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Comparing the Cognitive Screening Tools: MMSE and SLUMS

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Abstract
Practitioners have long relied upon the Mini Mental Status Exam (MMSE) to quickly assess cognitive functioning in older adults. The Saint Louis University Mental Status (SLUMS) exam possesses many potential psychometric advantages, however data on the relationship between scores on the SLUMS and MMSE has yet to be established. Therefore, the purpose of this study was to establish comparative norms between the MMSE and the SLUMS examinations. The current study hypothesized that participants would score lower on the SLUMS than the MMSE, with adults exhibiting higher levels of cognitive reserve, as measured by educational attainment, having a greater difference between the test scores. A total of 118 individuals (96 female, 21 male) with an age range from 41 to 96 ($M=80.03, SD=8.71$) with an average educational attainment of 14.97 years ($SD= 2.68$), completed both tests. Results indicate a significant difference between the mean SLUMS and MMSE scores ($p<.001$), as well as a significant difference between those in assisted and independent living environments ($p<.001$). The evidence did not support the cognitive reserve hypothesis. Implications and suggestions for future research will be discussed.

Keywords
MMSE, SLUMS, Dementia, Dementia screening, Cognitive impairment, Older adults

Cover Page Footnote
This research was reviewed and approved by the Institutional Review Board of Western Oregon University.

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Practitioners have long relied upon the Mini Mental Status Exam (MMSE) to quickly assess cognitive functioning in older adults. The Saint Louis University Mental Status (SLUMS) exam possesses many potential psychometric advantages, however data on the relationship between scores on the SLUMS and MMSE has yet to be established. Therefore, the purpose of this study was to establish comparative norms between the MMSE and the SLUMS examinations. The current study hypothesized that participants would score lower on the SLUMS than the MMSE, with adults exhibiting higher levels of cognitive reserve, as measured by educational attainment, having a greater difference between the test scores. A total of 118 individuals (96 female, 21 male) with an age range from 41 to 96 (M=80.03, SD=8.71) with an average educational attainment of 14.97 years (SD= 2.68), completed both tests. Results indicate a significant difference between the mean SLUMS and MMSE scores (p<.001), as well as a significant difference between those in assisted and independent living environments (p<.001). The evidence did not support the cognitive reserve hypothesis. Implications and suggestions for future research will be discussed.

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Much of the world, including the United States, is preparing for the repercussions of a dramatic increase in older adult populations. For example, the percentage of people age 65 and older will increase from 13% to 16% by the year 2020 (Karel, Gatz, & Smyer, 2012). Health care professionals must also prepare for an increased number of patients presenting dementia-like symptoms or mild cognitive impairment (Tariq, Tumosa, Chibnall, Perry, & Morley, 2006). Due to a significantly increased older adult population, a quick screening tool to determine cognitive impairment may be beneficial to healthcare professionals.

Currently the rates of dementia in those age 65 and older are between 3%-11%, depending on how the disease is defined, while dementia is seen in 25%-47% of people older than 85 (Tariq et al., 2006). A sensitive screening tool can allow older adults experiencing cognitive impairment and their families to begin doing what they can to delay the symptoms and begin planning for the future. There is a growing need for a cognitive test that is quick, reliable, and easy to administer in order to assist in determining age-related cognitive impairment (Tariq et al., 2006).

Over 30 years ago, two physicians created what is one of today's most commonly used screening tools for cognitive impairment. The Mini Mental Status Exam (MMSE) consists of 11 questions that are divided into two sections: the first section addresses orientation, attention, and memory, while the second addressing verbal and written skills. An overall score between zero and 30 is possible. A score of, or close to, 30 is indicative of normal cognitive function. The lower the score the higher the level of impairment. The MMSE was originally developed by Marshall and Susan Folstein as a tool to quickly assess cognitive function in the elderly hospitalized population. The MMSE only assesses certain aspects of cognitive function, while dismissing other important factors, such as mood and a more complete assessment of executive function. Originally, the MMSE was tested on a mere 206 patients before Folstein declared that this exam could accurately determine one's cognitive abilities. Folstein created the MMSE with the intention of determining whether an elderly patient was getting "better" or "worse," not as the sole test to determine if one had dementia (Nieuwenhuis-Mark, 2010).

