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Validation and Optimal Cut-Off Scores of the Bahasa Malaysia Version of the Montreal Cognitive Assessment (MoCA-BM) for Mild Cognitive Impairment among Community Dwelling Older Adults in Malaysia

(Keesahan dan Skor Titik Potong Optimum Versi Bahasa Malaysia Penilaian Kognitif Montreal (MoCA-BM) untuk Kecelaan Kognitif Ringan dalam Kalangan Komuniti Rumah Warga Tua di Malaysia)

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ABSTRACT

The goal of this study was to examine the reliability and validity of the Bahasa Malaysia version of the Montreal cognitive assessment (MoCA-BM) and to determine its optimal cut-off score among older adults with mild cognitive impairment (MCI), after adjustments for age, gender, levels of education, physical functioning and depressive symptoms. A total of 2237 community dwelling older adults aged 60 years and above were randomly selected for the study, excluding those with MMSE score below 14. Instruments administered were the MoCA-BM, the Malay Mini-Mental State Examination (MMMSE), the Rey Auditory Verbal Learning Test (RAVLT), the Digit Span and the Digit Symbol subtests of the Wechsler Adult Intelligence Scale (WAIS), activities of daily living (ADL) and the Geriatric Depression Scale (GDS). MCI were determined using the Petersen's 2014 criteria as the gold standard. SPSS version 22 was used for reliability and validity analysis and optimal cut-off score detection. Cronbach's α of the MoCA-BM was 0.691 and concurrent validity was high between MoCA-BM and MMMSE scores (r=0.741). Optimal cut-off point for MoCA-BM to detect MCI among older adults in Malaysia was 17/18, with sensitivity of 68.2% and specificity of 61.3%. Using this cut-off, 38.9% of participants were detected to be at risk of MCI. In conclusion, MoCA-BM is a reliable and valid screening instrument for MCI among Malaysian elderly community. The newly derived optimal cut-off for MCI is much lower than the original MoCA with modest ability to discriminate between normal and MCI older adults in the community.

Keywords: Mild cognitive impairment; Mini Mental Status Examination; Montreal Cognitive Assessment; older adults; validation

ABSTRAK

Matlamat kajian ini adalah untuk mengkaji kebolehpercayaan dan keesahan Penilaian Kognitif Montreal (MoCA-BM) versi Bahasa Malaysia dan untuk menentukan skor titik potong optimum dalam kalangan warga tua yang mempunyai kecelaan kognitif ringan (MCI) selepas dilakukan penyesuaian untuk umur, jantina, tahap pendidikan, kefungsian fizikal dan simptom kemurungan. Sejumlah 2237 warga tua yang tinggal dalam komuniti rumah berumur 60 tahun ke atas telah dipilih secara rawak untuk kajian ini kecuali mereka yang mempunyai skor MMSE 14 ke bawah. Instrumen yang digunakan adalah MoCA-BM, Pemeriksaan Keadaan Mental Mini Bahasa Malaysia (MMMSE), Ujian Pembelajaran Lisan Pendengaran Rey (RAVLT), sub ujian Digit Span dan Digit Simbol dari Skala Kecerdasan Dewasa Wechsler (WAIS), Aktiviti Hidup Seharian (ADL) dan Skala Kekecewaan Geriatrik (GDS). MCI ditentukan menggunakan kriteria Petersen 2014 sebagai piawai emas. SPSS versi 22 telah digunakan untuk analisis kebolehpercayaan dan keesahan dan penentuan skor titik potong optimum. α Cronbach untuk MoCA-BM adalah 0.691 dan keesahan serentak adalah tinggi antara MoCA-BM dan skor MMMSE (r=0.741). Titik potong optimum MoCA-BM untuk menentukan MCI dalam kalangan warga tua di Malaysia adalah 17/18, dengan kepekaan 68.2% dan kekhususan 61.3%. Menggunakan titik potong ini, 38.9% peserta dikenal pasti mempunyai risiko MCI. Kesimpulannya, MoCA-BM adalah satu instrumen saringan MCI yang boleh dipercayai dan sah dalam kalangan komuniti warga tua Malaysia. Titik potong yang baru diperoleh untuk MCI adalah lebih rendah berbanding MoCA asal dengan kebolehan sederhana untuk membezakan antara warga tua yang normal dan warga tua MCI dalam komuniti.

