Original article:

Correlation Between The Indonesian Versions of Montreal Cognitive Assessment (MoCA-INA) and Visual Cognitive Assessment Test (VCAT-INA) as Cognitive Screening Tools

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Abstract

Background and purpose: Screening for cognitive impairment has become increasingly important as the population ages, especially using tools that is not mainly affected my translational process so it can be used in multilingual population. The aim of this study was to determine the correlation between the Indonesian version of Montreal Cognitive Assessment (MoCA-INA) and Visual Cognitive Assessment Test (VCAT-INA) as cognitive screening tools. **Methods:** This was a cross sectional study involving subjects recruited for cognitive screening in general population and memory clinic Adam Malik General Hospital Medan Indonesia between December 2019 and April 2020. All subjects underwent physical and neurologic examination and cognitive assessment including MoCA-INA and VCAT-INA, that was adapted from the original version. **Results:** A total of 104 subjects were studied, consisted of 41 (39.4%) males and 63 (60.4%) females. The mean age of subjects was 64.4±10.07 years and ranged from 41-82 years. Most of the subjects had 12 years of education (45 subjects; 43.3%). Most of the subjects had abnormal MoCA-INA and VCAT-INA scores. Both scores showed comparable result but VCAT-INA showed lower average and a broader range of scores. There was a strong positive significant correlation between the scores ($r=0.815$; $p < 0.001$). **Conclusions:** MoCA-INA score is strongly correlated with VCAT-INA score. As visual-based test, VCAT-INA can be applied as a cognitive screening tool in daily clinical practice without significant language barrier.

Keywords: cognitive screening, dementia, Montreal cognitive assessment, visual cognitive assessment test

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Introduction

It is estimated that there are over 50 million people living with dementia globally, a figure predicted to increase to 152 million by 2050. Someone develops dementia every three seconds and the current annual cost of dementia is estimated at US $1 trillion, a figure set to double by 2030.[1] The increased prevalence of dementia is highly correlated with the growing proportion of the ageing population that has become a worldwide universal concern. The number of elderly people in the world is projected to increase from 420 million in 2000 to nearly 1 billion by 2030, with the proportion of elderly people increasing from 7–12%. The most rapid and greatest increase in absolute numbers of older persons will occur in low- and middle-income countries (LMIC) such as China, India, and other South Asian nations. As a result, the LMIC share of the worldwide ageing

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population will increase from around 60% to more than 70%. Thus, as a strongly age-dependent disorder, dementia or Alzheimer's disease will have a huge impact on public health, healthcare, and social service systems in all countries throughout the world. Therefore AD has indeed become a global challenge and remains a global health priority.[1-3]

The issue of screening for dementia and cognitive impairment will become more increasingly important. Other that the increased prevalence of AD, the improvements in survival rates following stroke also mean that there will be an increase in vascular and post-stroke dementias since approximately 30% of stroke patients will develop dementia.[4] Early diagnosis and intervention of dementia may allow the patient to compensate for the disability, minimize disease-related and medication complications, improve quality of life and optimize the use of resources.[5] Screening tests for cognitive impairment in the clinical setting generally include asking patients to perform a series of tasks that assess at least 1 cognitive domain (memory, attention, language, and visuospatial or executive functioning). Neuropsychological testing is the gold-standard for assessing dementia and cognitive impairment, but it is time-consuming and requires adequate training.[6] Therefore it is highly important for clinicians to use effective short cognitive tests as appropriate to the clinical setting for suspected dementia.[7]

