# Reading Ability, Education, and Cognitive Status Assessment Among Older Adults in Harlem, New York City

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ABSTRACT

*Objectives.* This study examined reported level of education and current reading ability as predictors of cognitive status among older African Americans in central Harlem, New York City.

*Methods.* A probability sample of 164 noninstitutionalized older African Americans was assessed. Mini-Mental State Examination (MMSE) scores were regressed on education and reading ability measures.

*Results.* Reading ability and educational attainment were significant, independent predictors of MMSE performance. Within any level of education, subjects whose grade-equivalent reading ability exceeded reported level of education scored significantly higher on the MMSE.

*Conclusions.* Reading ability may be useful in interpreting the results of cognitive screening among low-educated and minority groups. (*Am J Public Health.* 1999;89:95–97)

The Mini-Mental State Examination (MMSE)[1] is commonly used to assess cognitive status in epidemiological field studies. It assesses orientation, registration and recall of information, attention and calculation, language, and visuospatial construction. MMSE performance has repeatedly been shown to be related to educational attainment, in both clinical[2] and community[3,4] samples and among both ethnic minorities and nonminorities.[5–7] This association may lead to misclassification of elders with low education as cognitively impaired.[2,8,9]

It would be valuable to improve the specificity of cognitive assessment instruments among individuals with low levels of formal education. To this end, we examined reading ability as a determinant of MMSE performance in a population sample of minority elders. A secondary aim was to examine the disjunction between grade-equivalent reading ability and reported education as a predictor of MMSE performance. This effort may help clarify sources of variation in late-life cognitive status.

The effect of low literacy on the performance of cognitive assessment measures has only recently been investigated. For example, a comprehensive review of the MMSE did not discuss the effect of literacy on MMSE performance.[10] More recently, 2 studies reported that reading level predicted MMSE performance in regression models that controlled for age and education.[11,12] These studies, however, were not population based and did not include a large proportion of minorities.

## Methods

### *Sample*

Elders assessed in this research were drawn from the Harlem Household Survey, a population-based study in Harlem, New York City.[13] In this survey, 963 households were randomly selected. A total of 881 of these households (91.5%) were successfully contacted by the research team from 1992 to 1994 and completed a basic household composition survey; 168 households contained a person aged 65 or older, for a total of 189 older adults (148 households with 1 elder, 19 households with 2, and 1 household with 3). Interviews were completed with 164 of these 189 elders, for a response rate of 86.8%. All identified themselves as "African American," and all reported English as their first language.

### *Strategy*

Elders were approached in their homes by trained interviewers and completed an interview lasting approximately 1 hour. Interviewers were trained at the Hebrew Home for the Aged in Riverdale, NY, and they completed a 4-day program in which they were observed interviewing and rating elders. Interviewers had to achieve at least 95% exact agreement with an expert rater over 4 tests before being sent into the field.

In scoring the MMSE, the better score from 2 exercises, successively subtracting 7 from 100 and spelling the word *world* backward, was used. Missing data for MMSE items were on the whole low (<5%) (owing largely to interviewer error or broken-off interviews) and in these cases were replaced with sample means. MMSE scores were categorized by scoring conventions applied in the Epidemiologic Catchment Area study: 0–17 indicates severe cognitive impairment, 18–23 indicates mild cognitive impairment, and 24–30 indicates no impairment.[14] These cutoff scores, it should be noted, were established in clinic-based samples rather than population-based studies.

Subjects also completed the reading test of the Wide Range Achievement Test—Revised (WRAT-R), level I.[15] In the WRAT-R, subjects are asked to read and pronounce 75 progressively harder words. Level I raw

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This paper was accepted July 24, 1998.

