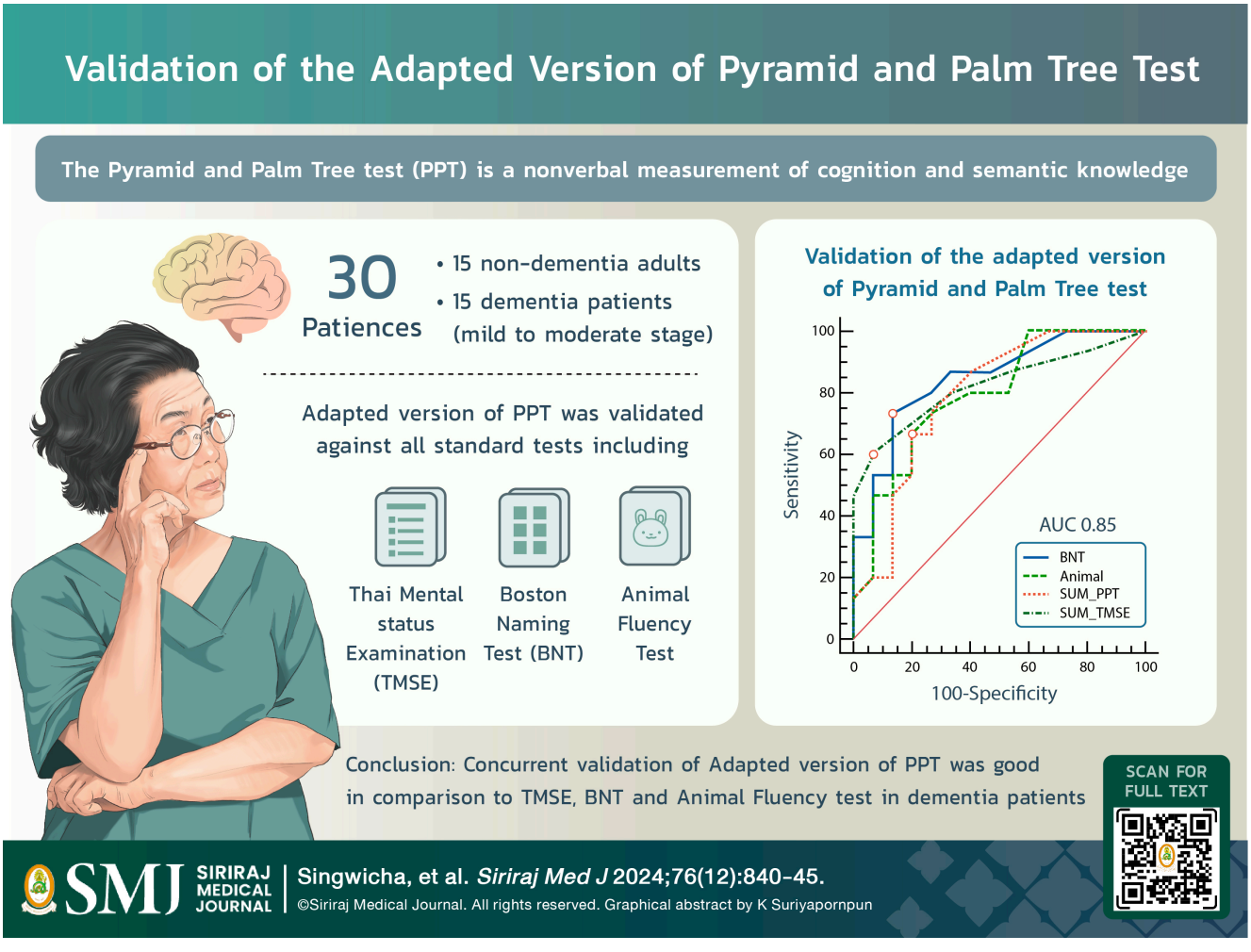
Validation of the Adapted Picture Version of the Pyramids and Palm Trees Test for Thais with Dementia

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ABSTRACT

Objective: We aimed to validate Pyramids and Palm Trees test (PPT) in dementia cohort and explore reliability measurement of this test.

