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Comprehensive Psychiatry 55 (2014) S70–S75

COMPREHENSIVE PSYCHIATRY

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Is the Bahasa Malaysia version of the Montreal Cognitive Assessment (MoCA-BM) a better instrument than the Malay version of the Mini Mental State Examination (M-MMSE) in screening for mild cognitive impairment (MCI) in the elderly?

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Abstract

Introduction: Mild Cognitive Impairment (MCI) is a known precursor to Alzheimer disease, yet there is a lack of validated screening instruments for its detection among the Malaysian elderly.
Objective: To compare the Bahasa Malaysia version of the Montreal Cognitive Assessment (MoCA-BM) with the Malay version of the Mini Mental State Examination (M-MMSE) in the detection of MCI among the Malaysian elderly.
Methodology: This is a cross-sectional study conducted at the primary care centre of Universiti Kebangsaan Malaysia, Kuala Lumpur from December 2011 to mid-January 2012. Subjects aged 60 and above were recruited using systematic sampling method. Cut-off scores of 22/23 for MoCA-BM and 25/26 for M-MMSE were adopted. Kappa value and Pearson's correlation coefficient were used to ascertain the correlation between MOCA-BM and M-MMSE. Data were analysed using Mann–Whitney and Chi Square tests.
Results: The mean age of the 180 subjects enrolled was 65.3 years (SD = 5.4). They had a median of 6 years (IqR 25–75 = 5–11) total formal education. The prevalence of MCI using MoCA-BM and M-MMSE was 55.6% and 32.8% respectively. The odds of developing MCI were 1.153 (95% CI = 1.055, 1.261; $p < 0.05$) for every 1 year increase in age, 0.813 (95% CI = 0.690, 0.959; $p < 0.05$) with every extra year of education. Increasing age and lower education level were significantly associated with MCI. The MoCA-BM showed good internal consistency with Cronbach's alpha of 0.80. It had moderate correlation with M-MMSE (Pearson correlation coefficient = 0.770, $p < 0.001$) and moderate agreement for detecting MCI with Kappa values of 0.497 ($p < 0.001$).
Conclusion: The prevalence of MCI was higher using MoCA-BM compared to M-MMSE. Both instruments showed moderate concordance for screening MCI with correlation of their scores.

1. Introduction

In 2008, the proportion of Malaysians aged 60 years and above was 7% or a total of 1.9 million elderly persons [1]. With the increasing number of elderly, the incidence of age-related illnesses will also increase. One inevitable effect of aging is mild cognitive impairment (MCI) which is now recognised to be a precursor of Alzheimer disease (AD) [2].

The 2006 International Psychogeriatric Association Expert Conference on MCI defined MCI as "A cognitive decline greater than that expected for an individual's age and education

Publication of this supplement was supported by Universiti Kebangsaan Malaysian Medical Centre, Kuala Lumpur, Malaysia.
Conflict of interest: None.
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http://dx.doi.org/10.1016/j.comppsych.2013.04.010

level but that does not interfere notably with activities of daily life"[3]. To clinically diagnose MCI, there has to be memory complaints, preferably confirmed by someone else, objective memory impairment using any of the neurocognitive tools, normal general cognitive function and intact activities of daily living. The individual should have no history of dementia [4].

MCI can be further developed into 4 clinical subgroups. These groups are amnestic MCI–single domain, amnestic MCI–multiple domains, non-amnestic MCI–single domain and non-amnestic MCI–multiple domains [3]. Of the different subgroups, amnestic MCI has the highest risk of progression to dementia, particularly of the Alzheimer type [2]. Several studies have shown that those with MCI have a 10%–15% risk per year of progressing to Alzheimer's Disease (AD) [5]. Therefore, there is a critical need to identify patients in the earliest stages of the disease.

