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Original Research Article

Validity and performance of cognitive scales in elderly patients with depression in a tertiary care hospital in Chennai

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ABSTRACT

Background: Late-life depression in older adults can cause reversible cognitive impairment, often resulting in pseudo-dementia. Cognitive impairment can lead to executive dysfunction, reduced flexibility, and difficulty thinking and decision-making. This study aimed to assess the validity and performance of cognitive scales in late-life depression among patients attending the outpatient department of the institute of mental health, Chennai.
Methods: This prospective study included 360 patients aged >50 years who were diagnosed with depression and attended the OPD at the institute of mental health, Chennai. Baseline assessments were performed at the time of recruitment into the study (visit 1), and scheduled visits were performed every six months for two years (visits 2 to 5). Unscheduled visits were done every month, and adverse events were monitored and recorded periodically
Results: Among 59 patients, 53.1% were female, 32.2% were diabetic, and 93.9% were experiencing subjective working difficulties. The Montreal cognitive assessment scale classified 51.4% as moderate, while the ADAS-cog and ACE scales classified 86% and 99.7%, respectively, as having abnormal mental status. However, a significant correlation and discrepancy between scores were observed for scales such as ACE, ADAS-cog, standardised mini-mental status examination, and Montreal cognitive assessment scale. A strong correlation was found between ACE, MMSE, MoCA, and ACE; however, FAST showed a significant negative correlation. The MoCA was strongly correlated with the MMSE, ACE, ADAS-cog, and Mini-Cog, indicating good alignment with the FAST.
Conclusions: Cognitive scales strongly correlate with late-life depression in patients, suggesting an improvement in assessment, evaluation, and treatment to address cognitive deficits.

Keywords: Late-life depression, Cognitive impairment and the assessment scales, MoCA, MMSE, ACE, ADAS-cog, Mini-Cog

INTRODUCTION

In some elderly adults, late-life depression may exhibit reversible cognitive impairment (pseudo dementia).[1] Usually, severe late-life depression may exhibit mild cognitive impairment. In reality, it is difficult to distinguish between cognitive impairment due to depression and cognitive impairment due to neuropsychological causes. Major depressive disorder is often associated with cognitive problems and, at times, with loss of higher mental functions.[2] This may dominate the clinical picture and significantly impact the individual.[3] Depression can lower one's cognitive flexibility in adapting to changing situations and cause executive dysfunction, making it difficult to do something.

The difficulties in thoughts, attitudes, inference, recall and interpretation of information may be due to biased cognitive processing and dysregulation of emotions due to 3 mechanisms causing depressive cognition, inhibiting

process and deficits in working memory, reflective responses to negative mood, and inability to use positive, rewarding stimuli to regulate negative mood.[4] For people with severe depression, medications provide some relief from low mood, energy, and lack of sleep but not much relief from the cognitive impairment related to depression (lancet-May 2016). Remediation, along with antidepressants, yields better results in improving depression and cognitive impairment. Reversible cognitive impairment caused by physical illness can coexist with irreversible deficits and, hence, with true dementia and a partially independent dimension of depression. Over 70% of older people with pseudo dementia converted to true dementia.[2]

Depression is an emotional disorder that has cognitive components, such as reduced concentration and focus and difficulties in multiple cognitive domains.[5] This can be assessed by subjective and objective measures, which often overlap. The subjective is the patient's evaluation, and the objective is neuropsychological tests. Hot cognition has an affective bias that negatively impacts working memory and attention, and cold cognition deficits in executive dysfunction, attention, and memory independent of emotions. This is due to disrupting dopamine activity during memory coding to form stable memory.

Cognitive distortions in depression considerably affect the functioning of individuals and increase the recurrence of depression. Hence, it's important to evaluate the presence of pseudo dementia, identify the aetiology and treat medical illness, and use a multidimensional approach in care to patients with pseudo dementia.[4]

This study aimed to assess the validity and performance of cognitive scales in late-life depression among patients attending the outpatient department of the institute of mental health, Chennai.

METHODS

This prospective study was conducted on 360 patients aged >50 years who were diagnosed with depression and had attended the OPD at the institute of mental health, Chennai, for Two years.

Inclusion criteria

Patients aged > 50 years who were diagnosed with major depressive disorder according to the ICD 10/ DSM-5 criteria were included.

Exclusion criteria

Patients without MDD as a primary diagnosis, those with severe medical illness making it difficult to participate, people from outside Chennai, and uncooperative patients were excluded.