**TABLE 1—Performance on MMSE by Age and Education for Subjects Completing WRAT-R, Harlem Aging Sample**

| | MMSE Score by Years of Education | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0–4 | | | 5–8 | | | 9–12 | | | 13+ | | |
| Age, y | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects |
| 65–70 | . . . | . . . | 0 | 23.8 (4.0) | 25 | 4 | 26.8 (2.9) | 27 | 25 | 29.0 (1.0) | 29 | 3 |
| 71–74 | 21.0 (3.4) | 22 | 5 | 24.7 (3.3) | 24 | 12 | 23.3 (4.9) | 24 | 23 | 29.2 (1.1) | 30 | 5 |
| 75-79 | 24.0 (2.8) | 24 | 2 | 25.3 (3.2) | 25 | 8 | 24.8 (5.3) | 27 | 15 | 25.1 (3.8) | 27 | 7 |
| 80+ | 24.0 (3.9) | 23 | 6 | 21.3 (4.2) | 22 | 12 | 23.8 (4.5) | 24 | 13 | 28.8 (1.5) | 28 | 3 |

*Note.* n = 143 (1 subject missing data on education).

scores were converted to level II (adult) scores by using an algorithm provided by the test developer (Jastak Assessment Systems, Wilmington, Del). WRAT-R norms for establishing grade-equivalent reading levels were developed from large samples, of which 15% to 23% (depending on geographic region) were non-White.

*Analyses*

Mean and median MMSE scores were calculated for age groups according to years of education and grade-equivalent reading ability. Differences in means were assessed with analysis of variance. Spearman rank correlations were calculated to assess the association between MMSE performance and predictors. Multiple logistic regression models were developed, with MMSE as a dichotomous outcome indicating impairment (MMSE score $\leq 23$). Educational attainment and reading ability were divided at the sample median, and resulting subgroups were dummy-coded; in this way, we calculated the risk associated with low performance on either or both measures.

## Results

Three of the elders (1.8%) were unable to complete the MMSE because they were mute or could not be aroused; these individuals were excluded from analyses. Of the remaining 161 subjects with MMSE scores, 144 completed the WRAT-R. Reasons for not completing the WRAT-R included visual impairment (n = 7), refusal (n = 5), and unspecified (n = 5). MMSE scores of these 17 subjects did not differ significantly from those of subjects completing the WRAT-R.

The sample was approximately 70% female, nearly half were widowed, and 14% had education beyond high school. The mean age was 75.4 (SD, 7.3), with a range of 65 to 105; 10% reported that they were employed and receiving wages. In more than half the interviews, no one besides the elder and interviewer was present.

*MMSE Performance*

Among subjects who completed the WRAT-R, 37.5% scored 23 or below on the MMSE (mild impairment cutoff score) and 6.3% scored 17 or below (severe impairment cutoff score). Table 1 shows mean and median MMSE scores by age and education. MMSE scores were significantly associated with age ($r = -0.21$, $P < .01$) and education ($r = 0.32$, $P < .001$).

*Reading Levels Among Harlem Elders*

On the WRAT-R, nearly a quarter of subjects were reading below the third-grade level and another quarter above the twelfth-grade level. MMSE scores by grade-equivalent reading level are shown in Table 2.

Reading ability was significantly correlated with MMSE performance ($r = 0.48$, $P < .001$) and years of school ($r = 0.42$, $P < .001$). Sixty-six percent of respondents in the lowest tertile of reading ability, 34.8% in the middle tertile, and 13.7% in the upper tertile met MMSE criteria for mild impairment ($F = 17.5$, $P < .0001$).

Reading ability was most highly correlated with MMSE language-based items, such as spelling *world* backward ($r = -0.45$, $P < .001$), but reading ability was also highly correlated with a number of "nonlanguage" items, such as successively subtracting 7 from 100 ($r = -0.41$) and naming the day of the month ($r = -0.42$).

*Multiple Regression Analysis of Reading Level and Education*

Reading level and education were significant, independent predictors of cognitive impairment on the MMSE in logistic regression models that adjusted for age and gender. Relative to subjects scoring above the median on both measures, the odds ratio was 5.0 (95% confidence interval [CI] = 1.4, 17.7) for subjects with low education only, 5.6 (95% CI = 1.6, 18.7) for subjects with low reading ability only, and 12.7 (95% CI = 4.1, 52.5) for subjects scoring below the median on both measures.

