ADAPTATION AND EVALUATION OF HOME FALL RISK ASSESSMENT TOOLS FOR THE ELDERLY IN THAILAND

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Abstract. Falls are a leading cause of mobility and mortality among the elderly. The aim of this study was to evaluate psychometric properties of 3 fall risk screening instruments, including the content validity of the Thai-HFHAT, agreement between the HOME FAST and HOME FAST-SR, the inter-reliability of the Thai-HFHAT and HOME FAST-SR, and the test-retest reliability of the 3 instruments in order to inform future studies of falls among Thai elderly. The 3 instruments tested were one instrument modified for the Thai context [Thai Home Falls Hazards Assessment Tool (Thai-HFHAT)], and 2 instruments translated into Thai but not modified for the Thai context [Home Falls and Accidents Screening Tool (HOME FAST) and the Home Falls and Accidents Screening Tool self-reported version (HOME FAST-SR)]. The study consisted of 2 assessments using the 3 study instruments performed 2 weeks apart to assess test-retest reliability. Study subjects were selected by multiple stages convenience sampling to obtain subjects residing in Sichon District, Nakorn Si Thammarat, Thailand. A total of 30 subjects were then selected by quota sampling for the study; 10 from each 3 Thai house types: a one-story elevated house, a one-story non-elevated house and a two or more story house. Inclusion criteria for study subjects were Thai citizens aged ≥ 60 years who could communicate well in the Thai language. Exclusion criteria for study subjects were dementia and the inability to perform daily activities. Caregivers for the study subjects and a village health volunteer (VHV) were included when evaluating inter-rater reliability of the Thai-HFHAT and HOME FAST-SR. A physical therapist was also included to evaluate the HOME FAST agreement and test-retest reliability. Content validity of the Thai-HFHAT was assessed by 3 specialists using the item content validity index (I-CVI) for the content validity of each item and the content validity index for scale (S-CVI) for the whole instrument. Agreement between the HOME FAST and HOME FAST-SR was assessed using the kappa statistic. Of the 30 study subjects, 60% were female. The mean [± standard deviation (SD)] age of study subjects was 76 (±8) years. Sixty percent of study subjects had a fall with in the previous 12 months, 67% of those occurred in the home. On Thai-HFHAT, out of the total of 69 items, 62 had excellent content validity (I-CVI = 1.00) and 7 had acceptable content validity (I-CVI = 0.67). The overall S-CVI was good (S-CVI = 0.90). Agreement between the HOME FAST and HOME FAST-SR showed that 13 items had moderate agreement ($\kappa = 0.69$), 4

had strong agreement (κ = 0.85), 2 had nearly perfect agreement (κ = 0.91), 2 had weak agreement (κ = 0.50) and 4 items could not be determined. The ICC values for the HOME FAST-SR and Thai-HFHAT inter-rater reliability were 0.64 (95% CI: 0.45-0.79) and 0.87 (95% CI: 0.78-0.93), respectively. The overall ICC values for the HOME FAST, HOME FAST-SR, and Thai-HFHAT test-retest reliability were 0.76 (95% CI: 0.55-0.89), 0.71 (95% CI: 0.47-0.85) and 0.78 (95% CI: 0.58-0.89), respectively. In conclusion, the Thai-HFHAT appears suitable for assessing risk of falls among Thai elderly. Further study, using a prospective design, is needed to determine whether this instrument can predict falls among Thai elderly and determine its clinical usefulness.

Keywords: elderly, falls, home fall risk assessment tool, Thailand

INTRODUCTION

A 2018 World Health Organization Report stated falls are the second leading cause of unintentional injury deaths, with an estimate 646,000 victims per year worldwide. More than 80% of falls are estimated to occur in western Pacific and Southeast Asian countries and 60% are estimated to occur in people aged ≥ 60 years (WHO, 2018). Thailand's Department of Disease Control has predicted during 2017-2021, falls among Thai elderly will account for 27% of deaths in the elderly resulting in a death rate due to falls among Thai elderly of 50 per 100,000 populations per year (Srichang and Kawee, 2018).