Currently, the gold standard for diagnosis of MCI is a clinical one. However, there is a lack of consensus regarding its clinical criterion [6]. For better diagnostic accuracy, a combination of clinical features, neuropsychological testing, biomarkers and neuroimaging should be used for diagnosis. However, these set of tests are time consuming and impractical. Of all the currently available cognitive impairment screening tools, the MMSE is the most widely used and has been translated and validated into many languages including the Malay language [7].

The Montreal Cognitive Assessment (MoCA) was developed by Nasreddine in 2005 as a screening test for MCI in subjects who have normal MMSE scores. It has been translated into various languages and still shows excellent sensitivity and specificity in detecting MCI despite some cultural and country specific modifications. Using a cut-off point of 25/26, the Japanese MoCA (MoCA-J) demonstrated a sensitivity of 93.0% and specificity of 87.0% [8]. In Korea, a cutoff score of 22/23 was used considering the lower education level among their elderly [9]. The MoCA only takes 10 min to complete and is easy to use, thus making it a suitable and sensitive tool for MCI detection by frontline clinicians.

Sensitivity and specificity of MoCA have been shown to be higher than those of the MMSE in the detection of MCI and mild AD [10]. Using a cutoff score of 26, the sensitivity for MMSE and MoCA to detect MCI was 18% and 90% respectively. In the mild AD group, the MMSE had a sensitivity of 78%, while the MoCA had 100%.

Such encouraging findings have created interests among local authors to translate and test MoCA for use in the local population. Thus, this study aims to determine the correlation and agreement between MoCA-BM and M-MMSE in detecting MCI among the elderly attending an urban primary care centre. Bahasa Malaysia was chosen as it is the official and national language of Malaysia, widely spoken among the Malays and other ethnic groups in the country.

2. Methodology

2.1. Subjects

A cross-sectional study was conducted among elderly attendees at the 'Pusat Perubatan Primer UKM' (PPPUKM), the primary care clinic of Universiti Kebangsaan Malaysia, located at Bandar Tasik Selatan in Kuala Lumpur over a 6-week period from early December 2011 to mid-January 2012. A systematic sampling method was adopted whereby every 5th patient registered at the clinic was approached for this study. Inclusion criteria included those aged 60 and above, with subjective complaints of mild memory impairment, with no impairment in daily functioning, literate in Bahasa Malaysia and not having severe visual or hearing impairment. Those with history of neurological diseases affecting cognitive functions (such as stroke and dementia) were excluded. Information sheet and verbal explanation were given before individual written consent was taken.

2.2. Instruments

Two sets of measuring instruments were used in this study: the Montreal Cognitive Assessment—the Bahasa Malaysia version (MoCA-BM) and the Malay version of the Mini Mental State Examination (M-MMSE).

2.2.1. MoCA-BM

MoCA is a one-page 30-point test that can be completed in 10 min. It tests for 8 key cognitive domains: attention and concentration, executive function, memory, language, visuo-constructional skills, conceptual thinking, calculations and orientation. A cut-off score of 26 or more was used to differentiate between normal and those with MCI [10].

For this study, the English version was translated into Bahasa Malaysia and changes were made to make it more relevant and culturally acceptable to the study population. A cut-off point of 22/23 was adopted, as in other studies involving Asian populations in Korea and Hong Kong [9,11], considering the lower level of educational achievements among the elderly in Malaysia. Furthermore, 1 point was added to the total MoCA-BM score if the patients had 12 or less years of formal education, as suggested in Nasreddin's original study [10].

2.2.2. The Mini Mental State Examination (MMSE)

The original version was developed by Folstein in 1975 and is still being used widely as a screening tool for dementia. The original instrument consisted of 11 items with a total score of 30. It tests for orientation, registration, attention, calculation, recall, naming, repetition, 3 stage command, reacting, writing and copying. A score of 21 or less is suggestive of dementia when corrected for gender and education. As the MMSE was originally invented as a tool to detect and monitor the progress of dementia, a cut-off score for MCI was never suggested. A meta-analysis of all the studies available using MMSE to detect MCI found no standardized cut-off score but one which ranged from 23 to 29 [12]. There are 3 Malay language versions of MMSE (M-MMSE-7, M-MMSE-3 and MMSE-S) with cut-off scores of 20/21, 17/18 and 16/17 respectively which are significantly influenced by gender and educational level differences [7]. For this study, MMSE scores of 26 or below would indicate

possible mild cognitive impairment as suggested by Tasha et al. [13].

