Original Article

The Correlation of Thai Mental State Examination (TMSE) and Montreal Cognitive Assessment (MoCA) and Conversion Table

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Background: Thai Mental State Examination (TMSE) and Montreal Cognitive Assessment-Thai version (MoCA) are commonly used cognitive tests in Thailand.

Objective: To look for the correlation of TMSE and MoCA scores and develop the conversion table between TMSE and MoCA.

Materials and Methods: TMSE and MoCA done on the same day were retrospectively studied. The relationship between TMSE and MoCA was analyzed and a TMSE-MoCA conversion table was developed.

Results: There were 183 TMSE and MoCA studies, which were performed in 27 subjects with normal cognitions, 64 with mild cognitive impairment (MCI) and 92 with dementia. Correlation between TMSE and MoCA was analyzed and a TMSE-MoCA conversion table was developed. Using linear regression model, TMSE and MoCA could be presented as the following formula: TMSE = 11.87+0.7 MoCA.

Conclusion: In cognitive assessment in subjects with MCI, MoCA was superior to TMSE. The TMSE-MoCA conversion table was developed to facilitate smooth transition between these scores.

Keywords: Thai mental state examination, Montreal cognitive assessment, Dementia

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Prevalence of dementia increases with age and has been expanding rapidly, particularly in countries with low and middle income[1]. In Thailand, the prevalence of dementia was reported at 1.8 to 9.9%[2-5]. Tools or tests to evaluate or screen global cognitive function are important as a necessary part in the diagnosis of dementia. The Mini-Mental State Examination (MMSE) is the most widely applied test for dementia screening. However, the MMSE has poor sensitivity in diagnosis of early dementia and is under copyright restrictions which limit its routine use in clinical and research settings. The Montreal Cognitive Assessment (MoCA) has been designed to improve sensitivity for detecting mild cognitive impairment (MCI)[6]. Several studies have been done to correlate MMSE and MoCA scores and MMSE-MoCA conversion tables have been created and validated[7-9].

The Thai Mental State Examination (TMSE) was developed in 1993 and has been widely used in Thailand to screen cognitive impairment and dementia[10]. The TMSE was studied in a large number of Thai population[11]. Montreal Cognitive Assessment-Thai version (MoCA) is increasingly used in Thailand. The MoCA was validated in screening for amnestic MCI and Alzheimer's disease[12]. The MoCA contains more executive tasks, complex visuospatial processing and tests higher-level language abilities as compared to TMSE (Table 1). A reliable conversion table between TMSE and MoCA is needed to ensure continuity in various setting and facilitate smooth transition between TMSE and MoCA scores. The purpose of the present study is to develop the conversion table between TMSE and MoCA.

Materials and Methods

The present study was a part of the Multicenter Dementia Registry research. TMSE and MoCA done on the

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same day were retrospectively included. Subjects who had cognitive assessment were sent from neurology and psychiatric clinics. MOCA were used to evaluate cognitive function, with the cutoff point of 24/25 of MOCA to define cognitive impairment/normal cognition[12]. If the patients had cognitive impairment, they were sent to be evaluated for the activities of daily living, using the disability assessment for dementia-Thai version (DAD-T). Mild cognitive impairment (MCI) was diagnosed if the patients had cognitive impairment, but it did not cause deficits in activities of daily living. Dementia was diagnosed by trained neurologists, psychiatrists and geriatrists, using standard criteria[13-16]. Each TMSE and MoCA was reviewed. Demographic data, TMSE and MoCA scores were described using frequencies, mean and standard deviation (SD). The relationship between TMSE and MoCA was illustrated using scatterplot with linear prediction and Pearson's correlation. Linear regression analysis was performed to develop a score conversion of TMSE from MoCA. The conversion table was demonstrated from the linear regression formula, and the scores of TMSE from the formula were rounded up/down to the nearest numbers. In order to examine the differences between the diagnoses, the authors split the data in two subgroups: Alzheimer's disease (AD) and non-Alzheimer's disease (vascular dementia, mixed dementia and frontotemporal dementia). The authors used a linear model to statistically compare the difference between the Alzheimer's disease and non-Alzheimer's disease subgroups' curves. All analyses were carried out in STATA version 14.0. The study was approved by the ethical review committee of Faculty of Medicine, Thammasat University.