Those who fulfilled all inclusion criteria and none of the exclusion criteria were recruited into the study and followed up for two years. Baseline assessments (visit 1) were performed at the time of recruitment into the study, and scheduled visits were done every six months for two years (visits 2 to 5). Every month, unscheduled visits were performed to perform routine psychiatric reviews/medical examinations and obtain their medications. Adverse events were monitored and recorded periodically. The assessment tools included Mini cog, MMSE, ACE, MoCA, and ADAS-Cog.

Statistical analysis

Data were checked for duplication and outliers, and logical validation was conducted before analysis. All statistical analyses were performed using STATA v15.0 (Stata corporation, college station, TX, USA). Descriptive analysis summarized participant characteristics: frequency, percentage, median, and interquartile range. The Mann-Whitney U test was used for between-group comparisons of cognitive scores and other continuous variables. Internal consistency reliability was assessed by calculating Cronbach's alpha and item-total, item-item, and domain-domain correlations using Pearson's correlation analysis. Convergent and divergent validity were explored using Pearson's correlation matrix between the items and domains. Latent profile modelling was performed with varying latent classes ranging from two to five classes, utilizing random start values and 20 iterations. The fit of the four models was compared using Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (BIC). Based on these criteria, the model with the smallest AIC and BIC values was considered the best. Subsequently, we determined the expected classification for each individual in the dataset based on the predicted posterior class probabilities. Considering these predictors, the performance of each scale was evaluated using logistic regression to calculate predictive probability. The Youden index was used to determine the optimal cutoff of the scale score, which maximized the sum of the sensitivity and specificity minus 1. The data are presented as the sensitivity, specificity, and predictive value of a positive or negative depression scale. All statistical analyses were two-sided with a type I error set at α=0.05.

RESULTS

A total of 358 participants were interviewed using structured and standardized questionnaires. The median age of the patients was 59 years (range, 50-80 years). Among them, 53.1% were females, 32.2% had diabetes, 93.9% reported subjective working difficulties, and 1.1% experienced a complete decrease in organizational capacity. The Montreal cognitive assessment scale classified 51.4% as moderate and only 1.4% as normal, with a median score of 16 and a range of 0-30. The standardized mini-mental examination indicated that 93.0% had an abnormal mental status, with a median score

of 18 and a range of 0 to 30. ADAS-cog and ACE scales showed that 86% and 99.7% were classified as having an abnormal mental status. Similarly, the mini-cog also showed abnormal range scores in 94.1% of the participants (Table 1).

Table 2 shows correlation and comparison of factors and scale scores with FAST. Results indicated no significant correlation between age, sex, diabetes, and mini-Cog. However, significant correlation and discrepancy between scores observed for scales such as ACE, ADAS-cog, standardized mini-mental status examination and Montreal cognitive assessment scale.

Figure 1 shows sex differences in Montreal cognitive assessment scale, ACE, and standardized mini-mental status, but no differences in scoring patterns due to diabetes.

Table 3 shows a strong correlation between ACE and MMSE (rho: 0.895, p<0.001) as well as with MoCA (rho: 0.849, p<0.001) and ACE (rho: 0.529, p<0.001). However, FAST (rho: -0.443, p<0.001) also exhibited a significant negative correlation. FAST showed a significant negative correlation with all the scales. The MoCA was strongly correlated with MMSE (rho: 0.758, p<0.001), ACE (rho: 0.849, p<0.001), ADAS-cog (rho: 0.535, p<0.001), and Mini-Cog (rho: 0.387, p<0.001). Overall, all cognitive scales were well aligned and strongly correlated with FAST.

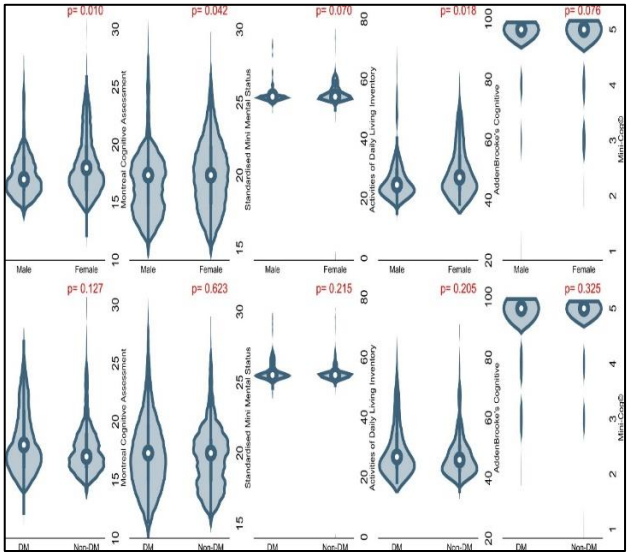

Figure 1: Comparison of cognitive assessment scores by gender and diabetes status of participants.

