Executive Impairment and MoCA Performance in Patients with MCI and AD

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Objective

- To determine if patients with mild cognitive impairment (MCI) and mild Alzheimer's disease (AD) with high vs. low levels of executive impairment perform more poorly on the MoCA than the MMSE.
- To examine the relationship between the MoCA and MMSE and changes in frontal behaviors.

Background

- The MMSE may lack sensitivity to MCI.[1]
- MCI patients with executive impairment may be at greatest risk for conversion to a diagnosis of dementia,[2,3,4] highlighting the need to identify these individuals for early treatment when it might be most effective.[5]
- The MoCA was developed as an alternative to the MMSE and has been shown to differentiate more successfully between cognitively normal individuals and patients with MCI.[6]
- The increased sensitivity of the MoCA to MCI may be due to the additional executive items and more difficult memory assessment.[6]
- We compared the MoCA and MMSE performances of patients with MCI and mild AD with high vs. low levels of executive impairment (eMCI vs. MCI; eAD vs. AD).
- We also examined the relationship between MoCA performance and dysfunction in frontally-mediated behaviors.

Hypotheses

- MoCA scores will be significantly lower in the eMCI subgroup than in the MCI subgroup, but MMSE scores will be similar in the two subgroups.
- The eAD and AD subgroups will perform similarly on both the MoCA and the MMSE.
- MoCA scores will be strongly correlated with decline in frontally-mediated behaviors.

Methods

- Participants were normal elderly controls (NEC; n=10), patients with MCI (n=18), and patients with mild AD (n=20).
- All participants completed the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA)
- MCI and AD patients completed a battery of neuropsychological tests assessing their level of executive functioning.

- Executive tests:
  - Initiation/Perseveration from Dementia Rating Scale-2 (DRS-2)
  - Abstract Conceptualization from the DRS-2
  - Controlled Oral Word Association Test (COWAT)
  - Trail-Making Test, Part B (TMT-B)
  - Behavioral Dyscontrol Scale (BDS)
- Subgroup Assignment:
  - eMCI participants had impairment ($z \leq -1.0$) on ≥ 2 of the 5 executive measures in the battery
  - eAD participants had impairment ($z \leq -1.5$) on ≥ 3 of the 5 executive measures.
- Behavioral Assessment:
  - The Frontal System Behavior Scale (FrSBe).

Analysis

- Statistical tests included ANOVA, chi-square, student's t-tests, bivariate correlations, and discriminant function analysis.

Results

- The NEC, AD, and MCI groups (collapsed for executive dysfunction) did not differ significantly by sex or education.
- The AD group was older and performed more poorly on the MMSE and MoCA than the NEC and MCI groups.
- The NEC and MCI groups did not differ significantly by age, MMSE, or MoCA performance (Table 1).

Table 1: Demographics & Diagnostic group comparisons (Mean ± SD)

Variable	NEC (n=9)	MCI (n=18)	AD (n=20)	F	Overall p
Age	70.3±10.1[a]	70.7±7.5[a]	79.0±8.1[b]	5.92	.005
Education	15.2±4.1	15.0±2.7	14.1±2.4	.30	.740
MMSE	28.0±1.7[a]	27.9±1.4[a]	23.3±2.9[b]	16.24	<.001
MoCA	26.1±2.1[a]	23.8±3.1[a]	18.4±3.1[b]	16.44	<.001

Note: Superscripts with different letters identify groups that differed significantly from each other (p<.05) in post-hoc tests.

- Subgroup analyses
  - The eMCI group scored significantly lower on the MoCA than the MCI group, but the groups performed similarly on the MMSE (Table 2).
  - The AD and eAD groups did not differ significantly in their performances on the MoCA, but the eAD group showed a statistical trend to perform more poorly on the MMSE (Table 2).

Table 2: MCI vs. eMCI & AD vs. eAD (Mean ± SD)

	MCI (n=10)	eMCI (n=8)	t	Overall p
MMSE	28.3±1.3	27.4±1.4	1.43	.17
MoCA	25.3±3.2	22.0±1.9	2.72*	.02
	AD (n=10)	eAD (n=10)	t	p
MMSE	24.5±1.5	22.1±3.4	2.02*	.07
MoCA	19.2±2.6	17.6±3.5	1.16	.26

*equal variances not assumed

- Classification analyses
  - DFA showed that the MoCA but not the MMSE discriminated eMCI from MCI (Canonical corr (MoCA) = .54, Wilk's λ = .71, p = .02)
  - A parallel DFA was not significant for the eAD vs. AD subgroup discrimination (p = .18)
- MoCA Item Analysis
  - The eMCI subgroup performed significantly more poorly than the MCI subgroup on memory items and on visuospatial/executive/abstraction items (Tables 3 & 4)
  - Visuospatial/executive/abstraction items were the best discriminator between the eMCI and MCI subgroups (canonical corr = .65, Wilk's λ = .56,, p = .003)

Table 3: Cognitive domains assessed in MoCA

Cognitive Domain	Items on the MoCA that assess this domain
Visuospatial / Executive / Abstraction	Trail-making, cube copy, clock drawing, and similarities
Language	Naming, repetition, and fluency
Attention	Digit span, vigilance, and serial subtraction
Memory	5-word delayed recall
Orientation	Orientation to time and place, comprised of 6 components

Table 4: MoCA Domains in MCI vs. eMCI

	MCI (n=10)	eMCI (n=8)	F	p
Visu/Exec/Abstr	6.0±.7	4.4±1.3	11.83	.003
Language	5.1±.9	5.0±1.3	.04	.85
Attention	5.6±.7	5.5±.8	.09	.78
Memory	2.6±2.0	.88±1.2	4.48	.05
Orientation	5.9±.3	5.75±.4	.67	.43

- The MMSE correlated significantly with apathy and disinhibition in the AD group (Table 5). There were no significant correlations in the MCI group.

Table 5: Correlation between MMSE & MoCA and FrSBe

MCI	Apathy	Disinhibition	Dysexecutive	Total
MMSE	-.169	-.129	-.248	-.254
MoCA	-.264	-.068	-.135	-.219
AD	Apathy	Disinhibition	Dysexecutive	Total
MMSE	-.483*	-.544*	-.304	-.519*
MoCA	-.318	-..302	-.198	-.307

*significant at the .05 level (2-tailed)
Note: MCI & AD groups are collapsed across executive dysfunction

Conclusions

- The results support the hypothesis that the MoCA is more sensitive than the MMSE to executive impairment in MCI.
- This advantage appears to be driven by the MoCA items that assess executive function.
- The advantage of the MoCA for identifying higher levels of executive impairment in MCI is absent in patients who meet the diagnostic criteria for AD.
- The lack of significant correlations between MoCA performance and the FrSBe variables in the MCI group could reflect relatively limited behavioral disturbance in MCI.
- There may have been insufficient statistical power due to small sample size to detect differences between MCI patients and controls on the MoCA.

References
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