Kata kunci: Kecelaan kognitif ringan; keesahan; Penilaian Kognitif Montreal; status pemeriksaan mental mini; warga tua

INTRODUCTION

The Montreal Cognitive Assessment (MoCA) has gain increasing popularity in Malaysia after the Mini Mental State Examination as a cognitive screening tool to detect persons with mild cognitive impairment (MCI). Validation of the MoCA-BM has been conducted by Cheah et al. (2014) in a clinical-based study among a small sample of patients from four hospitals but no large scale study involving older adults in the community was conducted in Malaysia. The study also did not adjust for age, gender, levels of education, physical functioning and depressive symptoms of the participants.

Consensus opinion among researchers is that MoCA is more sensitive compared to MMSE in detecting mild cognitive impairment. Cheah et al. (2014) study support this whereby MoCA-BM is better than the Malay-MMSE (M-MMSE) in differentiating clinical dementia using CDR score from 0 to CDR score > 0 as the gold standard. Using the cut-off point of less than 22, MoCA-BM has the sensitivity of 0.824 and specificity of 0.818 to detect cognitive impairment compared to M-MMSE with sensitivity of 0.765 and specificity of 0.636 with the cut-off point of less than 27. The original MoCA developed by Nasreddine et al. (2005) also showed higher sensitivity than MMSE in detecting MCI. Nasreddine et al. (2005) used the cut-off below 26 to indicate cognitive impairment with additional 1 point score for those with 12 years or less of education.

Several studies found that the optimal cut-off score for MoCA in Asian people tend to be lower than the western population. In Thailand, a validation study of MoCA was undertook among 120 elderly subjects from the memory clinic as well as determining the appropriate cut-off score for MoCA-T in clinical setting using the Clinical Dementia Rating Scale (CDR) as the gold standard. The results showed that the internal consistency of MoCA was 0.914 and highly correlated with MMSE (r = 0.900). The cut-off score for MoCA was optimum at 25/26 for amnestic MCI with sensitivity of 0.8 and specificity of 0.8 and 22/23 for Alzheimer's disease (sensitivity of 1.0 and specificity of 0.98) (Tangwongchai et al. 2011). In Singapore, the MoCA performance was evaluated by education groups among older Singaporean Chinese adults in both clinical and community-based studies (Ng et al. 2015). The MoCA modestly discriminated those with MCI from normal control at cut-off 28/29 in the clinical-based sample (Area under the curve, AUC = 0.63) with sensitivity of 0.65 and specificity of 0.55. The MoCA cut-off was lower at 22/23 in the community-based sample with sensitivity of 0.65 and specificity of 0.55 (AUC = 0.65). Even in the highest education group (>6 years education), the MoCA performance was less satisfactory at a cut-off of 27/28 (AUC = 0.50, sensitivity = 0.54, specificity = 0.51). The validation study of MoCA in Hong Kong which was conducted among 272 older adults from memory clinic found the optimal cut-off score for the HK-MoCA to be 21/22 to differentiate between MCI and dementia from normal controls after adjusting for educational levels (AUC = 0.920, sensitivity = 0.928, specificity = 0.920) (Yeung et al. 2014). The cut-off to detect MCI was 21/22 (AUC = 0.847, sensitivity = 0.828, specificity = 0.735). The Beijing version of MoCA (MoCA-BJ) was administered to 1001 Chinese elderly from several urban and rural communities in Beijing, China. The optimal cut-off for MoCA-BJ was at 22/23 (sensitivity = 68.7%, specificity = 63.9%) (Yu et al. 2012). The Changsa version of MoCA was conducted among 388 ischemic cerebral disease patients in Hunan Province of China to determine its reliability, validity and optimal cut-off score (Tu et al. 2013) and to differentiate between vascular cognitive impairment-no dementia (VCI-ND) and vascular dementia (VD). Cronbach's α of the MoCA-Changsa (MoCA-CS) was 0.884 and was highly correlated with MMSE scores (r = 0.867) and simplified intelligence quotients (r = 0.822). The optimal cut-off for detecting VCI-ND was 23/24 (sensitivity = 74.9%, specificity = 99.2%). Currently, there is no cut-off point for the Malay MoCA among community dwelling elderly in Malaysia and previous studies relied on the Asian cut-off point. Hence, it is important to determine the optimal cut-off point for MoCA among elderly population in Malaysia for future reference.