Materials and Methods: The study was designed as a cross-sectional study. A total of 30 subjects were recruited from the Memory Clinic at Siriraj Hospital, Thailand: 15 non-dementia adults and 15 dementia patients (mild to moderate stage). In content validation, the picture version of the PPT was given to experts to evaluate the content of the test. According to consensus, some pictures with cultural issues were adapted to be more culturally appropriate. For concurrent validation, the PPT was compared against standard tests (Thai Mental Status Examination (TMSE), Boston Naming Test (BNT), Animal Fluency Test) using Spearman correlation and Receiver Operating Characteristic (ROC) analysis. The internal reliability of the PPT was assessed using Intraclass Correlation Coefficient (ICC) and Cronbach's Alpha.

Results: Among the 52 pictures in the PPT, 25 pictures were changed. The median score of the PPT was 49 for non-dementia group and 43 for dementia group. The PPT was significantly correlated with the Animal Fluency Test, the BNT, and the TMSE. ROC analysis revealed an Area Under the Curve (AUC) of 0.8. ICC was 0.86 (95% CI, 0.78 to 0.92), and internal consistency was 0.87, indicating good to satisfactory reliability.

Conclusions: The PPT demonstrated good concurrent validity compared to the TMSE, BNT, and Animal Fluency Test in dementia patients. Based on this study, it is recommended as a test for semantic memory in Thai individuals with dementia.

Keywords: Dementia; semantic memory; neuropsychiatric testing; pyramids and palm trees test (Siriraj Med J 2024; 76: 840-845)

INTRODUCTION

Similar to many other countries, the aging society in Thailand has become an important issue. The diseases that come from cognitive degeneration, such as Alzheimer's dementia, and Parkinson's, will be increasingly encountered. Such neurodegenerative diseases involve physical symptoms and a decrease in patient cognition. In the course of the diseases, they will impact the cognitive memory domain. Some patients will find themselves having problems in their language abilities, such as effortful speech, word-finding difficulty, or low speech production. These effects will decrease their quality of life.[1] Abnormalities in language are found in Alzheimer's disease, frontotemporal dementia, corticobasal degeneration, and vascular pathology. These conditions can lead to primary progressive aphasia (PPA).[2,3] The 3 variants of PPA are semantic variant PPA (svPPA), logopenic variant PPA (lvPPA), and nonfluent variant PPA (nfvPPA). Determining the cause of pathology, physical examination followed by neuropsychological testing is essential.

Semantic knowledge encompasses the general knowledge and features that form the concepts people acquire from their experiences.[4] These experiences culminate in memories related to people, places, and the meaning of words. This semantic memory is a component of declarative memory and can be retrieved from the anterior temporal lobe.[5,6] The most common neuropsychological tests to measure semantic memory are naming tests, verbal fluency tests for category and letter fluency, and the Pyramids and Palm Trees (PPT) test.

The PPT test is a nonverbal measurement of cognition and semantic knowledge. The test is available in both word and picture modalities to assess verbal and nonverbal semantic memory, respectively. It was designed by Howard and Patterson in 1992 and standardized in England.[7] Since then, it has been used across Europe. Nevertheless, applying the picture version of the test in other countries may have limitations due to cultural and education issues related to the pictures. Several studies have used the PPT test to investigate semantic memory in their population to establish normative data. The Spanish population's formal education level correlated with the PPT test results.[8] Similarly, an investigation of a Chinese population showed that schooling affected test performance.[9]

In Asian countries, including Thailand, the PPT test has not been used due to cultural issues related to the test pictures. This study aimed (1) to validate a Thai adaptation of the picture version of the PPT test with 2 standard tests—the Boston Naming Test (BNT) and the Verbal Fluency (VF) test—in a dementia cohort and (2) to explore its reliability in the Thai population.

