global Public Health gateway.
Introduction

Falls among the older adults are considered a major public health problem, becoming the second leading cause of death and unintentional injuries\(^1\) (https://www.who.int/news-room/fact-sheets/detail/falls). Thailand’s Department of Disease Control has predicted that during 2017-2021, falls among the Thai older adults will account for 27.0% of deaths in the older adults, resulting in a death rate due to falls among Thais of 50 per 100,000 populations\(^2\) (https://www.dop.go.th/th/know/side/1/1/1159).

The precipitating cause for falls in the older adults involved the interaction of various risk factors categorized as intrinsic or extrinsic.\(^3\) Muscle weakness of the lower extremities and balance impairment were the most important intrinsic factors for the fall.\(^3\) In addition, extrinsic factors such as lots of clutter on the floor, inadequate lighting, or slippery floors were also considered mediators in precipitating falls.\(^4\) However, most of the evidence comes from high-income countries. Despite the significant burden of falls, prevention strategies are not prioritized in the policy agendas of government in low- and middle-income countries.\(^5\) Therefore, identifying potential hazards in Thai houses with an appropriate home hazard screening tool is an effective measure to prevent falls and reduce the risk of falls among the older adults.\(^6\)

In Thailand, Thai Fall Risk Assessment Test (Thai-FRAT) is a widely used tool to screen risks of fall.\(^7\)-\(^9\) Of a total of 6 items of Thai-FRAT, there is only one item to evaluate home environmental risk: “Do you live in a traditional Thai house built with an elevated ground floor exceeding 1.5 meters?” Therefore, the 69-question Thai Home Falls Hazards Assessment Tool (Thai-HFHAT) was designed as a self-reported screening tool to assess the risk of falls at home and is considered suitable for use in Thailand. Psychometric properties of the 69-question Thai-HFHAT were acceptable.\(^10\) However, it is time-consuming (45 minutes to complete all the questions) and difficult for older users to precisely complete all questions.

A subsequent study investigated the development of the 44-question Thai-HFHAT based on the instrument design and methodology of the original Thai-HFHAT. The Cox proportional hazard model using stepwise variable selection methods was used to re-design the 69-question Thai-HFHAT.\(^11\) There was a report of psychometric properties of 44-question Thai-HFHAT as the adjusted hazards ratio (HR) was 1.26 (95% CI: 1.20-1.33), a cut-off was 18 points, the sensitivity and specificity were 0.93 and 0.72, and the area under the receiver operating characteristic curve (AuROC) was 0.90.\(^12\) In addition, the study also found that the 44-question Thai-HFHAT was designed for older participants to complete it within 30 minutes. Occasionally, due to the inability to answer all the elders’ questions in practice, the remaining questions were answered by a caregiver or a village health volunteer for the elders. However, the reliability of this tool has not been studied. In order for the 44-question Thai-HFHAT to have psychometric properties in all aspects, a reliability study is required.

Studies on home hazards frequently investigate the area where the hazards are present, the numbers of hazards in the home and how these hazards could contribute to falls.\(^13\),\(^14\) Such a unilateral approach does not take into account the characteristics of the older adults and how these might make the home environment more hazardous. Romli et al., 2018 was to investigate the older adult’s characteristics that contribute to home hazards. Lower educational attainment, greater number of home occupants, lower monthly expenditure, traditional housing, Chinese ethnicity and younger age were the factors associated with home hazards.\(^15\) The researcher proposes that older Thai participants’ characteristic will correlate with the number of home hazards Therefore, this study also aimed to determine the Thai elderly’s characteristic factors contributing to home hazards.

Methods

Ethical approval statement

This study was approved by Institutional Review Board of Walailak University (approval number WUEC-20-302-01) on September 16, 2020.
Informed consent
Written informed consent was obtained from each of the participants.

Study design
A descriptive cross-sectional study design was used to study the area at risk of falling, personal factors, and inter-rater reliability of the 44-question Thai-HFHAT. The test-retest reliability was evaluated using a prospective study that all participants answered and a weeks later, the 44-question Thai-HFHAT were repeated. This study was conducted in Tha Khuen Sub-District, Tha Sala District, Nakhon Si Thammarat.

Participants
The target population consisted of Thai older adults aged 60 years or over, with a total number of 2,552 adults residing in Tha Khun Subdistrict, Tha Sala District, Nakhon Si Thammarat Province (https://www.dop.go.th/th/know/1). Inclusion criteria were those who achieved fluency in the Thai language. Exclusion criteria were those who could not perform activities of daily living (ADLs) according to Barthel ADLs Index, those who were completely dependent or disabled (ADL scores: 0-4), and had dementia determined by the Mini Mental State Examination-Thai 2002. Researchers approached the participants at their homes to explain the study. Fifty-one older people, who met the inclusion and exclusion criteria as above, were chosen because for our primary purpose examining inter-rater reliability and test-retest reliability. The study was conducted to examine test-retest and inter-rater reliability for the level of reliability of the 44-question Thai-HFHAT. These different groups were chosen to help identify whether each group of participants can be replaced by other groups when assessing the hazards in the event the older participant cannot complete the instrument by themselves in real life.