**TABLE 2—Performance on MMSE by Age and Grade-Equivalent Reading Level, Harlem Aging Sample**

| | Grade-Equivalent Reading Ability | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ≤3rd Grade | | | 4th–8th Grade | | | 9th–12th Grade | | | >High School | | |
| Age, y | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects | Mean (SD) | Median | No. of Subjects |
| 65–70 | 23.8 (4.5) | 23 | 5 | 27.4 (2.1) | 27 | 11 | 26.5 (279) | 27 | 6 | 27.3 (3.1) | 29 | 10 |
| 71–74 | 20.2 (4.6) | 21 | 15 | 24.7 (2.7) | 26 | 7 | 26.0 (3.4) | 26 | 15 | 27.0 (2.0) | 27 | 8 |
| 75–79 | 22.5 (7.1) | 24 | 6 | 22.3 (3.0) | 21 | 7 | 26.2 (2.6) | 27 | 13 | 27.7 (2.0) | 28 | 6 |
| 80+ | 20.9 (4.3) | 23 | 7 | 22.6 (4.2) | 22 | 11 | 23.9 (3.7) | 23 | 10 | 25.9 (5.0) | 27 | 7 |

*Note.* n = 144.

*Discrepancies Between Self-Reported Education and Current Reading Level*

In 25.9% of subjects, educational level and grade-equivalent reading level were equivalent; in 26.6%, subjects' reading levels exceeded self-reported educational level; and in 47.5%, reading levels were below that expected for reported education. This discrepancy was evident in all education groups. For example, of 18 subjects reporting more than 12 years of school, only half were reading at grade level. Within each education category, subjects whose grade-equivalent reading ability was below their reported educational level had lower MMSE scores, and subjects whose reading ability exceeded reported years of education scored higher ($F = 7.7$ by analysis of variance, $P < .01$).

## Discussion

Our findings confirm recent reports of the strong association between literacy skills and MMSE performance in the elderly[11,12] and extend this finding to a population-based sample of African Americans. In multiple logistic regression models, low reading ability and education each independently predicted cognitive impairment by MMSE criteria. Within groups defined by years of education, subjects with higher reading ability performed better on the MMSE than subjects whose reading ability was below their reported level of education.

Why do reading ability and education independently predict MMSE performance? A number of explanations are possible. First, because of variation in the adequacy of schooling (or errors in reporting years of school), years of education may not always adequately reflect cognitive ability; for some subjects, reading ability may more accurately reflect cognitive ability. Alternatively, current reading ability may reflect gains or decrements in cognitive ability over the lifespan. Finally, it is also possible that reading ability itself is sensitive to cognitive decline.[16] Subjects whose reading levels were below grade-equivalent reading levels may have begun to decline cognitively.

Disparities between reported education and reading ability among the elderly have also been reported by Weiss et al.,[11] Mayeaux et al.,[12] and Baker et al.[17] The disjunction between reading level and reported education may be a common feature of late life and should be considered in interpreting MMSE scores. For example, low-educated individuals could be further subdivided by literacy status when MMSE norms are developed.

One limitation of this research was our inability to conduct neurologic examinations or full neuropsychological assessments of subjects. However, the proportion of subjects whose scores fell below MMSE cutoffs was similar in our sample to that reported for the Epidemiologic Catchment Area populations.[14]

To conclude, current reading ability should be considered when interpreting cognitive screening test results and may prove useful in improving the specificity of cognitive screening among low-educated and minority groups. □

## Contributors

Dr Albert conceived the idea for the paper, conducted statistical analyses, wrote successive drafts of the paper, and discussed the ideas at scientific meetings. Dr Teresi coordinated the project, ensured the integrity of data, commented on drafts of the paper, and contributed expertise on sampling and statistical issues.

## Acknowledgment

This research was supported by National Institute on Aging grant AG07232 and by the Harlem Household Survey.

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