Table 1: Characteristics of study participants.

Variables		N	Percentage (%)
Age classification (In years)	≤55	69	19.27
	56-60	138	38.55
	61-65	75	20.95
	66-70	45	12.57
	>70	31	8.66
Gender	Male	168	46.93
	Female	190	53.07
Diabetes	Diabetes	115	32.21
	Non-diabetes	242	67.79
Montreal cognitive assessment scale classification	Normal (>25)	5	1.4
	Mild (18-25)	169	47.21
	Moderate (10-17)	184	51.4
	Score	16 (0, 30)	
Standardised mini mental status examination classification	Normal	25	6.98
	Abnormal	333	93.02
	Score	18 (0, 30)	
ADAS-cog	Normal (≤18)	50	13.97
	Abnormal (>18)	308	86.03
	Score	53 (0, 76)	
ACE scale	Normal (≥88)	1	0.28
	Abnormal (<88)	357	99.72
	Score	42 (0, 91)	
FAST	No difficulty	18	5.03
	Subjective work difficulties	336	93.85
	Decreased organizational capacity	4	1.12
Mini-Cog©-quick screening for early dementia detection classification	Normal (<4)	21	5.87
	Abnormal (≥4)	337	94.13
	Score	5 (0, 5)	

Table 2: Association of factors with functional assessment staging (FAST).

Variables		Functional assessment staging (FAST)						P value
		Normal, (n=18)		Abnormal, (n=340)		Total, (n=358)		
		N	%	N	%	N	%	
Age classification (In years)	≤55	4	22.2	65	19.1	69	19.3	0.055
	56-60	6	33.3	132	38.8	138	38.5	
	61-65	8	44.4	67	19.7	75	20.9	
	66-70	0	0	45	13.2	45	12.6	
	>70	0	0	31	9.1	31	8.7	
Age (In years)		59.5 (52.0, 65.0)		59.0 (50.0, 80.0)		59.0 (50.0, 80.0)		0.79
Gender	Male	8	44.4	160	47.1	168	46.9	0.829
	Female	10	55.6	180	52.9	190	53.1	
Diabetes	Diabetes	8	44.4	107	31.6	115	32.2	0.254
	Non-diabetes	10	55.6	232	68.4	242	67.8	
Montreal cognitive assessment scale classification	Normal (>25)	4	22.2	1	0.3	5	1.4	<0.001
	Mild (18-25)	10	55.6	159	46.8	169	47.2	
	Moderate (10-17)	4	22.2	180	52.9	184	51.4	
	Score	22.5 (15.0, 30.0)		17.0 (12.0, 26.0)		17.0 (12.0, 30.0)		<0.001
Standardized mini mental status exam classification	Normal	7	38.9	18	5.3	25	7	<0.001
	Abnormal	11	61.1	322	94.7	333	93	
	Score	23.0 (19.0, 30.0)		20.0 (15.0, 29.0)		20.0 (15.0, 30.0)		<0.001
ADAS-cog	Normal (≤18)	10	55.6	40	11.8	50	14	<0.001
	Abnormal (>18)	8	44.4	300	88.2	308	86	
	Score	59.0 (53.0, 76.0)		54.0 (00.0, 74.0)		54.0 (00.0, 76.0)		<0.001
ACE scale	Normal (≥88)	1	5.6	0	0	1	0.3	<0.001
	Abnormal (<88)	17	94.4	340	100	357	99.7	
	Score	63.5 (47.0, 89.0)		46.0 (35.0, 84.0)		46.0 (35.0, 89.0)		<0.001
Mini-Cog© quick screening for early dementia detection classification	Normal (<4)	2	11.1	19	5.6	21	5.9	0.331
	Abnormal (≥4)	16	88.9	321	94.4	337	94.1	
	Score	5.0 (1.0, 5.0)		5.0 (2.0, 5.0)		5.0 (1.0, 5.0)		0.004