Research instruments
The 44-question Thai-HFHAT
The Thai-HFHAT is composed of 44 questions grouped into 7 sections/rooms. Four items were used to assess hazards in a living room, 4 in a kitchen room, 5 in a garage, 6 for house curtilage, 7 in stairs, 8 in a bedroom, and 10 in a bathroom. Also, the instrument contained a drawing for each room to help the older adults to identify hazards more easily.

The Barthel Activities of Daily Living Index
This is an assessment tool for evaluating ADLs for the performance of daily activities by the older adults in 10 activities. The older participants were then classified into three groups according to the scores received: those who were completely independent and able to help others (ADL scores: ≥12), those who were moderately dependent and spent most of their time in their home (ADL scores: 5-11), and those who were completely dependent or disabled (ADL scores: 0-4).

The Mini Mental State Examination-Thai 2002 (MMSE-Thai 2002)
This is a Thai version of the cognitive impairment assessment tool for the Thai older adults. The cognitive impairment of the older adults can be preliminarily determined when the older adults who received no formal education had MMSE-Thai scores of ≤14, when the older adults who received only upper secondary education had scores of ≤17, and when the older adults who continued their education received a score of ≤22. MMSE-Thai 2002 has a Sensitivity value of 87% Specificity value is 82%.

Data collection
Data on demographic characteristics of the older adults, caregivers, and VHVs were collected. Three groups of study participants were asked to fill out the 44-question Thai-HFHAT. They were instructed to enter each room in their home and answer a list of questions for assessing fall hazards in each room using a guided drawing. For the example of questions to identify hazard such as “Does the lighting not suitable for activities?” “Does the clutered objects or wires block the path?” etc. Scoring of potential hazards from the screening tool was performed. High scores have been associated with an increased risk of falls. The study participants were informed to complete the screening tool within 30 minutes. The hazard areas, the participant’s characteristic factors, and inter-rater reliability were conducted after obtaining data from all participants.
All three groups were instructed to perform the second assessment a week later\textsuperscript{15} so that researchers could collect more data for examining test-retest reliability. During the assessment, the older adults, caregivers, and VHV participants had to independently answer assessment questions, and no conversation was permitted. We considered the intraclass correlation coefficient (ICC) with values ranging from 0 to 1 suitable for the evaluation of inter-rater and test-retest reliability. The ICC results were classified as follows: values between 0.00-0.49 were classified as poor reliability, values between 0.50-0.74 as moderate, values between 0.75-0.90 as good, and 0.91-1.00 as excellent.\textsuperscript{18} Data collection started in July 2021 and ended in August 2021.

**Data analysis**

All data were recorded and entered using the statistical package software version 22 (IBM Corp. Armonk, NY, USA). Mean and standard deviation (SD) were used to analyze the participants’ characteristics. Frequency and percentage were used show the data of home hazard areas. Inter-rater and test-retest reliabilities were evaluated using an intra-class correlation coefficient (ICC), that is, ICC (2, k) and ICC (3, k), respectively. The test-retest performed for the three groups separately. Mean score differences between the older adults, caregivers, and VHV participants were evaluated using a One-Way ANOVA. Differences in mean scores from the first and the second visits (1 week apart) were analyzed using an independent-samples t-test. We used multiple linear regression to predict the independent factors, consisting of sex, occupation, and education level, affecting the 44-question Thai-HFHAT score.\textsuperscript{19,20}

**Results**

This study included 107 study participants, and the demographic characteristics of all participants and fall history of the older participants are shown in Tables 1 and 2, respectively. 59% of the older adults lived in a one-story non-elevated house, 55.8% had blurred vision, and 86.5% demonstrated normal balance ability (≥10 seconds of tandem standing). The underlying diseases of the older participants included hypertension (46.2%) and hyperlipidemia (44.2%). Most caregivers had a close relationship with the older participants (53.9%). The mean (±SD) duration of caregiving in the caregiver group was 21.73 (±5.71) hours/day or 6.88 (±0.83) days/week. The mean (±SD) working experience of the VHV participants was 12.96 (±6.63) years.

A total of 107 participants identified fall risk areas within the home. The most home hazards that may cause a fall was found for the bathroom 94.1%, then bedroom (74.5%), living room (56.9%), kitchen room (37.3%), around the home (35.3%), garage (25.5%), and stair in the home (7.8%), respectively. Percentage of identified home hazards that may cause a fall in each room shown in Figure 1.

