

Assessment of Internal Consistency and Convergent Validity of the Activities-specific Balance Confidence (ABC) Scale Thai Version

นิพนธ์ต้นฉบับ

Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อประเมินความสอดคล้องภายในของมาตรวัด Activities-specific Balance Confidence (ABC) Scale ฉบับภาษาไทยและความตรงเชิงบรรจบของมาตรวัดนี้เมื่อเทียบกับมาตรวัด Fall Efficacy Scale (FES) ฉบับภาษาไทย และ Timed Up and Go Test (TUG) วิธีการศึกษา: ใช้การประเมินความสอดคล้องภายใน ความตรงเชิงบรรจบและผลลัพธ์พื้น/เพดาน (floor/ceiling effects) ของมาตรวัด ABC ฉบับภาษาไทยในผู้สูงอายุไทยจำนวน 40 คนซึ่งมีอายุเฉลี่ยเท่ากับ 66.5 ± 5.7 ปี การประเมินความสอดคล้องภายในแสดงด้วยค่า Cronbach's alpha coefficient, item total correlation และ Cronbach's alpha coefficient if items deleted การทดสอบความตรงเชิงบรรจบของมาตรวัด ABC ฉบับภาษาไทยใช้เทียบกับมาตรวัด FES ฉบับภาษาไทยและ TUG การประเมินความสัมพันธ์ในแต่ละมาตรวัดใช้ Spearman's rank correlation ส่วนผลลัพธ์พื้น/เพดานยืนยันด้วยการวิเคราะห์ความเบ้ ผลการศึกษา: มาตรวัด ABC ฉบับภาษาไทยมีความสอดคล้องภายในในระดับสูงมาก (ค่าสัมประสิทธิ์ Cronbach's alpha = 0.96) มาตรวัด ABC ฉบับภาษาไทยมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับ TUG แต่อยู่ในระดับต่ำ (Spearman's rho = -0.34) c และยังมี ความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับมาตรวัด FES ฉบับภาษาไทย (Spearman's rho = 0.66) ไม่พบผลลัพธ์พื้นในมาตรวัด ABC ฉบับภาษาไทยและมาตรวัด FES ฉบับภาษาไทย แต่พบผลลัพธ์เพดานของมาตรวัด FES ฉบับภาษาไทย (-1.27) สัดส่วนของผู้สูงอายุที่ได้คะแนนเต็มของมาตรวัด ABC ต่ำกว่า สัดส่วนของมาตรวัด FES ฉบับภาษาไทยอย่างมีนัยสำคัญทางสถิติ (7.50% vs. 42.50%, $P < 0.05$) สรุป: มาตรวัด ABC ฉบับภาษาไทยมีระดับความเที่ยงเชิงความสอดคล้องภายในในระดับสูงและความตรงเชิงบรรจบเมื่อเทียบกับมาตรวัด FES ฉบับภาษาไทยในระดับปานกลาง จากการที่ไม่มีผลด้านพื้น/เพดานจึงมีความไวในการทดสอบมากกว่ามาตรวัด FES ฉบับภาษาไทยเมื่อใช้ประเมินในผู้สูงอายุไทยที่มีสรีระการทำงานสูง

คำสำคัญ: ความสอดคล้องภายใน, ความตรงเชิงบรรจบ, มาตรวัด ABC ฉบับภาษาไทย, ผู้สูงอายุไทย