An increasing number of studies highlighted on the influence of education on MoCA performance, however, limited studies have examined the influence of age, gender, levels of education, physical functioning and mood on MoCA. A study by Ng et al. (2015) evaluated the MoCA's test performance by educational groups among older Singaporean Chinese adults. Using multivariate analyses to control for age and gender, MCI diagnosis was associated with a <1-point decrement in MoCA score (η^2 = 0.010), but lower (1–6 years) and no education was associated with a 3- to 5-point decrement (η^2 = 0.115 and η^2 = 0.162, respectively) indicating that MoCA score is more sensitive to education than the MCI diagnosis.

The objective of the study was to determine the reliability, validity of the MoCA-BM and the optimal cut-off point of MoCA-BM among MCI older adults in the community using the current Petersen's criteria as the gold standard.

Materials and Methods

PARTICIPANTS

The participants were recruited as part of the LRGS TUA research project which is a prospective study on aging focusing on a wide range of neuroprotective factors among a population based sample of Malaysian elderly from four states in Malaysia (Shahar et al. 2015). A total of 2237 elderly were selected from 2296 subjects after excluding those with the MMSE score of 14 which is classified as severe cognitive impairment. The recruitment of participants was through multistage sampling. The participants were screened with the Geriatric Depression Scale (GDS) to ensure that the subjects did not suffer from depression because it will indirectly affect the overall cognitive function of the subject. This study was approved by the Medical Research and Ethics Committee of the Universiti Kebangsaan Malaysia.

THE ADAPTATION OF THE MONTREAL COGNITIVE ASSESSMENT INTO BAHASA MALAYSIA

The English version of MoCA was translated by a group of researchers (Din et al. 2013) for a study among elderly people of FELDA and adapted to be more culturally relevant and acceptable to the study population. It has been used in a study by Razali et al. (2014) to compare the use of MoCA-BM and the Malay MMSE in detecting MCI among a clinical-based sample using a cut-off point of 22/23. One point was added to the total score of the MoCA-BM for those elderly with 12 years or less years of education based on the Nasreddin's suggestion in his original study. Almost 20% of the elderly in this study had no formal education and had difficulty in understanding the test. Changes were made for the list of words, sentences in the language test, as well as the words used for abstract thinking into Malay language. Instructions were also given in Malay language to the participants.

STUDY INSTRUMENTS AND DATA COLLECTION TECHNIQUE

Subjects were interviewed face to face using a standardized questionnaire and measured for a number of parameters. The questionnaire consists of information on sociodemography, past medical history, neuropsychological battery, psychosocial, lifestyle and dietary intake. All participants completed the neuropsychological battery which include the Malay version of Mini-Mental Examination State (M-MMSE), Bahasa Malaysia version of Montreal Cognitive Assessment (MoCA-BM), the Rey Auditory Verbal Learning Test (RAVLT), the Digit Span and the Digit Symbol subtests of the Wechsler Adult Intelligence Scale (WAIS). Physical functioning was assessed using the Lawton Instrumental Activities of Daily Living (IADL) (Graf 2008) and they were screened for depressive symptoms using the Geriatric Depression Scale.