**Table 1. Demographic characteristics of study participants.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Older adults (n = 51)</th>
<th>Caregiver (n = 51)</th>
<th>VHV (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>20 (39.2)</td>
<td>23 (45.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Women</td>
<td>31 (60.8)</td>
<td>28 (54.9)</td>
<td>5 (100.0)</td>
</tr>
<tr>
<td>Mean ± SD age in years</td>
<td>73.40 (7.21)</td>
<td>58.12 (15.82)</td>
<td>45.5 (6.24)</td>
</tr>
<tr>
<td>Mean ± SD BMI in kg/m²</td>
<td>25.67 (1.23)</td>
<td>22.71 (3.81)</td>
<td>22.33 (4.45)</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 1-3</td>
<td>44 (86.3)</td>
<td>19 (37.3)</td>
<td>1 (20.0)</td>
</tr>
<tr>
<td>Grades 4-6</td>
<td>3 (5.9)</td>
<td>12 (23.5)</td>
<td>3 (60.0)</td>
</tr>
<tr>
<td>Above grade 6</td>
<td>4 (7.8)</td>
<td>20 (39.2)</td>
<td>1 (20.0)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No partner</td>
<td>6 (11.8)</td>
<td>6 (11.8)</td>
<td>1 (20.0)</td>
</tr>
<tr>
<td>Have a partner</td>
<td>45 (88.2)</td>
<td>45 (88.2)</td>
<td>4 (80.0)</td>
</tr>
<tr>
<td>Occupations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housekeeper</td>
<td>30 (58.8)</td>
<td>19 (37.3)</td>
<td>2 (40.0)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>12 (23.5)</td>
<td>23 (45.1)</td>
<td>2 (40.0)</td>
</tr>
<tr>
<td>Personal business</td>
<td>9 (17.7)</td>
<td>9 (17.7)</td>
<td>1 (20.0)</td>
</tr>
</tbody>
</table>

VHV, village health volunteers.
Inter-rater reliability
The ICC for the 44-question Thai-HFHAT was 0.74 (95% CI: 0.57-0.84). The mean (±SD) scores of the older adults, caregiver, and VHV groups were 6.65 (±3.29), 5.37 (±3.22), and 4.88 (±2.65), respectively. The mean difference in scores for all three groups was statistically significant ($p = 0.012$), as shown in Figure 2.

Test-retest reliability
The ICC for the 44-question Thai-HFHAT was 0.80 (95% CI: 0.64-0.88) for the older adult group, 0.80 (95% CI: 0.65-0.89) for the caregiver group, and 0.70 (95% CI: 0.48-0.83) for the VHV group. The mean difference in scores obtained before and after one week of the assessment of the older adults ($p = 0.283$), caregiver ($p = 0.604$), and VHV ($p = 0.984$)
groups was not statistically significant. The average scores of the 1st and 2nd time of the older adults, caregivers, and VHV are shown in Figure 2.

Demographic characteristics of older adults associated with home hazards

As shown in Table 3, the values of variance inflation factor (VIF) are all less than 5 and all the tolerance values are more than 0.10. The p-value for all independent variables, that is, personal business career and education level grade 1-3 are less than 0.05, which shows they have a significant relationship with the dependent variable, 44-question Thai-HFHAT score.

Discussion

Thirty-seven older participants in this study (72.6%) had no history of falls. This may be attributed to regular exercise of the participants, as the 34 participants (91.9%) performed a regular exercise routine. This figure supports the study by Hopewell S. et al. (2018) who reported that the practice of regular exercise would decrease fall rates and reduce the risk of falls in the older adults. Of all the older adults surveyed participants, 27.5% reported a fall. This number is close to that predicted by the Thailand Department of Disease Control report on the prevalence of falls during 2017-2021, in which falls among Thai older adults account for 27.0% (https://www.dop.go.th/th/know/side/1/1/1159). The area of the home with the most falls was the bathroom at 94.1%, consistent with several studies on both Thais and in other countries. The bathrooms are areas where water is trapped with no separation between wet and dry areas. In addition, the present step in the room, no toilet or seat with hanging legs, and no shower seat/shower chair are causes of most falls in the bathroom.

The inter-rater reliability of the study participants using the 44-question Thai-HFHAT was moderate (ICC = 0.74) and the test-retest reliability among the older adult was good (ICC = 0.80). Our results indicated that the 44-question...
Thai-HFHAT is as reliable as the 69-question Thai-HFHAT, whose inter-rater reliability was good (ICC = 0.87) and the test-retest reliability was good (ICC = 0.87). In our study, the 44-question Thai-HFHAT had lower ICC than the 69-question Thai-HFHAT. This is probably because prior to the use of the 44-question Thai-HFHAT assessment, there was no training like the 69-question Thai-HFHAT assessment, it was only an explanation of the assessment method. The same is accurate for the Tomita MR et al., 2014 study, where testing inter-rater reliability between two occupational therapists who were trained for home safety assessment using older adults' homes resulted in a higher ICC value of inter-rater reliability (ICC = 0.89) than that of the recent study (ICC = 0.74).25

The inter-rater and the test-retest reliability of the 44-question version was higher than the Modified HOME FAST-SR (Thai version) (ICC = 0.64 and 0.71, respectively).12 This is probably because the Thai-HFHAT was designed to have questions listed in an organized manner with drawings to help illustrate each room in a house, allowing participants to identify home hazards at ease. However, the text in the HOME FAST-SR may have been confusing. For instance, in the HOME FAST-SR question 8b asks “Does it take you several attempts to get up out from your sitting chair?”, and question 8c asks “When you lower yourself into the chair, can you do it without falling back on the chair?”. These two statements may have caused confusion that could lead to medical measurement errors.27

