The Mini-Mental State Examination: Strengths and Weaknesses of a Clinical Instrument

Over the past 20 years, the mini-mental state examination has proven to be a useful and reliable tool—especially for initial contact with a patient having intellectual deficits or experiencing deterioration.

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The Mini-Mental State Examination (MMSE) is a clinical diagnostic tool that is used both for research and in neurologic and psychiatric clinical practice. The MMSE is also one of the most frequently used screening and outcome measures in cognition-enhancing drug trials for Alzheimer’s disease (AD).1 It is, therefore, important to be knowledgeable about the characteristics, strengths and weaknesses of this cognitive evaluation for the detection and follow-up of dementia.

Instrument Description

The MMSE is a short and easy-to-administer test of a person’s intellectual capacities. The MMSE is divided into two sections. The first section requires only oral responses; it covers temporal and spatial orientation, memory (registration, repetition and recall of three objects) and attention (counting backwards in units of seven, starting with 100, or spelling the word “world” backwards). The second section tests language; and visuospatial functions; it requires the subject to name simple objects (watch and pencil), follow verbal and written commands, write a sentence spontaneously and copy two intersecting pentagons. The maximum MMSE Score is 30.2 A good sensitivity and specificity on the MMSE is demonstrated by Folstein et al; the scores on the MMSE differed significantly in 69 patients with dementia syndromes, affective disorder (major depressive disorder) and affective disorder with cognitive impairment.2 They also found good concurrent validity when compared to the Verbal and Performance Intellectual Quotient (VIQ and PIQ) of the Wechsler Adult Intelligence Scale (WAIS), as well as an excellent test-retest and inter-rater reliability.2 Other studies have confirmed the reliability of the MMSE and its capacity to measure cognitive improvement following treatment of depression.3

The MMSE and the Evaluation of Cognitive Impairment

The cut-off scores of 24-25 provides a reliable diagnosis of dementia with high sensitivity, specificity and diagnostic values.3 Norms with per-
centiles and z scores, comparing the performance of an individual to an alternate score from the same disease group, are now available for AD patients, vascular dementia and non-demented patients complaining of memory problems. It is, however, impossible to differentiate the type of dementia by simply using cut-off scores on the MMSE. This instrument can, nevertheless, effectively measure the severity of dementia and cognitive decline over a period of one to two years, which is consistent with physician measures of transitional mental and physical health, self-care and interactive abilities of patients. A pattern of deteriorating mental functions can also be described using the MMSE. A study conducted by Ashford et al, studying 86 patients meeting DSM-III criteria for primary degenerative dementia (average age of 74 ± 8 and an average education of 11 ± 3), and using logistic regression analyses, describe the progressive loss of some items of the MMSE. In the mild stage of dementia (MMSE score above 20), items with the highest severity of impairment are the ones related to recent memory and attention functions: recall of three objects, recall of the date and the serial seven calculations. In the moderate stage of dementia (MMSE score greater than 10 and less than 20), impaired items are related to long term memory functions like orientation for time and place. In the severe stage of dementia (MMSE score of 10 or less), lost items include repetition of words, naming of simple objects and following commands. Naming objects, writing and reading are lost even later in AD than the repetition and command items. Some items remain difficult to achieve throughout the disease process. For early and long standing dementia, the two items “Recall” and “Copy a Design” of the MMSE are the most difficult items to perform successfully.

**Norms for the MMSE**

The MMSE has been found to be sensitive to age and education level. Population-based norms for age and education level have therefore been developed. In 1993, Crum et al assessed the MMSE scores of 18,056 adults, ranging from age 18 to greater than 85 years old, with no education to having a Bachelor’s degree or higher education. The researchers reported MMSE scores as mean, median and percentile distributions specific for age and education level. They found an inverse relationship between MMSE scores and age, ranging from a median of 29 for those 18 to 24 years of age, to 25 for individuals over the age of 80. The median MMSE score has been 29 for individuals with at least nine years of schooling, 26 for those with five to eight years of schooling and 22 for those with none to four years of schooling.

Some minor modifications have also been made:

1. **Attention:** counting forward and backward instead of serial calculations;
2. **First recall:** three words instead of three objects and introduction of category cues and three choices of answer;
3. **Temporal orientation:** acceptation of the closeness of the response as opposed to the original correct/incorrect scoring;
4. **Spatial orientation:** choice of answer for the hospital item;
5. **Naming:** name body parts instead of “watch” and “pencil”;
6. **Repetition:** addition of one sentence: “I would like to go home/out”;
7. **Writing:** a sentence is provided to the subject instead of asking for a spontaneous sentence;
8. **Copy of the two intersecting pentagons:** a time limit of one minute and a 0-10 graded scoring are now given instead of the 0-1 scoring of the MMSE.

One significant difference between the 3MS and the MMSE is that the 3MS provides a range of scores on many items for which a correct/incorrect dichotomy is given in the MMSE.

The range of scores has broadened from 0-30 to 0-100 with the 3MS.
Data gathered on 1600 subjects from the “Canadian Study of Health and Aging” indicate that the 3MS has a better validity than the MMSE in identifying dementia and all levels of cognitive impairment. The superiority of the 3MS is due more to its extended scoring system than to its additional questions.1

Weaknesses of the MMSE
Criticism of the MMSE can now be addressed after being utilized for the past 20 years in a number of neurolologic, psychiatric and pharmacologic studies. When applied to the detection of mild AD, for example, in the screening phase of a cognition enhancing drug trial, the MMSE may lack sensitivity to early signs of dementia and present “ceiling effects”, resulting in false-negative diagnosis.1,3 It is now acknowledged that memory is composed of different and, sometimes, overlapping systems. Some of these systems are the first and most severely impaired systems. Some of these systems are the first and most severely impaired aspects of cognition, even in the minimal stage of AD, while other memory systems are relatively spared.1 The measures of memory functions included in the MMSE are, however, very limited; there are no cueing, recognition paradigms, no visuals, personal or working memory measures and the assessment of attention is done only through serial calculations or spelling the word “WORLD” backwards.

In addition, the MMSE does not have any tasks to assess executive functions like tests of the capacity to abstract, or to judge a social situation. These intellectual abilities have been found to be altered early in the AD process. In addition to possible “ceiling effects” in mild AD, the MMSE may also present “floor effects” in advanced stages of AD, with the difficulty to assess memory, language and perceptual problems in severely impaired patients.

Another problem with the MMSE is that it can cause interpretation problems—particularly in cognition-enhancing drug trials where repetitive assessments are often done in short time intervals. Repetitive testing with the same instrument may produce practice effects, especially in mild AD.1

Conclusion
Although the MMSE presents some weaknesses, it still remains a useful and reliable tool—especially for first contact with a patient having intellectual deficits or deterioration. It rapidly provides data that illustrates the severity of the cognitive impairment. The MMSE is a universally known instrument that provides information on the mental state of a patient; the information is easy to communicate and interpret for professionals. Due to the weaknesses mentioned previously, however, using the MMSE along with other recommended cognitive measures to confirm a diagnosis of dementia and to provide follow-up data, particularly in cognition-enhancing drug trials for AD, is recommended.

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References