2.3. Research procedure

2.3.1. Translation of MoCA into Bahasa Malaysia

Prior to the initiation of the study, permission to translate MoCA was requested from the original author of MoCA, Dr Ziad Nasreddine. The original English version of MoCA was first translated into Bahasa Malaysia by 2 appointed independent language experts before it was back-translated into English by another 2 appointed independent language experts. The back-translated versions were then compared with the original MoCA to ensure accuracy before a harmonised version was produced.

A panel of experts consisting of a public health physician, a geriatric psychiatrist, a group of psychologists and family medicine specialists then reviewed the harmonised MoCA-BM together. It was assessed sentence by sentence to ensure accuracy of translation, comprehensibility of the instruction and cultural relevance for its use in a local setting. Several changes were made to ensure that the tool was suitable, such as:

i). The original English version used 5 different nouns — "Face", "Velvet", "Church", "Daisy" and "Red" to assess memory and delayed recall. As "baldu" (translation of "velvet") was unfamiliar to many Bahasa Malaysia speakers, it was replaced with "kapas" (translation of "cotton"). "Church" was replaced with "school" to avoid religious sensitivity as Malaysia is a multicultural country which practises various religions. "Daisy" was changed to "rose" as the latter is more common and sounds similar in Bahasa Malaysia. "Red" was changed to "blue" ("biru") to prevent association with "Rose". Only "face" remained unchanged from the original version.

ii). For language assessment, the name "John" was changed to "Johan" as it is a common local name.

iii). For fluency test, letter "S" was used instead in the translated version as there were more words beginning with the letter "S" than "F" in Bahasa Malaysia.

iv). All other domains in the Bahasa Malaysia version were translated verbatim. Following these changes, the pre-final version of MoCA-BM underwent pilot-testing.

2.3.2. Pilot testing

MoCA-BM was tested on 20 selected attendees at the PPPUKM using the inclusion and exclusion criteria. Preliminary results showed good internal consistency with a Cronbach's alpha of 0.80 based on the standardised items. This tool took approximately 10–15 min to complete. No difficulties were encountered during the testing and subjects gave favourable feed-back when questioned regarding comprehension and ease of the questionnaire. It was then decided that no further amendments were needed and the MoCA-BM was ready for use.

2.3.3. Data collection

A self-administered questionnaire on sociodemographic data was given to subjects prior to the administration of MoCA-BM and M-MMSE.

2.4. Statistical analysis

All analysis was done using the Statistical Package for Social Sciences (SPSS) software version 20. P values less than 0.05 were taken as representing significant difference for all analyses. Descriptive analysis was used to depict the sociodemographic data of the subjects to determine the prevalence of MCI using both the MoCA-BM and M-MMSE. Pearson correlation coefficient was used to correlate the findings of both MoCA-BM and M-MMSE. The agreement between M-MMSE and MoCA-BM to detect MCI was obtained from the Kappa value.

3. Results

A total of 180 patients were included in this study. They have all completed the questionnaires fully as required.

3.1. Prevalence of MCI

The prevalence of MCI using cut-off points of 22/21 for MoCA-BM and 26/25 for M-MMSE was 55.6% and 32.8% respectively (Table 1).

3.2. MoCA-BM and M-MMSE scores

MoCA-BM scores ranged from 7 to 29 with a mean of 20.6 (SD = 5.2) whereas M-MMSE scores ranged from 9 to 30 with a mean of 26.8 (SD = 3.4). As shown in Fig. 1, subjects who scored low in the MoCA-BM also had similar scoring trends for the M-MMSE. There was moderate correlation between MoCA-BM and M-MMSE using Pearson correlation with correlation coefficient of 0.770 and this finding was statistically significant with $p < 0.001$ (Fig. 2).