We found that the older participants had a higher mean home hazard rating, followed by caregivers and VHV participants. This is likely because most of our older participants had a health issue and considered falling one of the health issues that cause the most damage,25 prompting the older adults to pay more attention to risk factors that contribute to falls than caregiver and VHV groups. Also, the difference in mean home hazard ratings between the older adults and VHV participants was statistically significant (p = 0.012). Our results are consistent with the previous study by Morgan et al. (2005) who investigated the reliability of a self-report home hazard screening tool and found some questions, i.e. “Is lighting suitable for activities?”, could not be precisely answered by looking around the home environment. Such questions were viewed by the older participants as increasing the risk of falls, whereas the VHV participants may not.29 Thus, the self-report 44-question home hazard screening tool was preferred for the home hazards assessment among the older adults. In our study, the mean ratings of the 44-question Thai-HFHAT among the older adults, caregivers, and VHV groups were varied in the first and second assessments. We found a slight decrease in the mean rating of the older participants on the second visit. This may be due to changes in the behavior of the older participants and in the home environment between the first and the second visits. The study participants may have removed obstacles like power cords from walkways before the second home visit. This phenomenon is called “reactivity” and can occur as a result of administering an instrument to the study participants multiple times. Participants become sensitized with the instrument and “learn” to respond when they perceive how they are expected to respond.30

Older participants with higher education levels had lower number of home hazards. These older participants might have greater awareness and more access information to assist with improving the safety of their home environment. Higher educational attainments are likely to be associated with better income and socioeconomic status, and therefore greater affordability for safer housing and home modification.31 Moreover, home hazards appeared to be associated with occupation. This study found that the group of people those who served as housewives in their own homes had a higher risk of falling, which may be related to the amount of clutter in the home.

The main limitation of our study was the small number of the sample size. To achieve the valid generalization that covers most types of Thai houses, this study should have been conducted with a larger sample size to ensure the applicability of the screening tool. Another limitation in this study, we studied only three demographic factors: occupation, education, and sex. I did not control for other factors contributing to falls, such as age, alcohol intake, incontinence, vision and hearing problems, physical and cognitive function, etc. Therefore, the number of sample sizes should be increased to have enough to control for these variables. Further studies are needed to investigate the changes in house environment after using the 44-question Thai-HFHAT to determine what particular changes could reduce fall risk. Finally, the 44-question Thai-HFHAT was developed in the Thai version. Therefore, cross-cultural translation of 44-question Thai-HFHAT is important for widespread use.

**Conclusions**

Our study confirmed that the 44-question Thai-HFHAT is suitable for the home hazards assessment among the older adults in Thailand.

**Author contribution**

Conceptualization, CL; Data curation, CL, YW; Investigation, CL, YW, JN, SL, LM; Methodology, CL, YW, JN, LM; Project administration, CL; Supervision, JN, SL, LM; Writing-original draft, CL, SL; Writing-review & editing, CL, RP, JN, SL, LM.
Data availability

Underlying data
	nfigshare: Underlying data and extended data of Reliability on the 44-question Home Fall Hazard Assessment Tool and Demographic Characteristics Associated with Home Hazards among the Thai Older Adults. https://doi.org/10.6084/m9.figshare.c.6239961.v1.32

- General information of the older adults. https://doi.org/10.6084/m9.figshare.21382278.v1.33
- General information of caregiver. https://doi.org/10.6084/m9.figshare.21343374.v1.34
- General information of village health volunteer. https://doi.org/10.6084/m9.figshare.21343380.v1.35
- 1st test done by the older adults. https://doi.org/10.6084/m9.figshare.21343383.v1.36
- 1st test done by caregiver. https://doi.org/10.6084/m9.figshare.21343413.v1.37
- 1st test done by VHV. https://doi.org/10.6084/m9.figshare.21343431.v1.38
- 2nd test done by the older adults. https://doi.org/10.6084/m9.figshare.21343464.v1.39
- 2nd test done by VHV. https://doi.org/10.6084/m9.figshare.21343476.v1.41

Extended data

- Supplementary Table 1. https://doi.org/10.6084/m9.figshare.21304887.v1.42
- Inform consent. https://doi.org/10.6084/m9.figshare.21304920.v1.43

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Acknowledgments

The authors thank all of the older adults who participated in the study.

References

17. Department of Medical Services, Ministry of Public Health.
Open Peer Review

Current Peer Review Status: ✔️  ✔️

Version 3

Reviewer Report 11 July 2023

https://doi.org/10.5256/f1000research.148757.r183646

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✔️ Machiko R Tomita
Department of Rehabilitations Science, University at Buffalo, Buffalo, NY, USA

The revised manuscript reads well. I noticed the lack of mentioning about statistical analysis software used (SPSS) in this manuscript. It is a good practice to reveal it.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Fall prevention, smart house, e-health in gerontological population.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 2

Reviewer Report 18 May 2023

https://doi.org/10.5256/f1000research.144999.r165889

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❓ Machiko R Tomita
Department of Rehabilitations Science, University at Buffalo, Buffalo, NY, USA

This article has been improved, but being viewed with fresh eyes, there are some issues that need to be addressed by authors.
Major issue: What was the reason that fall related personal characteristics were not included in the study using regression? Age, past falls, past fall injuries, physical and cognitive function, balance/dizziness, foot problems, alcohol intake, incontinence, vision and hearing problems, high blood pressure, etc. It looks like you have information about some of them. If you are interested in demographic factors only, you should have controlled for these fall risk factors that are known to cause a fall. To do so, you need more than 51 participants to use a regression analysis.

