


## RESEARCH ARTICLE

# The Reported Edmonton Frail Scale-Thai version: Development and Validation of a Culturally-Sensitive Instrument

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## Abstract

Frailty may lead to increased vulnerability, disability, and adverse health outcomes in older adults. Early detection has been described as the best approach to manage frailty; however, frailty instruments are not widely available, particularly in the Thai language. The purpose of this cross-sectional study was to develop a culturally adapted Thai version of the Reported Edmonton Frail Scale and to validate the psychometric properties of the new instrument in hospitalized older Thai adults. Reliability and validity were examined. Participants completed questionnaires that included demographic and health information, and the Reported Edmonton Frail Scale-Thai version. Results revealed that the new instrument was reliable and had good content validity. Inter-rater reliability was strong. Confirmatory factor analysis showed a fair fit for the whole model, but most domains were strongly associated with frailty. On average, the instrument was completed under 7 minutes. The Thai version of the frailty instrument may be a practical tool for frailty evaluation, and could inform inpatient care, both locally and internationally; future research is needed to confirm predictability and feasibility in other clinical settings and populations.

## KEYWORDS

Culturally adapted instrument, Frailty, Hospitalized older adults, Psychometric properties, Reported Edmonton Frail Scale, Thai language

## 1 | INTRODUCTION

Frailty is a clinical symptom associated with age-related decline (Fielding, 2015; Sieber, 2017), which was labeled as “a new geriatric giant” (Morley, 2016, p. 59). Frailty influences health in older adults, leading to increased vulnerability, adverse health outcomes, long-term care needs, and higher mortality rates (Buigues, Juarros-Folgado, Fernandez-Garrido, Navarro-Martinez, & Cauli, 2015; Buta et al., 2016; Theou et al., 2018).

Frailty also impacts direct and indirect healthcare costs (Cesari & Vellas, 2015; Sieber, 2017). Early detection of frailty by health care professionals is pertinent as it guides intervention to delay dependency and prevent poor health outcomes in older adults. Although the consequences of frailty have been extensively investigated, the identification and assessment of frailty in clinical care has been challenging. Nevertheless, it is essential to assess frailty to strengthen clinical decision-making and model appropriate care planning (Sieber, 2017).

Many instruments have been proposed for frailty assessment; however, broad gaps still exist. Notably, cultural barriers have

Full instrument is available on request to the contact author: Inthira Roopsawang.

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prevented widespread adoption of existing instruments; indeed, just few clinical frailty instruments have been widely translated (Braun, Grüneberg, & Thiel, 2018; Buta et al., 2016; Jung et al., 2016). Instrument complexity presents another significant barrier in that most clinical frailty instruments require specific equipment, training, and relatively long completion times (Buta et al., 2016; Dent, Kowal, & Hoogendijk, 2016; Sutton et al., 2016). Identifying a reliable and comprehensive yet rapid assessment may be the key to successful integration of a frailty instrument in clinical care. Finally, because universally recognized standards for frailty assessment are lacking, existing frailty instruments may be applicable to only specific settings and countries (Buta et al., 2016; Cesari & Vellas, 2015; Sutton et al., 2016). Culturally sensitive frailty evaluation instruments are needed to capture different meanings of frailty in a reliable and reproducible way within and across cultures (Beaton, Bombardier, Guillemin, & Ferraz, 2000; Sousa & Rojjanasrirat, 2011). As such, a use of culturally adapted and psychometrically sound instruments not only captures diverse perspectives on frailty but also, enables benchmarking of managing frailty in older adults across populations (Beaton et al., 2000; Hambleton, 2005).

A recent literature review revealed no published studies of frailty instruments translated and psychometrically evaluated in Thai culture, and there was a lack of studies with hospitalized frail older adults. This gap raises the risk of inappropriate care for Thai older adults. To overcome the gap, promote equity, improve quality of care, and enhance healthcare efficiency, a validated Thai frailty instrument is needed. Such an instrument will be practical for monitoring health outcomes, making clinical decisions, and enabling appropriate management in Thai older adults.