MoCA is a short cognitive instrument to screen for mild cognitive impairment and dementia. It tests for 8 key cognitive domains: Attention and concentration, executive function, memory, language, visuoconstructional skills, conceptual thinking, calculations and orientation. MoCA has been validated in Malaysia by Razali et al. (2014). Cronbach's alpha of MoCA-BM in this study is 0.691. Changes in MoCA-BM include translation of instructions on the page into Malay language. The pictures for naming subtest were retained because Malaysians are quite familiar with them. For memory subtest, the words face, velvet, church, daisy and red were replaced with Malay words muka, kapas, sekolah, ros and biru, respectively. Sentences in language subtest were translated i.e. 'I only know that John is the one to help today' to 'Saya hanya tahu Johan yang perlu dibantu hari ini' and 'the cat always hid under the couch when dogs were in the room' into 'kucing sembunyi bawah meja bila anjing ada dalam bilik'. For fluency test, the letter F for English version of MoCA was replaced with the letter S for Malay version. For abstraction subtest, the pair of words 'train-bicycle' was replaced with 'keretapi-basikal' and 'watch-ruler' with 'jam tangan-pembaris'.

THE DIAGNOSTIC CRITERIA FOR MILD COGNITIVE IMPAIRMENT

The detailed diagnostic criteria of MCI were based on the current Petersen's criteria (Petersen et al. 2014). Those with MCI were operationalized as having: Self- or informant-reported cognitive complaint; objective cognitive impairment (either memory, executive function, attention, language or visuospatial skills); preserved independence functional abilities; an absence of dementia; no depressive symptoms that may affect the memory of older adults; and MMSE score above 14. Based on these criteria, 14.9% of the participants had MCI.

STATISTICAL ANALYSIS

Participants were grouped into normal elderly and those with MCI. Comparison of their cognitive functioning, activities of daily living and depressive symptoms were analysed using the independent t-test. Internal consistency of the MoCA-BM was determined using Cronbach's alpha while Pearson correlation coefficients between the MoCA-BM and the M-MMSE were carried out to determine the concurrent validity. In assessing the optimal cut-off for the MoCA-BM, the predicted probability of each MoCA-BM scores were determined using the binary logistic regression analysis and adjusted for age, gender, education levels, activities of daily living and depressive symptoms. The optimal cut-off was determined using the classification plot and adjustment of the classification cut-off from 0.15 to 0.5. Receiver operating characteristic (ROC) analysis was used to determine the area under the curve and specificity and sensitivity of each MoCA-BM score using the MCI/non-MCI group as the gold standard. Statistical analysis was conducted using the IBM-SPSS version 22.

RESULTS

A total of 2237 older adults in the community completed the MoCA-BM screening in which 1904 (85.1%) were normal subjects and 333 (14.9%) were MCI subjects. As shown in Table 1, participants with MCI had a significantly less education years, lower score on MoCA and MMSE, but they were more active and had less depressive symptoms than the non MCI participants. The optimal cut-off for the MoCA-BM score was 17/18 in differentiating MCI with non MCI participants in the community, with a sensitivity of 68.2%, a specificity of 61.3% and AUC of 0.710 (95% CI, 0.681-0.739) (Figure 1). Using this cut off point, 38.9% of participants were classified as at high risk of MCI.

Figure 2 shows the MoCA-BM test performance by education groups. The MoCA-BM's test performance was least satisfactory in the group with no education (AUC = .423). Participants with education year between 1 and 6 years had better performance (AUC = 0.545) than those without education (AUC = .423) and those with more than 6 years education showed the best performance (AUC = 0.648).