Minor issues: These are mainly for writing clarifications and are easy to fix.

Abstract

1. In Background, use the word “demographic” rather than “personal” characteristic because in Methods, only sex, occupation, and education are mentioned. Why was age not included?

2. Choose either “interrater” or “inter-rater”.

3. In Results, the p-value should be less than .05. If it is significantly related, it should be $p \leq .05$; therefore, it is not necessary to talk about it. Revise the sentence to something such as “In demographic variables, business career and education level (grades 1-3) had significant relations with the total number of home hazards in the 44-questions Thai-HFHAT.”

Introduction

4. Words such as “the elderly” and “elderly” are not preferred terms. Use “older adults”, instead. This is for the whole manuscript.

5. Can you be a little more specific about poor housing conditions?

6. How many minutes does it take to complete the 69-question Thai HFHAT while 44-questions take 30 minutes?

Methods

7. In Study design, a description is only for interrater reliability. Write one for test-retest reliability. They are written in the Abstract.

8. Start a new sentence for determination of dementia using MMSE-Thai 2002 or follow my suggestion for # 12 below.

9. 51 should be spelled out. Same for 4 items in Research and 37, the beginning in Discussion when a sentence starts with a number.

10. The word “passed” should be replaced with “met”.

11. After “this number was adequate” it is better to say, “for our primary purpose – examining interrater and test-retest reliability.” It is because if you used only 51 participants for regression, it is not enough. The parts talking about the sample sizes are a bit confusing. Please clarify the sample size for each of three analyses. You had these 3 groups for interrater reliability study,
which was one of the study strengths.

12. The information about MMSE-Thai 2002 is redundant with that in Participants. This part is easier to understand than in Participants section. It may be better to leave it something like “had dementia determined by the Mini Mental State Examination-Thai 2002. Do you have the information about psychometric properties of MMSE-Thai 2002?

13. In Data collection, if participants were instructed to complete the assessment within 30 minutes, you have to revise the sentence In the Introduction, “requires only 30 minutes for elderly users to complete”. It is because we read the sentence that “older participants took 30 minutes to complete” and you are reporting the fact. The revised sentence should be “…was designed for older participants to complete it within 30 minutes.”

14. Were 51 older participants’ houses used for reliability tests?

15. Provide one or two examples of instructions or questions to identify a home hazard. Were they asked, “Isthis room lighted well?” “Does this room light well not to fall?”, etc.?

16. “So that researchers could collect more data for examining test-retest reliability,” should be “for test-retest reliability.”

17. In Data analysis, citation (SPSS Inc., Chicago, IL, USA) should be replaced with (IBM Corp. Armonk, NY, USA). IBM bought SPSS in 2009.

18. Was the test-retest performed for the three groups separately or altogether? Later I understood but it should be written here also.

19. Sentences starting with “Information bias” are not necessary. It should be covered by IRB. If you must write it for some reason, it should be placed in the Data collection section.

**Results**

20. Caregivers provided care about 22 hours/day on average. The hour seems extremely high even if care recipients have dementia.

21. In Table 2, 14 participants fell but in fall injury, 16 participants answered. The total should be 14. Also, the percentage should be calculated out of 14.

22. The result section should be written in past tense.

23. Is the sentence starting with “the area at the most risk of fall risk are…” 94.1% of 107? Revise the sentence, such as “The most home hazards that may cause a fall was found for the bathroom (94.1% of 107), then bedroom…” Did 94.1% of participants identify at least one of 4 items in the bathroom is a fall risk?

24. “The risk of falling in each room” and the title of Figure 1 should be replaced by for example “Percentage of identified home hazards that may cause a fall in each room.”
25. Who are participants for personal characteristics associated with home hazards? 51 older adults?

26. Why was age not included in independent variables? Please read a major concern.

27. In Table 3, all r should be R. Discussion 28. I would use (91.9% of 37 non-fallers) rather than (66.6%).

29. I would state “This figure supports the study by Hopewell...” rather than “Our results are consistent..” because this was not the purpose of the study and happened to find it.

30. Remove the last sentence of the first paragraph on page 8, staring “This makes it more reliable than....”. When raters are homogeneous, they tend to rate in a similar manner. In your study, the raters are diverse. Accordingly, the reference 26 should move after (ICC=0.74)” When we use 1 vs. K, the use of ICC(2,k) produces a larger ICC value than ICC (2,1). It is not always that a larger sample size produces a lower ICC value than a small sample size. When there is little variation among raters given to each item, then the ICC v values become high. Revision of these paragraphs related to the sample size and ICC values is recommended or if the statement is true, put citations.