## 2 | BACKGROUND

Early detection and intervention to delay functional decline have become foci of interest in geriatric care (Briggs & Dreinhofer, 2017). Geriatric conditions such as frailty, although important, is not well understood because different conceptual definitions have been proposed. One of the most cited definitions is that frailty is a condition of age-related decline in physiological reserves and (multiple) organ system function due to an increased vulnerability to stress (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Xue, 2011). This definition of frailty is consistent with Fried's frailty phenotype model (Fried et al., 2001), which describes frailty as a common, serious but potentially modifiable geriatric condition of age-related changes linked with increasing vulnerability to adverse health events identified clinically by the presence of three out of five phenotypic criteria of frailty (unintentional weight loss, self-reported exhaustion, muscle weakness, slow gait, and low level of physical activity) (Fried et al., 2001, 2004). Major adverse outcomes of frailty include disability, functional impairment, increased incidence of hospitalization, increased cost of care, and increased mortality (Pérez-Zepeda, Cesari, & Garcia-Peña, 2016; Theou et al., 2018; Zaslavsky et al., 2013). This suggests that as the aging population increases globally, the escalating care burden of frail older adults will drive direct and indirect healthcare costs. To prevent

poor outcomes and promote health, it is important to identify frailty early. Indeed, the World Health Organization (WHO) has formally recognized effective frailty screening as the fifth priority area in its 2020 agenda targeting delayed care dependency and enhanced quality of care for the aging population (WHO, 2017).

Different conceptualizations and definitions of frailty have led to a variety of instruments to evaluate frailty, such as the FRAIL scale, PRISMA 7, and Fried's frailty phenotype (Buta et al., 2016; Theou et al., 2018). Review of these reveals that the majority assess frailty based on physical performance status predominantly and to lesser (and varying) degree, on cognitive status (Buta et al., 2016; Theou et al., 2018). The lack of a consensus regarding definition has fostered debate about the optimal instrument for frailty evaluation (Buta et al., 2016; Dent et al., 2016; Sutton et al., 2016). Furthermore, implementation of frailty evaluation in clinical settings has been somewhat slow (Buta et al., 2016; Theou et al., 2018), since the majority of frailty instruments require specific equipment, training and/or laboratory tests, or are time-consuming to complete (Cesari & Vellas, 2015; Dent et al., 2016). Despite these limitations, most of the clinical frailty measurements do offer a comprehensive, multidimensional assessment of important geriatric measures including cognition, social support, and emotion (Buta et al., 2016; Dent et al., 2016). The content and format of a clinical frailty assessment instrument, however, depends not only on its dimensions and clinical resources, but also the cultural context in which it is used. Previous authors have suggested that use of culturally adapted and sensitive instruments establishes the meaningfulness of the concept in other cultures and languages, while also permitting investigation of cross-cultural differences, enhancing our ability to generalize (Beaton et al., 2000; Hambleton, 2005). To fill the gap, there is a need to develop a valid, culturally sensitive frailty screening measure that is simple, inexpensive, safe, precise, and quick to administer to hospitalized older adults in non-Western countries.

Despite an increase in the number of studies about frailty, there are discrepancies in what we know about frailty and its importance in different countries, including Thailand. In particular, there is a lack of published Thai studies on frailty in hospitalized older adults and on evaluations of frailty instruments in the Thai language (Buta et al., 2016; Theou et al., 2018). Thus, validation of a culturally adapted frailty screening instrument is a priority. To bridge the gap in frailty assessment and to strengthen care in older Thai adults, a culturally adapted frailty screening instrument is crucial not only for promoting health but also, for strengthening clinical decision-making and modeling appropriate care planning. Additionally, Thai clinical settings (and other similar limited-resource settings) require a practical frailty screening measurement, one that is simple, rapid, inexpensive, and precise. The Reported Edmonton Frail Scale (REFS) (Hilmer et al., 2009) may provide one such efficient frailty assessment. The REFS has the benefit of providing a quick, reliable measurement, and multidimensional health assessment. The REFS evaluates holistically and is well-aligned with Fried's conceptualization of frailty. The validity and reliability of the original REFS were previously established in a hospital setting, using standard measurements: the Geriatrician's Impression of Frailty, Mini-Mental State Examination, Charlson

Comorbidity Index, and the Katz Daily Living Scale. The REFS demonstrated a good validity and acceptable reliability (Cronbach's  $\alpha = 0.68$ ) even when administered by non-geriatric-trained personnel (Hilmer et al., 2009). Based on this, the REFS is a strong candidate clinical instrument for adaptation and evaluation in Thai culture.