There are 4 groups of factors contributing to falls: biological, behavioral, social and economic, and environmental (WHO, 2007). Home hazards are significantly associated with falls among elderly Thais (Romli *et al*, 2017b). Several studies have attempted to explore the risk factors associated with falls in elderly Thais. One study examined whether the environment in or around the house was associated with fall risk and found a slippery floor in the first story of the house, a slippery floor in the bathroom or toilet, and having a bathroom or toilet located outside the house were all significantly associated with falls among elderly Thais (Sophonratanapokin *et al*, 2012). Another study reported environmental hazards caused at least one fall among study subjects during the previous six months (Thaweewannakij *et al*, 2016).

There are a variety of tools used to screen for fall risk; each has different variables, methods of administration, scores, durations of screening, languages and assessed psychometric properties. These psychometric properties consist of content validity and inter-rater and test-retest reliability. Among these, the Home Falls and Accidents Screening Tool (HOME FAST) (Mackenzie *et al*, 2002) is widely accepted as a reliable screening tool that takes psychometric properties into account and is used specifically by healthcare professionals in Australia, Europe and Malaysia to screen elderly

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people for fall risk (Romli *et al*, 2018). In 2011, Hassani Mehraban *et al* (2011) developed a self-reported home falls hazard screening tool (HOME FAST-SR). This tool is filled out by elderly people; it is a reversion of the 25-question HOME FAST tool and consists of an 87-question instrument to screen for fall risk. There was moderate agreement between the HOME FAST and HOME FAST-SR instruments (Hassani Mehraban *et al* (2011).

In Thailand, no context specific fall risk screening instrument has been developed or tested. The Home FAST and HOME-FAST-SR instruments are not appropriate to the geology, culture and architecture of Thailand and are not available in the Thai language. An example of a non-specific instrument is Thai architecture. There are 3 main types of Thai houses (Akepalakorn, 2016): a one-story elevated house that the elderly has to climb stairs to enter, a one-story non-elevated house where they do not have to climb stairs, and two or more story house where the elderly has to climb stairs to get to the second story. To develop an adequate fall risk screening instrument, factors like the one mentioned above need to be considered for Thailand's elderly population. Psychometric properties also need to be taken into consideration when developing a screening tool suitable for Thais.

In our study, we aimed to evaluate psychometric properties of 3 fall risk screening instruments, including the content validity of the Thai-HFHAT, agreement between the HOME FAST and HOME FAST-SR, the inter-reliability of the Thai-HFHAT and HOME FAST-SR, and the test-retest reliability of the 3 instruments in order to inform future studies of falls among Thai elderly.

MATERIALS AND METHODS

Ethical approval

This study was approved by the Research Ethics Review Committee for Research Involving Human Research Participants, Faculty of Medicine, Chulalongkorn University (IRB reference no. 492/61). Written informed consent was obtained from all study subjects prior to participation in the study.

Study design

A cross-sectional survey design was used to study the content validity of the Thai-HFHAT. Agreement between the HOME FAST and HOME FAST-SR, inter-rater reliability was assessed and a prospective design was used to study the test-retest reliability component.

Study subjects

Study subjects were chosen by multiple stage convenience sampling to obtain subjects residing in the Sichon District, Nakorn Si Thammarat, Thailand. Inclusion criteria were those aged ≥ 60 years who were fluent in Thai and were willing to participate in the study. Exclusion criteria were those who could not perform activities of daily living and those with dementia. Thirty subjects were chosen because we deemed this number adequate to examine inter-rater reliability and test-retest reliability. Subjects were selected by quota sampling and categorized based on their home being one of the 3 house types with 10 subjects from each type: one-story elevated house, one-story non-elevated house, and a two or more story house.

In addition to the above study subjects, caregivers for the elderly and a village health volunteer (VHV) were included in order to examine inter-rater reliability for the level of reliability

between the Thai-HFHAT and HOME FAST-SR instruments for the 30 study subjects, for the caregivers, and the VHV. These different groups were chosen to help identify whether or not each group of subjects can be substituted for other groups when assessing the hazards in the event the elderly subject cannot complete the instrument by themselves in real life. A healthcare professional was included to evaluate agreement and test-retest reliability of the HOME FAST test. A physical therapist was chosen to be the healthcare professional.

