Original article:

The Montreal Cognitive Assessment (MoCA-Ina) versus the Mini-Mental State Examination (MMSE-Ina) For Detecting Mild Cognitive Impairment among The Elderly

Ida Untari[1], Achmad Arman Subijanto[2], Diah Kurnia Mirawati[2], Rossi Sanusi[3,]

Abstract:

Background: There are many neuropsychological instruments are used for screening cognitive functions in adults, with or without health problems such asthe MMSE-Ina and MoCA-Ina. ***Objectives:***This study was designed to test the correlations and differences between MMSE-Ina and MoCA-Ina for early detection of decreasing cognitive function in the elderly. ***Methods:*** Total 278 subjects were randomly selected from the 17 sub dictricts of Surakarta Municipality, Central Java, Indonesia. Data collection was carried out in December 2018 and January 2019, withall subjects individually interviewed using two cognitive tests (which lasted 30 – 45 minutes) along with physical and neurological examinations. The MMSE-Ina and MoCA-Ina scores of each participant were correlated using the non-parametric Spearman rank test. Both scores were compared based on level of education and gender. ***Results:*** The MoCa-Ina detected using MCI was 215 (77.3%) while MMSE-Ina was 189 (68%), with 176 (63.3%) in severe 10 (3.5%). This study also showed a strong correlation between the MMSE-Ina and MoCA-Ina scores ($r = 0.633$ $p < 0.000$). The cut pointin this study were 23/24 for the MMSE-Ina and 25/26 for the MoCA-Ina which was less than 23 and 25, indicated cognitive impairment. ***Conclusion:*** The MoCA-Ina is usedto screen cognitive impairment in the elderly.

Keywords: Correlation, MMSE-Ina, MoCA-Ina, Elderly, Mild Cognitive Impairment.

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Introduction

The increasing in elderly population, led to a rise in their health problems such as the decline in cognitive function of their geriatric syndromewhich requires serious treatment. Therefore, cognitive impairment is a common problem in the elderly which is associated with age. It has an occurrence rate of approximately 21.5–71.3 per 1,000 persons[1]. Mild cognitive impairment (MCI) rates ranges from 3% to as high as 42% in population studies, and 8 6% to 85% in clinical settings[2,3]. The MCI conversion rate to dementia is 10% per year which is increased to 80%–90% after approximately 6 years. It is estimated that a new case of dementia is added each 7 seconds, withits prevalence in the elderly population between 1% to 2% per year 11,29. According to analysis, the number of cases in developing countries,is likely to increase by 100% between 2001 and 2040. Furthermore, it is likely to increase from 9.4% in 2000 to 23.5% by 2050 adults above 60 years [4]. The prevalence of MCI increased with age, from 4.5% for people in their 60s, to 7.1% for those in their 80s[5].

MCI is common in the elderly and impacts on prognosis and quality of life[6-9]. The areas of cognitive impairment which is occured at this stage primarily involve attention, verbal fluency, executive function and visuo-spatial skills which differs from language and memory skills that are Ecommonly associated with dementia[10]. MCI is commonly defined as cognitive impairment consisting of global functioning without dementia. Many researchers consider it as a transitional stage between the natural aging and

1. Graduate Program, Departement of Public Health, Universitas Sebelas Maret, Surakarta, Indonesia and Institut Teknologi Sains & Kesehatan PKU Muhammadiyah, Surakarta, Indonesia
2. Departement of Public Health, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
3. Departement of Public Health, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia

Correspondence to: Graduate Program, Departement of Public Health, Universitas Sebelas Maret, Surakarta, Indonesia and Institut Teknologi Sains & Kesehatan PKU Muhammadiyah, Surakarta, Indonesia
E-mail: idauntari@itspku.ac.id

dementia[11]. Early identification and intervention tends to help slow down the development of dementia, with its prevalence about four-times greater. Petersen et al was the pioneer that introduced MCI, with its characteristics associated with the decline and disturbance of cognition, minimal impairment of complex activities, ability to perform regular daily functions, and absence of dementia[12]. Typically, this memory impairment is at a greater decline rate than expected for an individual's age and educational level without impairing daily activities with the ability to impact on the prognosis and quality of life[13].