Abstract

Objective: To assess the internal consistency of the Activities-specific Balance Confidence (ABC) Scale Thai version and convergent validity of the scale compared with the Fall Efficacy Scale (FES) Thai version and Timed Up and Go Test (TUG). **Method:** The internal consistency, convergent validity and floor/ceiling effects of the ABC scale were assessed in 40 healthy older Thai adults with the mean age of 66.5 ± 5.7 years. The internal consistency was determined using the Cronbach's alpha coefficient, item total correlation and Cronbach's alpha coefficient if items deleted. The convergent validity of the ABC scale Thai version was assessed using the FES scale Thai version and TUG. Correlations between the scales were determined by the Spearman's rank correlation, whereas the floor/ceiling effects were confirmed by the skewness analysis. **Results:** The internal consistency of total ABC scores was high (Cronbach's alpha coefficient = 0.96). There was a significant correlation between the ABC scale Thai version and the TUG, albeit low degree of correlation (Spearman's rho = -0.34), and another significant correlation with the FES scale Thai version (Spearman's rho = 0.66) was identified. There was no significant floor effect in the ABC scale Thai version and the FES scale Thai version, but the ceiling effect was found only in the FES scale Thai version (-1.27). The proportion of those persons with full scores of the ABC scale was significantly lower than those of FES scale (7.50% vs. 42.50%, $P < 0.05$). **Conclusion:** the ABC scale Thai version had the high level of internal consistency reliability and moderate level of convergent validity with the FES scale Thai version. As the scale had no ceiling or floor effect, it is more sensitive than the FES scale when using in the highly functional older Thai persons.

Keywords: internal consistency, convergent validity, Activities-specific Balance Confidence Scale Thai version, older Thai adults

Introduction

Falls are commonly found in older adults which lead to several problems in the elderly, ranging from physical injuries, mental health impairments^{1,2}, negative psychological symptoms³⁻⁵, decreased performance in activities of daily living^{6,7}, increased health care cost and increased health care burden to care givers.⁸ According to reports of the World Health Organization (WHO) in 2007, falls in older

people aged 65 or over occurred approximately 28 - 35%.⁹ The number of falls in older adults increased when people get older; it increased to 32 - 42% among those over 70 years of age.⁹⁻¹² In 2014, the National Statistical Office, Ministry of Information and Communication Technology, Thailand, surveyed falls in Thai elderly.¹³ They reported that the percentage of falls within 6 months of Thai elderly people

was 11.6% and the percentage of women who fell (12.8%) was higher than men (10.2%).¹³ Of those elderly who fell, the majority of them had a single fall (6.6% of 11.6%), whereas a few had 2 - 3 falls (3.8%) and only 1.2% of those who fell had multiple falls (more than 3 times).¹³

The consequences of falls among older adults can be divided into physical and psychological ones. The physical consequences of fall include major injuries, such as dislocation and laceration with sutures and fractures, and minor injuries such as soft tissue injuries, open wound, bruise, sprain, joint dislocation and strained muscle.¹⁴⁻¹⁷ Hip fracture is one of the most reported major injuries from fall among older adults.¹⁴ Physical injuries from fall result in a functional decline (35.3%), health services required (23.5%), treatments needed (17.2%), declined social activities (16.7%) and declined physical activities (15.2%).¹⁸ The psychological consequences of fall in older adults are negative psychological problems such as fear of falling, anxiety and depression.^{3,14} The common psychological consequences of older adults who fell was fear of falling¹⁴ which led to a limitation of activities¹⁹, including avoidance or difficulties in performing activities of daily living, loss of self-confidence and increased risk of fall.^{5,20,21}

Approximately 50% of the older adults who fell have fear of falling and about 25% of the older adults who fell usually avoided certain activities due to fear of falling and decreased balance confidence.²⁰ Such changes in behavior of fallers could be explained by self-efficacy theory.^{6,22} Based on this theory, the performance of each person is directly related to self-belief of oneself, or perceived self-efficacy.²³ The perceived self-efficacy can be developed from experience, performance accomplishment, verbal persuasion, physiological and emotional state as well as positive and negative psychological conditions.²³ The example of the negative psychological conditions is fear of falling.²³ A previous study also demonstrated the relationship between fear of falling and lower balance confidence.²⁴ Balance confidence is the most important psychological factor for older adults to help themselves maintain balance when movements occurred.^{20,25} Those elderly who had fear of falling were likely to reduce their mobility in order to prevent themselves from fall.²¹

