Use of MoCA Index Scores in Assessing Cognitive Impairment in Patients with Long COVID

Adam K. Adelsberg[1,2] and Dennis L. Kolson[2]

[1]Philadelphia College of Osteopathic Medicine; [2]Perelman School of Medicine, University of Pennsylvania

Introduction and Methods

Background: The COVID-19 pandemic altered the landscape of medicine in 2020, and its sequelae throughout the body are an ongoing point of research. The Penn Neuro Covid Clinic was established to evaluate and manage patients presenting with neurological complications following COVID-19 infection. Among the Neurologist who founded the clinic is Dennis Kolson, MD, PhD. Dr. Kolson's patient cohort were all seen in-person for a neurological assessment and the data collected offers valuable insight into the clinical manifestations of COVID-19 on the nervous system.

Methods: From April 2021 to June 2024, 194 Patients with neurological complaints following infection with COVID-19 were seen by neurology provider, Dennis L. Kolson. Each patient underwent a thorough medical history, comprehensive neuro-physical exam, and cognitive testing. Components of the neuro-physical exam included: cranial nerve testing, motor strength and reflexes, cerebellar functionality and gait, and sensation. Cognitive testing primarily focused on the Montreal Cognitive Assessment (MoCA), with evaluation of overall MoCA performance, out of a score of 30, and multiple cognitive domain index scores. The cognitive domains represented and assessed via specific index scores included: memory, attention, executive function, visuospatial, language, and orientation.

MoCA Index Score Breakdown

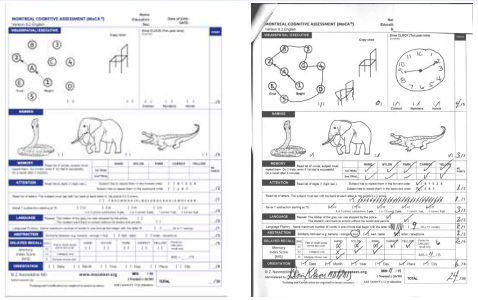

Fig 1. An incomplete (left) and complete (right) Montreal Cognitive Assessment (MoCA), version 8.2

Memory (MIS)	Attention (AIS)	Executive (EIS)	Visuospatial (VIS)	Language (LIS)	Orientation (OIS)
Delayed recall	Digit span forward	Trail making	Chair copy	Naming	Orientation
	Digit span backward	Clock drawing	Clock drawing	Sentence repetition	
	Letter A	Digit span forward	Naming	Language fluency	
	Serial 7s	Digit span backward			
	Sentence repetition	Letter A			
	Immediate recall	Serial 7s			
		Language fluency			
		Abstraction			

Table 1. Items that contribute to each of the domain-specific index scores that can be generated from the overall MoCA

Memory Index Score Performance Compared to Regression Based Normative Data

(A) Male

Age group	Mean MIS	Number of pts	Kolson percentile	Kessels et al percentile
18-29	14	3	33rd	62nd
30-39	13	6	33rd	39th
40-49	11	13	38th	11th
50-59	11	15	33rd	13th
60-69	11	10	40th	16th
70-79	13	5	40th	50th
≥80	8	2	50th	5th

(B) Female

Age group	Mean MIS	Number of pts	Kolson percentile	Kessels et al percentile
18-29	14	6	33rd	51st
30-39	14	23	39th	57th
40-49	12	38	47th	15th
50-59	11	23	35th	8th
60-69	12	24	42nd	22nd
70-79	10	7	43rd	6th
≥80	11	2	N/A	16th

Table 2. Data for the male **(A)** and female **(B)** Long COVID patients were further subdivided into age groups based on their current age at time of assessment. MIS performances for each decade of life subdivision were compared to published, regression based normative data for MIS performances of the same demographic criteria published in Kessel et al. Relative performance is being gauged through percentile comparisons for the mean MIS of a given age group.