Study instruments

Translation of the HOME FAST and HOME FAST-SR instruments into Thai was conducted after obtaining written permission from the owner of these instruments. The translation was conducted following Castro and Leite (2017). These 2 instruments were translated from English to Thai by two independent translators. The Thai versions of these 2 instruments were then back-translated into English by a different translator not involved in the initial translation and who was unaware that the 2 instruments were initially written in English. A researcher and a third translator then compared the back-translated version with the original English version of both instruments for discrepancies.

The Thai-HFHAT was newly constructed by the researchers to assess the elderly in Thailand and was composed of relevant variables collated from the Thai and international literature. These variables were then reviewed and discussed in a focus group with a review board consisting of 3 elderly Thai persons and 5 respected professionals who had at least three years' experience in related fields: one architectural scholar, one physical therapy scholar, one occupational therapy scholar, one registered nurse providing care for elderly Thai people at home, and one person who was the head of a group of assistant providing elderly care. The researchers then constructed a self-reported home hazards assessment instrument based on the reviewed variables to be used as a fall hazard screening tool for Thailand.

Assessment of study instrument agreement

Agreement between the 87-question HOME FAST-SR, filled out by the 30 study subjects, and the 25-question HOME FAST, filled out by a physical therapist during home evaluations of each of the subjects, was assessed. Our research team then converted the scores for the HOME FAST and HOME FAST-SR so they were comparable using a conversion form (Hassani Mehraban *et al*, 2011). Agreement was evaluated using the kappa statistic.

Assessment of study instrument content validity

The content validity of the Thai-HFHAT was assessed by 3 scholars with at least three years experience: an architectural scholar, a physical therapy scholar and an occupational therapy scholar. A content validity index (CVI), that included an item content validity index (I-CVI) and content validity for scale (S-CVI), given by the scholars was used to describe the content validity of the instrument.

Assessment of inter-rater reliability

The 30 elderly subjects and their caregivers were asked to measure home hazards using the HOME FAST-SR and the Thai-HFHAT. One VHV also evaluated the home hazards at each of the homes of the elderly study subjects using the HOME FAST-SR and Thai-HFHAT. These assessments were made

independently to avoid potential bias. Inter-rater reliability was evaluated using an intra-class correlation coefficient (ICC).

Assessment of test-retest reliability

Test-retest reliability of the coefficient of stability for the 3 instruments was conducted by having the elderly study subjects fill out the HOME FAST-SR and Thai-HFHAT and the physical therapist fill out the HOME FAST to initially and then again 2 weeks later for both the elderly study subjects and the physical therapist as recommend in the literature (Marx *et al*, 2003). Test-retest reliability was then evaluated using an intra-class correlation coefficient (ICC). If there was any missing data, the participated data was excluded from all 3 screening tools.

Data analysis

The Statistical Package for the Social Sciences (SPSS), version 22.0 (IBM Corporation, NY) for Windows was used to perform all data analyses. Demographic data were analyzed using descriptive statistics. The Kappa results were classified as follows: a Kappa value of 0-0.20 was classified as none, 0.21-0.39 as minimal, 0.40-0.59 as weak, 0.60-0.79 as moderate, 0.80-0.90 as strong, and above 0.90 as nearly perfect. (Cohen, 1960).

The content validity index (CVI) was classified into 4 levels: a CVI of 1.00 was classified as not relevant, a CVI of 2.00 as somewhat relevant, a CVI of 3.00 as quite relevant, a CVI of 4.00 as relevant. (Lynn, 1986). Item content validity (I-CVI) was determined by the number of experts giving a question a score of 3 or 4 (out of a possible score range of 0- 4) divided by the total number of experts. A I-CVI >0.67 was classified as having acceptable agreement, >0.80 as a good agreement and 1.00 as excellent agreement (Polit and Beck, 2006).

The content validity for scale (S-CVI) was defined as the ratio of the number of questions with a score of 3 or 4 divided by the total number of questions. A S-CVI >0.80 was classified as having good content validity for that scale (Waltz *et al*, 2005).