The Activity-specific Balance Confidence (ABC) Scale is commonly recommended for evaluating the person's confidence related to fear of falling. This self-administered

scale was developed by Powell²² to measure the confidence in performing various ambulatory activities without falling.²² The ABC scale contains 16 items to assess balance confidence in performing simple to complex activities, such as walking around the house, stepping onto an escalator, and walking outside on an icy sidewalk.^{6,22} The total score of ABC scale ranges from 0% - 100%, where 0% means "not confident" and 100% means "completely confident".²² The confidence scores could be interpreted in a categorical fashion of high (> 80%), moderate (50 - 80%) and low (< 50%) levels of physical functioning.²² In addition, the score of ABC scale less than 67% in the elderly is the indicator of future fall.²⁶ The ABC scale demonstrated good psychometric properties with high internal consistency reliability (Cronbach's alpha coefficient of 0.96), excellent test-retest reliability ($r = 0.92$), good convergent validity with physical activities subscale of the physical self-efficacy scales ($r = 0.63$) and good discriminant validity between fallers and non-fallers.²² The ABC scale was found to be more reliable than other fear of falling scales such as the Fall Efficacy Scale (FES) ($r = 0.71$).⁶ The ABC scale was also better than the FES scale in discriminating between high versus low mobility participants^{6,22}, where the FES scale showed a ceiling effect person with high mobility.⁶ In addition, the ABC scale was best predicting fall in the elderly when compared with the FES scale and Fear of Falling Avoidance Behavior Questionnaire (FFABQ).^{6,22,26}

The Activities specific Balance Confidence (ABC) scale has been translated and cross culturally adapted into many languages such as Canadian²⁷, Chinese²⁸, Swedish²⁹, Turkish³⁰ and Thai.³¹ In the ABC scale Thai version, some items of ABC English version have been modified to accommodate cultural differences.³¹ Those culturally adapted items are items 10, 12, 13, where the word "mall" has been adapted to "mall/market" to fit the lifestyle of Thai community and "walk outside on icy sidewalks" of item 16 was modified to "walk outside on slippery sidewalks." The test-retest reliability of total ABC score (ICC = 0.99) and item scores were excellent (ICC = 0.79 - 0.96).³¹ However, other types of reliability and validity of the ABC scale Thai version have not been evaluated. This study, therefore, aimed to examine internal consistency reliability and convergent validity of the Thai version of the Activities specific Balance Confidence (ABC) Scale with the Fall Efficacy Scale (FES) Thai version and Timed Up and Go test (TUG).

Methods

Forty healthy older adults aged between 60 - 85 years participated in the study. All participants were recruited from Klong Luang district, Pathum Thani province, Thailand. The recruitment period was from July 2017 to January 2018. To be eligible, these elderly individuals had to understand Thai language and have the ability to walk independently at least 3 meters. The participant who had poor communication or cooperation, blindness, hearing loss, neurological disease, such as Parkinson's disease, stroke and cognitive impairment (Mini-Mental State Examination score Thai version score of < 24 points) were excluded. All participants gave the written informed consent prior to the study. This study received ethical approval from the human research protection committee at the Public Health Office, Pathum Thani province (0032/4418) and from the ethic review board of the Faculty of Physical Therapy, Srinakharinwirot University, Thailand (PTPT2017-008). Prior to data collection, the participant's health history, history of fall, and fear of falling were gathered. Cognitive function was assessed using the Mini-Mental State Examination Thai version (TMSE).

The psychometric properties testing of the Activities-specific Balance Confidence (ABC) scale Thai version was in the following aspects: the internal consistency, convergent validity and floor/ceiling effect. All participants performed self-evaluation using the ABC scale Thai version (APPENDIX A) & FES scale Thai version (APPENDIX B). Their balance and mobility were assessed by the Timed Up and Go (TUG) test which is a functional balance test consisting of several tasks such as standing up from the chair, walking a 3-meter distance, turning around, returning to the chair and sitting down.³² A longer time to complete the task indicates a higher risk of falling. The TUG showed excellent reliability with the reported ICC value of 0.99 for the community dwelling elderly people.³² Moreover, this test is useful for predicting the risk of fall in older adults with a sensitivity of 87% and specificity of 87%.³³ The intra-rater reliability among the raters who assessed the TUG in this study was excellent as indicated by an ICC of 0.99 (95% confidence interval: 0.96 - 0.99). The sequence of the testing was randomly assigned to each participant.