### 3 | METHODS

#### 3.1 | Aims

The aims of the study were to (i) develop a culturally adapted Thai-language version of the REFS (REFS-Thai) for use with older Thai adults, and to (ii) evaluate the validity and reliability of the REFS-Thai in hospitalized older adults.

#### 3.2 | Study design and setting

A cross-sectional study design was employed. Older Thai adults admitted to tertiary care at Mahidol University Ramathibodi Hospital in Thailand were invited to participate in this study.

#### 3.3 | Participants

Eligible participants were aged 60 years or older, able to read and speak Thai fluently, and were scheduled for elective surgery, including general surgery, neurological surgery, vascular surgery, urology surgery, and orthopedic surgery, from February to July 2018. The exclusion criteria were: emergency surgery; cognitive impairment (Mini-Cog score  $< 3$ ); acute psychiatric condition; history of stroke, brain injury, or Parkinson's disease; or bedridden or receiving therapy (e.g., mechanical ventilation or cervical traction). The planned sample sizes were based on recommendations from previous research: cognitive interviews were conducted with a small number of subjects (Beatty & Willis, 2007; Peterson, Peterson, & Powell, 2017), while inter-rater reliability was validated with a separate group of subjects (Hilmer et al., 2009); psychometric testing was based on recommendations for cross-cultural translation validation (Sousa & Rojjanasrirat, 2011). Participant frailty status was determined at the preoperative assessment.

#### 3.4 | Ethical considerations

Following approval from the Internal Review Boards of the University of Washington (STUDY00003624) and Mahidol University (MURA2017/796), prospective participants were recruited by trained registered nurses. All participants signed a written informed consent form before engaging in study procedures; in situations where a participant had a visual impairment, a verbal agreement to participate in the study was accepted. Participant anonymity was preserved in all cases.

### 3.5 | Data collection

The data collection was conducted in two stages, involving the: (i) translation, cognitive interview and content validation by expert raters; and (ii) reliability evaluation (consisting of inter-rater reliability testing and psychometric testing).

Stage 1 involved translation, cognitive interviews, and content validation. After receiving copyright permission from the owner of the REFS, we applied the WHO guidelines for instrument translation and cross-cultural adaptation, to develop the REFS-Thai. The WHO guidelines for translation (WHO, n.d.) suggest four steps: (i) forward translation, (ii) expert panel back-translation, (iii) pretesting and cognitive interviewing, and (iv) revision and creation of the final version. For step 3, we used small group interviews to complete the cross-cultural translation and refinement of the frailty screening instrument. Cognitive interviewing methods (Izumi, Vandermause, & Benavides-Vaello, 2013) were used to examine the content and the meaning attached to each item by the respondents and to explore the level of difficulty the respondent had in completing the instrument. The mention of ambiguities and suggestions for improvement were also noted. Finally, expert agreement methods were applied to evaluate the content validity index (CVI) of the REFS-Thai.

Stage 2 involved the reliability evaluation. For equivalence reliability evaluation, inter-rater reliability was determined between two non-geriatrics-trained healthcare personnel. Psychometric testing, which was based on heuristics for cross-cultural translation validation, established the internal consistency of the REFS-Thai, to substantiate its reliability and validity. Confirmatory factor analysis (CFA) was used for construct validation testing.

### 3.6 | Measures

#### 3.6.1 | Mini-Cog (Thai version)

The Thai version of the Mini-Cog (Mini-Cog-Thai) (Trongsakul, Lambert, Clark, Wongpakaran, & Cross, 2015) is a translation of the original Mini-Cog, which is used to screen for cognitive impairment or dementia. The Mini-Cog-Thai test is scored on two activities: a three-item recall and a clock-drawing test. The total possible score is 5, and a score  $< 3$  indicates greater likelihood of cognitive impairment or dementia. The Mini-Cog-Thai version has shown good inter-rater reliability ( $\kappa = 0.80$ , 95% confidence interval [CI] 0.50, 1.00,  $P < 0.001$ ) and positive concurrent validity with the Thai version of the Mini-Mental State Examination ( $r = 0.47$ , 95%CI 0.37, 0.55,  $P = 0.007$ ).