TABLE 1. MoCA-BM and MMSE scores of MCI and non MCI participants

	MCI	Non MCI	p
Participants	333	1904	
Female	148	1009	0.040
Mean age ± SD, years	68.48 ± 5.92	69.55 ± 5.97	0.020
Mean education ± SD, years	5.63 ± 4.03	4.48 ± 3.22	0.000
Mean MoCA-BM score ± SD	19.63 ± 5.25	18.53 ± 4.11	0.000
Mean MMSE score ± SD	23.75 ± 3.97	23.39 ± 2.81	0.050
Mean GDS score ± SD	2.41 ± 2.15	3.82 ± 2.46	0.000
Mean ADL score ± SD	12.52 ± 2.25	12.27 ± 1.37	0.006
MoCA-BM			
AUC ± SE	0.710 ± 0.15		
Sensitivity	68.2		
Specificity	61.3		

SD = Standard Deviation, SE = Standard Error

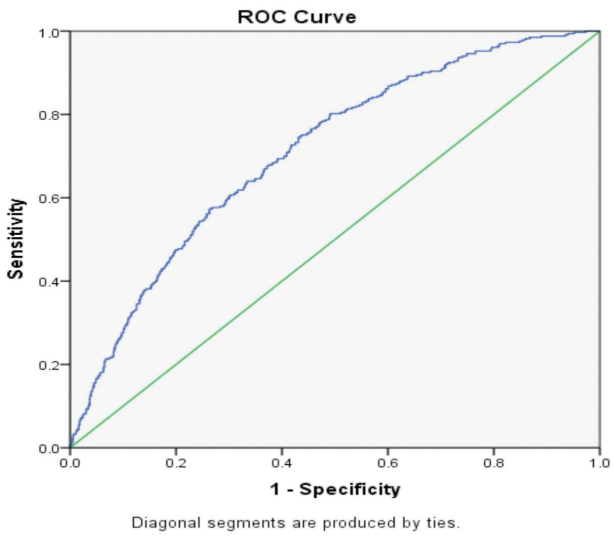

FIGURE 1. Receiver operating characteristic curve of MoCA-BM

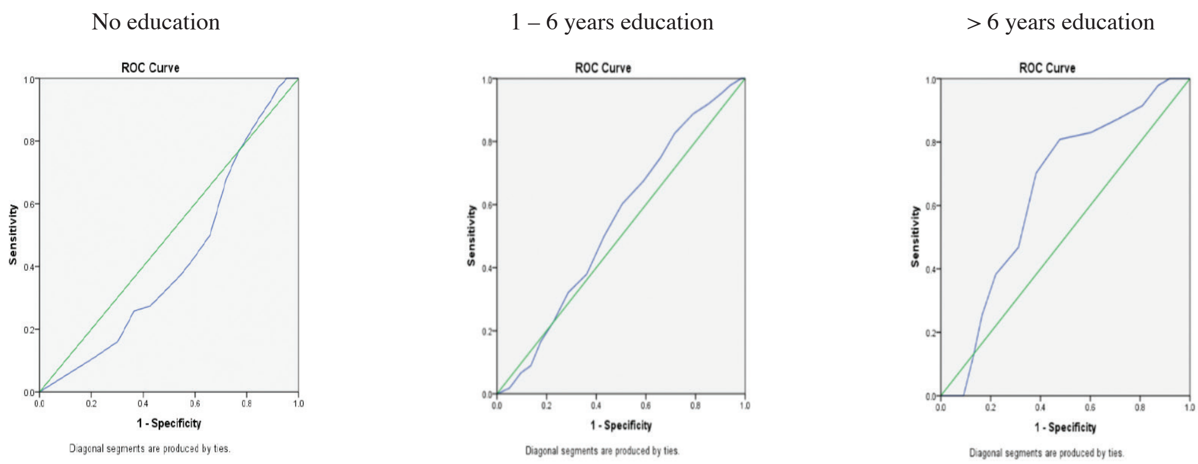

FIGURE 2. Receiver operating characteristic curve of MoCA according to different education groups

PSYCHOMETRIC PROPERTIES OF THE BAHASA MALAYSIA VERSION OF MONTREAL COGNITIVE ASSESSMENT

The internal consistency of MoCA-BM in this community-based study is moderate with the Cronbach's alpha score of 0.691. The concurrent validity of MoCA-BM with the M-MMSE was high (r = 0.741).