One of the most widely used cognitive screening tool currently is the Montreal Cognitive Assessment (MoCA), that was developed as a brief cognitive screening tool to detect mild-moderate cognitive impairment. The MoCA assess several cognitive domains including executive fuction, visuospatial function, attention and concentration, memory, language, calculation and orientation. The Indonesian version of MoCA, namely MoCA-INA has been developed and validated in Indonesia and so it can be used as a cognitive screening tool.[9] It has been found to have high sensitivity and specificity for the detection of mild cognitive impairment (MCI and mild dementia.[10] With a cut-off score of 26, the Mini Mental State Examination (MMSE) had a sensitivity of 17% to detect subjects with MCI, whereas the MoCA detected 83%.[11] Several previous studies have found the superiority of MoCA compared to MMSE in detecting cognitive impairment in various clinical setting including mild cognitive impairment and dementia[10,11,] elderly population[12,13,14],post-stroke patients[15], parkinson's disease[16], aneurysmal subarachnoid hemorrhage[17], epilepsy[18] and HIV-associated neurocognitive disorders (HANDs).[19] While the MoCA-INA has been translated from the original MoCA and has been culturally validated in Indonesia[9], nevertheless, as like any other existing cognitive screening tools, it was designed for use in specific language. Cognitive screening tools that have been modified and translated more likely to result in overdiagnosis of cognitive impairment in non-English speakers.[20]

The Visual Cognitive Assessment Test (VCAT) is a cognitive screening tool that is developed as a visual-based test. Its diagnostic performance and discriminative validities were superior compared to MMSE and comparable to MoCA. [21] The VCAT has been validated in four southeast asian countries including Indonesia, without language translation or cultural adaptation. It was found to be effective in discriminating between healthy control and subjects with cognitive impairment (MCI and mild AD dementia).[22] The Indonesian version of VCAT, namely VCAT-INA has also showed good diagnostic performance in post stroke cognitive impairment, compared to MoCA-INA and MMSE-INA.[23] No study has yet evaluated its use as cognitive screening test. The objective of this study was mainly to compare and determine the correlation between the MoCA-INA and VCAT-INA scores as cognitive screening tool.

Materials and Methods

This was a cross sectional study involving 104 subjects consisted of 71 subjects which were recruited from Medan Helvetia District, Medan, North Sumatera, Indonesia, because it was one of the most densely populated district in Medan and 33 subjects recruited from Memory Clinic Neurology Department Adam Malik General Hospital Medan North Sumatera, Indonesia between December 2019 and April 2020. Inclusion criteria were able to speak Bahasa Indonesia fluently, able to read and write, had no significant vision or hearing impairments and gave written consent to be included in the study. We excluded subjects who were medically unstable (delirium), had psychiatric disorders or had an aphasia. All subjects underwent physical and neurologic examination and cognitive assessment including MoCA-INA and VCAT-INA. The MoCA-INA assesses

several cognitive domains which are visuospatial/ executive, naming, memory, attention, language, abstraction, delayed recall and orientation (to time and place). Visuospatial abilities are assessed using a clock-drawing task and a trail-making task which is said to be useful in assessing fitness to drive. Attention, concentration and working memory are evaluated using a sustained attention task (target detection using tapping), a serial subtraction task and digits forward and backward. Its score range is 0-30, higher score indicates better cogntive performance,and a cut off of more than 26 is considered normal. The MoCA adds one point for those whose educational level is 12 or fewer years.[8] There are several adjusments of MoCA-INA compared to the original version in assessment of naming, memory and delayed recall and language function because of transcultural validation.[9]

The Visual Cognitive Assessment Test is a visual-based cognitive screening tool designed to detect early cognitive impairment. It is language neutral and encourages simple application to multilingual populations without the need for translation of test content.[21] The VCAT is a 30-point test that evaluates memory, executive function, visuospatial function, attention, and semantic knowledge. The test items for each cognitive domain are visual based, with pictures and figures selected from the International Picture Naming Project and locally validated in older adults.[22] The episodic memory domain consists of seven test items assessing immediate and delayed recall using a scenario, shapes and objects. The executive function domain consists of four items evaluating pattern recognition-completion, mechanics of gear movement and grouping of pictures based on categories. The visuospatial function domain contains two items assessing visuospatial abilities via cube reconstruction, visual depth perception and grid navigation. In the language domain with two items, participants were required to name pictures. The semantic fluency were assessed using four categories which were countries, vegetables, modes of transport and kitchen utensils. A symbol recognition cancellation task was used to assess attention domain. The VCAT scale range was 30 with lower score indicating greater impairment. The cut offs were: normal 23-30, MCI 18-22 and dementia 0-17. [21]

All statistical procedures were performed with SPSS. The correlation between MoCA-INA and VCAT-INA scores was measured using the pearson correlation. Both scores were also compared based on level of education and age group. Our study had been approved by the Faculty of Medicine Universitas Sumatera Utara/Haji Adam Malik General Hospital Ethical Committee.