#### 3.6.2 | The REFS-Thai

The REFS-Thai, an instrument using self-report, was translated from the original REFS. The original instrument defines frailty using the accumulation deficit model (Hilmer et al., 2009). The REFS-Thai evaluates nine domains: general health status, cognitive function, functional

independence, continence, medication use, nutrition, mood, social support, and self-performance. The maximum possible score is 18, and frailty is classified as “severe frailty” (score 12–18), “moderate frailty” (score 10–11), “mild frailty” (score 8–9), “apparently vulnerable” (score 6–7), and “not frail” (score 0–5).

Three experts, including a gerontologist (physician), a geriatric nurse (PhD), and a surgeon were asked to rate each REFS-Thai item for content validity in the Thai context. Based on standard research recommendations, a 4-point rating scale was used, with 1 = not relevant, 2 = item needs some revision, 3 = relevant but needs minor revision, and 4 = very relevant (Polit & Beck, 2006).

### 3.7 | Data analysis

R version 3.0.1 software was used for data analysis. Descriptive summaries were used to report the number of participants who were screened, eligible, and enrolled in the study, as well as their demographic characteristics. The content validity index (CVI) rating scale was used to verify the relevance of the REFS-Thai to the concept of frailty. CVIs, representing the proportion of expert agreement about relevance, were obtained for individual REFS-Thai items (I-CVIs). In turn, these were used to estimate the validity measure for the full scale according to the universal agreement method (S-CVI/UA), which calculates the percentage of items for which there is full expert agreement. Based on standard recommendations for content analysis (Bolarinwa, 2015; Polit & Beck, 2006), I-CVI values  $\geq 0.78$  and S-CVI/UA values  $\geq 0.80$  were considered excellent with respect to the REFS-Thai content validity.

Inter-rater reliability (kappa coefficient) was evaluated by two raters (non-geriatrics-trained) in a sample of hospitalized older adults. A kappa coefficient value  $\geq 0.60$  was considered to be a moderate level of concordance between the raters (higher kappa values indicate higher concordance).

Internal consistency reliability of the translated REFS-Thai was evaluated by Cronbach's alpha value. Cronbach's alpha  $\geq 0.70$  was considered as acceptable reliability for the REFS-Thai. Construct validity was established with CFA using a Z-score method ( $n = 100$ ). All nine domains of the REFS-Thai were analyzed, and  $P$ -value  $< 0.05$  indicated a strong association of each domain with frailty. The cutoff criteria for the model fit indices used in the covariance structure analysis were based on the work of Hu and Bentler (1999).

## 4 | RESULTS

Content validation of the translation reflected high expert agreement regarding the clarity of the REFS-Thai. The I-CVI was 0.97 and S-CVI/UA was 0.92 (Table 1), indicating excellent internal validity.

A total of 141 hospitalized older adults participated in different evaluation activities: cognitive interview ( $n = 10$ ), reliability and validity testing ( $n = 100$ ), and inter-rater reliability testing ( $n = 31$ ). The

majority of study participants were women (72%), had a mean age of 69 years (range 60–92 years), and had comorbidities (90%).

The pretest cognitive interview was conducted with 10 participants (4 men, 6 women) who had a mean age of 68.8 years (range 63–75 years). Among these, five participants required assistance: three participants had misplaced their glasses and needed reading assistance, while two participants had painful musculoskeletal conditions (rheumatoid arthritis and shoulder impingement syndrome) affecting hand and wrist movement while drawing the clock (item 1). Most male participants showed hesitancy when asked about functional independence items, particularly for meal preparation, house-keeping, and laundry (item 3). All participants reported easy understanding of the meaning of each item. Very few word changes were required in the REFS-Thai: these involved the addition of age-specific pronouns reflecting respect according to Thai tradition. Participants offered some practical suggestions, including regarding the evaluation of functional independence (item 3) and self-reported performance (item 9-3), and these are presented in Table 2.

Table 3 presents the characteristics of the 100 hospitalized older adults who participated in the reliability evaluation. The majority of participants were female (72%) and had a mean age of 69.9 years (standard deviation [SD] = 7.0 years; range 60–92 years). The mean REFS-Thai score was 4.9 (SD = 2.9; range 0–13), and the mean time to complete the instrument was 6.5 min (SD = 3.8 min; range 3–30 min). Cronbach's alpha for the REFS-Thai was 0.728 and considered satisfactory for internal consistency, as presented in Table 4. In