31. You discussed a lot about interrater reliability but not much about test-retest reliability.

32. Finally, if you do have answers for my major concern, please state them and if not, you should state lack of control for known fall risks in the limitation.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Fall prevention, smart house, e-health in gerontological population.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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**Author Response 23 May 2023**

**Charupa Lektip**

**Major issue:** What was the reason that fall related personal characteristics were not included in the study using regression? Age, past falls, past fall injuries, physical and cognitive function, balance/dizziness, foot problems, alcohol intake, incontinence, vision and hearing problems, high blood pressure, etc. It looks like you have information about some of them. If you are interested in demographic factors only, you should have controlled for these fall risk factors that are known to cause a fall. To do so, you need more than 51 participants to use a regression analysis.

**Response**

The main objective of this study was to study home hazards associated with falls using a developed assessment form. Home hazards were classified as extrinsic factors affecting falls that were also important to reduce the risk of falls from home hazard. Romli et al., 2018
reported that older adult characteristics consist of education, number of home occupants, monthly expenditure, traditional housing, ethnicity, and age were correlated with home hazard, but were not reported for the Thai older adult.

Therefore, in this study, which was conducted in a Thai population, so interested in the educations, sex, and income-generating occupation, but there is also a limitation on the age variable since the study was conducted in an elderly population that 75% was middle elderly (70-79 years) and 15% was the late elderly (80-89 years) of the Thai population tended to be low survivors. This is a limitation in the analysis of regression data. The researchers will write a limitation in the next study for clarity.

The other variables recommended by the reviewer are good recommendations as they are intrinsic factors that affect falls as well. But with the main objective of focusing on home hazards, the researchers did not collect data on these variables. However, inclusion criteria were used by the investigators to attempt to control for intrinsic factors as much as possible. For this reason, I would like to adjust the title to only demographic characteristics and would like to take the reviewer’s advice as a limitation and suggestion next time.

**Minor issues:** These are mainly for writing clarifications and are easy to fix.

**Abstract**

1. In Background, use the word “demographic” rather than “personal” characteristic because in Methods, only sex, occupation, and education are mentioned. Why was age not included?

**Response**

I have changed personal to demographic characteristic. Because the study was conducted in an elderly population that 75% was middle elderly (70-79 years) and 15% was the late elderly (80-89 years) of the Thai population tended to be low survivors. The researchers assumed that the irrelevant age of the subjects would not affect the home hazard.

2. Choose either “interrater” or “inter-rater”.

**Response** I have changed interrater to inter-rater.

3. In Results, the p-value should be less than .05. If it is significantly related, it should be p ≤ .05; therefore, it is not necessary to talk about it. Revise the sentence to something such as “In demographic variables, business career and education level (grades 1-3) had significant relations with the total number of home hazards in the 44-questions Thai-HFHAT.”

**Response** I have fixed as you suggest.

**Introduction**

4. Words such as “the elderly” and “elderly” are not preferred terms. Use “older adults”, instead. This is for the whole manuscript.

**Response** I have change elderly to older adults as you suggest.

5. Can you be a little more specific about poor housing conditions?

**Response** I have described poor housing in the line 12.
6. How many minutes does it take to complete the 69-question Thai HFHAT while 44-quesitons take 30 minutes?
Response 45 minutes.

Methods
7. In Study design, a description is only for interrater reliability. Write one for test-retest reliability. They are written in the Abstract.
Response I have described about test-retest in the line 67.

8. Start a new sentence for determination of dementia using MMSE-Thai 2002 or follow my suggestion for # 12 below.
Response I follow as you suggest in item 12.

9. 51 should be spelled out. Same for 4 items in Research and 37, the beginning in Discussion when a sentence starts with a number.
Response I have already change as you suggest in line 82, 98 and 202.

10. The word “passed” should be replaced with “met”.
Response I have already change as you suggest in line 83.

11. After “this number was adequate” it is better to say, “for our primary purpose – examining interrater and test-retest reliability.” It is because if you used only 51 participants for regression, it is not enough. The parts talking about the sample sizes are a bit confusing. Please clarify the sample size for each of three analyses. You had these 3 groups for interrater reliability study, which was one of the study strengths.
Response I already clarify as you suggest about sample size for inter-rater reliability and test-retest reliability as our primary purpose in line 84-89.

12. The information about MMSE-Thai 2002 is redundant with that in Participants. This part is easier to understand than in Participants section. It may be better to leave it something like “had dementia determined by the Mini Mental State Examination-Thai 2002. Do you have the information about psychometric properties of MMSE-Thai 2002?
Response I have added the information about psychometric properties in the line 116.

13. In Data collection, if participants were instructed to complete the assessment within 30 minutes, you have to revise the sentence In the Introduction, “requires only 30 minutes for elderly users to complete”. It is because we read the sentence that “older participants took 30 minutes to complete” and you are reporting the fact. The revised sentence should be “…was designed for older participants to complete it within 30 minutes.”
Response I have already changed the sentence in the Introduction as you suggest in line 39-40.