The Mini-Mental State Examination (MMSE) has been widely used for more than 30 years as a screening instrument for the development of cognitive disorders[17-19]. This has proven to be very useful in the evaluation of delirium and cortical dementia such as Alzheimer's (AD). However, it is less useful in detecting milder forms of cognitive impairment such as MCI, and in the evaluation of frontal/subcortical dementia[20-24]. Montreal Cognitive Assessment (MoCA) in a number of studies that are superior to MMSE in detecting non-cortical dementia such as Parkinson's disease [20,21].

There are many neuropsychological instruments was used for screening cognitive functions, and indiagonizing adults with health problems such asthe MMSE and MoCA. MMSE was introduced by Folstein et al [10,14]while MoCA was introduced by Nasreddine and colleagues in 2005[14,15].

In its development, the Mini-Mental State Examination (MMSE) has been widely used for more than 30 years as a screening instrument for cognitive disorders[17-19]. This has proven to be very useful in the evaluation of delirium and cortical dementia such as Alzheimer's (AD). However, it is less useful in detecting milder forms of impairment such as MCI, and in the evaluation of frontal/subcortical dementia[20-24]. MoCA in a number of studies that are superior to MMSE in detecting MCI and non-cortical dementia such as Parkinson's disease [20,21].

This study therefore was designed to test the correlations and differences between MMSE-Ina and MoCA-Ina for early detection of decreased cognitive function in the elderly.

Methods.

This was a cross sectional study of 278 subjects which were randomly selected from 17 sub dictricts of Surakarta municipal Central Java, Indonesia. Data collection was carried out in December 2018 and January 2019. The inclusion criteria were adults above 60 years, fluent speakerof the Indonesia language, those able to read, write, and give written informed consent. Medically unstable (delirium) subjects with other psychiatric disorders, and aphasia were excluded from the study.All subjects were interviewed individually using two cognitive tests (which lasted 30 – 45 minutes) along with physical and neurological examinations. The demographic information collected includes age, sex, occupation, level of education, history of those with stroke, hypertension and diabetes mellitus. The MMSE-Ina and MoCA-Ina Scores were obtained, withall statistical procedures performed using SPSS. The MMSE-Ina and MoCA-Ina scores for each participant were correlated using the non-parametric Spearman rank test. Both scores were compared based on level of education and gender using the non parametris Mann Whiney Test. The study was performedand approvedby the Health Research Ethical Committee Medical Faculty of Universitas Sebelas Maret, Surakarta, with number: 278/UN27.6/KEPK/ 2018.

Results

A total of 278 subjects consisting of 38 (13,7%) males and 240 (86,3%) females were studied, with an average age of 67,5 ranging from 60 to 93 years old. There were. Majority had high school education (19 subjects, 6.8%), with 42 subjects, (15,1 %) with history of hypertension, 18 (6.5%) with Diabetes Mellitus and 2 (0.7%) with history of previous stroke. The demographic characteristics are shown in Table

Table 1. Demographic Characteristics

Characteristics	Number (%) (n = 278)
Sex:	
Male	38 (13.7)
Female	240 (86.3)
Age, mean ± SD, years	67.54 ± 6.387
Level of education:	
No school	25 (14.7)
Elementary school	48 (28.2)
Junior high school	42 (24.7)
High school	43 (25.3)
College/University	12 (7.1)
Residence:	
With family	271 (97.5)
No family	7 (2.5)
History of Sick:	

Characteristics	Number (%) (n = 278)
Asthma	3 (1.1)
Hypertension	42 (15.1)
Heart	11 (4)
Cholesterol	7 (25)
Musculo skeletal	1 (0.4)
Vertigo	3 (1.1)
Gastritis	10 (3.6)
Anemia	1 (0.4)
Uric acid	3 (1.1)
Cataract	3 (1.1)
Hypotension	1 (0.4)
Tuberculosis	1 (0.4)
Cancer	1 (0.4)
Stroke	2 (0.7)
Rheumatism	3 (1.1)
Diabetes mellitus	18 (6.5)
Healthy	168 (60.4)
MMSE, mean ± SD	23.37 ± 4.237
<24	189 (68)
≥24	89 (32)
MoCA, mean ± SD	22 ± 5,945
<26	215 (77.3)
≥26	63 (22.7)

The average MMSE-Ina score was 23,37 ± 4.237, while the MoCA-Ina was 22 ± 5.95. Both scores showed comparable result but MoCA-Ina hadlower average and a broader range of scores. The comparison between MMSE and MoCA-Ina scoresare shown in Table 2.