Test-retest and inter-rater reliabilities were evaluated using the intra-class correlation coefficient model 3, 1 ($ICC_{3,1}$) with values ranging from 0 to 1. Reliability results were classified as follows: an ICC <0.50 was classified as poor reliability, 0.50-0.74 as moderate, 0.75-0.90 as good, and >0.90 as excellent reliability (Koo and Li, 2016). The Bonferroni test was used to make comparisons among the ratings of study subjects, caregivers, and the VHV.

RESULTS

Study subject characteristics

Demographic characteristics of the study subjects are shown in Table 1. The mean (±SD) age of the 30 elderly study subjects was 76 (±8) years; 18 females. All of the study subjects were Thai, 98% were Buddhists, 53% were married and 63% had a primary education. Sixty percent of subjects reported a fall in the previous 12 months, of which 67% occurred at home.

Content validity of the Thai-HFHAT

Sixty-two of the 69 items on the Thai-HFHAT had excellent agreement (I-CVI = 1) and 7 items had acceptable agreement (I-CVI = 0.7). The S-CVI was good (0.9).

Agreement between the HOME FAST and HOME FAST-SR

Fifty-two percent of the questions in the HOME FAST and HOME FAST-SR had moderate agreement ($\kappa = 0.69$), 16% had strong agreement ($\kappa = 0.85$), 8% had nearly perfect agreement ($\kappa = 0.91$) and 8% had weak agreement ($\kappa = 0.50$) (Table 2).

Table 1
Demographic characteristics of study subjects (n = 30).

Characteristics	n (%)
Mean (±SD) age in years	76 (±8)
Sex	
Male	12 (40)
Female	18 (60)
Ethnicity	
Thai	30 (100)
Religion	29 (97)
Buddhism	1 (3)
Islam	
Marital status	
Single	2 (7)
Married	16 (53)
Widowed	12 (40)
Education level	
Grades 1-3	19 (63)
Grades 4-6	8 (27)
Grades 7-9	3 (10)
History of fall in the previous 12 months	
Yes	18 (60)
No	12 (40)
Fall inside home	
Yes	12 (67)
No	6 (33)

SD: standard deviation; n: number

Due to the unique characteristics of Thai houses, 3 items on the HOME FAST-SR could not be evaluated: "Do you bathe in a bathtub?", "Do you take a shower rather than a bath?"and "Do you use a shower stall?". The researchers had to assign 4 scores to these 3 items that could not be evaluated on the HOME FAST. The physical therapist determined the home hazards for the subjects were greater than the home hazards determined by the subjects, except for two items (cluttered walkways and inadequate footwear).

Inter-rater reliability

The overall ICC value for the HOME FAST-SR was 0.64 (95% CI: 0.45-0.79). The mean HOME FAST-SR scores determined by study subjects, caregivers and VHV were: 6.13 (95% CI: 5.27-7.00), 6.60 (95% CI: 5.73-7.48) and 8.10 (95% CI: 7.02-9.18), respectively. The mean HOME FAST-SR score given by the VHV was significantly higher than the mean scores for the study subjects and caregivers (p = 0.001 and p = 0.003, respectively).

The overall ICC value for the Thai-HFHAT was 0.87 (95% CI: 0.78-0.93). The mean Thai-HFHAT scores obtained from the study subjects, caregivers and the VHV were 13.90 (95% CI: 11.76-16.04), 14.47 (95% CI: 12.35-16.58), and 17.87 (95% CI: 16.33-19.40), respectively. The mean Thai-HFHAT score given by the VHV was significantly higher than the mean scores for the study subjects and the caregivers (p <0.001 and p <0.001, respectively) (Fig 1).

Test-retest reliability

The overall ICC value for the HOME FAST was 0.76 (95% CI: 0.55-0.89). The mean pretest score for the HOME FAST was 6.73 (95% CI: 5.63-7.87) and the mean post-test for the HOME FAST was 6.23 (95% CI: 5.33-6.93).

The overall ICC value for the HOME FAST-SR was 0.71 (95% CI: 0.47-0.85). The mean pretest score for the HOME FAST-SR was 6.13 (95% CI: 5.33-7.00). The mean post-test for the HOME FAST-SR was 5.83 (95% CI: 5.07-6.60).