In terms of psychometric properties estimation, the Cronbach's alpha coefficient, item total correlation and

Cronbach's alpha coefficient if item deleted were calculated to determine the internal consistency reliability of the ABC Thai version. The internal consistency reliability based on Cronbach's alpha coefficient was classified as poor, moderate, and excellent with the corresponding coefficients of < 0.7, 0.7 - 0.8, and > 0.8, respectively.³⁴ The convergent validity was determined using the Spearman's rank correlation analysis to indicate correlations between the ABC Thai version scores and FES Thai version scores and TUG scores. Spearman's rank correlation was chosen because the total scores of ABC and FES scales were not true continuous data to fulfil the assumption of Pearson's correlation analysis. Spearman's correlation coefficients of 0.0 to 0.49 were interpreted as poor, 0.50 to 0.79 as moderate, and 0.8 or higher as excellent.³⁴ Floor and ceiling effects were determined by the proportion of individuals with the lowest and highest possible scores for each test, respectively. Floor or ceiling effects were considered to be substantial if the proportion was greater than 20%.^{35,36} A positive skewness value of $y_1 > 1.0$ or a negative skewness value of $y_1 < -1.0$ indicated a substantial skewness to confirm a floor or ceiling effect, respectively. The bootstrapping test was used for complex estimates of the standard error and confidence intervals. This test was more accurate than using the sample variance as it is appropriate to control and assess the stability of the results.³⁷ The McNemar's test was used in ceiling effect calculation to compare proportions of participants with the ABC score and those with the FES score.³⁸⁻⁴⁰

Results

Characteristics of the participants

Forty elderly participants took part in the psychometric properties testing of the Activities-specific Balance Confidence (ABC) scale Thai version. Demographic characteristics of the participants are summarized in Table 1. There were more male than female participants but there were no age differences between these two genders. All participants had body mass index within the normal range. The majority of participants finished primary education. More than half of participants reported no history of fall. All participants had no cognitive impairments as indicated by the score of TMSE. The participants were not in the group of

high risk of fall as considered by the TUG scores. They were also considered in the group of no fear of falling which was presented by the score of FES Thai version. The participants were classified as having a moderate to high level of physical function, which was shown by the score of ABC Thai version.

Table 1 Demographic characteristics of subjects (N = 40).

Variables	Mean ± SD or N (%)
Age (years)	66.5 ± 5.7
Male / Female	66.1 ± 5.6 / 67.1 ± 5.9
Gender	
Male / Female	24 (60.0%) / 16 (40.0%)
BMI	24.1 ± 4.7
Education	
Primary education	35 (87.5%)
Secondary education	5 (12.5%)
Fall history (in the past 12 months)	
No	25 (62.5%)
Yes	15 (37.5%)
TMSE /30	28.3 ± 1.5
TUG (s)	8.4 ± 1.4
FES /10	9.4 ± 0.7
ABC /100	79.9 ± 16.0

Note: BMI = Body mass index, TMSE = Mini Mental Status Examination Thai version, TUG = Timed Up and Go test, FES = Fall Efficacy Sale, ABC = Activities-specific Balance Confidence Scale.

Internal consistency reliability

The internal consistency reliability of the overall ABC scores was excellent as indicated by a Cronbach's alpha coefficient of 0.96 (Table 2). When considering each item-total correlation of ABC Thai version, the Cronbach's alpha coefficient values of each item ranged from 0.65 to 0.92. Once individual item was deleted, the overall Cronbach's alpha coefficients ranged from 0.95 - 0.96, similar to the overall Cronbach's alpha coefficient when all items were retained.