THE EFFECTS OF GENDER, AGE, EDUCATION, PHYSICAL FUNCTIONING AND MOOD ON MOCA-BM TEST PERFORMANCE

The relative contribution of gender, age, education, physical functioning and mood on MoCA-BM test performance was examined using multiple regression analysis. Education has strong influence on MoCA performance. No education was associated with more than 5 point decrement in MoCA score while 1 to 6 years education was associated with 3 point decrement in MoCA score. Age, gender and mood were associated with < 1 point decrement of MoCA score. Physical functioning was associated with better MoCA performance with the highest contribution toward MoCA score (R^2 = 0.190), followed by education (R^2 = 0.07) while mood has the least effect on MoCA score (R^2 = .001) (Table 2).

DISCUSSION

The study showed that MoCA-BM is a reliable and valid screening tool for MCI among older adults in the community with lower optimal cut-off in detecting MCI compared to the original MoCA. The optimal cut-off in this study is slightly lower than the elderly in Hong Kong, China or Korea. However, these studies adopted a lower level of education adjustment to 6 years of education to add 1 point to the total score of MoCA. The reason for lower cut-off score for MoCA-BM is partly due to the participants' level of education whereby a sizeable number of them are illiterate and also due to the stringent adjustment for covariates in our study. MoCA-BM is considered a reasonably good screening test for MCI comparable to the M-MMSE. Different studies also reported varying cut-offs depending on the different education levels, language, culture and population being studied (Ng et al. 2015) ranging from 20/21 to 23/24 (Wu et al. 2013; Yu et al. 2012; Zhou et al. 2014).

A local study conducted among primary care clinic elderly attendees using MoCA-BM cut-off score of 22/23 and M-MMSE cut-off score of 25/26 as a comparative screening tool showed a high prevalence of MCI of 55.6% and 32.8%, respectively (Razali et al. 2014). Another local study using MMSE cut-off score of 21/22 for MCI had also showed a high prevalence of MCI among medical clinic elderly attendees (Razali et al. 2012). Besides low education (Ibrahim et al. 2009; Razali et al. 2012), their medical health status could have contributed to the high prevalence of MCI.

The diagnosis of MCI in the study followed the current criteria by Petersen et al. (2014) and DSM-V making it more stringent than the previous research. The DSM-V criteria by the American Psychiatric Association (2013) for mild neurocognitive disorders (NCD), almost resemble that of MCI criteria which include four features: Clinical concern raised by the patient or an informant, or observations made by the clinician; cognitive impairment in one or more cognitive domains preferably relative to appropriate normative data for that individual; preservation of functional independence; and no dementia. We also adjust for depressive symptoms that may affect the cognitive performance of the person. As suggested by Petersen et al., we have used a battery of neuropsychological test such as the Rey Auditory Verbal Learning Test to assess verbal memory, Digit Span and Digit Symbol from the WAIS to assess for attention and psychomotor speed and the Trail Making Test to assess for executive function.

The MoCA-BM test performance among older adults in this community study was very much influenced by their education level and physical functioning. Many of the elderly in the community in Malaysia are illiterate or have no formal education (Table 2). This brings down the MoCA score more than 5 points. Those with 1 to 6 years of education also affect the performance of MoCA by 3 points. Those with 6 years and more education performed better on MoCA compared to those with less than 6 years education. The results supported the findings for those less than 6 years of education among older Singaporean Chinese and elderly in China (Ng et al. 2015; Zhou et al. 2014). Those with more than 6 years of education performed in unpredictable manner in several studies (Ng et al. 2015; Wu et al. 2013) whereby they performed poorly on MoCA compared to those less than 6 years of education. This was explained by similar performance on