The ICC value for the Thai-HFHAT was 0.78 (95% CI: 0.58-0.89). The mean pretest score for the Thai-HFHAT was 13.90 (95% CI: 11.90-15.83) and the mean post-test score for the Thai-HFHAT was 10.87 (95% CI: 9.37-12.47) (Fig 2).

Table 2
Agreement between study subjects and the physical therapist regarding HOME FAST items (n = 30).

HOME FAST items	Kappa	p-value	Percent identified by study subject	Percent identified by physical therapist
Cluttered walkways	0.90	<0.001	80	77
Floor covering in poor condition	0.64	<0.001	7	13
Slippery floor surfaces	0.67	<0.001	50	60
Loose mats	0.87	<0.001	40	47
Difficulty with bed transfers	0.85	<0.001	33	33
Difficulty with lounge transfers	0.74	<0.001	20	30
Poor lighting	0.68	<0.001	27	33
No access to bedside light	0.71	<0.001	37	37
Poor lighting on outdoor paths	0.86	<0.001	37	43
Difficulty with toilet transfers	0.71	<0.001	37	37
Difficulty with bath transfers	N/A	N/A	N/A	0
Difficulty with shower transfers	N/A	N/A	N/A	0
No access to hand rails in bath	N/A	N/A	N/A	20
No non-slip mats in the bathroom	N/A	N/A	N/A	17
Toilet not close to bathroom	0.53	0.002	23	37
Difficulty reaching items in kitchen	0.47	0.002	3	10
Difficulty carrying meals	0.71	<0.001	13	13
Inadequate/absent step/stair rails indoors	0.62	<0.001	10	20
Inadequate/absent step/stair rails outdoors	0.82	<0.001	20	27
Difficulty using the stairs	0.63	<0.001	7	13
Undefined stair edges	0.76	<0.001	17	17
Difficulty using entrance doors	0.65	<0.001	3	7
Hazardous outdoor paths	0.78	<0.001	30	40
Inadequate footwear	0.91	<0.001	27	23
Hazardous pets	0.73	<0.001	50	57

N/A: Not Applicable

DISCUSSION

The content validity of the Thai-HFHAT had 7 of the 69 items with acceptable agreement (I-CVI = 0.7) and the other 62 items with excellent agreement (I-CVI = 1.0). This is due to the architectural scholar interpreting home hazards as covering all other injuries, not just falls. For example, the item "Poor lighting not suitable for activities in the kitchen" was given a score of 2 out of 4 points, with the comment that where a cutting board or a sharp knife is used, there should be brighter lighting. Overall, the content validity for scale of the instrument was good (S-CVI = 0.9).