Table 3: Correlation between the depression scales.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Age (in years)	1.000						
(2) Fast	0.085*	1.000					
	(<0.001)						
(3) MoCA score	-0.093*	-0.427*	1.000				
	(<0.001)	(<0.001)					
(4) MMSE score	-0.009	-0.449*	0.758*	1.000			
	-0.722	(<0.001)	(<0.001)				
(5) ADAS-cog score	-0.113*	-0.278*	0.535*	0.489*	1.000		
	(<0.001)	(<0.001)	(<0.001)	(<0.001)			
(6) ACE score	-0.018	-0.443*	0.849*	0.895*	0.529*	1.000	
	-0.457	(<0.001)	(<0.001)	(<0.001)	(<0.001)		
(7) Mini-Cog score	0.029	-0.485*	0.387*	0.538*	0.235*	0.459*	1.000
	-0.22	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	

Table 4: Sensitivity, specificity and predictive values at the recommended cutoff for the cognitive scales.

Scale	Cutoff (Score)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Accuracy (95% CI)	ROC (95% CI)
MoCA	20	86.5 (78.2, 93.3)	99.3 (98.1, 99.9)	97.0 (91.8, 99.6)	96.6 (94.2, 98.3)	96.6 (94.6, 98.3)	92.9 (88.9, 96.8)
MMSE	22	75.3 (65.6, 84.4)	97.2 (94.9, 98.8)	87.9 (79.4, 94.6)	93.5 (90.4, 96.0)	92.5 (89.5, 95.0)	86.2 (81.3, 91.2)
ADAS-cog	56	68.2 (58.6, 77.7)	97.8 (95.7, 99.2)	90.9 (83.2, 96.6)	90.4 (86.8, 93.5)	90.5 (87.3, 93.3)	83.0 (78.0, 88.0)
ACE	54	82.5 (73.8, 90.1)	100.0 (98.7, 100.0.)	100.0 (94.6, 100.0.)	95.2 (92.5, 97.4)	96.1 (93.9, 97.8)	91.2 (87.1, 95.4)

Continued.

Scale	Cutoff (Score)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Accuracy (95% CI)	ROC (95% CI)
Mini-Cog	4	31.7 (20.1, 48.1)	83.3 (79.1, 87.2)	19.7 (12.1, 31.3)	90.4 (86.8, 93.5)	77.4 (73.0, 81.6)	57.5 (50.0, 65.0)

PPV-Positive predictive value, NPV-Negative predictive value.

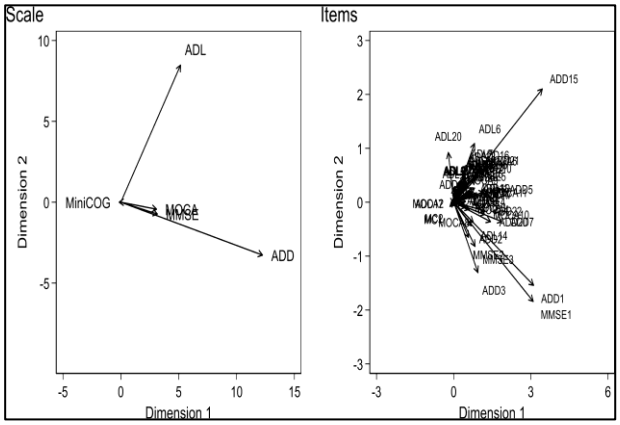

Figure 2: Correlation and correspondence between cognitive assessment scales and their assessment items.

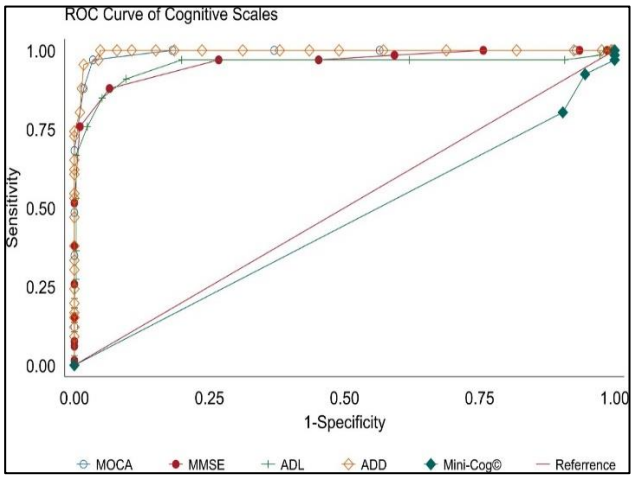

Figure 3: Receiver operating characteristic curve demonstrating the performance of cognitive scales.

