

Brief International Cognitive Assessment for MS (BICAMS): Reliability and Identifying Statistically Reliable Change

Ralph HB Benedict¹, Maria P Amato², Jan Boringa³, Bruno Brochet⁴, Frederick Foley⁵, Sten Fredrikson⁶, Päivi Hämäläinen⁷, Hans-Peter Hartung⁸, Lauren B. Krupp⁹, Iris-Katharina Penner¹⁰, Anthony Reder¹¹, Dawn W Langdon¹²

¹SUNY Buffalo School of Medicine, Buffalo, NY, USA ²Careggi University Hospital, Florence, Italy ³Meander Medisch Centrum, Amersfoort, The Netherlands ⁴Universite de Bordeaux, Bordeaux cedex, France ⁵Yeshiva University, Bronx, NY, and Holy Name Hospital MS Center, Teaneck, NJ, USA ⁶Karolinska Institute, Huddinge University Hospital, Stockholm, Sweden ⁷Masku Neurological Rehabilitation Centre, Masku, Finland ⁸Heinrich-Heine-Universität, Düsseldorf, Germany ⁹Stony Brook Medicine, Stony Brook, NY, USA ¹⁰University of Basel, Basel, Switzerland ¹¹University of Chicago, Chicago, IL, USA ¹²Royal Holloway University of London, London, UK

Abstract

Background. The Brief Cognitive Assessment for MS [BICAMS] may be used for international monitoring of cognitive function in clinical and research contexts and comprises the Symbol Digit Modalities Test [SDMT], first five recall learning trials of the California Verbal Learning Test – II [CVLT2] and the first three recall trials of the Brief Visuospatial Memory Test – Revised [BVMTR]. This tool has been constructed by expert consensus to address the cognitive domains most vulnerable to MS, using the most sensitive scales. In the future, evidence-based decisions regarding individual’s cognitive change will require group psychometric data, concerning test variability and reproducibility.

Goal. To identify confidence intervals of expected change in longitudinal performance that can be used to compose reliable change indices [RCIs], thereby indicating statistically significant change in test scores between testing. This will facilitate appropriate clinical and research interpretation of longitudinal BICAMS data.

Method. A comprehensive literature review was undertaken focusing on the SDMT, CVLT2, and BVMTR in MS samples. Only peer-reviewed articles reporting test-retest reliability coefficients from control or placebo group samples in MS studies, standard deviation metrics and multiple time points were considered. The data can be used to calculate standard errors of the measure, standard errors of the difference, and RCIs in accordance with the method of Temkin 2004.

Results. Studies have ranged from a 2 to 4-week test-retest interval. Reliability for SDMT has ranged from 0.83 to 0.97, for CVLT2 0.78 to 0.83 and for BVMTR 0.74 to 0.91. When integrated with the standard deviation metrics in these studies, 80% confidence intervals have averaged 7.4 raw score points for SDMT, 10.8 points for CVLT2 and 5.9 points for BVMTR. Additional data that becomes available prior to theECTRIMS 2012 meeting will be included in our presentation.

Discussion. We will recommend RCIs for the BICAMS component tests and for the battery overall, thus identifying statistically significant changes in BICAMS test scores between repeat testing. This will allow for meaningful interpretation of longitudinal changes in MS patients’ cognitive performance. Those with a real change in cognitive performance can be identified and appropriately managed.

Introduction and purpose:

The Brief International Cognitive Assessment for MS (BICAMS) has been recommended by an international expert consensus committee (1). It comprises:

1. Symbol Digit Modalities Test (SDMT)
2. California Verbal Learning Test 2nd Edition (CVLT-II), first five recall trials
3. Brief Visuo-Spatial Memory Test-Revised (BVMTR), first three recall trials.

An international validation protocol has been developed (2) and national validation studies are underway or planned in many countries (Italy, Iran, Czech Republic, Argentina, Canada, 3).

The purpose of this presentation is to discuss reliable change on repeat BICAMS testing. Clinically meaningful change has yet to be clearly defined and for these recommendations, we focus on statistically significant change (4).

Methods

A comprehensive literature search identified peer-reviewed articles reporting test-retest reliability coefficients from healthy control samples in MS studies. Standard deviations and multiple time points were required (2-4 week test-retest intervals were available). Thus standard errors of measurement and standard errors of difference could be calculated and reliable change indices derived (5).