The results of the HOME FAST filled

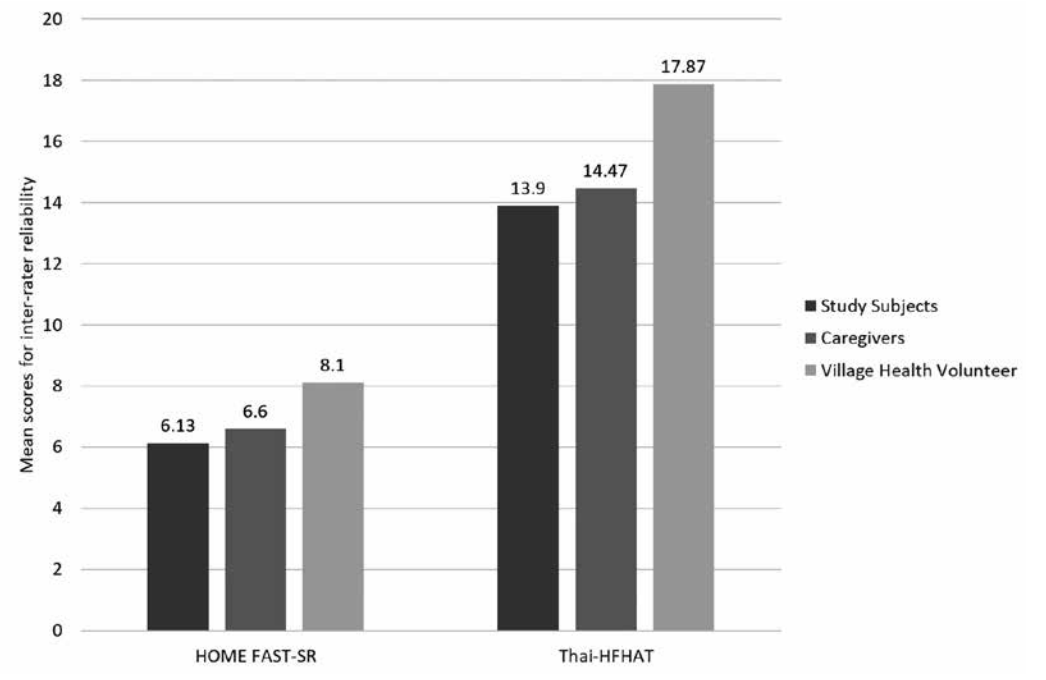

Fig 1-Comparison of mean home hazard rating scored by raters.

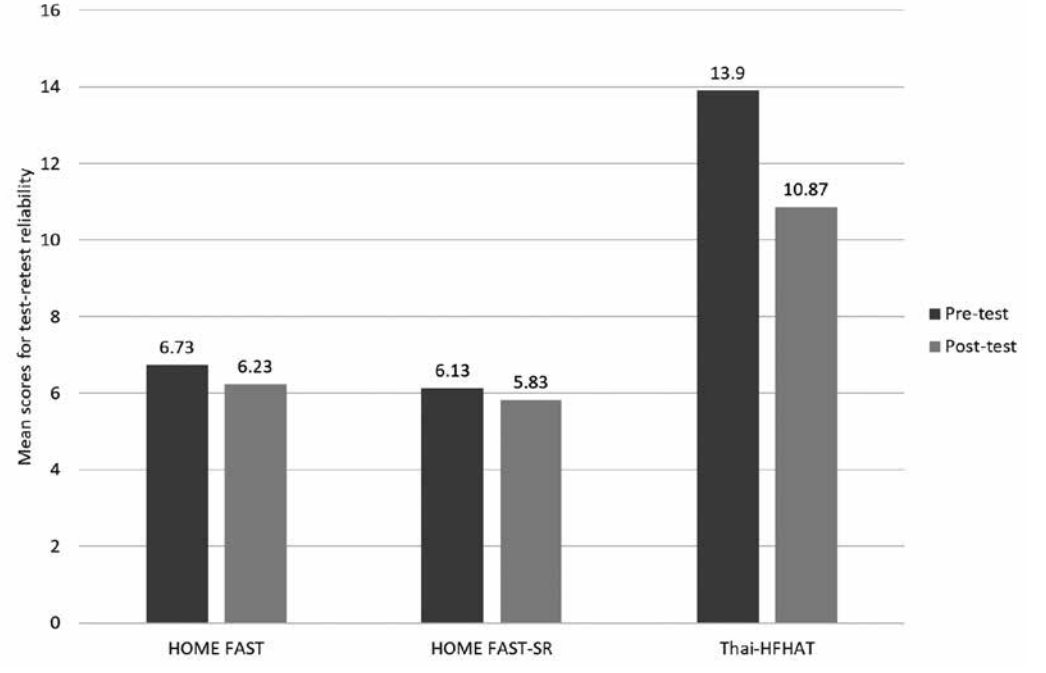

Fig 2-Comparison of study instrument mean test scores initially and again 2 weeks later.

out by the physical therapist showed a greater risk of falls than the HOME FAST-SR filled out by the study subjects. This is likely because the physical therapist has training in fall risk and its prevention. Also, the study subjects are more familiar with their environment and do not see the hazards present. Our results are in contrast to those reported by Hassani Mehraban *et al* (2011) who reported the elderly subjects indicated a higher risk for falls than an occupational therapist. The participants in that study were eligible for occupational therapy services; therefore, they may have overestimated their fall risk.

We found satisfactory agreement between the HOME FAST and the HOME FAST-SR lower than study by Morgan *et al* (2005) who found excellent agreement.