14. Were 51 older participants’ houses used for reliability tests?
Response Yes, of course.

15. Provide one or two examples of instructions or questions to identify a home hazard. Were they asked, “Isthis room lighted well?” “Does thisroom light well not to fall?”, etc.?
Response I have already added the example of questions in line 126-128.

16. “So that reserachers could collect more data for examining test-rest reliability,” should be “for test-retest reliability.”
Response I have already edited in line 134.

17. In Data analysis, citation (SPSS Inc., Chicago, IL, USA) should be replaced with (IBM Corp. Armonk, NY, USA). IBM bought SPSS in 2009.
Response I have already change as you suggest in line 145.

18. Was the test-retest performed for the three groups separately or altogether? Later I understood but it should be written here also.
Response I have already added “the test-retest performed for the three groups separately” in line 150.

19. Sentences starting with “Information bias” are not necessary. It should be covered by IRB. If you must write it for some reason, it should be placed in the Data collection section.
Response I have already deleted “Information bias” out of data analysis part.

Results
20. Caregivers provided care about 22 hours/day on average. The hour seems extremely high even if care recipients have dementia.
Response Most caregivers are family members such as husbands, daughter or son who live in the same house. Each person's care period is almost 24 hours.

21. In Table 2, 14 participants fell but in fall injury, 16 participants answered. The total should be 14. Also, the percentage should be calculated out of 14.
Response I apologize for adding the wrong numbers. I have done the fix as you suggested.

22. The result section should be written in past tense.
Response I have written the result section in the past tense.

23. Is the sentence starting with “the area at the most risk of fall risk are…” 94.1% of 107? Revise the sentence, such as “The most home hazards that may cause a fall was found for the bathroom (94.1% of 107), then bedroom...” Did 94.1% of participants identify at least one of 4 items in the bathroom is a fall risk?
Response I have rewritten the sentence as you suggest. Participants who identify at least one of all questions in each room assume that the fall risk.

24. “The risk of falling in each room” and the title of Figure 1 should be replaced by for example “Percentage of identified home hazards that may cause a fall in each room.”
Response I have rewritten as suggest in line 179-180 and the title of Figure 1.

25. Who are participants for personal characteristics associated with home hazards? 51 older adults?
Response Yes, the demographic characteristics of 51 older adults. I have added word “older adults” in the topic for easy to understand.
26. Why was age not included in independent variables? Please read a major concern.
**Response** Because the study was conducted in an elderly population that 75% was middle elderly (70-79 years) and 15% was the late elderly (80-89 years) of the Thai population tended to be low survivors. The researchers assumed that the irrelevant age of the subjects would not affect the home hazard.

27. In Table 3, all r should be R.
**Response** I have replaced r by R as you suggest.

**Discussion**
28. I would use (91.9% of 37 non-fallers) rather than (66.6%).
**Response** I have changed from 66.6% to 91.9%.

29. I would state “This figure supports the study by Hopewell....” rather than “Our results are consistent.” because this was not the purpose of the study and happened to find it.
**Response** I have edited as you suggest in line 213-214.

30. Remove the last sentence of the first paragraph on page 8, staring “This makes it more reliable than.....”. When raters are homogeneous, they tend to rate in a similar manner. In your study, the raters are diverse. Accordingly, the reference 26 should move after (ICC=0.74)” When we use 1 vs. K, the use of ICC(2,k) produces a larger ICC value than ICC (2,1). It is not always that a larger sample size produces a lower ICC value than a small sample size. When there is little variation among raters given to each item, then the ICC v values become high. Revision of these paragraphs related to the sample size and ICC values is recommended or if the statement is true, put citations.
**Response** I have moved references 26 to after (ICC=0.74). I've changed the reason for this study's ICC being less than the previous study without justifying the sample size in the line 235-238.

31. You discussed a lot about interrater reliability but not much about test-retest reliability.
**Response** I added the discussion on test-retest reliability in the same section as the discussion on inter-rater reliability.

32. Finally, if you do have answers for my major concern, please state them and if not, you should state lack of control for known fall risks in the limitation.
**Response** I have already explained the major concern in the first part of your question. It will be put in the limitation section in line 295-300.

**Competing Interests:** No competing interests
Asmidawati Ashari
Department of Human Development and Family Studies, Faculty of Human Ecology, University Putra Malaysia, Serdang, Malaysia

Thank you for your kind responses toward my comments. I am agreed with the revised version.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Fall prevention and aged care research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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The paper by Lektip *et al.* analysed the reliability of the 44-question Thai Home Fall Hazard Assessment Tool (Thai-HFHAT) and determine the person characteristics associated with home hazards. This is an interesting study and the authors have collected a unique dataset using cutting edge methodology.

Overall, the information presented represents valuable information regarding the feasibility of using (Thai-HFHAT). The main strength of this paper is that it addresses an interesting question and finds a novel solution based on a carefully selected set of rules and provides a clear answer in culturally context. The paper is generally well written and structured. The title and abstract are appropriate for the content of the text.

However, in my opinion the paper has some shortcomings regarding some data analyses and discussion. The number of subjects for VHV group is too small (5) as compared to other groups. This number is too small which may affect the analysis. I also suggested to add further
information on caregiver and VHF personal characteristic to explain any important aspects contributing to the variation in (Thai-HFHAT) score.