Figure 2 illustrates the item-item and scale-scale correlations. MMSE strongly correlates with MoCA, while MoCA and MMSE correlate well with ADAS-cog, ACE, and Mini-COG. Similar trends were observed on the item scales. Convergent validity indicates that 87.5% of the items had a correlation coefficient with the score of their dimension greater than 0.40, and divergent validity indicates that 90.6% of the items had a correlation coefficient with the score of their dimension greater than those computed with other scores, clearly indicating that scales consist of similar core domains. The convergent and divergent validity of corresponding scales were evaluated, and convergent validity of the MoCA, MMSE, ADAS-cog, ACE, and mini-Cog was 81.8%, 100%, 95.7%, 77.3%, and 100%, respectively. Similarly, there was a 100% correlation coefficient for all scales' divergent validity.

Table 4 and Figure 3 display each scale's suggested cutoff and the sensitivity, specificity, and predictive values using latent class classification. The findings showed that the cognitive scales MoCA, ACE, MMSE, and ADAS-cog were deemed more valid and accurate among the participants, as they exhibited higher accuracy values. Conversely, the Mini-COG score was the least performing scale. These results are consistent with and support convergent validity, indicating a need for improvement in their items.

DISCUSSION

This study was conducted with 360 elderly patients with depression using structured and standardised questionnaires. Regarding Table 1, the median age of the participants was 59 years; 53.1% were females, and 32.2% were diabetic. On assessment, 93.9% had subjective work difficulties, and 1.1% experienced a complete decrease in organisational capacity. The various cognitive scales-MoCA (51.4% moderate and 1.4% normal and median score of 16), MMSE (93% abnormal and median score of 19), ADAS-cog (86%), and ACE (99.7%) had abnormal scores. This indicates that late-life depression (both reversible and irreversible) exhibits cognitive impairment, as proven by many studies in the past.[1,2]

As shown in Table 2, FAST, the functional assessment scale, was not significantly correlated with age, sex, diabetes, and mini cog. FAST has a significant correlation and discrepancy between score levels observed in the cognitive scales ACE, ADAS-cog, MMSE, and MoCA. (Figure 1), with scoring patterns with sex differences and not due to diabetes. This study shows that depression is being more than sad and has cognitive impairment leading to functional difficulties, which has been proven by earlier studies, too.[3]

Table 3 shows a strong correlation between ACE, MMSE, MoCA, and ADAS-cog. MoCA has a strong correlation with MMSE, ACE, and ADAS cog. However, the FAST was negatively correlated with all cognitive scales. This might explain how different the cognitive processes are related to each other and the emotional dysregulation-which is the hallmark of depressive cognition.[4]

Similarly, Figure 2 shows a strong item-item and scale-to-scale correlation between MMSE and MoCA. Both MMSE and MoCA have a good correspondence with ADAS-cog, ACE and Mini cog- with a convergent validity (87.5% items had a correlation coefficient of their dimension greater than 0.40) and divergent validity (90.6% items had a correlation coefficient greater than those computed with other scores)- indicating that all these scales consist of similar core domains.

The convergent validity of MoCA (81.8%), MMSE (100%), ADAS-cog (95.7%), ACE (77.3%), and Mini cog (100%) and 100% correlation coefficient for divergent validity for all the cognitive scales indicate that 80% to 100% of measures are closely related to the other scales and 100% divergent validity indicates that the measures that are not supposed to be related to are unrelated. This finding satisfies the requirement for excellent construct validity and paves the way to provide a creative solution to the problem of cognitive impairment in the depressed elderly. This has been discussed elaborately in earlier studies.[5-9]

Lastly, in Table 4, the cognitive scales MoCA, ACE, ADAS-cog, and MMSE were more sensitive and specific, with good predictive values that were more valid and accurate, exhibiting higher accuracy values, unlike the mini cog. These consistent results support convergent validity and indicate the need for improvement in the items in measure. This has been discussed in earlier studies, too.[8,10-13]

Limitations

This study was conducted in a tertiary care psychiatric institution, and the findings should be interpreted cautiously. This study was conducted over two years, and the course and severity of cognitive impairment could be better explained over a longer period.

CONCLUSION

In conclusion, various cognitive scales were strongly correlated with each other in measuring cognitive impairment in patients with late-life depression. The approach to the assessment, evaluation, and treatment of cognitive impairment in depression needs improvement to provide a creative solution to cognitive deficits in depression.

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