The Correlation between the Montreal Cognitive Assessment (MoCA) and the Rowland Universal Dementia Assessment Scale (RUDAS) for the Detection of Mild Neurocognitive Disorder among Older Patients in an Outpatient Setting

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Objective: To demonstrate the correlation and develop conversion scores between the Montreal Cognitive Assessment (MoCA) and Rowland Universal Dementia Assessment Scale (RUDAS) in patients with mild neurocognitive disorder (NCD).

Materials and Methods: A cross-sectional study of outpatients aged ≥60 years of the general geriatric clinic of Ramathibodi Hospital, Thailand between February 2020 and March 2021 was conducted. Baseline information was collected, and the MoCA and RUDAS were administered to each patient by a clinical psychologist. Subsequently, geriatricians assessed each patient for mild NCD according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders-5.

Results: A total of 156 patients were recruited and mild NCD was identified in 117 patients (75%). The Pearson correlation coefficient between the tests was 0.4 (p<0.00). The RUDAS-MoCA conversion score was developed where age and educational level were the independent factors associated with those tests. A conversion formulation was MoCA=5.91-1.61(age)-1.51(years of education)+0.61(RUDAS score); where age <70 years scores 0 and age 70 years or over scores 1, and 6 years of education or lower scores 0 and more than 6 years of education scores 1.

Conclusion: The RUDAS and MOCA had a positive correlation, and the conversion table was developed to simplify the smooth transition of the scores in patients with mild NCD.

Keywords: Cognitive assessment; Cognitive disorders; Cognitive screening; Mild cognitive impairment

Mild neurocognitive disorder (NCD) is an early stage of cognitive ability loss, it is the phase between normal cognitive decline with aging and dementia. There are several causes of mild NCD. Some of them can be treatable or even preventable such as medications, psychiatric diseases, systemic conditions, and neurological diseases[1-4]. The individual with mild NCD can reverse to normal aging,

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steady, or develop dementia[5-8]. The annual progression rate from mild NCD to dementia is about 5 to 17%[2,5,8,9]. It is found in about 6.7 to 25.2% of older adults and the prevalence is higher in advancing age, lower education, and more effects in men than women[1-4]. However, one meta-analysis and systematic review in community-dwelling Chinese populations aged over 55 years reported a pooled prevalence of 12.2% and risk factors were women, rural inhabitants, individuals who lived alone, and low education level[10]. Diagnosis of mild NCD is crucial as some causes can be treatable and once when the patients develop dementia, symptomatic treatment, and behavioral intervention are the main principle in management in the majority of the cases[11]. Thus, early recognition of this condition and applying potential interventions might prevent or delay the onset of dementia and consequently diminish adverse health outcomes of dementia[12].

The Montreal Cognitive Assessment (MoCA) is the most recommended screening tool for mild NCD[13] with the

sensitivity and specificity of 80.5% and 81.2% at a cut-off score below 25[14] and 80 to 100% and 50 to 76% at the cut-off score below 26[4]. Factors related to the test performance are educational level, lifestyle, and cultural background[15,16]. In Thailand, the MoCA is the only bedside screening tool for mild NCD according to the Thai dementia guideline 2020[17]. However, the Rowland Universal Dementia Assessment Scale (RUDAS) had been recently validated in patients with mild NCD with a sensitivity of 78.7% and specificity of 61.8%, respectively (the area under the Receiver operating characteristic (ROC) curve was 0.82). Educational level does affect its performance but not for age and gender[18]. The MoCA were positively correlated to the RUDAS[19,20] and both tools were linked to functional independence measures at discharge destination among geriatric patients in a multicultural rehabilitation setting[20]. Since the MoCA rather consumes time to administer than other cognitive screening tools like the Mini-mental state examination (MMSE) or RUDAS[21,22], the RUDAS might be an option screening tool in clinical practice. The development of conversion scores between the MoCA and the RUDAS is likely to be valuable for physicians. It is beneficial not only for cognitive tracking continuously but also for the comparison and incorporation of cognitive information from various studies. Therefore, the present study aimed to determine the correlation between the MoCA and the RUDAS in geriatric patients with mild NCD and validate the conversion score between those tools.