**TABLE 1** The CVIs for each REFS-Thai item, according to three experts

Item	Relevance rating <sup>a</sup>	I-CVI	$p_c^b$	Interpretation
Item 1	3	1	0.125	Excellent
Item 2-1	3	1	0.125	Excellent
Item 2-2	3	1	0.125	Excellent
Item 3	3	1	0.125	Excellent
Item 4	3	1	0.125	Excellent
Item 5-1	3	1	0.125	Excellent
Item 5-2	3	1	0.125	Excellent
Item 6	3	1	0.125	Excellent
Item 7	3	1	0.125	Excellent
Item 8	2	0.67	0.375	Fair
Item 9-1	3	1	0.125	Excellent
Item 9-2	3	1	0.125	Excellent
Item 9-3	3	1	0.125	Excellent

Abbreviations: CVI content validity index; I-CVI item-level content validity index; S-CVI/UA scale-level content validity index (using the universal agreement method). Mean I-CVI = 0.97, S-CVI/UA = 0.92.

<sup>a</sup>Relevance was scored as: 1 (not relevant), 2 (item needs some revision), 3 (relevant but needs minor revision), or 4 (very relevant) (Polit & Beck, 2006).

<sup>b</sup>Probability of chance occurrence was calculated as:  $P_c = [N!A!(N - A)!]$

\*0.5 N, where N = number of experts and A = number agreeing on good relevance (Polit & Beck, 2006).

**TABLE 2** Issues with REFS-Thai items 3 and 9-3, identified during the cognitive interviews

REFS-Thai item	Issue	Interpretation	Conclusion/recommendation
<b>Item 3: Functional independence</b> <i>"For how many of the following activities do you require help? Meal preparation/shopping/transportation/telephone use/housekeeping/laundry/managing money/taking medication."</i>	Men were hesitant to answer questions regarding certain activities: <i>"Meal preparation/Housekeeping/Laundry."</i>	Items conflicted with traditional views of gender roles (Thai men do not perform women's duties).	Acknowledge traditional Thai roles. Then, give an example to explain: If no woman is managing these activities, are you able to without requiring help?
<b>Item 9-3: Self-reported performance</b> <i>"Two weeks ago, were you able to Walk 1 kilometer without help?"</i>	Lacking ability to accurately estimate <i>"1 kilometer."</i>		Related to individual experience of environment/reformulate the question: Could you walk back and forth from the front door to the end of the unit four times without stopping? Could you walk at a slow pace for 13 min without stopping?

Abbreviation: REFS-Thai = Thai version of the Reported Edmonton Frail Scale.

the item analysis, all items showed Cronbach's alpha >0.65 (range 0.66–0.73). Examination of corrected item-total correlation scores showed all but two were <0.3 (the values for item 1 and item 4 were 0.039 and 0.024, respectively). The inter-rater reliability for the REFS-Thai among the 31 participants showed notable agreement, with unweighted kappa = 0.78 and linearly weighted kappa = 0.87 ( $P < 0.001$ ).

In the evaluation of construct validity, all but one of the REFS-Thai domains showed significant association with the REFS-Thai's construct ( $P < 0.05$ ) (Table 5). Among the nine domains in the REFS-Thai, the strongest associations with frailty were shown for social support ( $r^2 = 0.981$ ,  $P = 999.00$ ), medication use ( $r^2 = 0.912$ ,  $P < 0.0001$ ), and mood ( $r^2 = 0.545$ ,  $P < 0.0001$ ) domains, while cognition ( $r^2 = 0.015$ ,  $P = 0.540$ ), functional independence ( $r^2 = 0.145$ ,  $P = 0.018$ ), and incontinence ( $r^2 = 0.127$ ,  $P = 0.032$ ) showed weaker associations. The weight factor ( $\beta$ ) ranged from 0.122–0.991, with the most significant being for the social support, followed by medication use domain, and associations with frailty for the nine domains ranged from 1.5% to 98%. Finally, Table 6 shows that the CFA model indicated fair fit for the final REFS-Thai instrument with all nine domains of frailty ( $\chi^2/df = 4.716$ , comparative fit index [CFI] = 0.817, root mean square error of approximation [RMSEA] = 0.193).

## 5 | DISCUSSION

The purpose of this study was to implement procedures for cultural adaptation to the REFS-Thai measure and to evaluate the psychometric properties of the final instrument. Overall, the REFS-Thai was easy and quick to administer in hospitalized, older Thai adults scheduled for surgical intervention. As crucial concern in measurement

development and translation is the reduction of cross-cultural barriers, in the present study, cognitive interviews were successfully applied to correct identified problems and clarify difficulties. This, in turn enabled us to optimize the instrument validity and reliability (Peterson et al., 2017).

