Original Article

The Predictive Value of Revised Petersen's Criteria in Detection of Mild Cognitive Impairment in A sample of Community-Dwelling Egyptian.

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Abstract
Background: Mild cognitive impairment is a condition that progresses to dementia in most of the cases. Early detection and management with correction of modifiable risk factors is the only way to reduce the burden of dementia. Hence, using proper screening tools for mild cognitive impairment are warranted. This study aimed to test the validity of revised Petersen's criteria in the screening for mild cognitive impairment among a sample of community-dwelling Egyptian elderly.
Methods: A cross-sectional study including 106 elderly patients was done. Montreal cognitive assessment (MoCA) test was used as the gold standard test to diagnose mild cognitive impairment (MCI). Revised Petersen`s criteria were applied to all participants. Patients with dementia, depression, severe hearing or visual impairment, physical or neurological disease that hinder their ability to perform the tests were excluded from the study.
Results: Prevalence of MCI in the study sample was 70.8% using MoCA. Compared to MoCA, Revised Petersen criteria had high specificity (90.3%) and positive predictive value (92.7%), but low sensitivity (50.7%).
Conclusion: The Arabic version of MoCA cut-off points need to be re-evaluated in Egyptian population as it is unlikely that percentage of MCI among community-dwelling elderly be that high (70.8%). With such a low sensitivity, revised Petersen's criteria cannot be used for screening of MCI. It can be applied for confirmation of MCI cases (Specificity 90%).
Keywords: MoCA, Mild cognitive impairment, revised Petersen's criteria, Elderly, Egyptians.

Introduction

Mild Cognitive Impairment (MCI) is considered a transitional phase preceding the onset of dementia. It is characterized by cognitive changes that are more than would be expected with normal aging, but they do not substantially affect functional independence (1). Mild cognitive impairment is frequently identified through brief screening tools in the clinical setting, especially primary healthcare centers (2). A recent meta-analysis reported that up to 19.7% of community dwellers aged over

50 years were affected by MCI worldwide (3).

Studies have demonstrated that MCI is a heterogenous syndrome, with several underlying factors contributing to the cognitive decline (4-5).

Studies have proposed that vascular risk factors and vascular disease indicators not only contribute to the development of vascular dementia but also Alzheimer's disease (AD). Milder forms of cognitive impairment have also been linked to such vascular risk factors (6-8).

Preventing dementia greatly depends on the early intervention of cognitive impairment. Cognitive impairment can result from structural and functional alterations in the brain caused by cerebral hypoperfusion (9).

For the early diagnosis of AD and MCI, screening is crucial. MoCA was developed as a screening tool to be used by a qualified health professional in order to distinguish between MCI, dementia and normal cognitive function. It takes approximately ten minutes to complete. MoCA has a high sensitivity for detecting MCI in patients who would score as normal on the Mini-Mental State Examination (MMSE). Using a cut-off of 26 for MCI MoCA had a sensitivity of 90% whereas the MMSE had a sensitivity of only 18% (10-11).

Despite being widely used, some studies have revealed that the original MoCA cut-off score of 26 particularly for older and/or low educated individuals, results in a higher rate of false positive misclassification. Furthermore, it has been argued that the education one-point correction is inadequate to take into consideration variations in education (12-14)

By proposing criteria based on an observational study of aging, Petersen and colleagues (1999) developed their criteria for detection of MCI cases. Their efforts were supported by the emerging clinical need for a diagnosis that goes beyond the simple binary distinction between dementia and absence, as this could allow an earlier diagnosis and secondary prevention (15).

In this study we test the validity of Petersen's criteria as screening tool for MCI in community-dwelling Egyptian elderly attending the Geriatric outpatient clinic in both Ain Shams and El-Mansoura University Hospitals.

Methods

Study design

A cross-sectional observational study.

Study Population and setting

Sample size: One hundred and six (106) elderly people participated in the study.