Materials and Methods
Population and setting

This was a cross-sectional study that was conducted at the general geriatric clinic of Ramathibodi Hospital, Mahidol University, Thailand between February 2020 and March 2021. Participants were patients who were older patients aged 60 years old or over by Thai definition without evident acute illness that can contribute to the performance of the Thai version of RUDAS and the MoCA and were referred from geriatric family medicine and geriatric medicine physicians for cognitive assessment. Exclusion criteria were patients with long-term use of antipsychotic drugs; patients with severe visual, hearing, or limb dysfunction; patients with depressed mood determined by the Thai version of the Patient Health Questionaire-9 (PHQ-9) >9[23]; patients with impaired instrumental activities of daily living (iADLs) determined by the Chula ADL index <9[24]; patients who were unable to communicate with Thai or the local language, and the ones who were reluctant to complete the tests (Figure 1).

Operational definition

Mild neurocognitive disorder (mild NCD): Mild NCD is diagnosed according to the Diagnostic and Statistical
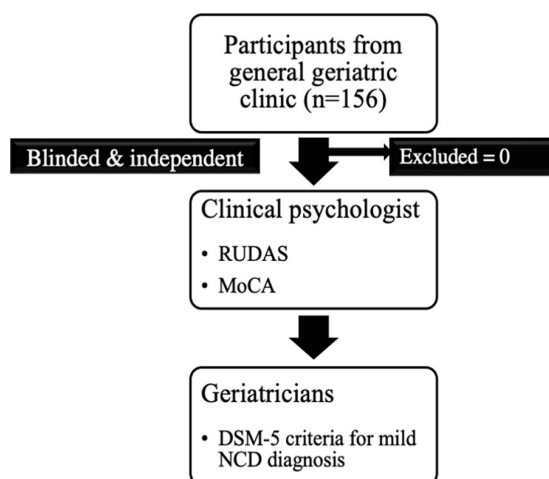

Figure 1. Study flow of the present study.

DSM-5=Diagnostic and Statistical Manual of Mental Disorders; Mild NCD=mild neurocognitive disorder; RUDAS=Rowland Universal Dementia Assessment Scale; MoCA=Montreal Cognitive Assessment

Manual of Mental Disorders (DSM-5) criteria which include: 1) Evidence of modest cognitive decline from a former level of performance in at least one cognitive domain, 2) The cognitive impairment does not interfere with the daily activities, 3) The cognitive impairment is not better explained by delirium or other mental disorder[25].

Neuropsychological assessment

Montreal Cognitive Assessment (MoCA): The MoCA is a cognitive screening test that measured multiple cognitive functions including orientation, memory, attention, language, abstract thinking, visuospatial abilities, and executive function. The maximum score is 30 and the lowest score is 0, with a higher score reflecting higher cognitive performance. For the MoCA-Thai in detecting mild NCD, at the cut-off score below 25, it showed sensitivity and specificity of 80% and 80%, respectively where adding one point to the score of individuals with 6 or fewer years of education to correct for education effects[26].

Rowland Universal Dementia Assessment Scale (RUDAS): The RUDAS was a brief cognitive test that was developed in a multicultural setting in Australia. There are six items including attention, memory, praxis, visuoconstruction, language, and visuospatial abilities[27,28]. Its scores range from 0 to 30 points, with a greater score representing greater cognitive performance. The points 24 to 25/30 are used to detect mild NCD in patients with six years of education or lower (sensitivity of 85.7% and specificity of 61.8%), and 25 to 26/30 in patients with more than 6 years of education (sensitivity of 71.4% and specificity of 68.9%[18]. The scores over these cut-off points were considered normal cognitive function.

Procedure

The present study was approved by the ethics committee of the Faculty of Medicine, Mahidol University (COA. MURA2020/921 Ref.899) with respect to the Helsinki Declaration, and all participants provided written informed consent before conducting the project.

Demographic information of the participants using convenience sampling was collected which were age, gender, years of education, marital status, and comorbid condition. Then, the clinical psychologist administered the RUDAS-Thai (about 10 minutes) and the MoCA-Thai (about 10 to 15 minutes) in random order. Subsequently, minor NCD was assessed by the two geriatricians according to DSM-5 criteria on the same day. The clinical psychologist and geriatricians were blinded to the results of each other. The role of geriatricians' diagnosis was only to rule out dementia and did not affect the analysis in the present study.

Sample size calculation

The sample size was calculated based on the aim of the present study. The total sample size was determined using an alpha of 0.05, a beta of 0.2 and an r (the expected correlation coefficient) of 0.2. Therefore, the required population was 153. The present study included 156 patients[29].