TABLE 2. Regression model estimates of the relative contributions of gender, age, education, mood and physical functioning on MoCA-BM

	B	SE	Beta	t	p	R^2
(Constant)	21.969	1.446		15.194	.000	
Gender (vs female)	-.471	.189	-.046	-2.497	.013	.001
Age	-.107	.016	-.125	-6.558	.000	.012
No education (vs 6 years)	-5.584	.312	-.415	-17.873	.000	.077
1-6 years education (vs 6 years)	-3.043	.218	-.296	-13.938	.000	.070
GDS	-.089	.041	-.040	-2.192	.029	.001
IADL	.676	.045	.284	14.954	.000	.190

MoCA domains of naming, attention, language, abstraction and orientation between MCI and normal elderly especially those with more than 6 years of education in Singapore and China.

Physical functioning was known to be one of the neuroprotective factors of cognitive impairment. In this study, activities of daily living were found to be the highest contributor of MoCA performance using stepwise regression analysis (Table 2). Despite the well-known relationship between increased physical activity and cognitive ability for centuries, the underlying mechanisms were not clear (Phillips et al. 2014). Recent evidence suggests that physical activity offers an affordable and effective method to improve cognitive function in all ages, particularly the elderly who are most vulnerable to neurodegenerative disorders. The parallel relationship between physical activities and cognitive performance was due to the common biological changes and underlying age-related decline shared by both physical and cognitive functioning (Clouston et al. 2013).

Physical activity improve cardiac and immune function, alters trophic factor signaling and in turn, neuronal function and structure in areas critical for cognition (Phillips et al. 2014). Cognitive performance was found to be associated with muscle strength (Alfaro-Acha et al. 2006), balance ability and mobility (Blankevoort et al. 2013). A study by Won et al. (2014) on the relationship between different types of physical function (i.e. ten step test for agility, short physical performance battery test for an overall physical function, static balance test using a Pro-Balance board and dynamic balance using the Functional Reach Test) and different measures of cognitive performance (i.e. the Mini Mental State Examination, Clock Drawing Test, Rey Auditory Verbal Learning Test, Digit Symbol Test, Digit Span Test, Matrix Reasoning Test and Block Design Test) among 164 older adults in Malaysia found a negative and significant correlation between agility with Digit Symbol Test, Clock Drawing Test, Matrix Reasoning Test and Block Design Test. A significant positive correlation was also found between dynamic balance, Digit Symbol Test and Matrix Reasoning Test. Agility test appeared as a significant predictor of a few cognitive performance that included Digit Span Test, Clock Drawing Test and MMSE. The results suggested that a decline in most cognitive performance can be predicted by lack of involvement in a more demanding physical performance measure such as ten step agility test among community dwelling older adults. The results of the study suggested the benefit of a more complex and cognitively challenging exercises and activities for maintaining optimal cognitive performance among older adults.

Other variables such as gender, age and depressive symptoms have weak and negative relationship with cognitive function of the elderly but the relationships were significant probably due to the large sample size in this study. These variables also did not contribute much to the cognitive outcome.

The strengths in this study include involvement of a large number of community elderly populations all over Malaysia, the use of the new MCI criteria by Petersen and the adjustment of several covariates. However, this study has several limitations. One of the limitations in conducting the MoCA-BM test was due to the language factor as the study involved different ethnic groups. Education level also has a strong effect on the performance of the test. Financial status and the presence of co-morbidities were also not controlled to determine their effect on cognitive status of the Malaysian elderly in the community.

In conclusion, the MoCA-BM is a reliable and valid instrument to assess cognitive impairment of the older adults and has modest accuracy for detecting MCI among a community-dwelling older population in Malaysia. The MoCA-BM has lower optimal cut-off score compared to other elderly in Asian countries due to their education level and adjustment of several covariates.

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