Today the MMSE is commonly used when attempting to assess dementia. Practitioners also use the MMSE to determine cognitive abilities in patients suffering from depression, stroke, Parkinson's disease dementia,

delirium, and Multiple Sclerosis (Nieuwenhuis-Mark, 2010). Unfortunately, some doctors use only the MMSE scores to determine a patient's need for medication as well cognitive ability (Zarit, Blazer, Orrell, & Woods, 2008). In addition, recent research designed to determine the optimal time to begin a so-called memory drug, such as an acetylcholine esterase inhibitor, to manage the symptoms associated with dementia, was based only on the individual's MMSE score (i.e., Molinuevo, Berthier, & Rami, 2010).

While the MMSE may seem convenient, it has shown to be biased in assessing non-English speakers by consistently providing lower scores to those who are not Caucasian. In a study that compared the relationship between levels of education among Mexican Americans, the Mexican American participants who were screened with the MMSE repeatedly scored lower on the MMSE when compared to non-Hispanic Caucasians. These differences may arise from cultural differences, such as the levels and quality of education received (Matallana, de Santacruz, Cano, Reyes, Samper-Ternent, Markides, & Reyes-Ortiz, 2011).

Since the MMSE does not take a patient's mood into consideration, a low score may not necessarily imply the level of cognitive ability when there is a possibility that the patient was distracted by an unaccounted for variable such as mood. This can be the case when depression or anxiety is present. The Rosenberg Self Esteem Scale would be an appropriate solution to this issue when added preliminary to the MMSE or the Saint Louis University Mental Status (SLUMS). This scale is a ten item questionnaire based upon a Likert response scale ranging from 1 to 4. Using the Rosenberg Self Esteem Scale would control for mood based criticisms in both the MMSE and the SLUMS. The MMSE also fails to differentiate between a mild cognitive impairment (MCI) and any early stage of dementia, regardless of the form (Nieuwenhuis-Mark, 2010). It is important to make the distinction between MCI and early stages of dementia. MCI is not the same as dementia; however individuals suffering from MCI are at greater risk of developing dementia. While experts are still refining the clinical guidelines that define MCI, they can agree that it can be defined as a notable deficit in cognition that is unusual for a person's age or education and the severity of which is insufficient to constitute a diagnosis of dementia. MCI can also be characterized by cognitive deficits broadly classified as amnestic (memory) and/or nonamnestic (e.g., executive function, abstract reasoning, language, or perceptual speed), which, in turn, may reflect multiple and often comorbid pathologies of neurodegenerative, vascular, metabolic, or traumatic origin (Wadley et al., 2007).

Mild cognitive impairments should be thought of as a state on a continuum of cognitive changes between normal aging and impairments that are recognized as defining features of early dementia. Early dementia is the official first stage of dementia where physical changes are starting to occur in the brain and as a result multiple areas of cognitive and functional abilities see significant decreases. The major difference between these two conditions are that MCI is insufficient in severity to warrant a diagnosis of dementia where as early stages of dementia have recognizable and defining symptoms that warrant a diagnosis of dementia (Wadley et al., 2007). Both conditions should be approached differently making it important to have an evaluation that reflects a distinction in diagnosis between these two conditions.

The Saint Louis University Mental Status (SLUMS) is another 30-point test that was designed to measure one's ability in the domains of orientation, executive function, memory, and attention. We believe the SLUMS deals with many of the shortcomings in the MMSE, and may in fact be psychometrically superior to the MMSE. An additional cause for concern when using the MMSE is its heavy reliance on orientation questions which can be problematic when considering the prevalence of moving or relocating that many older adults undergo, especially as their need for assistance becomes greater. This lack of awareness could lead to a lower score on the questions that address orientation. The MMSE's great reliance on orientation bases 10 of the possible 30 points on that general area, whereas the SLUMS bases only three of 30 points based on orientation. Another example of potential psychometric superiority are the five words that a participant is asked to remember on the SLUMS, compared to only three words on the MMSE. The SLUMS therefore provides a greater range in possible scores and potentially greater discrimination in measuring one's ability to remember information after a short delay. The SLUMS may also be able to better detect aphasia (i.e., language impairment) than the MMSE by providing a possible score of three (zero, one, two, or three points), whereas the MMSE only asks a participant to identify two simple objects, such as a paperclip or pencil (Tariq, Tumosa, Chibnall, Perry, & Morley, 2006). It is very rare for someone to miss the aphasia questions on the MMSE. The SLUMS uses a well-established test, in which people are asked to report as many animals as they can in 60 seconds. The animal test yields a consistent distribution of scores between zero and three.

