How to Select Between the MMSE and MoCA When Accounting for the Base Rate of the Sample and the Level of Severity Being Screened For

Katie McCulloch, M.A.[1, 2] & Robert L. Collins, Ph.D. ABPP-CN[1, 3]

[1]Michael E. DeBakey Veteran's Affairs Medical Center, [2]University of Houston, [3]Baylor College of Medicine

Introduction

The Mini-Mental State Examination (MMSE) it is one of the most utilized cognitive screeners for detecting dementia (Folstein et al., 1975). Recently, the Montreal Cognitive Assessment (MoCA) was developed by Nasreddine, et al. (2005) to screen for milder symptoms of dementia. Undocumented dementia is estimated to range from approximately 3 to 12% in primary care settings, whereas the prevalence of dementia in memory clinics is estimated to be 60% (Boustani, et al, 2003; Mitchell, 2009). In a meta-analysis, the MMSE was found to have greater positive predictive value in specialist settings, with higher base rates of dementia, and greater NPV in non-specialist settings (Mitchell, 2009). As of yet, diagnostic utility of the MoCA has not been evaluated across varying base rates of dementia or types of settings.

Methods

- 167 Veterans referred by Neurological services completed an MMSE and MoCA.
- Participants (*n*=49) had been removed for suboptimal effort, as demonstrated on the Word Memory Test (<82.5), the Test of Memory Malingering (<45), or the California Verbal Learning Test-II Forced Choice (<14).
- Sensitivity (SE), specificity (SP), negative predictive value (NPV), and positive predictive values (PPV) were calculated at each level of screener cut and selected base rates (.10, .30, .50, and .70).
- Neuropsychological testing, as the "gold standard", was set to at multiple levels of impairment: ≤ -1.5 *SD* on at least two cognitive domains and ≤ -2.5 *SD* on at least two cognitive domains.
- Optimal cuts were determined from a previous study in this sample: MMSE <28 for -1.5 *SD* and <26 for -2.5 *SD*; MoCA <22 for -1.5 *SD* and <21 for -2.5 *SD*.

Results and Conclusions

- When detecting milder cognitive impairment (< -1.5 *SD*), the MMSE and MoCA have similar NPV rates across base rates, while the MoCA tends to have greater PPV rates than the MMSE across base rates.
- When detecting severe levels of cognitive impairment (< -2.5 *SD*), the MoCA tends to have greater NPV, particularly at high base rates, in comparison to the MMSE. PPV rates are similar across base rates among each measure.
- These tables allow clinicians to select the most appropriate measure for their population.

MMSE – Impairment ≤ -1.5 SD

Cut (<)	SE	SP	Base Rate .10 PPV	Base Rate .10 NPV	Base Rate .30 PPV	Base Rate .30 NPV	Base Rate .50 PPV	Base Rate .50 NPV	Base Rate .70 PPV	Base Rate .70 NPV
30	0.94	0.20	0.12	0.97	0.33	0.88	0.54	0.76	0.73	0.57
29	0.79	0.42	0.13	0.95	0.37	0.83	0.58	0.67	0.76	0.47
28	0.68	0.58	0.15	0.94	0.41	0.81	0.62	0.65	0.79	0.44
27	0.43	0.78	0.18	0.92	0.45	0.76	0.66	0.58	0.82	0.37
26	0.35	0.87	0.23	0.92	0.53	0.76	0.72	0.57	0.86	0.36
25	0.27	0.93	0.31	0.92	0.63	0.75	0.80	0.56	0.90	0.35
24	0.17	0.97	0.37	0.91	0.69	0.73	0.84	0.54	0.92	0.33
23	0.14	0.98	0.42	0.91	0.73	0.73	0.87	0.53	0.94	0.33
22	0.10	0.99	0.49	0.91	0.79	0.72	0.9	0.52	0.95	0.32
21	0.05	0.99	0.32	0.90	0.65	0.71	0.81	0.51	0.91	0.31
20	0.05	0.99	0.32	0.90	0.65	0.71	0.81	0.51	0.91	0.31
19	0.05	0.99	0.32	0.90	0.65	0.71	0.81	0.51	0.91	0.31
18	0.02	1.00	1.00	0.90	1.00	0.70	1.00	0.50	1.00	0.30
17	0.02	1.00	1.00	0.90	1.00	0.70	1.00	0.50	1.00	0.30
16	0	1.00	1.00	0.90	1.00	0.70	1.00	0.50	1.00	0.30