Site and timing of recruitment: Participants were recruited from the outpatients' clinics of El-Mansoura and Ain shams University hospitals between April 2021 and April 2023.

Inclusion criteria included: Elderly male and female participants 60 years and above, with more than 4 years of formal education.

Exclusion criteria included:

- Patients with history of dementia and on anti-dementia medications or those with a MoCA score less than 21 (10).
- Depression detected using the short form of Geriatric Depression Scale (GDS 5) cut-off value (depressed: ≥ 2) (16), or psychosis.
- Patients with functional disability hindering writing and drawing,
- Patients with sensory impairment (visual and hearing impairment) severe enough to interfere with the assessment,
- Patients with neurological disorders affecting comprehension, communication (like aphasia) or movement.

Clinical Assessments

All participants were subjected to a semi-structured interview questionnaire including socio-demographics and medical characteristics.

The Montreal Cognitive Assessment (MoCA) test: Before inclusion in the study, every participant was assessed using MoCA to verify his cognitive status. MoCA was used in this study as the gold standard to which revised Petersen's criteria were compared. It is a 30-point test measuring short-term memory recall, visuospatial abilities, executive functions, language, calculation, orientation and attention. The rater adds 1 point to the score of patients with ≤ 12 years of education. Participants with scores ≥26 were considered to have normal cognition, those with score <26 but ≥ 21 were considered as having MCI and those with scores less than 21 were diagnosed as dementia and excluded from the study (10).

Diagnosing MCI according to revised Petersen`s criteria 1) Change in cognition recognized by the affected individual or observers. 2) Objective impairment in one or more cognitive domains. 3) Preservation of independence in functional activities and 4) Absence of dementia (17). The criteria were applied using history and Arabic version of MMSE (18-19).

Statistical Analyses

Version 28.0 of IBM SPSS statistics (Statistical Package for Social Sciences), IBM Corp., Chicago, USA, 2021, was used to code, tabulate, and statistically analyze the collected data. To verify that quantitative data was normal, the Shapiro-Wilk test was performed. The data was then described as mean ±SD (standard deviation) and the minimum and maximum values within the range. An independent t-test was used to compare the results. Chi square testing is an effective method for comparing qualitative data with a percentage basis and numerical data. When the p- value was less than 0.050, it was considered significant; if not, it was considered non-significant.

Ethical consideration:

Prior to their enrollment in the study, each subject provided an informed consent. The Ain Shams University Faculty of Medicine's Ethical Committee revised and approved the study protocol (FMASU MS 111/2021).

Results:

The mean age of the participants was 65.0 ± 4.6 years range (60.0 – 77.0 years). Males constituted most of the study sample (77.4%) and 49.1% had an education of ≤12 years (49.1%). More than half (52.8%) never smoked, 66% had Diabetes mellitus, 61.3% had hypertension and 34.9% had coronary heart disease (Table 1).

Table (1): Socio-demographic and medical characteristics among the studied cases.

Characteristics		Mean±SD	Range
Age (years)		65.0±4.6	60.0–77.0
		n	**%**
Sex	**Male**	82	77.4%
	Female	24	22.6%
Education duration	**≤12 years**	52	49.1%
	> 12 years	54	50.9%
Smoking	**Current**	33	31.1%
	Ex-smoker	17	16.0%
	Never	56	52.8%
Comorbidities	**Diabetes mellitus**	70	66.0%
	Hypertension	65	61.3%
	Coronary heart disease	37	34.9%
	Chronic liver disease	17	16.0%
	Deep venous thrombosis	6	5.7%
	Hypothyroidism	5	4.7%
	Limb ischemia	4	3.8%
	Stroke	4	3.8%
	Chronic kidney disease	2	1.9%
	Arrythmia	2	1.9%

Total=106

MCI cases constituted 70.8% of the study sample according to MoCA test while only 38.7% were diagnosed using the revised Petersen's criteria (Table 2). Only 50.7% were classified as having MCI using both criteria, 9.7% were classified as MCI by revised Petersen's criteria but non-MCI by MoCA, and 90% agreement between tests was noted in exclusion of cognitive impairment (Table 3).