Results

Table 1. Test-retest statistics for the SDMT

SDMT	Mean1	SD1	Mean2	SD2	pooled SD	raw score change	d	Retest r	SEm1	SEm2	Sdiff	80% CI	80% RCI	90% CI	90% RCI	Notes
Benedict 2005 (6)	51.9	16.0	55.4	17.4	16.7	3.5	0.2	0.97	2.8	3.0	4.1	5.2	9	6.8	10	2-wk interval; same form
Benedict 2012 (7)	59.3	11.7	63.5	10.3	11.0	4.2	0.4	0.84	4.7	4.1	6.2	8.0	12	10.3	14	2-wk interval; alt form; time 2-1
Benedict 2012 (7)	63.5	10.3	62.7	10.8	10.6	-0.8	-0.1	0.86	3.9	4.0	5.6	7.1	6	9.2	8	2-wk interval; alt form; time 2-3
Benedict 2012 (7)	62.7	10.8	64.5	10.8	10.8	1.8	0.2	0.89	3.6	3.6	5.1	6.5	8	8.4	10	2-wk interval; alt form; time 3-4
Benedict 2012 (7)	64.5	10.8	64.9	13.5	12.2	0.4	0.0	0.90	3.4	4.3	5.5	7.0	7	9.0	9	2-wk interval; alt form; time 4-5
Morrow 2009 (8)	35.7	10.5	41.7	11.9	11.2	6.0	0.5	0.83	4.3	4.9	6.5	8.4	14	10.8	17	4-wk interval; alt form; placebo group
Stuifbergen 2012 (9)	46.4	13.7	48.1	14.0	13.9	1.7	0.1	0.89	4.5	4.6	6.5	8.3	10	10.7	12	4-wk interval; alt form; placebo group; time 1-2
Stuifbergen 2012 (9)	48.1	14.0	50.6	13.1	13.6	2.5	0.2	0.87	5.0	4.7	6.9	8.8	11	11.4	14	4-wk interval; alt form; placebo group; time 2-3
Average					12.5		0.2	0.9			5.8	7.4	9.8	9.6	12.0	

Table 2. Test-retest statistics for the CVLT-II, first five learning trials

CVLT2 TL	Mean1	SD1	Mean2	SD2	pooled SD	raw score change	d	Retest r	SEm1	SEm2	Sdiff	80% CI	80% RCI	90% CI	90% RCI	Notes
Benedict 2005 (6)	51.7	14.9	52.7	12.8	13.9	1.0	0.1	0.78	7.0	6.0	9.2	11.8	13	15.2	16	2-wk interval
Morrow 2009 (8)	41.1	12.1	44.8	14.1	13.1	3.7	0.3	0.79	5.5	6.5	8.5	10.9	15	14.0	18	4-wk interval; alt form; placebo group
Stuifbergen 2012 (9)	50.3	12.2	50.2	12.1	12.2	-0.1	0.0	0.83	5.0	5.0	7.1	9.1	9	11.7	12	4-wk interval; alt form; placebo group; time 1-2
Stuifbergen 2012 (9)	50.2	12.1	53.8	14.4	13.3	3.6	0.3	0.78	5.7	6.8	8.8	11.3	15	14.6	18	4-wk interval; alt form; placebo group; time 2-3
Average					13.1		0.2	0.8			8.4	10.8	12.8	13.9	15.9	

Table 3. Test-retest statistics for BVMTR-R, first three learning trials

BVMTR TL	Mean1	SD1	Mean2	SD2	pooled SD	raw score change	d	Retest r	SEm1	SEm2	Sdiff	80% CI	80% RCI	90% CI	90% RCI	Notes
Benedict 2005 (6)	24.2	7.8	24.8	6.8	7.3	0.6	0.1	0.91	2.3	2.0	3.1	4.0	5	5.1	6	2-wk interval
Morrow 2009 (8)	15.9	8.1	17.0	9.1	8.6	1.1	0.1	0.82	3.4	3.9	5.2	6.6	8	8.5	10	4-wk interval; alt form; placebo group
Stuifbergen 2012 (9)	24.4	8.0	24.1	7.8	7.9	-0.3	0.0	0.74	4.1	4.0	5.7	7.3	7	9.4	9	4-wk interval; alt form; placebo group; time 1-2
Stuifbergen 2012 (9)	24.4	8.0	24.1	7.8	7.9	-0.3	0.0	0.83	3.3	3.2	4.6	5.9	6	7.6	7	4-wk interval; alt form; placebo group; time 2-3
Average					7.9		0.0	0.8			4.6	5.9	6.2	7.7	7.9	

Discussion

Overall the test-retest correlations are excellent, further confirming the strong psychometric properties of these scales (1). The average reliable change index for the SDMT is 7.4 (80% confidence) and 12.0 (90% confidence), for the CVLT-II learning trials 12.8 (80% confidence) and 15.9 (90% confidence) and for the BVMTR-R learning trials 6.2 (80% confidence) and 7.9 (90% confidence). These values allow a clear judgment to be made about the meaning of differences between scores at two time points, based on statistical evidence. The correct interpretation of differences between test scores at different times will allow for precise monitoring of longitudinal change of cognition in MS patients.

We are presently acquiring new data on this question. The data we have presented is from American studies. As the BICAMS validation project progresses, we will recommend RCIs for other countries.

Conclusions

The recommendations for significant change values on the BICAMS scales are:

SDMT	8 (likely) 12 (convincing)	CVLT-II LT	13 (likely) 16 (convincing)	BVMTR-LT	7 (likely) 8 (convincing)
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