

# Objective Measurement of Cognitive Impairment in Multiple Sclerosis Patients Using Novel Computerized Testing

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## ABSTRACT

**Objective:** At the completion of this presentation, participants should be able to assess the reliability of Cognivue<sup>®</sup> as a cognitive assessment tool in multiple sclerosis (MS).

**Background:** Cognivue<sup>®</sup> is an FDA-cleared computerized testing tool rooted in adaptive psychophysics and designed to assess early signs of cognitive impairment (CI). CI has a substantial impact on productivity and quality of life in patients with MS, but testing has been limited. A brief, easy-to-administer neuropsychological test could increase the frequency of routine assessment of cognitive impairment among patients with MS, leading to a positive impact on MS management.

**Methods:** The study was conducted at the University of Massachusetts Medical School between June 2016 and March 2018, and enrolled consecutive patients who consented to testing. Study participants completed the Expanded Disability Status Scale (EDSS), symbol digit modality test (SDMT), 9 hole peg test, timed 25-foot walk, and 10-minute Cognivue<sup>®</sup> testing (basic motor & visual ability, perceptual processing, and memory processing). Statistical analyses using a one-way ANOVA were performed to determine differences between neuropsychological testing methods.

**Results:** Thirty-six patients (mean age 48.6 y [range 20-74], 78% female [n=28/36]), completed the various tests. Based on Cognivue<sup>®</sup> scores, 50% of patients were categorized as having normal cognitive function (mean 84.7; EDSS 2.64), 33.3% as having low CI (mean 66.0; EDSS 3.38), and 16.7% as having moderate to severe CI (mean 39.2; EDSS 5.17). Overall Cognivue<sup>®</sup> scores demonstrated statistically significant correlations with EDSS (Pearson correlation coefficient -0.54), SDMT (0.67), and timed 25-foot walk (-0.56). No relationship was seen between patient age and Cognivue<sup>®</sup> scores. All key cognitive domains were equally affected.

**Conclusions:** Cognivue<sup>®</sup> is beneficial in detecting early stages of multi-domain CI in MS patients providing a potential opportunity for early intervention strategies to improve patient outcomes.

## BACKGROUND

- Deficits in cognitive function confer substantial burden upon patients with MS, in both decreased quality of life and productivity<sup>1</sup>
- Tools for routinely evaluating potential cognitive decline in patients with MS are infrequently utilized in clinical practice<sup>1</sup>
  - Often due to limited duration of office visits and time required for traditional cognitive assessment tools<sup>1,2</sup>
- Cognivue<sup>®</sup>, an FDA-cleared computerized test rooted in adaptive psychophysics, was developed to evaluate cognitive function. It eliminates constraints and subjectivity commonly associated with traditional question & answer testing (Figure 1; Table 1)

Figure 1. Cognivue<sup>®</sup>—A) closed and B) open Table 1. Sample screens of Cognivue<sup>®</sup> subtests

Sub-battery	Sub-test	Sample screen
Visuomotor	Adaptive motor	
	Visual salience	
Perception	Letter discrimination	
	Word discrimination	
	Shape discrimination	
Memory	Motion discrimination	
	Letter memory	
	Word memory	
	Shape memory	

## BACKGROUND (CONT.)

- Cognivue is a 10-minute self-administered test using scores from a sequence of tasks to provide clinicians and patients with a simple, easy-to-read 2 page report including an overall score and subsequent breakdown into 6 key cognitive domains and 2 speed parameters (Figure 2)
- It is FDA-cleared for use as an adjunctive tool to evaluate cognitive function in patients 55–95 years of age, and is not intended to be used alone for diagnostic purposes
- A previous pivotal clinical trial has demonstrated the validity, reliability, and psychometric properties of Cognivue<sup>®</sup><sup>3</sup>

Figure 2. Sample Cognivue<sup>®</sup> reports



## METHODS

**Purpose:** Compare the Cognivue<sup>®</sup> quantitative assessment tool to other neuropsychological & functional motor skills' tests commonly used in MS

**Participants:** Consecutive MS patients who consented to testing were enrolled in the current study between Jun 2016-Mar 2018

**Tests:** Participants completed 5 tests during the study visit

- Expanded Disability Status Scale (EDSS)
- Symbol digit modality test (SDMT)
- Nine-Hole Peg Test (NHPT)
- Timed 25-foot walk
- Cognivue<sup>®</sup>

**Analyses:** Statistical analyses using one-way ANOVA model were conducted to evaluate differences between tests mentioned above