MATERIALS AND METHODS

A cross-sectional study design was used. A total of 30 eligible participants were recruited from the Memory Clinic of Siriraj Hospital, Thailand. Participants were separated into 2 groups. There were 15 healthy subjects (the "non-dementia group") and 15 subjects with mild to moderate stages of Alzheimer's disease according to DSM-5 criteria and NIA-AA criteria of Alzheimer's disease dementia[13,14] which requires objective cognitive decline that is severe enough to interfere with activities daily living and decline of neuropsychiatric testing more than 2 standard deviation (the "dementia group"). Different inclusion criteria were applied to each group. In the case of the non-dementia group, the participants were (1) aged between 50 and 80, (2) did not have underlying diseases related to memory or language problems, and (3) could communicate in Thai. In the dementia group, the criteria were (1) aged between 50 and 80; (2) a mild to moderate stage of Alzheimer's disease (defined as a Thai Mental State Examination [TMSE] score of 10–23); and (3) capable of communicating in Thai. In both groups, the participants' levels of education were divided into under 12 years and over 12 years of formal education.

The picture version of the PPT test consists of 55 sets of pictures. The first 3 sets are examples used to instruct participants on the test, while the remaining 52 sets are the test stimuli. Each set comprises 3 pictures that are presented on a display board. One, the "stimulus," is positioned in the upper half of the board; the other 2 pictures (1 "target" and 1 "distractor") are in the lower half. Participants are requested to select the lower-level picture that they consider to be more relevant to the stimulus. The maximum test score is 52, and the median score for normal cognition is 49.

An expert panel evaluated the content of the picture version of the PPT test used in English-speaking cultures to develop content for a Thai adaptation. Six experts (2 neurologists and 4 psychiatrists) agreed that 25 of the 55 picture sets needed to be replaced by ones more appropriate to Thailand (Supplementary Table A). For instance, it was decided to replace a picture of an Eskimo and igloo with one of a farmer and hut. Similarly, a picture of a shepherd's cane and sheep was substituted with a picture of a herding stick and buffalo. Additionally, minor changes were made to some pictures, such as using a Thai bus ticket instead of a London bus ticket. Some picture images were also sharpened (eg, one of a star and the moon and another of a pillow with a wrinkle). A pilot study was performed on 6 adults of various ages and education levels. The final, Thai-oriented version was then used in this study.

The proposed Thai adaptation of the PPT test was validated with 2 tests that correlate with semantic knowledge: the VF test (both category and letter fluency) and the BNT. To establish a baseline, the TMSE was first administered to all participants. Those scoring less than 24 on the TMSE were assigned to the dementia group. At the same visit as the TMSE, the dementia group was assessed using the Thai adaptation of the PPT test, the VF test, and the BNT. All tests were administered to the participants by 2 certificated psychiatrist assessors by using papers of pictures. The administration of the 3 tests took 45 to 50 minutes.

Statistical analysis

Statistical analyses were conducted with PASW Statistics for Windows, version 18.0 (SPSS Inc, Chicago, IL, USA). Continuous data (age) are summarized using descriptive statistics (the mean ± standard deviation). Categorical variables (sex, education, and underlying diseases) are summarized using numbers (percentages).

Pearson's correlation coefficients were used to determine the validity of the Thai adaptation of the PPT test in both healthy and dementia patients, with statistical significance indicated by probability (P) values < 0.05 ($P < 0.050$). Spearman's rank correlation coefficient was used to perform concurrent validation[12] of the PPT test against the other instruments (TMSE, BNT, and VF). We also used Cronbach's alpha and intraclass correlation coefficients by using 95% confidence intervals to indicate the internal consistency of the proposed PPT test. A receiver operating characteristic (ROC) curve analysis was performed, with the area under the curve (AUC) indicating the reliability of the PPT test compared with the 3 standard tests. An AUC of 0.7 to 0.8 signified (fair reliability, while 0.8 to 0.9 indicated good reliability and 0.9 to 1.0 denoted excellent reliability.