MMSE – Impairment ≤ -2.5 SD

Cut (<)	SE	SP	Base Rate .10 PPV	Base Rate .10 NPV	Base Rate .30 PPV	Base Rate .30 NPV	Base Rate .50 PPV	Base Rate .50 NPV	Base Rate .70 PPV	Base Rate .70 NPV
30	1.00	0.15	0.12	1.00	0.34	1.00	0.54	1.00	0.73	1.00
29	1.00	0.35	0.15	1.00	0.31	1.00	0.61	1.00	0.78	1.00
28	0.71	0.48	0.13	0.94	0.32	1.00	0.58	0.63	0.76	0.42
27	0.71	0.71	0.22	0.96	0.34	1.00	0.71	0.71	0.85	0.52
26	0.71	0.80	0.29	0.96	0.37	1.00	0.78	0.74	0.89	0.55
25	0.29	0.86	0.18	0.92	0.40	1.00	0.67	0.55	0.82	0.34
24	0.29	0.92	0.28	0.92	0.45	1.00	0.78	0.56	0.89	0.36
23	0.14	0.93	0.19	0.91	0.51	1.00	0.68	0.52	0.83	0.32
22	0.14	0.96	0.28	0.91	0.55	1.00	0.78	0.53	0.89	0.32
21	0.14	0.98	0.44	0.91	0.61	1.00	0.87	0.53	0.94	0.33
20	0.14	0.98	0.44	0.91	0.60	0.85	0.87	0.53	0.94	0.33
19	0.14	0.98	0.44	0.91	0.65	0.86	0.87	0.53	0.94	0.33
18	0	0.99		0.90	0.64	0.80	0	0.50	0	0.30
17	0	0.99		0.90	0.71	0.81	0	0.50	0	0.30
16	0	1.00	0	0.90	1.00	0.70	0	0.50	0	0.30

MoCA – Impairment ≤ -1.5 SD

Cut (<)	SE	SP	Base Rate .10 PPV	Base Rate .10 NPV	Base Rate .30 PPV	Base Rate .30 NPV	Base Rate .50 PPV	Base Rate .50 NPV	Base Rate .70 PPV	Base Rate .70 NPV
30	1.00	0.02	0.10	1.00	0.3	1.00	0.50	1.00	0.70	1.00
29	1.00	0.05	0.10	1.00	0.31	1.00	0.51	1.00	0.71	1.00
28	1.00	0.12	0.11	1.00	0.33	1.00	0.53	1.00	0.73	1.00
27	0.95	0.26	0.12	0.98	0.35	1.00	0.56	1.00	0.75	0.67
26	0.89	0.36	0.13	0.97	0.38	0.89	0.57	0.77	0.77	0.59
25	0.78	0.44	0.13	0.95	0.37	0.82	0.58	0.67	0.76	0.46
24	0.73	0.61	0.17	0.95	0.44	0.84	0.65	0.69	0.81	0.49
23	0.60	0.70	0.18	0.94	0.46	0.80	0.66	0.64	0.82	0.43
22	0.60	0.80	0.25	0.95	0.57	0.82	0.75	0.67	0.88	0.46
21	0.51	0.85	0.27	0.94	0.59	0.80	0.77	0.63	0.89	0.43
20	0.35	0.89	0.27	0.92	0.58	0.76	0.77	0.58	0.88	0.37
19	0.29	0.91	0.26	0.92	0.58	0.75	0.76	0.56	0.88	0.35
18	0.24	0.94	0.30	0.92	0.63	0.74	0.80	0.55	0.90	0.35
17	0.18	0.95	0.31	0.91	0.63	0.73	0.80	0.54	0.90	0.33
16	0.12	0.97	0.32	0.91	0.64	0.72	0.81	0.53	0.91	0.32
15	0.11	1.00	1.00	0.91	1.00	0.72	1.00	0.53	1.00	0.32
14	0.07	1.00	1.00	0.91	1.00	0.72	1.00	0.52	1.00	0.32
13	0.07	1.00	1.00	0.91	1.00	0.72	1.00	0.52	1.00	0.32
12	0.05	1.00	1.00	0.90	1.00	0.71	1.00	0.51	1.00	0.31
11	0.05	1.00	1.00	0.90	1.00	0.71	1.00	0.51	1.00	0.31
10	0.05	1.00	1.00	0.90	1.00	0.71	1.00	0.51	1.00	0.31
9	0	1.00	1.00	0.90	1.00	0.70	1.00	0.50	1.00	0.30