A total of 56/180 (31.1%) subjects fell into the MCI range for both MoCA-BM and M-MMSE whereas 44/180 (24.4%) of those who tested normal in the M-MMSE actually tested positive for MCI using MoCA-BM. Of the total sample studied, 77/180 (42.8%) had normal scores for both MoCA-BM and M-MMSE. The Kappa value indicating agreement for diagnosis of MCI using MoCA-BM versus M-MMSE was 0.497 with $p < 0.001$(Table 2).

Table 1
Prevalence of MCI.

	MCI		No MCI		Total	
	n	%	n	%	N	%
BM-MoCA	100	55.6	80	44.4	180	100
M-MMSE	59	32.8	121	67.2	180	100

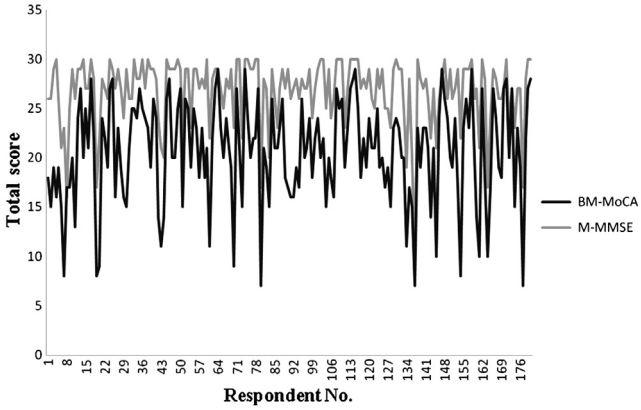

Fig. 1. Comparison of BM-MoCA and M-MMSE scores.

3.3. Goodness of fit of MoCA

Goodness of fit was performed using the Hosmer–Lemenshow Test and area under the receiver operator curve (ROC). The X^2 value using the Hosmer-Lemenshow Test was 8.25 ($p = 0.41$), indicating that the model fits and the observed event rates matched the expected event rates in the different subgroups of the model population. Area under the ROC was 0.82 (95% CI = 0.76, 0.88) with significant difference of $p < 0.001$ (Fig. 3). This showed that the MoCA-BM was a good test to differentiate MCI from non-MCI cases.

3.4. Sociodemographic profile and MCI

From the total of 180 subjects analysed, there were significant associations between MCI and age, educational achievement and gender based on the BM-MOCA. The mean age was 65.3 years with a standard deviation of 5.4. As their ages were not normally distributed, the median age was 63 years (IqR 25–75 = 61–68). The median age of those with MCI was significantly higher than those without any cognitive impairment ($p < 0.001$), whereby those with MCI had a median age of 65 years (IqR 25–75 = 62–70) whereas those without cognitive impairment were aged 62.5 years (IqR 25–75 = 60–64)

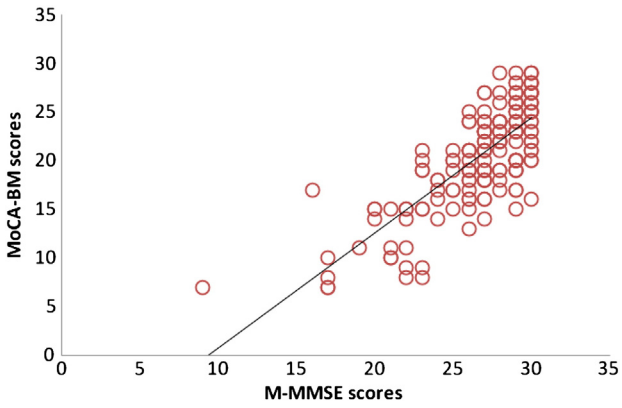

Fig. 2. Correlation between BM-MoCA and M-MMSE.