## RESULTS

- 36 patients with MS completed 1 testing session over the course of the study period
- Patients were predominantly female with relapsing-remitting MS (Table 2)

Table 2. Demographic characteristics of participants

Characteristic	Patients with MS (n=36)
Mean age, y (range)	48.6 (20-74)
Sex, n (%)	
Female	28 (78)
Male	8 (22)
MS profile, n (%)	
Relapsing-remitting	30 (83.3)
Secondary progressive	5 (13.9)
Not recorded	1 (2.8)

## RESULTS (CONT.)

- Based on overall Cognivue<sup>®</sup> score, 16.7% (n=6) had moderate to severe CI, 33.3% (n=12) had low CI, and 50% (n=18) had no CI
- Mean overall Cognivue<sup>®</sup> and EDSS scores according to degree of CI are shown in Table 3. Mean scores on other tests performed are also provided

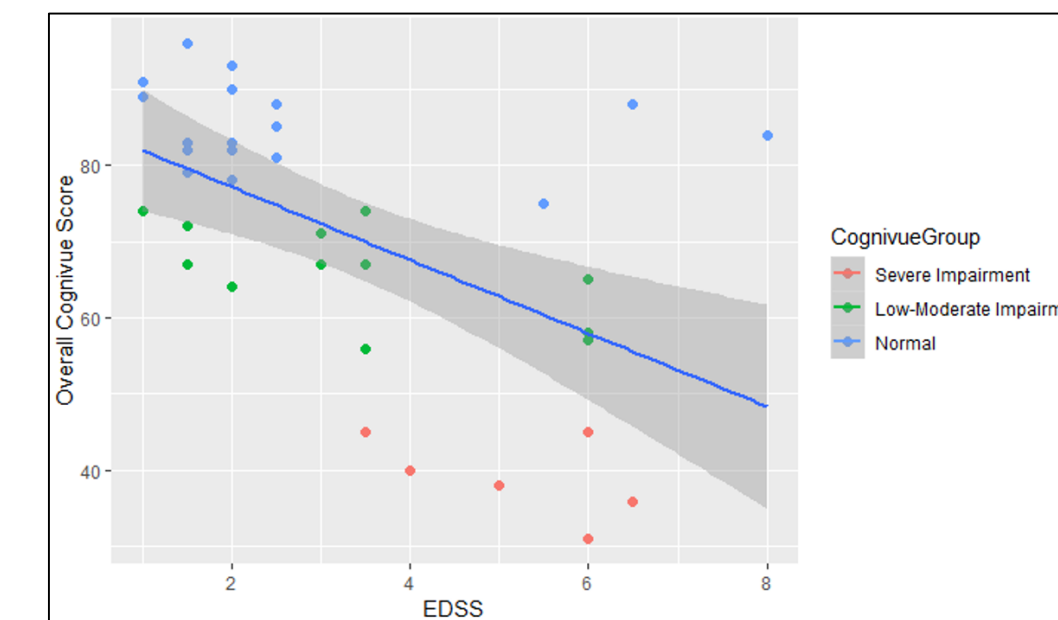
Table 3. Mean scores according to degree of CI (n=36)

Classification	Overall Cognivue <sup>®</sup>	EDSS	SDMT	NHPT	T25W
Normal cognitive function (n=18)	84.7	2.64	59.1	14.0	6.0
Low CI (n=12)	66.0	3.38	49.2	13.5	6.7
Moderate to severe CI (n=6)	39.2	5.17	37.5	21.0	11.3

CI: cognitive impairment; EDSS: Expanded Disability Status Scale; NHPT: Nine-Hole Peg Test; SDMT: Symbol Digit Modality Test; T25W: timed 25' walk

- Overall Cognivue<sup>®</sup> score demonstrated significant (p<0.05) negative correlation with EDSS score (Figure 3; Table 4)
- Statistically significant (p<0.05) correlations between overall Cognivue<sup>®</sup> score and SDMT & timed 25' walk scores were also demonstrated (Table 4)
  - Correlation between overall Cognivue<sup>®</sup> score and NHPT score was not statistically significant