MoCA – Impairment ≤ -2.5 SD

Cut (<)	SE	SP	Base Rate .10 PPV	Base Rate .10 NPV	Base Rate .30 PPV	Base Rate .30 NPV	Base Rate .50 PPV	Base Rate .50 NPV	Base Rate .70 PPV	Base Rate .70 NPV
30	1.00	0.01	0.10	1.00	0.30	1.00	0.50	1.00	0.70	1.00
29	1.00	0.03	0.10	1.00	0.31	1.00	0.51	1.00	0.71	1.00
28	1.00	0.07	0.11	1.00	0.32	1.00	0.52	1.00	0.71	1.00
27	1.00	0.17	0.12	1.00	0.34	1.00	0.55	1.00	0.74	1.00
26	1.00	0.26	0.13	1.00	0.37	1.00	0.58	1.00	0.76	1.00
25	1.00	0.36	0.15	1.00	0.40	1.00	0.61	1.00	0.78	1.00
24	1.00	0.48	0.18	1.00	0.45	1.00	0.66	1.00	0.82	1.00
23	1.00	0.59	0.21	1.00	0.51	1.00	0.71	1.00	0.85	1.00
22	1.00	0.65	0.24	1.00	0.55	1.00	0.74	1.00	0.87	1.00
21	1.00	0.72	0.29	1.00	0.61	1.00	0.78	1.00	0.89	1.00
20	0.67	0.81	0.28	0.96	0.60	0.85	0.78	0.71	0.89	0.51
19	0.67	0.84	0.32	0.96	0.65	0.86	0.81	0.72	0.91	0.52
18	0.50	0.88	0.31	0.94	0.64	0.80	0.80	0.64	0.91	0.43
17	0.50	0.91	0.39	0.94	0.71	0.81	0.85	0.65	0.93	0.44
16	0.50	0.95	0.52	0.94	0.80	0.82	0.91	0.65	0.96	0.45
15	0.50	0.97	0.68	0.95	0.89	0.82	0.95	0.66	0.98	0.45
14	0.50	0.99	0.86	0.95	0.96	0.82	0.98	0.66	0.99	0.46
13	0.50	0.99	0.86	0.95	0.96	0.82	0.98	0.66	0.99	0.46
12	0.33	0.99	0.81	0.93	0.94	0.78	0.97	0.60	0.99	0.39
11	0.33	0.99	0.81	0.93	0.94	0.78	0.97	0.60	0.99	0.39
10	0.33	0.99	0.81	0.93	0.94	0.78	0.97	0.60	0.99	0.39
9	0	1.00	1.00	0.90	1.00	0.70	1.00	0.50	1.00	0.30

Impairment ≤ -1.5SD and Impairment ≤ -2.5SD bar charts comparing MMSE and MoCA PPV and NPV at Base Rate 0.10 and Base Rate 0.70.