Statistical analysis

Descriptive statistics were used for the demographic variables. The frequency and percentage of categorical variables were reported whereas mean and standard deviation (SD) were used for continuous variables. The relationship between the RUDAS and MoCA scores (using raw scores without adjusting for educational level) was demonstrated using a scatter plot with linear prediction and Pearson's correlation. Linear regression analysis was used to develop a score conversion of MoCA from RUDAS presenting as the linear regression formula. Then, the conversion table was demonstrated. Listwise deletion was used for handling missing data. All data analyses were performed by using STATA version 10.0 (StataCorp, College Station, TX, USA) (Table 1).

Results

Baseline clinical and sociodemographic data are shown in Table 2. There were 156 participants recruited in the present study and 75% of them (117/156 cases) had mild NCD. Age, gender, and marital status was similar between the normal cognition and mild NCD group. The mean MoCA and RUDAS scores were lower in the mild NCD group.

Correlation of MoCA and RUDAS score in mild NCD patients

There was a moderately positive correlation between MoCA and RUDAS scores with a Pearson correlation coefficient of 0.4 ($p<0.00$) (Figure 2).

RUDAS-MOCA conversion table

A linear regression analysis was performed to develop a score conversion of the MoCA from the RUDAS

Table 1. Comparison of MoCA and RUDAS in the areas of cognitive domain assessment and scoring

Cognitive domains	MoCA (total scores = 30)	RUDAS (total scores = 30)
Orientation	6 items of question (6 points)	-
Memory		
Registration	5 words (no point)	4 words (no point)
Delayed recall	5 words (5 points)	4 words (8 points)
Attention		
Digit forward, backward	2 tasks (2 points)	-
Tapping with a hand at numbers	11 tasks (1 point)	-
Language		
Subtraction	5 tasks (3 points)	-
Naming	3 tasks (3 points)	1 task (8 points)
Verbal fluency	1 task (1 point)	-
Sentence repetition	2 sentences (2 points)	-
Abstract thinking/judgement	2 tasks (2 points)	1 task (4 points)
Perceptual motor/executive		
Copy figure	1 task (1 point)	1 task (3 points)
Alternating trail making	1 task (1 point)	-
Clock drawing test	1 task (3 points)	-
Visuospatial orientation	-	8 tasks (5 points)
Praxis	-	1 task (2 points)

Table 2. Baseline data of studied population

Variables	Normal cognition, n=39 (25%)	Mild NCD, n=117 (75%)
Age, mean±SD	71.4±8.2	71.4±7.0
Women, n (%)	29 (74.3)	88 (75.2)
Years of education, n (%)		
Six years or lower	10 (25.6)	46 (39.3)
More than six years	29 (74.4)	71 (60.7)
Marital status, n (%)		
Single	5 (12.8)	16 (13.7)
Married	24 (61.5)	76 (64.9)
Divorce	3 (7.7)	9 (7.7)
Widow	7 (18.0)	16 (13.7)
Comorbid disease(s), n (%)		
DM	17 (43.6)	63 (53.9)
HT	25 (64.1)	73 (62.4)
DLD	29 (74.4)	97 (82.9)
CKD	4 (10.3)	15 (12.8)
Hyperthyroidism	1 (2.6)	3 (2.6)
Hypothyroidism	0 (0)	8 (6.8)
AF	0 (0)	2 (1.7)
IHD	1 (2.6)	2 (1.7)
CVA	2 (5.1)	5 (4.3)
OSA	1 (2.6)	2 (1.7)
MoCA score, mean±SD	23.8±3.9	20.5±3.8
RUDAS score, (mean±SD)	26.4 (2.2)	24.8 (1.9)

n=numbers; SD=standard deviation; DM=diabetes mellitus; HTN=hypertension; DLD=dyslipidemia; CKD=chronic kidney disease; AF=atrial fibrillation; IHD=ischemic heart disease; CVA=cerebrovascular accident; OSA=obstructive sleep apnea; RUDAS=Rowland Universal Dementia Assessment Scale
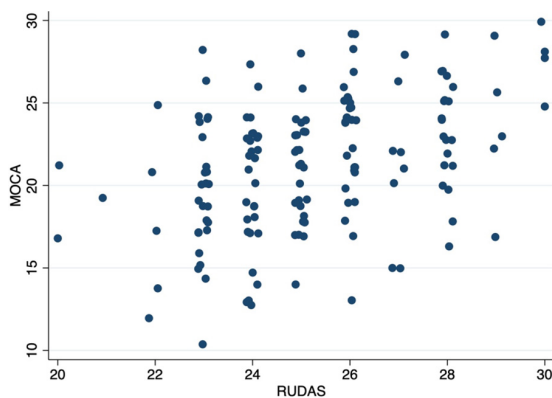

Figure 2. Scatter plot of MoCA and RUDAS.