RESULTS

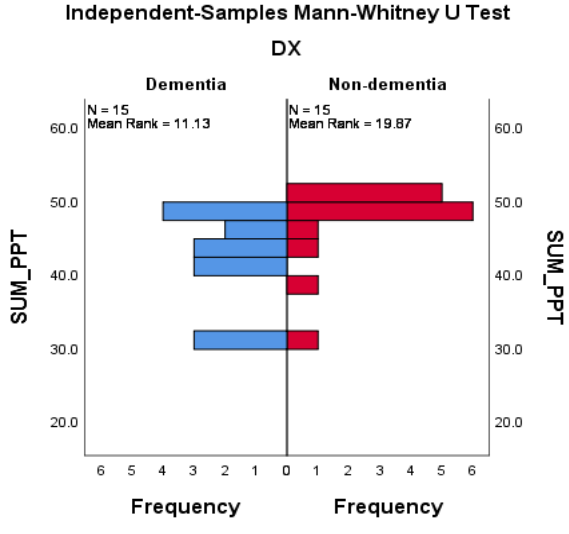
The 30 participants in the non-dementia and dementia groups had no significant differences in their baseline demographic characteristics (age, sex, education level, and underlying diseases; Table 1). However, the 2 groups had significant differences in their mean scores for all instruments (proposed PPT, TMSE, BNT, and VF; Table 2). The mean scores ± SD of the non-dementia and dementia groups were 46.93 ± 5.38 and 42.43 ± 6.27, respectively ($P = 0.044$). A Mann–Whitney U test determined that the median PPT test score was 49 for the non-dementia group and 43 for the dementia subjects ($P = 0.006$; Fig 1).

TABLE 1. Demographic characteristic.

	Non-dementia (N=15)	Dementia (N=15)	P-value
Sex			0.456
Male, n (%)	7(46.7)	5(33.3)	
Female, n (%)	8(53.3)	10(66.7)	
Age (mean ± SD)	65.47±8.58	72.0±10.92	0.790
Education (year), n (%)			0.713
≤ 12	9(60)	8(53.3)	
> 12	6(40)	7(46.7)	
Underlying disease, n (%)			
Hypertension	2(13.3)	5(33.3)	0.195
Dyslipidemia	7(46.7)	10(66.7)	0.269
Diabetes Mellitus	5(33.3)	9(60)	0.143
Atrial Fibrillation	2(13.3)	5(33.3)	0.195
Chronic Kidney Disease	0	1(6.7)	0.309
Others	0	1(6.7)	0.309

TABLE 2. Comparison between non-dementia and dementia group in all tests.

	Non-dementia (N=15) (Mean ± SD)	Dementia (N=15) (Mean ± SD)	P-value
Pyramid and palm	46.93±5.38	42.43±6.27	0.044
TMSE	28.27±1.28	24.33±4.25	0.002
Boston Naming Test	27.13±2.94	21.13±5.47	0.001
Verbal Fluency	20.60±5.73	14.00±5.33	0.003



Diagnosis	Sum PPT		p-value[a]
	Median	(IQR)	
Dementia	43	(42.0-47.5)	0.006
Non-dementia	49	(46.5-50.0)	

[a]Mann-Whitney U test

Fig 1. Median score of PPT test.

The 2 participant groups were combined to evaluate the correlation of the PPT test with the 3 standard tests for all patient types. Spearman's rank correlation coefficient was used to compare the PPT test with the other instruments. The PPT test was most correlated with the VF test (r = 0.652; $P < 0.001$), followed by the BNT (r = 0.641; $P < 0.001$), and last, the TMSE (r = 0.482; $P = 0.007$). Although the PPT test score also correlated with education level (r = 0.491, $P = 0.006$; Table 3), there was no correlation with age or sex.

Regarding the reliability of the test, an ROC analysis was performed to determine the AUC and make comparisons with the TMSE, BNT, and VF. The results showed that the proposed PPT test had an AUC of 0.85, the highest of the AUC values of the 4 instruments (Fig 2).

For the test's internal consistency, the intraclass correlation coefficient ($ICC_{3,k}$) was 0.86 (95% CI, 0.78-0.92), and Cronbach's alpha coefficient was 0.87.