Our findings identified significant cultural issues in the translated instrument, the most challenging being the selection of the most appropriate word usage. The Thai language has various dialects across the different geographical areas of Thailand. With five distinct regions, there are many subculture groups for whom words and phrases may have different meanings. For instance, the Northern Thai language is quite different from the Southern or Central Thai language with respect to structure, pronunciation, and meaning. Additionally, there are many religions in Thailand, including Buddhism, the hill tribe religions, Taoism, Confucianism, Islam, and Christianity, each exerting its influence on thoughts, beliefs, and values, and in turn, interfering with semantic equivalence. In this study, all participants were shown to understand the questions posed in the cognitive interviews. Furthermore, the expert panel supported the selection of formal Thai wording.

The findings of the study also identified that traditional Thai beliefs about gender roles significantly influenced responses to certain items of the REFS-Thai, in particular, the functional dependence items (item 3) pertaining to meal preparation, housekeeping, and laundry. In the cognitive interview, all of the male participants were hesitant about answering these questions because of their perception that said activities constitute women's work. This traditional belief was embedded in the responses to the REFS-Thai interview and is congruent with those about gender roles in many Asian countries. The finding underlined the importance of the cognitive interview as a vehicle for capturing significant cultural issues, such as the traditional belief in gender roles.

**TABLE 3** Participant characteristics (*n* = 100)

Characteristic	N (%)	Mean (SD)	Range
Age, years		69.98 (7.03)	60–92
Mini-cog score		4.18 (0.95)	2–5
REFS score		4.93 (2.88)	0–13
Time to complete REFS (min)		6.46 (3.82)	3–30
BMI (kg/m <sup>2</sup> )		24.91 (4.09)	16.17–35.50
Pain score <sup>a</sup>		1.48 (2.49)	0–9
Female gender, <i>n</i> (%)	72 (72%)		
Religion			
Buddhism	97 (97%)		
Islamic	2 (2%)		
Christian	1 (1%)		
Educational level			
Did not attend school	3 (3%)		
Primary school	51 (51%)		
Middle and/or high school	7 (7%)		
Diploma degree	7 (7%)		
Bachelor degree	30 (30%)		
Master degree or higher	2 (2%)		
Income			
Insufficient income, <i>n</i> (%)	17 (17%)		
Occupation			
Not working/retired	63 (63%)		
Agriculture	13 (13%)		
Merchant	9 (9%)		
Employed	8 (8%)		
Bank interest investment	4 (4%)		
Other	3 (3%)		
Medical payment			
Government/state enterprise	62 (62%)		
Universal coverage scheme	22 (22%)		
Personal payment	16 (16%)		
Comorbidity			
Comorbidity, <i>n</i> (%) report comorbidity(s)	90 (90%)		
ASA classification <sup>a</sup>			
Class I	1 (1%)		
Class II	39 (39%)		
Class III	55 (55%)		
Class IV	5 (5%)		
Type of surgery			
General surgery	61 (61%)		
Orthopedic	23 (23%)		

**TABLE 3** (Continued)

Characteristic	N (%)	Mean (SD)	Range
Traumatic	10 (10%)		
Vascular	6 (6%)		
Domicile post discharge			
Home	82 (82%)		
Relative's home	16 (16%)		
Other: Unplanned	2 (2%)		

Abbreviations: ASA = American Society of Anesthesiologists; BMI = body mass index; REFS = Reported Edmonton Frail Scale; SD = standard deviation. <sup>a</sup>ASA classification: class 1 a healthy patient; class 2 a patient with mild systematic disease; class 3 a patient with severe systematic disease; class 4 a patient with severe systematic disease that is a constant threat of life, Pain was scored from 0 (no pain) to 10 (worst pain).

Our findings also revealed the influence of social environment and/or personal experience on perceptions. Half of the participants requested an explanation of the “1-km distance” described in item 9-3, to validate their perception of the distance; thus, estimation of a 1-kilometer distance proved intangible for many participants. We found that relating this distance to a familiar environment was the most practical and preferable solution for all participants. Therefore, for example, for hospitalized older adults, we described the distance as being “4 times the distance from the front door to the end of the hospital unit”.