Results

There were 183 TMSE and MoCA studies, which were performed in 27 subjects with normal cognition, 64 with mild cognitive impairment (MCI) and 92 with dementia; comprising AD 50 (54%), vascular dementia 26 (28%), mixed AD and vascular dementia 6 (7%), and other dementia 10 (11%). Demographic data was presented in Table 2. Subjects with normal cognition were younger and had higher education than those with impaired cognition. Correlation between TMSE and MoCA scores were presented in Figure 1. TMSE-MoCA conversion formulation (TMSE = 11.87+0.7 MoCA), and a table was developed (Table 3). In subgroup analysis of

Table 1. Comparison of TMSE and MOCA in terms of the studied areas of cognition and scoring

Cognitive function	TMSE (Total = 30 points)	MOCA (Total = 30 points)
Orientation	6 items of questions (6 points)	6 items of questions (6 points)
Memory		
Registration	3 words (3 points)	5 words (no points)
Delayed Recall	3 words (3 points)	5 words (5 points)
Attention	Day in a week backward 5 tasks (5 points)	Digit forward, backward 2 tasks (2 points) Tapping with hand at number 11 tasks (1 point)
Language		
Subtraction (100-7)	3 tasks (3 points)	5 tasks (3 points)
Naming	2 tasks (2 points)	3 tasks (3 points)
Verbal fluency	-	1 task (1 point)
Sentence repetition	1 sentence (1 point)	2 sentences (2 points)
3-order command	3 tasks (3 points)	-
Reading	1 word (1 point)	-
Abstract thinking	1 task (1 point)	2 tasks (2 points)
Visuospatial/executive		
Copy figure	1 task (2 points)	1 task (1 point)
Alternating trail making	-	1 task (1 point)
Clock drawing test	-	1 task (3 points)

Table 2. Demographic characteristics

	Normal cognition (n = 27)	Mild cognitive impairment (n = 64)	Dementia (n = 92)	*p*-value
Gender: male	13 (48%)	35 (54.7%)	31 (33.7%)	0.051
Mean age (SD) (years)	61 (8.0)	68.4 (9.6)	75.4 (10.5)	<0.001
Education (SD) (years)	15.5 (3.8)	9.8 (4.1)	7.5 (4)	<0.001
Mean TMSE (SD)	29.1 (0.9)	26.2 (2.2)	19.5 (5.6)	<0.001
Mean MOCA (SD)	27 (1.8)	19.3 (3.3)	10.9 (5)	<0.001

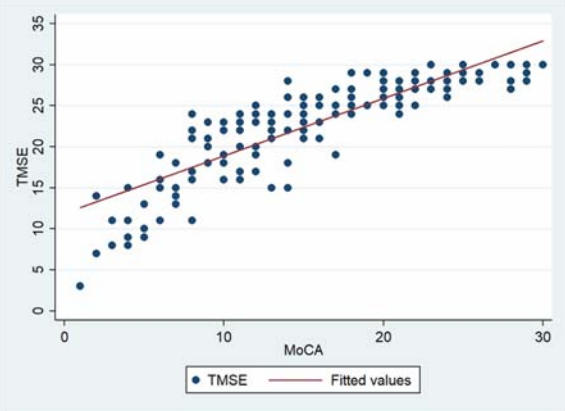

Figure 1. Correlation between TMSE and MoCA (scatter plot).

patients with dementia, the difference of the gap between TMSE and MoCA scores were wider in those with non-AD dementia. This difference could be presented as the following formula: TMSE = 8.43+0.99 MoCA in the subgroup with AD and TMSE = 9.98+0.9 MoCA in the subgroup of non-AD dementia using linear regression formula.

Discussion

Higher scores on TMSE as compared to MoCA in each individual were found which was consistent with the results from other studies comparing MMSE and MoCA. The difference between the scores of MMSE and MoCA was even larger in those with more severe dementia or lower MoCA scores. Bergeron et al showed that when predicting MMSE from the MoCA in a new patient, the 95% CI spans 6.0 MMSE points on average (4.7 when MoCA ≥20 and 8.8 when MoCA <20)[7]. The present study showed that MoCA scores were lower than predicted by TMSE, with a wider difference in lower MoCA (approximately 5 to 8 points lower on TMSE when MoCA was 12 to 24, and 9 to 12 points lower on TMSE, when MoCA was ≤11).

With the concept of the continuity of the disease, individual with MCI may be in the pre-dementia state and MMSE has a poor sensitivity (18%) to detect MCI. MoCA was developed to be a tool to better detect MCI with the sensitivity of 90%[6]. MoCA has been translated and validated in many language versions. Tangwongchai et al validated the Thai version of MoCA and showed that with the cut off score under 25, the sensitivity and specificity were 0.70 and 0.95 for diagnosis of amnestic MCI and with the cut off score under 18, the sensitivity and specificity were 0.80 and 0.95 for diagnosis of AD[12]. For the TMSE, the suggested cut off score to determine cognitive impairment is 23 out of 30[10]. Thus if using the TMSE cut off score, MCI could be missed because the MoCA score of 24 was equivalent to the predicted TMSE score of 29 from the present study.