The inter-rater reliability among the study subjects, the caregivers and the VHV using the HOME FAST-SR was moderate (ICC = 0.64), similar to a study by Romli *et al* (2017a) who also found moderate reliability among healthcare workers ($\kappa = 0.45$) but lower than a study by Vu and Mackenzie (2012) with the HOME FAST where among occupational therapists there was good reliability. Good reliability was also seem in other similar studies (κs = 0.62-0.85) (Chandler *et al*, 2001; Mackenzie *et al*, 2002; Maghfouri *et al*, 2013).

In our study, the inter-rater reliability with the Thai-HFHAT (ICC = 0.87) was higher than the HOME FAST-SR (ICC = 0.64). This is probably because the Thai-HFHAT was less complex and had drawings that illustrated each room in a house, helping the study subjects to identify home hazards more easily. However, the wording on the HOME FAST-SR may have been confusing. For instance, on the HOME FAST-SR question 8b asks "Does it take you several attempts to get up out of your sitting chair?" and Item 8c asks, "When you lower yourself into the chair, can you do so without falling back into the chair?" These two statements may have caused confusion resulting in errors with the medical measurement (Lilford *et al*, 2003).

The VHV tended to score the HOME FAST-SR and Thai-HFHAT higher, including greater fall risk, than the study subject. This may be due to the training and experiences of the VHV allowing them to identify hazards more readily (Visanuyothin *et al*, 2015).

In our study, the test-retest reliability of the HOME FAST was good (ICC = 0.76). This may be because there were only 25 items, and they may have remembered what they answered 2 weeks previously when they repeated the evaluation after 2 weeks. Our findings are similar to those by Vu and Mackenzie (2012) and Romli *et al* (2017a).

In our study, the test-retest reliability of the Thai-HFHAT was good (ICC = 0.78), which the test-retest reliability of the HOME FAST-SR was slightly lower (ICC = 0.71). This would be due to the HOME FAST-SR containing several items arranged in a disorganized manner, causing confusion for the raters.

The test-retest results showed the initial score were all higher with all 3 study instruments at the first visit than they were at the follow-up visit. This may be because the home environment or the study subject behavior may have changed between the first and the second visits. The study subject may have removed loose mats or cleared up cluttered walkways before the second home visit. This phenomenon is called "reactivity" and can occur when a subject

is administered an instrument multiple times. Subjects become sensitized to the instrument and "learn" to respond when they perceive how they are expected to respond (Hendrickson *et al*, 1993).

The HOME FAST is confirmed as multidisciplinary instrument designed for western countries (Mackenzie, 2017). It may not be as appropriate for evaluating home hazards in Thai houses having different characteristics. For example, a toilet room is located outside in some Thai houses, which can increase the risk of falling (Sophonratanapokin *et al*, 2012). Some items in the HOME FAST-SR were also inappropriate for Thai homes such as, "Do you get into the bathtub to bathe?", "Do you use a shower rather than a bath?" or "Do you use a shower stall?". The Thai-HFHAT was designed to compensate for these deficiencies with the other instruments and was found to have good inter-rater and test-retest reliability.

Our study had some limitations. First, our sample size was small (n = 30) but it was based on a study by Terwee *et al* (2012) and should have had fair reliability. Second, the data were only collected from one community so they cannot be applied to other study populations. Third, the subjects' results were compared with those of a physical therapist, who may not have the same knowledge level as other healthcare professions. However, Romli *et al* (2017a) reported the HOME FAST was suitable for most healthcare professionals. Finally, the cross-sectional study design prevented determining an association between calculated risk for falls and actual fall rates.

In our study, the 3 studied instruments showed moderate-to-good psychometric properties. With the Thai-HFHAT, most items (I-CVIs) had excellent content validity and good S-CVI. There was moderate agreement between the HOME FAST and HOME FAST-SR. The inter-rater reliabilities of the HOME FAST-SR and Thai-HFHAT were moderate and good, respectively. Test-retest reliabilities of the HOME FAST and Thai-HFHAT were good, and of the HOME FAST-SR was moderate. The Thai-HFHAT appears to be a reasonable instrument for identifying home hazards and for screening the elderly who have a potential risk for falls in the study population. Further, prospective studies are needed among several populations to determine if these instruments can be applied to other study populations and used for fall prediction.

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