The differences in scores seen between people that have a higher level of formal education verses those who have received less formal education is thought to be the result of some form of reserve mechanisms taking place within one's brain. This "cognitive reserve" hypothesis suggests that a myriad of circumstances influence mental abilities. These circumstances can include level of education, amount of mental stimulation, occupation, social activities/engagements, and hobbies (Liberati, Raffone, & Belardinelli, 2012). Those with more cognitive reserve may have a better aptitude to "fool" a test, such as the MMSE, by providing more effective cognitive strategies to answer questions. An example of the cognitive reserve

hypothesis can be seen in those who earn a perfect score of 30 on the MMSE, yet still exhibit symptoms of dementia. One study found that people with dementia could obtain perfect scores on the MMSE; presumably this potentially dangerous outcome (i.e., failing to accurately diagnose dementia case that could benefit from intervention) would be less likely with a more difficult test (Shiroky, Schipper, Bergman, Chertkow, 2007). Practitioners need a way to convert and compare MMSE and SLUMS test scores to track people who have had different tests and to use the studies that have based treatment recommendations (e.g., Molinuevo et al., 2010) on MMSE scores.

The purpose of this article is to provide health care practitioners with a simple conversion that can be used to compare the scores of the MMSE to the scores on the SLUMS. We predicted that scores on the SLUMS would be lower than scores on the MMSE, making it less likely that the SLUMS would miss a potential dementia case.

Method

Participants

Participants were recruited from independent living, assisted living, and skilled nursing facilities throughout Oregon. Convenience sampling was used and participation was open, with a majority of participants recruited by activities directors. Researchers collected data from 150 participants. Of those 150 participants, 118 (96 female, 21 male) completed the study and ranged from age 41 to 96 (*M*=80.03, *SD*=8.71). Additionally, each participant had an average educational attainment of 14.97 years (*SD*=2.68). Four individuals did not complete testing and 26 were dropped due to sensory impairments. Participants determined to be incompetent to make medical or financial decisions by a court were not included. Several items on the demographics questionnaire specifically assessed this item. Additionally, researchers communicated participant competence to the administration when collecting data at a particular facility (e.g., assisted living or skilled nursing).

Materials

The primary measurement tools used in this study were the MMSE and SLUMS. The MMSE is an 11 question cognitive measure that evaluates five areas of functioning: orientation, registration, attention and calculation, language and praxis, and recall. The SLUMS examination has 11 questions, a majority of which have multiple parts. Both of the tests have a total possible score of 30. Informed consent forms, demographics questionnaires, and post-evaluation debriefings were also utilized. The demographics questionnaire included questions addressing uncorrected sensory impairments (i.e., hearing and/or visual impairment), age, educational level, and living environment.