Convergent validity

The results of convergent validity are shown in Figures 1 and 2. There was a significant but poor correlation between the ABC scale Thai version and the TUG with a Spearman's rho correlation coefficient of -0.34 (P -value < 0.05). The negative correlation indicated an inverse correlation; the better ABC score, the less time when performing TUG tasks. The result also demonstrated another significant correlation between the ABC scale Thai version and FES scale Thai version with a Spearman's rho correlation coefficient of 0.66

(P -value < 0.05), indicating a moderate relationship between the ABC scale Thai version and FES scale Thai version.

Table 2 Item analysis of the Activities-specific Balance Confidence (ABC) scale Thai version: internal consistency, item total correlation and Cronbach's alpha coefficient if item deleted (N = 40).

Items	Item total correlation	Cronbach's alpha coefficient if item deleted
Overall Cronbach's alpha coefficient = 0.96		
ABC1	0.83	0.96
ABC2	0.92	0.95
ABC3	0.76	0.96
ABC4	0.74	0.96
ABC5	0.74	0.96
ABC6	0.79	0.96
ABC7	0.65	0.96
ABC8	0.73	0.96
ABC9	0.82	0.96
ABC10	0.76	0.96
ABC11	0.80	0.96
ABC12	0.74	0.96
ABC13	0.76	0.96
ABC14	0.75	0.96
ABC15	0.74	0.96
ABC16	0.67	0.96

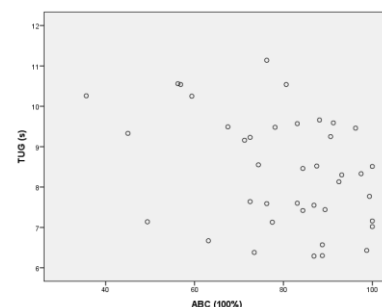


Figure 1 The correlation between the ABC Thai version and TUG scores (Spearman's rho correlation coefficient = -0.34, P -value < 0.05) (N = 40).

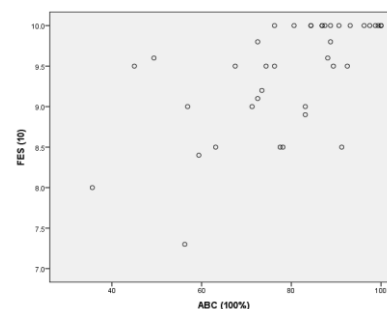


Figure 2 The correlation between the ABC Thai and FES Thai version scores (Spearman's rho correlation coefficient = 0.66, P -value < 0.05) (N = 40).

Floor and ceiling effects

Results of the floor and ceiling effects are shown in Table 3. There was no significant floor effect either in the ABC scale Thai version or the FES scale Thai version. However, the ceiling effect was found in the FES scale Thai version, but not the ABC scale Thai version. Analysis of the skewness demonstrated that the score distribution of the ABC scale Thai version was -0.93, indicating no significant ceiling effect. In contrast, the score distribution of the FES scale Thai version demonstrated significant negative skewness value of -1.27 which reflected substantial ceiling effect. The significant difference of the ceiling was found between proportions of persons with the full score of ABC scale (7.50%) and FES scale (42.50%) with P -value < 0.05.

Table 3 The distribution of score of the ABC Thai version and FES Thai version (N = 40).

Measure	ABC Thai version	FES Thai version
Skewness (SE)	-0.93 (0.37)	-1.27 (0.37)
Bootstrap (95%CI)		
Lower bound	-1.49	-1.96
Upper bound	-0.32	-0.48
Full score (n)	3.00	17.00
Floor effect (%)	0.00	0.00
Ceiling effect (%)	7.50	42.50
McNemar's test*	P -value < 0.001	

Note: FES = Fall efficacy scale, ABC = Activities-specific Balance Confidence scale, SE = Standard error.