Table 3 shows the association of MCI with formal education ($p < 0.001$) and gender ($p < 0.023$). There was a wide range in the total years of education (0 to 18 years), with a median of 6 years (IqR 25–75 = 5–11). The highest levels of education attained were primary school (44.4%) and secondary school (37.2%). Subjects with MCI had a median of 6 years (IqR 25–75 = 3–7) whereas those without MCI had 10 years (IqR 25–75 = 6–11) of education.

The ethnic distribution of subjects reflected Malaysian multi-ethnicity. Malays made up 55% of the study population followed by the Chinese and Indians at 21.1% and 22.2% respectively. There were more females with MCI (65.8%) compared to males (48.6%).

4. Discussion

In this study, the prevalence of MCI using the MoCA-BM was high with more than half (55.6%) of subjects screening positive for MCI. Similarly, high prevalence of MCI (64.7%) was also detected among elderly attendees of medical clinics in an urban hospital using MMSE cut-off score of 21/30 to 28/30, which was significantly associated with low education [14], as also shown in this study. Lower level of education is a known risk factor for MCI [15].

Another possible factor contributing to the high prevalence of MCI in our population was the tool itself. Most studies had used the original English version MoCA as a screening tool. Most of our Bahasa Malaysia-speaking subjects were more fluent speaking in its colloquial form, rather than its formal official form as used in this study. Those with a poorer command of the language might have scored lower than those who were more linguistically capable, thus contributing to the higher rate of MCI false positives.

The cut-off score of 22/23 might not be suitable for our population. Further validation of the MoCA-BM is needed to ascertain a cut-off score that is specific for our population. Unlike other studies which employed clinical as well as neuropsychological testings to diagnose MCI, this study

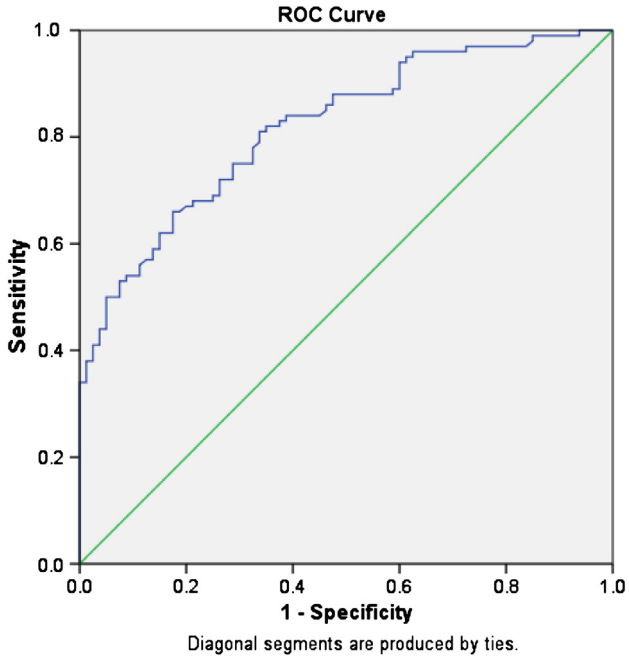

Fig. 3. ROC to assess Goodness of Fit for BM-MoCA.

only used the MoCA-BM and M-MMSE to screen for MCI, which might have led to its higher prevalence.

This study found a moderate strength correlation between MoCA-BM and M-MMSE scores with a Pearson correlation coefficient of 0.770 ($p < 0.005$). This positive linear relationship between MOCA-BM and M-MMSE scores was comparable to those reported by the original author of MoCA, which obtained high correlation between both tools with correlation coefficient of 0.87 ($p < 0.001$) [10]. The lower correlation coefficient in this study could be due to the types of items in the MoCA-BM which required more scholastic skills such as recognition of alphabets, arithmetic and drawing to complete when compared with the M-MMSE. The MoCA-BM and M-MMSE had a Kappa value of 0.495, indicating moderate agreement [16]. The agreement difference could be due to the difference in the functions of the instruments themselves, in which MoCA was designed specifically for screening MCI [10] whereas MMSE was initially designed to detect dementia.