The original REFS testing indicated that hospitalized older adults required approximately 4 minutes to complete the instrument questions (Hilmer et al., 2009); however, participants in the present study took somewhat longer, averaging 6.5 minutes. One reason for this difference is that four participants took much longer (25–30 minutes) than the others to complete the REFS-Thai. There are many environmental factors that can interfere with hospitalized adults' ability to focus, which could have influenced the completion times for these patients. Acute symptoms or severity of illness can also play a significant role. In the present study, this was observed during performance of the clock-drawing test (item 1) when participants with pain and discomfort from musculoskeletal conditions of the hand/wrist indicated their ability to complete the item was impaired. For these patients, pain impeded functional ability during testing, which is consistent with the recent modifications to the REFS. In the newly modified version (mod-REFS), the clock-drawing test has been replaced by self-report, to overcome challenges related to functional impairment seen in some older adults (Rose, Yang, Welz, Masik, & Staples, 2018). This same modification could be considered for future versions of the REFS-Thai. Another factor affecting completion time for the REFS-Thai may have been the participants' level of education. More than half of the participants in this study reported primary school education as the highest level of education attained; consequently, the participants may have labored over reading, resulting in a longer completion time. Despite the longer completion times than for the original REFS, the



**TABLE 4** Item analysis and Cronbach's alpha coefficient for the REFS-Thai ( $n = 100$ )

REFS-Thai item	Mean score with item deleted	Variance with item deleted	Corrected item-total correlation	R <sup>2</sup>	Cronbach's alpha with item deleted
Item 1	5.25	11.139	0.039	0.150	0.736
Item 2-1	4.84	9.065	0.439	0.288	0.678
Item 2-2	4.88	9.299	0.392	0.375	0.687
Item 3	5.20	9.838	0.325	0.356	0.697
Item 4	5.48	11.464	0.024	0.185	0.725
Item 5-1	5.19	9.671	0.573	0.430	0.665
Item 5-2	5.23	10.421	0.323	0.293	0.695
Item 6	5.29	10.430	0.330	0.385	0.695
Item 7	5.35	9.826	0.560	0.539	0.668
Item 8	5.34	10.590	0.290	0.403	0.699
Item 9-1	5.17	10.486	0.300	0.362	0.698
Item 9-2	5.51	10.071	0.627	0.544	0.670
Item 9-3	5.43	10.591	0.330	0.243	0.695

Abbreviation: REFS-Thai = Thai version of the Reported Edmonton Frail Scale.

Note: The inter-rater reliability testing for the REFS-Thai ( $n = 31$ ) showed unweighted kappa = 0.78 and linearly weighted kappa = 0.87 ( $P < 0.001$  for both).

Cronbach's alpha for the full scale = 0.728.

**TABLE 5** Standardized loading for the CFA model of frailty based on the REFS-Thai ( $n = 100$ )

REFS-Thai domain	<i>b</i> (SE)	$\beta$	R <sup>2</sup>	<i>P</i> -value
Social support <sup>a</sup>	1.00	0.991	0.981	—
Cognition	0.08 (0.13)	0.122	0.015	0.540
General health	0.57 (0.11)	0.732	0.535	0.000
Functional independence	0.28 (0.14)	0.381	0.145	0.018
Medication used	0.68 (0.05)	0.955	0.912	0.000
Nutrition	0.45 (0.09)	0.716	0.513	0.000
Mood	0.45 (0.08)	0.738	0.545	0.000
Continence	0.18 (0.01)	0.356	0.127	0.032
Functional performance	0.27 (0.06)	0.710	0.504	0.000

Abbreviations: CFA = confirmatory factor analysis; REFS-Thai = Thai version of the Reported Edmonton Frail; SE = standard error.

<sup>a</sup>SE and *P*-value were not reported for the social support domain, as this was a constrained parameter.

REFS-Thai was completed in under 7 minutes by the vast majority of individuals, making it a practical tool for use in frailty assessment.