* Test for difference in ceiling effects between the two scales.

Discussions and Conclusion

The present study was conducted to examine the internal consistency reliability of the Activities-specific Balance Confidence Scale (ABC) Thai version and its convergent validity with the Fall Efficacy Scale (FES) Thai version and Timed Up and Go (TUG) test. Our results demonstrated excellent internal consistency reliability and significant convergent validity of the ABC scale Thai version.

The internal consistency reliability reflects the extent to which items measure various aspects of the same characteristic.³⁴ The ABC scale Thai version showed a high internal consistency reliability with a Cronbach's alpha coefficient of 0.96. This indicates that the items in the ABC scale Thai version measure the same characteristic, which is the balance confidence in performing activities. We also found that the internal consistency reliability of the ABC scale Thai version was comparable to other versions of the

ABC scale. For example, Cronbach's alpha coefficient was 0.96 in the ABC Scale original version²², 0.97 in the Cantonese Chinese version²⁸, 0.96 in the Turkish version³⁰, 0.94 in the mandarin Chinese version⁴¹ and 0.93 in the Canadian French version.²⁷ Furthermore, the test for internal consistency reliability of individual items in the ABC scale was performed to determine the item redundancy. The item redundancy could be confirmed when there is an increase in Cronbach's alpha coefficient value of the total scale as that individual item was deleted.³⁴ In our study, although there was an increase in Cronbach's alpha coefficient of the total scale when each of the individual items was deleted (0.95 - 0.96), those increased values did not exceed the Cronbach's alpha coefficient of the total scale when all items were retained (0.96). Therefore, none of the items in the ABC scale was considered redundant.

To investigate the convergent validity, this study examined the relationship between the FES scale Thai version and the ABC scale Thai version. These two scales were developed based on the same construct (self-efficacy theory) and assessed similar types of daily activities.^{23,42} Thus, it was not surprising to observe a significant and moderate relationship ($r = 0.66$) between these two scales in our present study. In contrast, the relationship between the ABC Thai version score and the TUG score was poor ($r = -0.34$), although statistically significant. This could be due to differences in type, construct and purpose of these two scales. The ABC scale was the psychological based measurement for self-assessment of balance confidence²², whereas the TUG was the physical based measurement for assessing mobility, balance, walking ability, and fall risk in older adults.³² A person may perceive one's balance ability (through ABC scale) different from the actual balance performance when performing the TUG activity. This mismatch could lead to a poor relationship between the ABC scale Thai version and the TUG test. This finding, however, was not in accordance with the previous study where the correlation between the ABC scale and the TUG test was moderate ($r = 0.69$).⁴³ The differences may be due to difference in age group (older) and walking ability (TUG score = 16.00 ± 14.31 s) such that those with older age may be able to report their fear of falling more accurately than their younger counterpart.⁴³

We found no floor or ceiling effect of the ABC scale Thai version. In contrast, the FES scale Thai version showed a

substantial ceiling effect. This finding was consistent with the previous study that reported the ceiling effect of the FES scale in elderly persons who had a high level of physical function.²² This was due to the relatively easy activities in the FES scale, resulting in the limited use of the FES Thai version for assessing the balance confidence in Thai elderly who have a high level of physical function.

This study had some limitations. The tests of internal consistency reliability, convergent validity and floor/ceiling effect were performed in the elderly participants who lived in a rural community and were very active in daily activities. Future study should cover the elderly persons who live in the city and/or those who are frail. Further study may expand to evaluate other psychometric properties testing such as the predictive validity for future fall prediction.

In conclusion, the psychometric properties of the ABC scale Thai version were established with a high internal consistency reliability in elderly persons. The ABC scale Thai version had a good convergent validity as indicated by a strong relationship with the FES scale Thai version since both scales were similar in the purpose, type and construct. In addition, the ABC scale Thai version had no ceiling or floor effect, thus, it is more sensitive than the FES scale to be used in Thai elderly who have a high level of physical function.

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