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Partly

**Are the conclusions drawn adequately supported by the results?**
Partly

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**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Fall prevention and aged care research.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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Author Response 01 Mar 2023

**Charupa Lektip**

Thanks for the compliment and advice on my research. Allow me to explain the number of 5 VHV, which seems too small for inter-rater and test-retest reliability.

1) The most important target group used by the 44-question Thai-HFHAT was the elderly, followed by caregivers, while VHV was the final target group in cases where the elderly were unable to use the assessment and lacked caregivers.

2) In Thailand, one VHV takes care of people in around 10-15 households. Similarly, this study used one VHV to assess 10 elderly homes. In this study, 51 elderly people were studied, so 5 VHVs were used to assess.

**Competing Interests:** No competing interests
The purposes of the study are to establish reliability of 44-item home fall hazard assessment tool for Thai older adults and to find personal characteristics associated with the identified number of fall risks. The reliability section is done correctly but can be improved further.

1. One of the most comprehensive studies about reliability and validity of home hazard to prevent falls in older adults is missing\(^1\).

2. This study is a methodological study not cross-sectional.

3. A study replication cannot be done easily. Explain how the sample size was determined. Fifty-one is enough for inter-rater and test-retest reliability but not enough for a regression analysis. Make inclusion criteria of ADL and MMSE clearer. What are the compositions of 107 participants? Fifty-one older adults, 47 caregivers, and 5 VHS make only 103.

4. Personal characteristics should include those related to a fall risk, in addition to demographic information. For example, falls in past one year, no falls or no vicarious falls so far, experiences in fall related injury and hospitalization, MMSE and ADL scores, readiness to make home safer, dizziness, balance problems etc. should be included. However, the sample size is too small for a multiple regression.

5. In Discussion, "...the group who were working in their own homes as housekeepers..." does not make sense. Revise this sentence.

6. When we deal with human being for research, we use the word "participants" rather than "subjects". In Table 1, the statistical comparisons among these three groups are made; however, it is not the purpose of this study; therefore, they are not necessary. Descriptive statistics is sufficient.

7. Overall impression of this study is that authors may be able to do more meaningful analyses using existing data for the personal characteristics part, although it has to be based on hypotheses derived from literature review.

References
Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Fall prevention, smart house, e-health in gerontological population.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 19 Feb 2023
Charupa Lektip

1. One of the most comprehensive studies about the reliability and validity of home hazards to prevent falls in older adults is missing.

   Answer: I will include that study in the discussion section of my research to discuss the similarities and differences of reliability and validity.

2. This study is a methodological study not cross-sectional

   Answer: This study is a prospective study

3. A study replication cannot be done easily. Explain how the sample size was determined. Fifty-one is enough for inter-rater and test-retest reliability but not enough for a regression analysis. Make inclusion criteria of ADL and MMSE clearer. What are the compositions of 107 participants? Fifty-one older adults, 47 caregivers, and 5 VHS make only 103.

   Answer: 51 elderly people were adequate for examining inter-rater reliability and test-
retest reliability following the reference in the article" Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist" that recommends 50-99 subjects are Good sample size.

- I think a sample of 51 is sufficient for a regression analysis because correlation statistics will use 10-20 times the variable. And my main objective studies about the reliability and validity of home hazards to prevent falls in older adults.

- I exclude those who were completely dependent or disabled (ADL scores: 0-4) and those who received no formal education had MMSE-Thai scores of ≤14, when the elderly who received only upper secondary education had scores of ≤17, and when the elderly who continued their education received a score of ≤22.

- The compositions of 107 participants - Fifty-one older adults, 51 caregivers, and 5 VHV.

4. Personal characteristics should include those related to fall risk, in addition to demographic information. For example, falls in the past year, no falls or no vicarious falls so far, experiences in fall-related injury and hospitalization, MMSE and ADL scores, readiness to make home safer, dizziness, balance problems, etc. should be included. However, the sample size is too small for multiple regression.

**Answer:** I think the variables you've suggested are very helpful in regression analysis. But with a small sample size, because the main objective of my work is to find reliability and validity, I only take personal characteristics variables that I show in the demographic table characteristics of study subjects.

5. In Discussion, "...the group who were working in their own homes as housekeepers..." does not make sense. Revise this sentence.

**Answer:** I revise it to "This research found that the group of people who acted as housekeepers in their own homes had a higher risk of falling, which may be related to the amount of clutter in the home.

6. When we deal with a human being for research, we use the word "participants" rather than "subjects". In Table 1, the statistical comparisons among these three groups are made; however, it is not the purpose of this study; therefore, they are not necessary. Descriptive statistics are sufficient.

**Answer:** - I will use "participants" rather than "subjects".
- I will only use descriptive statistics to describe the three groups.

7. Overall impression of this study is that authors may be able to do more meaningful analyses using existing data for the personal characteristics part, although it has to be based on hypotheses derived from the literature review.

**Answer:** Thank you for your impression, I will add the literature review to support the
personal characteristics associated with home hazards.

**Competing Interests:** We have no competing interests.

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