Table (2): Results of MoCA and Revised Petersen's criteria among the studied sample.

Test		Mean±SD	Range
MoCA	**Visuospatial function**	2.6±1.2	1.0–5.0
	Naming	2.6±0.5	2.0–3.0
	Attention	5.9±0.3	5.0–6.0
	Language	2.1±0.3	2.0–3.0
	Abstraction	1.0±0.5	0.0–2.0
	Delayed recall	3.8±0.7	2.0–5.0
	Orientation	6.0±0.0	6.0–6.0
	Total	24.5±2.0	21.3–29.6
		n	**n**
	MCI	75	70.8%
	Normal	31	29.2%
		n	**n**
Revised Petersen's criteria	**Positive (MCI)**	41	38.7%
	Negative (Normal)	65	61.3%

MoCA: Montreal Cognitive Assessment; MCI: mild cognitive impairment.

Table 3: Agreement between MoCA and revised Petersen's criteria in the diagnosis of cognitive status.

		MoCA		p-value
		MCI (n = 75)	**Normal cognition § (n = 31)**	
Revised Petersen's criteria	**Positive**	38 (50.7%)	3 (9.7%)	**#<0.001***
	Negative	37 (49.3%)	28 (90.3%)	

#Chi square test; *Significant.

When comparing MCI to normal cognition group, female gender was significantly more likely on the MCI group (P value = 0.01) and coronary heart disease was significantly less frequent in cases with MCI (p value = 0.020) (Table 4).

Table (4): Comparison between study groups regarding socio-demographic and medical characteristics.

Characteristics		MCI (Total=75)	Normal (Total=31)	p-value
Age (years)		64.9±4.3	65.2±5.3	^0.708
Sex	**Male**	53 (70.7%)	29 (93.5%)	**#0.010***
	Female	22 (29.3%)	2 (6.5%)	
Education duration	**≤12 years**	39 (52.0%)	13 (41.9%)	#0.346
	> 12 years	36 (48.0%)	18 (58.1%)	
Smoking	**Current**	20 (26.7%)	13 (41.9%)	#0.070
	Ex-smoker	10 (13.3%)	7 (22.6%)	
	Never	45 (60.0%)	11 (35.5%)	
Comorbidities	**Diabetes mellitus**	47 (62.7%)	23 (74.2%)	#0.254
	Hypertension	49 (65.3%)	16 (51.6%)	#0.187
	Coronary heart disease	21(28.0%)	16 (51.6%)	**#0.020***
	Chronic liver disease	14 (18.7%)	3 (9.7%)	§0.384
	Deep venous thrombosis	4 (5.3%)	2 (6.5%)	§0.999
	Hypothyroidism	4 (5.3%)	1 (3.2%)	§0.999
	Limb ischemia	3 (4.0%)	1 (3.2%)	§0.999
	Stroke	4 (5.3%)	0 (0.0%)	§0.319
	Chronic kidney disease	2 (2.7%)	0 (0.0%)	§0.999
	Arrythmia	0 (0.0%)	2 (6.5%)	§0.084

^Indepednent t-test; §Fisher's Exact test; #Chi square test; *Significant.

Table (5): Diagnostic characteristics of revised Petersen test in differentiating MCI from normal (based on MoCA test as a reference test).

Characteristics	Value	95% CI
Sensitivity	50.7%	38.9%–62.4%
Specificity	90.3%	74.2%–98.0%
Diagnostic accuracy	62.3%	52.3%–71.5%
Youden's index	41.0%	25.6%–56.4%
Positive predictive value	92.7%	80.1%–98.5%
Negative predictive value	43.1%	30.8%–56.0%

CI: Confidence interval.

Revised Petersen's criteria had high specificity (90.3%) and positive predictive value (92.7%), but low sensitivity (50.7%), this limits its rule in screening for MCI. So, it could be used to confirm MCI, not to exclude it. But this raises the concern that Arabic version of MoCA cut-offs may be very high and; hence, it overdiagnosis MCI.