Age and education were significantly associated with MCI. This association between MCI and increasing age has also been shown in Swedish [17] and Singaporean [18] studies. However, there have been suggestions that the prevalence for MCI should remain stable across all ages as the diagnosis should be based on age and education specific norms [19]. Sattler (2012) reported that education level is an important marker for cognitive reserve as it reflects the extent of early cognitive stimulation of the brain and cognitive abilities. It has also been reported that high early education combined with high late life cognitive activity is beneficial and protective in preventing MCI [20].

Table 2
Agreement of BM-MoCA and M-MMSE to detect MCI.

N = 180	BM-MoCA		Total (%)
	MCI (%)	No MCI (%)	
M-MMSE			
MCI (%)	56 (94.9)	3 (5.1)	59 (100)
No MCI (%)	44 (36.4)	77 (63.6)	121 (100)

Table 3
Association between MCI and level of education.

N = 180	MCI, n (%)		X2	df	p value
	Yes	No			
Level of education					
None	15 (100)	0	26.76	3	< 0.001
Primary	53 (66.2)	27 (33.8)			
Secondary	25 (37.3)	42 (62.7)			
Tertiary	7 (38.9)	11 (61.1)			

5. Limitations

The study population consisted of elderly outpatients on treatment for various medical illnesses in an urban primary care centre. So the findings from this study cannot be generalized to the elderly community who often prefer to live in the rural areas. MCI-amnestic type was the main type of MCI experienced by these subjects, hence the findings might not be reflective of other types of MCI.

MoCA-BM required a good command of formal Bahasa Malaysia for it to be fully understood and comprehended. Despite Bahasa Malaysia being the most widely spoken language among all races, some of these older generation Chinese and Indians find difficulty in understanding some of the instructions in MoCA as it is not their mother-tongue language spoken at home. Most often they speak the colloquial form of the language in their daily life. A validated Tamil and Mandarin versions of the MoCA would perhaps be able to overcome this difficulty.

This study did not determine the cut-off score for MoCA-BM but instead had adopted a similar score used in another Asian MCI study. This could have contributed to the higher prevalence of MCI in our population as education, culture and ethnicity can affect the performance of the MoCA. A future formal validation study of the MoCA-BM is required to determine an appropriate cut-off score for our population based on the receiver operator curve (ROC).

6. Conclusion and recommendations

In general, the MoCA-BM was an acceptable and easy to use tool for MCI screening in the urban elderly. The prevalence of MCI was higher using MoCA-BM as compared to M-MMSE. The MoCA-BM and M-MMSE have shown moderate correlation in their scoring trend.

There was only moderate but significant concordance between MoCA-BM and M-MMSE in detecting MCI among the elderly patients attending PPPUKM. This was due to the fact that the MMSE was never invented to screen for MCI compared to the MoCA which was invented to do so. Further changes to some of the MoCA-BM items are needed for the instrument to be more acceptable to Bahasa Malaysia-speaking Malaysian population.

In the future, it is recommended that MoCA-BM be tested for its reliability and validity in a population already prediagnosed as having MCI using more strict diagnostic criteria and neuropsychological tests. A cut-off score for MoCA-BM should be determined for it to have high sensitivity and specificity as a screening instrument for MCI. It is also recommended that MoCA be translated and validated into other local languages as Malaysia is a melting pot of multiethnic groups of people.

Lastly, increasing age and lower levels of education were significantly associated with MCI. Therefore, elderly individuals with these risk factors should be screened periodically for MCI and early signs of dementia.

Acknowledgment

The authors would like to thank all clinic staff of PPPUKM for their cooperation and assistance during the course of this study. This study was funded by the University Fundamental Grant and had been approved by the Ethics Committee of Universiti Kebangsaan Malaysia as well as the National Medical Research Registry.

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