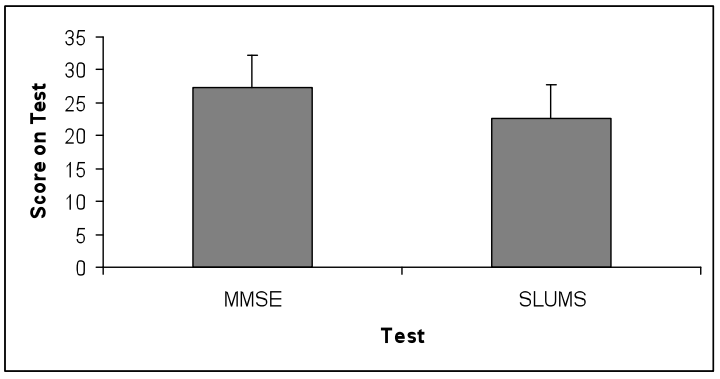
Procedure

Participants who had significant uncorrected sensory impairments did not continue. Examples of uncorrected sensory impairments would include participants' inability to read large font, hear questions, speak, or write. Individuals were subsequently given the MMSE and SLUMS cognitive screening tests. Researchers counterbalanced the order of presentation such that half of the participants were administered the MMSE first followed by the SLUMS. The other half of the participants were administered the SLUMS first followed by the MMSE. Evaluations were kept confidential for the safety and privacy of all participants involved, including those who were excluded from the study.

Results

As predicted, the mean score on the SLUMS (*M* = 22.68, *SD* = 5.55) was lower than the mean score on the MMSE (*M* = 27.24, *SD* = 3.37). Researchers observed an average participant score difference of 4.56 (*SD* = 4.03), with the SLUMS being the lower score. Results from a paired samples t-test showed this difference was significant; *t* (117) = 12.31, *p* <.001. (see Figure 1).

Figure 1 Mean MMSE and SLUMS test scores across al participants. Participant score (*M* = 4.56, *SD* = 4.03 difference between the MMSE (*M* = 27.24, *SD* = 3.37) and the SLUMS (*M* = 22.68, *SD* = 5.55) was significant; *t* (117) = 12.31, *p* <.001.



This study examined the average MMSE and SLUMS scores as a function of living environment (see Table 1). The assisted living group showed the highest difference score between the two averages, whereas the independent living group showed the lowest. To further explore these differences, an independent samples t-test comparing the mean difference in test scores between those residing in assisted living (*M* = 8.23, *SD* = 4.61) and independent living (*M* = 3.63, *SD* = 3.38) environments was ran. Results from this test were also significant; *t*

(111) = 5.32, $p < .001$ (see Figure 2). This evidence suggests these two groups are significantly different from one another in terms of score disparity.

Table 1. Average MMSE and SLUMS as a Function of Living Environment

Living Environment		
Assisted Living	MMSE	SLUMS
Independent Living	23.55	15.32
Skilled Nursing	28.03	24.41
Other	29.00	24.00

This study predicted participants with higher education attainment, and thus more cognitive reserve, would show a greater mean difference score. Upon examining our results, no evidence was found to support this cognitive reserve hypothesis. Results from an independent samples t-test comparing the mean difference in test scores between participants in the top quartile (years > 16.25) ($M = 3.86$, $SD = 3.69$) and bottom (years < 13) quartile ($M = 4.85$, $SD = 4.70$) of educational attainment were not significantly different, t (53) = .87, p = .39 (see Figure 3).

Discussion

The results supported our prediction that, in general, participants would score lower on the SLUMS than the MMSE. This finding appears to substantiate previous research suggesting the SLUMS may be psychometrically superior to the MMSE, and therefore less likely to miss a possible case of dementia because it would be more challenging to have a very high score on the SLUMS even though one had significant impairment, which is a serious flaw with the MMSE (Shiroky, Schipper, Bergman, & Chertkow, 2007).

Participants' SLUMS and MMSE scores were significantly different. This finding remained consistent when examining the average SLUMS and MMSE scores of participants residing in assisted, independent living, skilled nursing, and "other" living environments. When the mean difference in scores between the assisted living and independent living environments were compared, evidence was found suggesting these groups significantly differed in their difference scores. This provides compelling evidence that the SLUMS may be more sensitive at detecting cognitive impairments when individuals are in the mild cognitive impairment range, as seen in the non-independent living participants' difference scores.