Results

A total of 104 subjects were studied, consisted of 41 (39.4%) males and 63 (60.4%) females. The mean age of subjects was 64.4±10.07 years and ranged from 41-82 years. Most of the subjects belong to age group of 66-70 years and 71-75 years; each of the group consisted of 20 subjects (19.2%). Most of the subjects had level of education of senior high school, meaning had 12 years of education (45 subjects; 43.3%). There were 24 subjects (23.1%) with normal MoCA-INA score (26-30), and there was 27 subjects (26%) with normal VCAT-INA score (23-30). Based on VCAT-INA score there was 48 subjects (46.2%) with dementia (score 0-17) and 29 subjects (27.9%) with MCI (score 18-22). The characteristics of the subjects are shown in Table 1.

Table 1. Characteristics Data of The Subjects

Characteristics	Frequency (N=104)	Percentage (%)
Gender		
Male	41	39.4
Female	63	60.6
Age (years), Mean ± SD	64.4±10.07	
Age groups		
41-45 years old	7	6.7
46-50 years old	4	3.8
51-55 years old	9	8.7
56-60 years old	9	8.7
61-65 years old	25	24.0
66-70 years old	20	19.2
71-75 years old	20	19.2
76-80 years old	8	7.7
>81 years old	2	1.9
Educational Level		
Elementary school	15	14.4
Junior high school	19	18.3
Senior high school	45	43.3
University	25	24.0
MoCA-INA score, Mean ± SD	20.96±4.81	
MoCA-INA		
Normal (≥26)	24	23.1
Abnormal (<26)	80	76.9
VCAT-INA score, Mean ± SD	18.76±6.09	
VCAT-INA		
Normal (23-30)	27	25.9
Mild Cognitive Impairment (18-22)	29	27.9
Dementia (<18)	48	46.2

The average MoCA-INA score was 20.96±4.81 (range 10 to 30). The average VCAT-INA score was 18.76 ± 6.09 (range 4 to 30). Both scores showed comparable result but VCAT-INA showed lower average and a broader range of scores.(Table 2) There was a significant difference in MoCA-INA and VCAT-INA scores based on age group and level of education.(Table 3). The Pearson's correlation coefficient between the scores was 0.815 ($p < 0.001$). A graph showing the correlation between the MoCA-INA and VCAT-INA scores is shown in Figure 1

Table 2. Comparison of MoCA-INA dan VCAT-INA Scores

Cognitive Domains (MoCA-INA)	Mean±SD	Range	Cognitive Domains (VCAT-INA)	Mean±SD	Range
Total	20.96±4.81	10-30	Total	18.76±6.09	4-30
Visuospatial/executive	2.98±1.63	0-5	Memory	8.04±3.12	0-13
Naming	2.76±0.55	0-3	Language	3.92±0.99	1-5
Attention	4.55±1.50	1-6	Visuospatial	2.17±0.84	0-3
Language	2.10±0.86	0-3	Executive Function	3.26±1.68	0-6
Abstraction	1.13±0.67	0-2	Attention	1.30±1.35	0-3
Delayed Recall	1.81±1.19	0-5			
Orientation	5.81±0.48	3-6			