Discussion

Early diagnosis of MCI is important to start preventive measures before the patients progress to dementia. This cross-sectional study aimed to assess the ability of revised Petersen's criteria to detect MCI among a sample of 106 community-dwelling elderly attending the outpatient clinics in El-Mansoura and Ain Shams University Hospitals.

Some validation studies found that the ideal cut-offs for MoCA varied depending on several factors. They suggested that a cut-off score of (26/30) is too high and increases false positive test results (20-22). Suggested cut-offs decreased with the number of years of education and were lower than the standardized cut-off. Luis and colleagues administered MoCA to community-dwelling older adults in the Southeastern United States; the results showed that MoCA had a significantly higher sensitivity and specificity (96% and 95%, respectively) to distinguish between cognitive impairment and normal cognition, with a lower cut-off of (23/30) than the suggested cut-off of 26 (97% and 35%, respectively) (23). A systematic review concluded that reducing MoCA cut-off to (23/30) produced the most accurate diagnostic accuracy across a variety of parameters and lowers the false-positive rate (12).

Another cut-off was suggested in a meta-analysis which was (24/30). It was considered as optimal, with a sensitivity of (80%) and specificity of (81%) (24). A study evaluating African Americans attending an urban outpatient memory clinic used cut-off scores of ≤ 24 points for MCI and ≤ 22 points for dementia. They found MoCA had 95% sensitivity and 63% specificity for MCI and 96% sensitivity and 88% specificity for dementia (20). Using the Korean version of MoCA (MoCA-K) in elderly outpatients, it demonstrated good specificity of 84% and

excellent sensitivity of 89% when screening for MCI with a cut-off score of (22/23) (25). In this study we used MoCA cut-off ≥26 as normal cognition and scores <26 but ≥ 21 as MCI. Using this cut-off resulted in 70.8% of the study population being categorized as MCI. On the same sample, using revised Petersen's criteria, only 38.7% of participants were categorized as MCI. These results- compared to MoCA- revealed a sensitivity of 50.7%, specificity of 90.3% and positive predictive value of 92.7%. The reported prevalence of MCI in Egypt is 34.2 and 44.3% in men and women, respectively (26). A study to evaluate revised diagnostic criteria for mild cognitive impairment (Petersen/Winblad criteria) of the 308 subjects found that 45% had MCI by MCI-R and 7.4% had MCI by original Petersen's criteria. A significantly better prediction of transition to dementia was obtained with MCI-R than with the original Petersen criteria with sensitivity (95%, 5%), specificity (66%, 91%) respectively (27).
The present study had shown that MCI was more frequent in female cases. Other studies found females more prone to MCI as well (28-29).
Cardiovascular risk factors, such as hypertension, raise the risk of AD and cognitive decline (30). Midlife high blood pressure is considered a risk factor for late-life cognitive impairment and dementia (31). Yet, few studies found no relationship between the hypertension and mild cognitive impairment (28,32). Our study found that hypertension is more frequent in MCI but that was not statistically significant.
Our study found that coronary heart disease (CHD) is not associated with MCI and may not contribute to cognitive impairment. Despite wide evidence of association between CHD and cognitive impairment (33-34), a Chinese study found no association between MCI and CHD (28). One cohort study concluded that heart diseases detected in middle age do not increase the risk of dementia or AD later, and only heart diseases as late-life HF, but not CHD do so (35), Another study found no consistent correlation between CHD and cognitive impairment (36).

Conclusion

A high percent of the study sample suffered MCI according to MoCA (70.8%) while only 38.7% had MCI using revised Petersen's criteria. MoCA test cut-off points in minority populations or Arabic population with different cultures in low- and middle-income countries including Egypt need to be re-evaluated. Also, correlation between MoCA test and Revised Petersen's criteria should be re-evaluated if new cut-off points were produced for MoCA (according to age and education).

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