Contrary to what was expected, no evidence to support our cognitive reserve hypothesis was found. We did not find that cognitive reserve, operationally defined as the number of years of education, was not associated with greater difference scores between the MMSE and the SLUMS. This contradicts current research that suggests higher levels of cognitive reserve may leave one more apt at "fooling" a test (e.g., MMSE) despite the presence of dementia symptoms. However, two limitations may have impacted these results. First, the education levels of the participants may have been higher than average, therefore decreasing the likelihood of a significant result when comparing the top and bottom educational attainment quartiles. Second, a selection bias may have been introduced due to convenience sampling. It is possible that individuals who chose to participate in a study were highly educated, or more interested in scientific research. Likewise, individuals who did not choose to volunteer may be aware of their cognitive impairments and did not wish to risk embarrassment. These same individuals could have been of a lower educational attainment.

It is likely that the SLUMS is a more sensitive test, and is therefore more apt at accurately identifying possible dementia, where the MMSE might miss it. Consequently, a need to establish norms for converting scores between

Figure 2 Mean difference in test score by living environment. Score difference between assisted living ($M = 8.23$, $SD = 4.61$) and independent living ($M = 3.63$, $SD = 3.38$) environment groups was significant; t (111) = 5.32, p <.001.

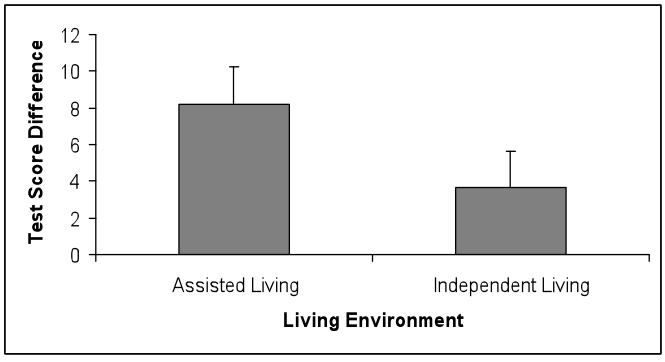
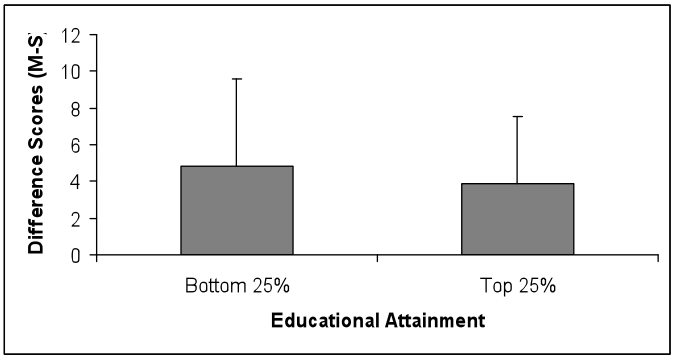


Figure 3 Comparison of bottom and top quartiles of educational attainment. Difference in score between the bottom (years < 13) and top (years > 16.25) quartiles was not significant; t (53) = .87, p = .39.



the two tests exists when treatment recommendations have been based solely on MMSE scores (e.g., Molinuevo et al., 2010). The purpose of our study was to establish these norms. Practitioners can now convert SLUMS and MMSE scores with our observation that there is an average difference of 4.56, with the SLUMS being the lower score. With the conversion this study developed, practitioners can now use the SLUMS scoring guild, which distinguishes between educational attainment, to better diagnose the difference between normal cognitive functioning, mild neurocognitive disorder, and dementia. This conversion also allows for the MMSE to be seamlessly replaced by the MMSE by converting old MMSE evaluations into still usable and relevant SLUMS scores.

Our study was not to advocate the use of one test over the other, but to merely show evidence that the MMSE scores may not be as sensitive to dementia and cognitive impairments as the SLUMS. At this point, we cannot suggest that one test be used more often or in place of the other, more extensive research must be conducted before that determination can be made. More research comparing the MMSE and SLUMS must be conducted. In the future, studies comparing the two scores should include participants from a broader range of education levels in order to more accurately assess the cognitive reserve hypothesis. In general, our study was lacking in terms of a representative sample of relevant demographic variables. Future research should also attempt to address the concern mood concerns by having participants take a preliminary evaluation on mood such as the Rosenberg self esteem scale to increase the validity of the study. Future studies should include larger samples with greater ethnic diversity from higher levels of assistive care to further assess the test differences between differing living environments.

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