Index Score Correlation with Overall MoCA Performance

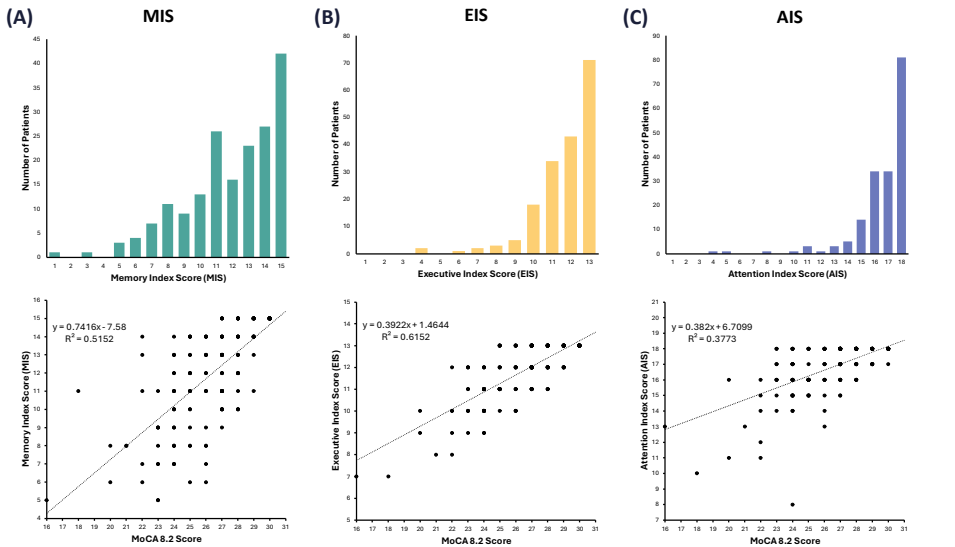

Figure 2. Frequency and correlation with overall MoCA performance is shown for the three domain-specific index scores of **(A)** memory, **(B)** executive, and **(C)** attention. Memory index (MIS) is scored out of 15, executive index (EIS) is scored out 13, and attention index score (AIS) is scored out of 18. The three index scores displayed here had the strongest positive correlations with overall MoCA performance of the six total domain-specific index scores generated from the MoCA.

Patient Demographics

Sex/Gender: 135 patients were female (69.6%), 56 patients were male (28.9%) and 3 patients were non-binary/not reported (1.5%)

Race/Ethnicity: 143 patients were white (73.7%), 21 patients were black (10.8%), 8 patients were Hispanic (4.1%), 3 patients were Asian (1.5%), 19 patients did not have a documented race (9.8%)

Vaccination Status: Vaccine data was able to be collected on 188 patients; 155 patients were vaccinated (82.4%) and 33 patients were unvaccinated or chose not to report their vaccination status

- 66 of the 155 were infected before vaccination (42.6%)
- 77 of the 155 were infected after vaccination (49.7%)
- 12 of the 155 were infected both before and after vaccination (7.7%)

Year of Infection: for 186 patients the year of infection was clearly documented; 49 in 2020, 61 in 2021, 55 in 2022, 18 in 2023, and 3 in 2024

Discussion

Summary of results: In comparison to the regression based normative data for MIS published in Kessels et al, the middle-aged, Long COVID patients (40-69 years old) had lower observed MIS scores. A strong positive correlation between MoCA score and MIS was found with an R^2 value of .52, despite only contributing to 17% of the overall MoCA score. The contribution to the overall MoCA by the MIS is the lowest of the six assessed domain-specific indexes. Although the EIS had the strongest positive correlation with overall MoCA score (R^2 value of .62) the items used to calculate EIS make up 43% of the total MoCA.

Conclusions: The strong positive correlation between MoCA scores and MIS may indicate the use of MIS as a quicker and still effective screening method for neurologic impairment in Long COVID patients presenting with neurologic symptoms. Middle aged patients' lower observed MIS scores warrant potential need for cognitive assessment of Long COVID patients in that age group.

References

1. Kessels RPC, de Vent NR, Bruijnen CJWH, et al. Regression-Based Normative Data for the Montreal Cognitive Assessment (MoCA) and Its Memory Index Score (MoCA-MIS) for Individuals Aged 18-91. *J Clin Med*. 2022;11(14):4059. Published 2022 Jul 13. doi:10.3390/jcm11144059

Acknowledgments

- Philadelphia College of Osteopathic Medicine
- Pennsylvania Osteopathic Medical Association
- University of Pennsylvania Perelman School of Medicine
- The outpatient neurology clinic located at the Perelman Center for Advanced Medicine