Table 3. MoCA-INA and VCAT-INA scores based on age and educational level groups

	MoCA-INA Score Mean±SD	p	VCAT-INA Score Mean±SD	P
Age groups				
41-45 years old	25.00±6.60		25.14±6.61	
46-50 years old	26.50±3.31		24.00±6.68	
51-55 years old	20.89±4.75		20.33±5.91	
56-60 years old	21.67±4.00		19.78±5.78	
61-65 years old	21.68±3.56	0.002	18.96±5.56	0.003
66-70 years old	21.55±4.88		19.25±5.49	
71-75 years old	18.70±4.24		15.9±5.68	
76-80 years old	17.38±4.20		13.88±3.04	
>81 years old	15.00±4.24		15.00±8.48	
Educational Level				
Elementary school	16.27±3.39		13.13±4.62	
Junior high school	18.16±3.50	<0.001	15.16±3.53	<0.001
Senior high school	21.80±3.98		19.07±5.14	
University	24.40±4.55		24.32±5.16	

ANOVA

Table 4. Correlation between MoCA-INA and VCAT-INA Scores

Variables	VCAT-INA	
	r	P
MoCA-INA	0.815	<0.001

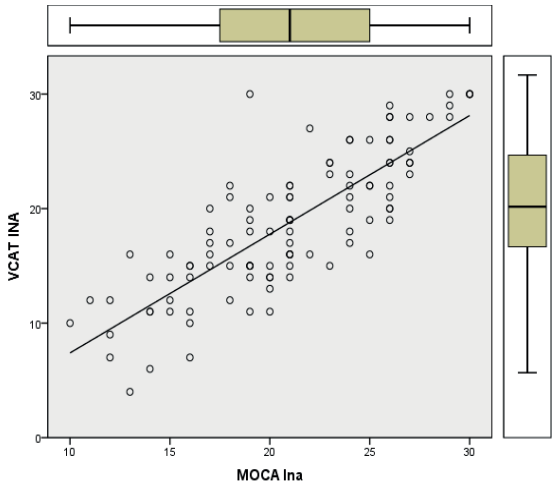

Figure 1. Correlation between MoCA-INA and VCAT-INA scores

Discussion

Dementia is a disabling syndrome characterized by progressive deterioration in multiple cognitive domains that is severe enough to interfere with daily functioning, including social and professional functioning.[3] In addition to identifying patients who may benefit from pharmacotherapy and non pharmacologic interventions, early detection of dementia helps families anticipate the patient's needs and helps physicians identify those in need of additional support.[6] As the population ages,

there is an increasing need for effective cognitive screening that can be widely used in multilingual population and can be used without significant language barrier. This study compared the MoCA-INA and VCAT-INA scores as cognitive screening tools. The VCAT-INA is adapted from the original VCAT but without significant translation other than instructions for the assessors. It is a visual-based cognitive test that can be applied in participants with various language.[21]

Kandiah et al, has developed and studied the use of VCAT in multilingual populations to detect dementia at an early stage and found that VCAT had good sensitivity and specificity for the diagnosis of mild cognitive impairment (MCI) and mild AD. They validated VCAT in a sample comprised of 206 subjects. The diagnostic performance of VCAT was generally satisfactory and comparable to MoCA in sensitivity (85.6%), specificity (81.1%) and overall discriminative ability (AUC=93.3; CI 90.1-96.4) for diagnosis of cognitive impairment (MCI and mild AD).[21]

The VCAT has also been validated in four south southeast asian countries including Indonesia. In a prospective, multicenter study involving 284 participants carried out across Singapore, Malaysia, Indonesia and Philippines, the VCAT, without local translation or adaptation, was found to be effective in discriminating between healthy controls and cognitively impaired subjects. Areas under the curve for Montreal Cognitive Assessment (0.916, 95% CI 0.884–0.948) and the VCAT (0.905, 95% CI 0.870–0.940) in discriminating between healthy controls and cognitively impaired subjects were comparable. The multiple languages used to administer VCAT in four countries did not significantly influence test scores.[22]