Table 3. Linear regression analysis regarding factors associated with MoCA

Variables	Coefficient	95% CI	p-value
RUDAS score	0.61	0.30 to 0.92	<0.01
Age ≥70 years	-1.61	-2.82 to -0.39	0.01
Years of education			
Six years or lower	1	-	-
More than six years	1.51	0.23 to 2.79	0.02
Constant	5.91		

Table 4. MoCA-RUDAS conversion table

RUDAS	MoCA			
	Age <70 years		Age ≥70 years	
	≤6 years of education	>6 years of education	≤6 years of education	>6 years of education
23	20	21	18	19
24	21	22	19	20
25	21	23	20	21
26	22	23	20	22
27	22	24	21	22
28	23	25	21	23
29	24	25	22	24
30	24	26	23	24

(Table 3) which shows that age and years of education were independent factors associated with the MoCA. Then MoCA and RUDAS conversion formulation (MoCA= 5.91-1.61(age)-1.51(years of education) +0.61(RUDAS score); where age <70 years scores 0 and age 70 years or over scores 1, and 6 years of education or lower scores 0 and more than 6 years of education scores 1, (Table 4). Since the present study included participants with independent activities of daily living and the literature review showed the optimal cut-off points to differentiate mild NCD from dementia using the MoCA and the RUDAS in Thai patients were <22/30[19] and <24/30[18] among Thai geriatric patients, and to lessen sampling bias, the present study presented the lowest conversion score at 23/30 of the RUDAS.

Discussion

The RUDAS and MoCA measure similarly 4 out of 6 cognitive domains (Table 1). The RUDAS had a low positive correlation with the MoCA in detecting patients with mild NCD according to the correlation coefficients in the present study[30]. In comparison with the two studies conducted at a tertiary hospital geriatric outpatient clinic in the northeastern part of Thailand[19] and a tertiary hospital geriatric rehabilitation in Sydney, Australia[20] that demonstrated moderate positive correlation of the tests, the difference might be due to the diversity of cultural background and methodology of the study. For example, the performance of the MoCA among Thai patients in the northeast was lower than in the central part of Thailand[19]. In addition, this current study was conducted in a special geriatric clinic where the participants were mainly referred from a general internal medicine clinic while other studies did not.

This is the first study that exhibited the RUDAS-MoCA conversion table. The results showed that the difference between scores of the RUDAS and the MoCA was even larger in those with greater MoCA scores and ages over 70 years old and lower years of education. The usefulness of this conversion table is to heighten the generalizability of those tests. For example, if the patient has both MoCA and RUDAS scores from different periods, converting scores to the same unit could help physicians to monitor the progression of cognitive impairment. Nevertheless, given the administration of the RUDAS is usually briefer than the MoCA, the assessing items are rather comparable, it is well-validated in mild NCD patients[18], and the RUDAS might be more suitable for administrating in a general setting. Furthermore, both tests have the cube-copying task where the participants did not repeat this task. This procedure would not affect the validity of those tests.

There were some limitations. First, the present study was conducted in a single center, further research with more sample size from a multicenter might be worthwhile to determine the usefulness of the conversion table in real clinical practice. Second, the study design limited the participants with preserved daily function, the results cannot be applied to patients with dementia.

Conclusion

The RUDAS and the MOCA had a positive correlation in patients with normal cognitive function and mild NCD. Age and educational level affect score conversion. The RUDAS-MOCA conversion table was developed to simplify the smooth transition of the scores between these tests. Since the RUDAS has some advantages over the MoCA, it might be an alternative tool to use in a clinical setting.

What is already known on the topic?

The MoCA is the only bedside screening tool for mild NCD according to the Thai dementia guideline 2020. The RUDAS has recently been validated in Thai patients with mild NCD and it demonstrated good performance in detecting this condition.

What this study adds?

The RUDAS was positively correlatedly to the MoCA. The RUDAS-MOCA conversion table was developed to simplify the smooth transition of the scores between the tests. This table is helpful in the generalizability of those tests.

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Conflicts of interest

The authors declare no conflict of interest.

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