DISCUSSION

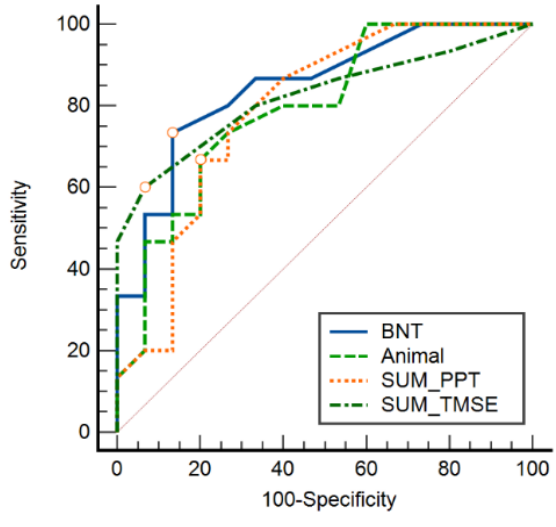
Several previous studies have been undertaken in various countries to determine the validity and reliability of the PPT test. Due to some cultural issues, normative data of a healthy population must be obtained before the test can be used with patients with dementia.

In Thailand, many tests are routinely used to evaluate multiple domains of cognition. In the case of the language domain, several tests are employed. The TMSE is a baseline test used to evaluate multiple domains for screening purposes, and it is administered to all patients

TABLE 3. Correlation of PPT with other tests.

Variables	Correlation coefficient	PPT	TMSE	BNT	Animal Fluency	Education
PPT	Spearman's Rho[a]	1				
	p-value	NA				
TMSE	Spearman's Rho[a]	0.482**	1			
	p-value	0.007	NA			
BNT	Spearman's Rho[a]	0.641**	0.583**	1		
	p-value	<0.001	0.001	NA		
Verbal Fluency	Spearman's Rho[a]	0.652**	0.650**	0.594**	1	
	p-value	<0.001	<0.001	0.001	NA	
Education	Spearman's Rho[a]	0.491**	0.455*	0.529**	0.585**	1
	p-value	0.006	0.012	0.003	0.001	NA

* Correlation is significant at the 0.05 level (2-tailed)., ** Correlation is significant at the 0.01 level (2-tailed).
[a] Spearman's rank correlation coefficient



Test	AUC
Boston Naming Test	0.071
Verbal Fluency	0.082
PPT	0.085
TMSE	0.080

Fig 2. Comparison of AUC of tests.

requiring neuropsychiatric assessment. Two tests that are more focused on language use are the BNT and the VF test (category and letter fluency). With the VF test, patients are given 1 minute to produce as many words as possible that either name animals (category fluency) or start with a given letter (letter fluency). The VF test can therefore be used to assess both language and executive functioning.

This study found that the proposed Thai adaptation of the picture version of the PPT test had a good correlation with other language tests and was highly correlated with the VF test ($r = 0.652$; $P < 0.001$). The adaptation also had a high ROC value, and the median scores for the Thai nondementia and dementia subjects were significantly different ($P = 0.006$). Additionally, the median PPT test score for the Thai patients without dementia was 49, which corresponds with the median score for the picture version used in English-speaking cultures. Furthermore, both the intraclass correlation and the internal consistency results were good to satisfactory (exceeding 0.8). Taken together, these results indicate that the proposed Thai adaptation is suitable for discriminating between dementia and non-dementia.

On the other hand, our investigation found an educational dependency in that participants' level of education (less than 12 years) was significantly associated with performance on the test. This finding is consistent with Guo and associates[9], whose investigation revealed that education level correlated with PPT test results in a Chinese population. Regarding age and sex, our research found no significant differences. Although these findings are consistent with Mehri[8], they conflict with the results of a study by Callahan and colleagues[10] on a Quebec-French population.

A limitation of this study is the size of the sample population. The small number of participants means that the findings may not be generalizable to the whole Thai population. It is recommended that further research should recruit a much larger sample.

CONCLUSION

The concurrent validation of the Thai adaptation of the picture version of the PPT test was good compared with the VF test, TMSE, and BNT in patients with dementia. Based on our investigation results, the Thai version of the PPT test can be employed as a test of semantic memory in Thais with dementia.

DECLARATION

Grants and Funding Information

This project is not funded by any external sources.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Author Contributions - none

VS and CR were responsible for the conceptualization. DS ,VS and CR handled the methodology. AR, SC, PD and NW performed data collection. SH carried out the formal analysis. VS and CR reviewed and edited the manuscript. VS supervised the project.

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