The original REFS showed excellent reliability when benchmarked against standard clinical frailty measurement being scored by personnel without medical training (Hilmer et al., 2009). In a later study of 47 cardiology inpatients who had percutaneous pulmonary intervention (mean age > 78.2 years), the reliability showed substantial agreement (Cohen's kappa = 0.70) (Hii, Lainchbury, & Bridgman, 2015). The REFS-Thai showed stronger reliability and validity than was found in these earlier studies. Although reliability was satisfied in the present study, validity was not uniform across all the scale items. Confirmatory factor analysis (CFA) demonstrated that the cognition domain had the weakest association with frailty ( $r^2 = 0.015$ ), while the social

**TABLE 6** Justification criteria for goodness of fit and the CFA model ( $n = 100$ )

Measure	Threshold	CFA's value
$\chi^2/df$	<3 good <5 sometimes permissible	4.716
<i>P</i> -value for the model	>0.05	0.000
CFI	>0.95 excellent >0.09 traditional acceptance >0.80 sometimes permissible	0.817
RMSEA	<0.05 good 0.05–0.10 moderate >0.10 poor	0.193
SRMR	<0.09	0.652

Note: The justification criteria for goodness of fit were based on Hu and Bentler (1999).

Abbreviations: CFA = confirmatory factor analysis; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean squared residual.

support domain had the strongest ( $r^2 = 0.981$ ). The study also found that item 1 (cognition) and item 4 (social support) had poor corrected item-total correlation scores (<0.3). Examining each of these, we found a right skew in the responses to both items, which decreased the strength of the association for the items. For item 1 (cognition), nearly 70% of participants completed the clock-drawing test correctly, but factors such as pain or treatment preparation might have distracted participants from the test (it is also possible that without time pressure, more participants would have accurately completed the test). For item 4 (social support), almost 90% of participants reported having someone to help them when needed. These results are in line with traditional Thai culture, according to which older adults live with

family. It is possible that even though the social support domain showed strong association with frailty, Thai people may generally show less severe frailty in this domain because of the norm of family support, accounting for the skew of item 4. Thus, certain domains (including cognition, functional independence, and continence) may indicate frailty less well than others. We considered deleting items with weaker association since the CFA model indicated fair fit based on the complete REFS-Thai scale (with nine domains of frailty), despite that the majority of domains were significantly associated with frailty; however, given that frailty is a dynamic process and in light of limited data, the effect of removing items or domains from the REFS-Thai must be interpreted with caution. Finally, we retained all the items, as per the original REFS, in recognition that frailty is complex and that multi-dimensional evaluation might be crucial to detect frailty in valid and reproducible matter (Buta et al., 2016; Theou et al., 2018).

In this study, frailty was classified on a spectrum from vulnerable to severe, in hospitalized older Thai adults similarly to previous studies (Hii et al., 2015; Rose et al., 2018). Furthermore, the participants' characteristics, including the presence of multiple comorbidities, polypharmacy, fall history, and malnutrition, were congruent with those found in other studies exploring frailty in clinical settings (Buigues et al., 2015; Dent et al., 2016; Theou et al., 2018). Although there is lack of consensus regarding a gold standard for frailty assessment, our findings indicate the REFS-Thai is potentially useful in evaluating frailty in the Thai context. Moreover, the participants—hospitalized older Thai adults—expressed strong interest in notion of frailty following the testing, asking questions about frailty characteristics and its impact on health. All enrolled participants completed the study procedures, supporting the notion that knowledge of frailty is pertinent but still limited in older population. As such, continued use of the REFS-Thai may reinforce our understanding of frailty and enhance our ability to assess frailty-related outcomes in Thailand and in other countries where the Thai language used.

## 5.1 | Limitations and recommendations for further study

This study has some limitations. The study was conducted in a single tertiary care university hospital in the center of Thailand, and most of participants lived in urban areas and were Buddhist. Thus, the participants were not representative of Thai people in other hospitals, from different geographical areas, or of other religions. Future studies, with larger and more diverse samples and multiple clinical settings, are needed. Moreover, further evaluation of frailty in special populations, for example, individuals with functional limitations or with lower health literacy, and use of proxy or biomarkers to identify frailty has the potential to lead to improvements in frailty assessment.

## 6 | CONCLUSION

This study takes an initial step towards improving an understanding of clinical frailty in Thailand. The REFS-Thai provides a reliable and valid

risk stratification tool for identifying frailty in hospitalized older adults. Furthermore, the REFS-Thai, a simple and rapid assessment, is easy to administer and might be practical for use in hospitals and other settings. We believe that integrating the REFS-Thai into routine clinical care can provide culturally-sensitive, patient-centered care and will ultimately strengthen the quality of care for older Thai adults who are frail or at risk of frailty.

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## AUTHOR CONTRIBUTION

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