In most MMSE-MoCA conversion studies, in the subgroup of patients with dementia were those diagnosed with Alzheimer's disease (AD) and in some studies included only AD patients. Whether these tables could be accurately applied to predict the scores in other types of dementia was still questionable. However, recently, there were more studies investigating the MMSE-MoCA correlation in other types of dementia, such as Parkinson's disease dementia. The major impaired cognitive domain in AD is memory, whereas in other dementia subtypes such as vascular dementia, and Parkinson's disease dementia, the impaired cognitive domain is primarily executive/visuospatial function, sometimes referred to as dysexecutive syndrome[7]. One study showed that patients with dysexecutive syndrome had a trend towards higher MMSE scores than AD patients for a given MoCA score[7], while another study did not reveal any difference[9]. The present study showed a slightly higher score of TMSE in patients with non-AD dementia. A higher TMSE/MMSE than predicted from the MoCA might be explained by the fact that the MoCA contains more executive and complex visuospatial tasks, and also weights on these tasks are in higher proportion as compared to TMSE/MMSE. Therefore, the patients with a dysexecutive syndrome can get lower

Table 3. TMSE-MOCA conversion table

MoCA	TMSE
0	12
1	13
2	13
3	14
4	15
5	15
6	16
7	17
8	17
9	18
10	19
11	20
12	20
13	21
14	22
15	22
16	23
17	24
18	24
19	25
20	26
21	27
22	27
23	28
24	29
25	29
26	30
27	30
28	30
29	30
30	30

Weighted Kappa: agreement 91.64%, Kappa 0.67
p<0.001

scores on MoCA with a relatively preserved MMSE score[7].

The present study had some limitations. First, the number of patients with severe cognitive impairment was relatively low. Therefore, the interpretation of conversion of the lower scores should be done with caution, particular in those with MoCA less than 10. Second, there were significant differences in demographic data on each group of subjects from different cognitive status, such as lower education, and younger age in subjects with normal cognition. This might limit the application in patients with dementia, if the demographic data of the patients was different from the study. However, this is the first study about TMSE-MoCA conversion, which will help in the longitudinal assessment of the cognitive function in clinical and research settings.

Conclusion and Recommendation

In cognitive assessment in subjects with MCI, MoCA was superior to TMSE. A TMSE-MoCA conversion table was developed to facilitate smooth transition of the scores between these tests.

What is already known on this topic?

TMSE and MoCA are commonly used cognitive tests in Thailand. Both of them were validated and the normal data was published.

What this study adds?

There was no study investigating the correlation between TMSE and MoCA-Thai version before. This is the first study which analyzes the correlation of the TMSE and MoCA score, and a conversion table is developed. This will allow smooth transition of the scores between these cognitive tests in clinical practice and research.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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การศึกษาความสัมพันธ์ของคะแนน Thai Mental State Examination (TMSE) และ Montreal Cognitive Assessment (MoCA) และตารางแสดงความสัมพันธ์

พรภัทร ธรรมสโรช, ธรรมนาถ เจริญบุญ, จินตนา อาศนะเสน, จรุงไทย เดชเทวพร, ชนินทร์ ลิ่มวงศ์, กัมมันต์ พันธุมจินดา

ภูมิหลัง: แบบทดสอบ Thai Mental State Examination (TMSE) และ Montreal Cognitive Assessment (MoCA) เป็นแบบทดสอบปริชานปัญญาที่ใช้บ่อยในประเทศไทย

วัตถุประสงค์: เพื่อศึกษาความสัมพันธ์ของคะแนนที่ได้จากการทดสอบ TMSE และ MoCA ร่วมกับสร้างตารางการปรับเปลี่ยนคะแนนของทั้งสองแบบทดสอบ

วัสดุและวิธีการ: แบบทดสอบ TMSE และ MoCA ที่ทำในผู้ป่วยหรือผู้ที่ได้รับการตรวจทั้งสองแบบทดสอบในวันเดียวกันจะถูกนำมาศึกษา ความสัมพันธ์ของคะแนน TMSE และ MoCA ถูกวิเคราะห์ด้วยวิธีทางสถิติ โดยได้สูตรและตารางแสดงถึงความสัมพันธ์ของคะแนนทั้งสองแบบทดสอบ

ผลการศึกษา: 183 แบบทดสอบ TMSE และ MoCA ได้รับการศึกษาและวิเคราะห์ โดยแบบทดสอบดังกล่าว ใช้ทดสอบในคนที่มีปริชานปัญญาปกติ 27 ราย คนที่มีปริชานปัญญาผิดปกติ 64 ราย และในผู้ป่วยสมองเสื่อม 92 ราย พบว่าคะแนนที่ได้จากแบบทดสอบ TMSE มากกว่า MoCA โดยความสัมพันธ์ของ TMSE, MoCA สามารถแสดงได้ดังนี้ TMSE = 11.87+0.7 MoCA

สรุป: ในการประเมินปริชานปัญญาพบว่าแบบทดสอบ MoCA มีประโยชน์ในการวินิจฉัยปริชานปัญญาผิดปกติระยะแรกเหนือกว่า ตารางความสัมพันธ์ของคะแนนจากแบบทดสอบ TMSE ความสัมพันธ์กับ MoCA ได้รับการสร้าง