A study by Ong, et al in Indonesia, which included 38 healthy subjects and 91 post-stroke cognitive impairment (PSCI) subjects has also found the satisfactory diagnostic performance test of VCAT-INA: it detected 80.8% of PSCI (AUC 0.734-0.882). With cut-off 21, VCAT-INA differentiated healthy subjects from PSCI patients with sensitivity of 74.7 and specificity of 62.2. Using cut off 17, VCAT-INA can differentiate PSCI non-dementia from those with dementia with sensitivity 0f 83.3 and specificity of 65.1. Their study also showed the diagnostic performance of VCAT-INA is comparable to MoCA-INA and MMSE-INA.[23]

The results of this study showed that The MoCA-INA and VCAT-INA showed comparable results but VCAT-INA showed lower average with wider range of scores. Our study found the mean MoCA-INA score was 20.96±4.81 and VCAT-INA 18.76±6.09. These scores were lower than those reported in previous studies. Study by Kandiah et al found a median score of MoCA 28, VCAT 26 in healthy control and MoCA 23, VCAT 17 in cognitively impaired group, respectively.[21] Lim et al reported mean (SD) MOCA 25.52 (3.37) and VCAT 22.48 (3.50) in healthy control and mean (SD) MOCA 16.59 (5.75) and VCAT 14.17 (5.05) in subjects with cognitive impairment.[22] These lower scores might be affected by educational level and age although most subjects in our study had level of education of senior high school, meaning had at least 12 years of education, but we also found significant differences in these scores based on level of education and age groups. This needs to be evaluated further in future studies.

Interestingly, using either MoCA-INA or VCAT-INA, the proportion of subjects with cognitive impairment was greater than normal subjects. There were 80 subjects (76.9%) subjects with abnormal MoCA-INA score and 77 subjects (74.1%) with abnormal VCAT-INA score, 29 (27.9%) with MCI and 48 (46.2%) with dementia respectively. Considering the fact that the subjects in this study were recruited from general population and memory clinic also, this finding might emphasize the importance of cognitive screening not only in daily clinical practice but also in general population for early detection of dementia.

It can be argued that the main purpose of the cognitive screening test is to show the likelihood of cognitive dysfunction. It is usually done by comparing the patient's score with the normal reference score in the general population. A very impaired score along with detail history may lead a clinician to make a diagnosis without further detailed investigation; a borderline score may need referral for more comprehensive

neuropsychological assessment.[4] Although no single tool is recognized as the "gold standard" for detection of cognitive impairment, an initial structured assessment should provide either a baseline for cognitive surveillance or a trigger for further evaluation.[24]

The cognitive screening tool is not intended to replace a full neuropsychological assessment. It can be used to obtain clue about cognitive domains that are affected in a short assessment time. Neuropsychological testing has consistently shown that subtypes of dementia are characterized by different patterns of impairment.[4] The VCAT was designed to detect deficits in wide range of cognitive domains with greater emphasize on episodic memory and executive function, two of the most affected domains in eraly AD and VaD, the two most common type of dementia.[21]

In population with diverse cultures and languages, a cognitive screening tool that is relatively free from translation bias becomes very important. This study was conducted in Medan, the capital of the province of North Sumatra, which was inhabited by various tribes in various languages. Although with an adequate educational background it can be said that knowledge in bahasa Indonesia is also adequate, but it does not rule out the possibility of variations in vocabulary understanding and words familiarity used in cognitive screening tools, along with other issues in translated tools for non English speakers, as some of the basic neuropsychological basis of specific test items might be lost during translations.[21] This issue needs to be studied in more detail in further studies, but it might give an insight in using translated tools in multilingual populations.

Conclusion

In conclusion, we found a strong positive correlation between MoCA-INA and VCAT-INA scores. As visual-based test, VCAT-INA can be applied as a cognitive screening tool in daily clinical practice without significant language barrier.

Declaration of interest and funding disclosure

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article. This research did not receive any financial support.

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Author's contribution: Data gathering, and ideas, study design, writing, submitting of manuscript, editing and approval of final draft, were all events conducted by the authors.

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