Table 2 Comparison between the MMSE-Ina and MoCA-Ina

No	Variable	Mean	Median	Modus	SD	Varians	Min	Max	p-value of Normality K-S
1	MMSE-Ina	23,37	23	23	4,24	17,95	1	30	0.000
2	MoCA-Ina	22	23	25	6,85	35,34	1	30	0.000

Note: K-S: Kolmogorov Smirnov Test.

This study also found a good correlation between the MMSE-Ina and MoCA-Ina scores (r = 0.633, p < 0.000). This finding is consistent with several previous studies onthe correlation between these scores in different clinical setting, such as patient rehabilitation centers (r = 0.695, p < 0.003),patients with Parkinson's disease (r = 0.740, p < 0.001)[16] and a clinical cohort (r = 0.820, p <0.001)[18]. A total of 24 cut points for the MMSE-Ina and 26 for the MoCA-Ina showed cognitive impairment. Although optimum sensitivity and specificity of MMSE-Ina probably vary depending on the patient's age and education level, a large body of literature suggests that a general cut point of 23/24 or 24/25 is appropriate for most primary care populations[3-6].

Table 3. MMSE-Ina and MoCA-Ina scores and cognitive impairment.

		MMSE-Ina			Total	r	p
		Unimp-airment (%)	Mild Impairment (%)	Severe (%)			
MoCA-Ina	Unimpa-irment	60	3	0	63	0,633	0,000
	Impairment	29	176	10	215		
	Total	89	179	10	278		

This study found a sufficient and positive correlationship between the level of education with cognitive function using MMSE-Ina as in the following table:

Table 4. Level Education and MMSE-Ina of Correlation

		MMSE-Ina			Total	r	p
		Unimpair-ment (%)	Mild Impairment (%)	Severe (%)			
Level Education	No. School	4	24	7	35	0,362	0,000
	Primary School	30	62	1	93		
	Junior hight School	20	42	2	64		
	Senior hight School	28	39	0	67		
	College	7	12	0	0		
	Total	89	179	10	278		

While the cognitive function using MoCA-Ina, found a sufficient and positive relationship between the level of educ0ation with cognitive functions as seen in the following table:

Table 5. Level Education and Mo CA-Ina of Correlation

		MoCA-Ina		Total	r	p
		Unimpairment	Impairment			
Level Education	No. School	3	32	35	0,436	0,000
	Primary School	14	79	93		

		MoCA-Ina		Total	r	p
		Unimpairment	Impairment			
	Junior hight School	14	50	64		
	Senior hight School	14	50	64		
	College	7	12	19		
	Total	63	215	278		

This study found a sufficient and inverse correlationship between gender and cognitive function using MMSE-Ina as seen in table 6.The cognitive function using MoCA-Ina found no correlationship with genderas seen in table 7.

Table 6. Gender and MMSE-Ina of Correlation

		MMSE-Ina			Total	r	p
		Unimpairment (%)	Mild Impairment (%)	Severe (%)			
Gender	Male	15	23	0	38	-0,122	0,042
	Female	74	156	10	240		
	Total	89	179	10	278		

Table 7. Gender and MoCA-Ina of Correlation

		MoCA-Ina		Total	r	p
		Unimpairment (%)	Mild Impairment (%)			
	Male	8	30	38		
Gender	Female	55	185	240	-0,048	0,428
	Total	63	215	278		

Discussion

Using the cross tab table between MMSE-Ina and MoCA-Ina as shown in table 3, it is analyzed that the elderly were still normal using MMSE-Ina with cognitive impairment of 29 (13.5%) while experiencing interference with the MMSE-Ina at MoCA-Ina Only 3 (4.8%). The finding in MMSE-Ina is less sensitive than the MoCA-Ina for the elderly. More participants were identified with cognitive impairment by MoCA-Ina with 215 (77.3%) compared to MMSE-Ina which had 189 (68%). In the cognitive function impairment specification, MMSE-Ina consists of a group of severe disturbances which do not belong to MoCA-Ina, where severe disturbances are identified as 10 (3.6%). Correlation between the two instruments was fairly good at the value of r: 0.633 p: 0,000 <0.05. This shows that both tends to be used in early detection of impaired cognitive function.