Figure 3. Overall Cognivue<sup>®</sup> score by EDSS



EDSS: Expanded Disability Status Scale

Table 4. Correlation between Cognivue<sup>®</sup> and other tests

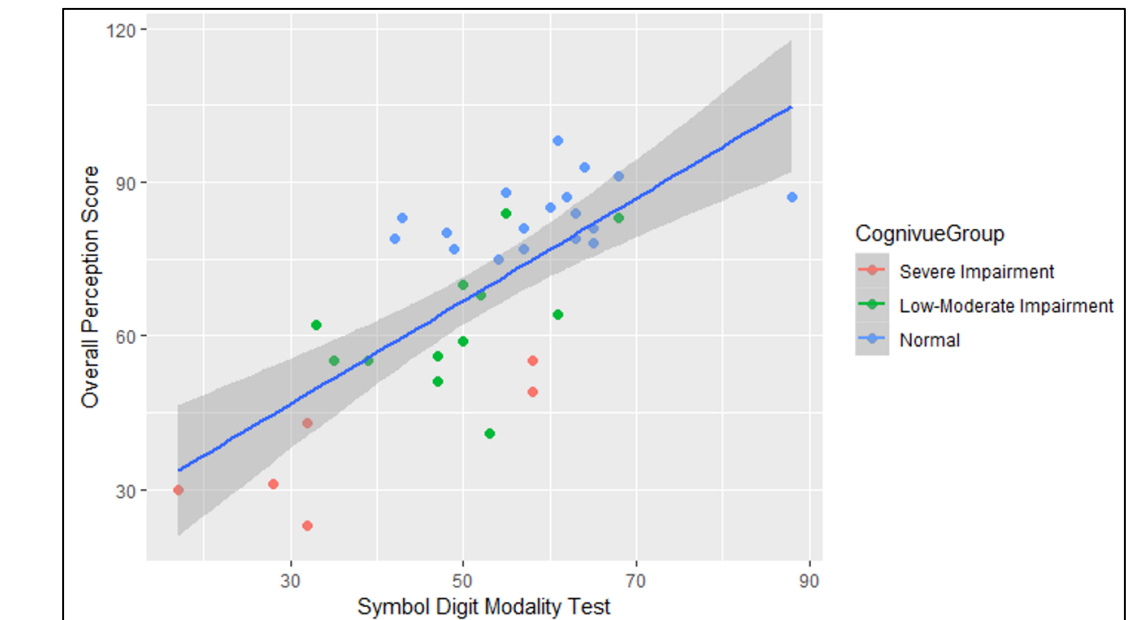
Test	Overall Cognivue <sup>®</sup> score	Overall perception score	Overall memory score
EDSS	-0.54*	-0.52*	-0.47
SDMT	0.67*	0.72†	0.53*
NHPT	-0.47	-0.40	-0.48
Timed 25' walk	-0.56*	-0.59*	-0.45

\*Moderate level of correlation; †High level of correlation; EDSS: Expanded Disability Status Scale; NHPT: Nine-Hole Peg Test; SDMT: Symbol Digit Modality Test

- A high positive correlation (0.72; p<0.05) was demonstrated between Cognivue<sup>®</sup> perception subscore and SDMT score (Figure 4; Table 4)

## RESULTS (CONT.)

Figure 4. Overall Cognivue<sup>®</sup> perception score by SDMT



SDMT: Symbol Digit Modality Test

- 7 of 10 Cognivue<sup>®</sup> sub-test scores demonstrated a statistically significant correlation with EDSS scores (Table 5)
  - This reinforces the fact that all key cognitive domains were equally affected

Table 5. Correlation between Cognivue<sup>®</sup> sub-tests and EDSS

Cognivue <sup>®</sup> sub-test	EDSS
Adaptive motor control	-0.31
Visual salience	-0.39*
Letter discrimination	-0.41*
Word discrimination	-0.55*
Shape discrimination	-0.51*
Motor discrimination	-0.29
Letter memory	-0.54*
Word memory	-0.36*
Shape memory	-0.37*
Motion memory	-0.25

\*p<0.05; EDSS: Expanded Disability Status Scale

- Overall Cognivue<sup>®</sup> score was not correlated with patient age or any other demographic variable
- A low correlation between EDSS score and age was shown

## CONCLUSIONS

- Significant correlation between overall Cognivue<sup>®</sup> score and EDSS score
- Significant correlation between overall Cognivue<sup>®</sup> score and SDMT score
  - Excellent correlation between Cognivue<sup>®</sup> perception score—which is associated with executive function domain—and SDMT score
- No correlation was found between overall Cognivue<sup>®</sup> score and patient age
- All key cognitive domains were equally affected
- Cognivue<sup>®</sup> is beneficial in detecting early stages of multi-domain CI in MS patients providing a potential opportunity for early intervention strategies to improve patient outcomes

## References

- Smith et al. *Mult Scler J Exp Transl Clin* 2018;4:1-9
- Kalb et al. *Mult Scler* 2018;24:1665-80
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