The correlationship between the level of education and cognitive function in MMSE-Ina in tables 4 and 5 shows a fairly good and positive correlation where the higher the level of education, the higher the cognitive function score at r: 0.363, p: 0,000, and vice versa. Similarly, cognitive function in MoCa-Ina is the same as MMSE-Ina with a good correlationship value of r: 0.436, and p: 0,000. These findings add to the evidence that the duration of education is a factor associated with impaired cognitive function of dementia or Al-zheimer Desease[17-19].

Gender correlations with cognitive function on MMSE-Ina in tables 6 and 7 shows a weak and inverse correlation where elderly women tend to experience impairment than men with a value of r: -0.122, p: 0.042. Unlike the gender correlation with cognitive function in MoCA-Ina there is no correlation with r: -0.048, p: 0.428. This finding shows that all elderly men and women experience cognitive impairment.

Interestingly in this study, the proportion of subjects with cognitive impairment was found to be higher than normal subjects, as in table 1. Although this is attributed to the history of previous disease with hypertension at 42 (15.1%) and diabetes mellitus at 18 (6.5%). The residence of the elderly with family of 271 (97.5%) becomes a factor associated with their cognitive function. Living with extended family types helps them to communicate, interact and socialize in their languages to train the innervation of the brain[20-22].

There were no statistical differences between these groups, which indicate the importance of screening the cognitive function in every day clinical practice. Early detection of cognitive impairment which indicates the transition to Alzheimer Desease (AD) tends to improve diagnosis and lead to better management of the disease. The basic purpose of cognitive screening tests is to indicate a likelihood of its impairment which is inferred by comparing the patient's score to reference norms. An impaired score, along with supporting history and clinical findings helps a clinician to make a diagnosis.While a borderline score may need further investigation, Cognitive screening test is not intended to substitute a full neuropsychlogical assessment but is used to obtain a key for impaired domain in patients[23].

The poorer performance of the MMSE-Ina at detecting cognitive impairment (CI) tends to be due

to several factors, as shown by an earlier study in acute stroke[24-26].The MMSE-Ina is less capable of testing for complex cognitive impairments in domains such as visuospatial, executive function and abstract reasoning. In addition, the MMSE-Ina subtests of Attention and Delayed Recall contain test items which are not as challenging as contained in the MoCA. For example, the MMSE-Ina test is serial 7 while the MoCA-Ina includes 2 additional tests (Digit Span and Vigilance). Similarly, the 3-item Delayed Recall in the MMSE-Ina is less difficult than 5-item Delayed Recall in the MoCA-Ina. In view of the restrictions of the MMSE-Ina, a brief executive function assessment (the trail-making test or digit symbol test) has been recommended to supplement the MMSE-Ina to improve itsbedside cognitive assessment[27]. The visuo-executive function (Trail B, Cube and Clock) tests in the MoCA-Ina distinguished between three groups of differing cognitive screening test results and hence is usedto screensub acute stroke participants. As shown in recent studies, cognitive impairment in visuo-executive function predicts poor survival after stroke[28], whilst the severity of CI is associated with incident dementia[16], therefore, its early detection by MoCA-Ina screening allows clinicians to intervene and improve prognosis. From findings, MoCA-Ina is superior to the MMSE-Ina particularly for the detection of deficits, and visuo-executive function.However, analyses are in accordance with recent findings from a community based sample of stroke patients[28], where the MoCA-Ina was shown to pick up more deficits in executive function. The disproportionate number of male participants, which is an artifact of the convenience sampling method was the study's limitation.

Conclusion

The MoCA-Ina is currently used for cognitive impairment screening in the elderly. However, further studies are required.

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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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