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Poorer Financial and Health Literacy Among Community-Dwelling Older Adults With Mild Cognitive Impairment

S. Duke Han, PhD[1,2], **Patricia A. Boyle, PhD**[1], **Bryan D. James, PhD**[1], **Lei Yu, PhD**[1], and **David A. Bennett, MD**[1]

[1]Rush University Medical Center, Chicago, IL, USA

[2]VA Long Beach Healthcare System, CA, USA

Abstract

Objective—Literacy is an important determinant of financial and health outcomes in old age, and cognitive decline has been linked with lower literacy. We tested the hypothesis that mild cognitive impairment (MCI) is associated with poorer financial and health literacy.

Method—Participants (*n* = 730) from the Rush Memory and Aging Project were given a clinical evaluation and an assessment of total, financial, and health literacy. Regression was used to examine whether MCI was associated with lower literacy. In secondary analyses, we investigated the association of particular cognitive systems with literacy.

Results—MCI was associated with lower total, financial, and health literacy. An interaction was observed such that higher education reduced the effect of MCI on total and financial literacy. Multiple cognitive systems were associated with literacy in participants with MCI, and semantic memory accounted for the most variance.

Discussion—Persons with MCI exhibit poorer financial and health literacy, and education mitigates this effect.

Keywords

literacy; cognition; mild cognitive impairment; education

Introduction

Literacy refers to the ability to identify, understand, and use information to function effectively in multiple contexts according to the United Nations Educational, Scientific, and Cultural Organization (Kutner, Greenberg, Jin, & Paulsen, 2006). Low rates of literacy are a significant problem for millions in the United States, and are particularly problematic for older adults above the age of 65 (Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004;

Corresponding Author: S. Duke Han, Rush Alzheimer's Disease Center, Rush University Medical Center, 600 S. Paulina St., Suite 1022, Chicago, IL 60612, USA. Duke_Han@rush.edu.

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Lusardi & Mitchell, 2007a). Two specific domains of literacy, financial and health literacy, may be particularly problematic for older adults. Financial and health literacy are of critical importance in old age, a time when adults must make complicated decisions in financial matters, such as intergenerational transfers of wealth and selecting methods of retirement disbursements, and in health matters, such as near end-of-life health care planning and medication management. In fact, lower financial literacy has been associated with less wealth close to retirement (Lusardi & Mitchell, 2007a), and lower health literacy has been linked with more comorbidities and poor access to health care (Sudore et al., 2006). Although relatively little is known about the factors associated with literacy in old age, poor literacy can thus have a profound impact upon independence and well-being of older adults, and consequently could escalate the financial and health burden of family members, care providers, and society. It is for these reasons that a greater understanding of the factors that could have a negative impact upon financial and health literacy in old age is an important public health issue.

We recently demonstrated that cognitive decline is associated with lower financial and health literacy among older adults without dementia, suggesting that low literacy may be an early manifestation of preclinical cognitive decline (Boyle et al., 2013). Thus, we hypothesized that persons with mild cognitive impairment (MCI) would show poorer financial and health literacy compared with non-cognitively impaired older adults. We tested this hypothesis using data from the Rush Memory and Aging Project, a community-based epidemiologic study of old age, and analyses controlled for the effects of age, education, and sex. We also explored how the severity and type of cognitive impairment affected literacy among older adults with MCI, as well as the effect of age, sex, and education on the association of MCI with literacy.

Method

Participants

Participants came from the Rush Memory and Aging Project, a clinical-pathologic study of aging and dementia (D. A. Bennett et al., 2012). This study recruited participants from local residential facilities, including retirement homes, senior housing facilities, and community organizations in and around the greater Chicago metropolitan area. Participants underwent detailed annual clinical evaluations as previously described (D. A. Bennett et al., 2012).

The Rush Memory and Aging Project began in 1997, and enrollment is ongoing. A financial and health decision-making and literacy sub-study was added in 2010. At the time of these analyses, 1,671 participants had completed the baseline evaluation for the parent study; of those, 564 died, 83 refused further participation in the parent project before they were able to complete the baseline literacy assessment, and 98 were not asked to participate due to severe difficulties with language, hearing, vision, or understanding, or having moved out of the geographical area. Of the remaining 926 potentially eligible persons, 802 (86.6%) completed the literacy baseline, 71 had not yet completed the literacy assessment, and 53 refused the literacy assessment. Of the 802 participants who had completed the literacy assessment, 41 had dementia and were excluded, and 31 had missing data in the variables of interest, leaving 730 eligible for these analyses.

Clinical Diagnoses

Diagnoses of dementia were determined in accordance with standard criteria (McKhann et al., 1984) by a clinician with expertise in aging as previously described (D. A. Bennett et al., 2012). An experienced neuropsychologist with expertise in aging and Alzheimer's disease (AD) and blinded to participant age, sex, and race reviewed all results of cognitive measures and rendered a clinical judgment as to cognitive impairment after reviewing data on education, sensory deficits, and motor deficits. Next, an experienced physician with expertise in the diagnosis of AD reviewed all available participant information (cognitive data, medical history, neurological exam, brain scan) and rendered a judgment as to dementia in accordance with NINCDS/ ADRDA criteria. Finally, any participant deemed to have cognitive impairment but not dementia was deemed to have MCI. Our characterization of MCI closely resembles the condition of "Cognitive Impaired Not Demented" or otherwise known as CIND (Graham et al., 1997) and has been used in several prior publications (Boyle et al., 2005; Boyle et al., 2006; Boyle et al., 2010a; Boyle et al., 2010b; Boyle et al., 2010c; James et al., 2011; Han et al., 2011; Schneider et al., 2009; Wilson et al., 2007; Aggarwal et al., 2005; Aggarwal et al., 2006; Yu et al., 2012; Bennett et al., 2005). Further, we have previously shown that persons who meet these criteria are at a substantially increased risk of developing AD (Boyle et al., 2006) and are intermediate between persons without cognitive impairment and those with dementia in terms of brain pathology (Bennett et al., 2005).

Assessment of Financial and Health Literacy

Literacy was measured with 32 questions developed to evaluate knowledge of financial and health information and concepts (Boyle et al., 2013; J. S. Bennett, Boyle, James, & Bennett, 2012; James, Boyle, Bennett, & Bennett, 2012). There were 23 questions on financial literacy, many of which were adapted from those used on the Health and Retirement Survey (Lusardi & Mitchell, 2007b). Questions assessed the ability to perform calculations (numeracy), as well as knowledge of financial concepts and entities such as stocks, bonds, and compound interest. There were nine questions on health literacy, which included questions on Medicare and Medicare Part D, following prescription instructions given by doctors, leading causes of death in older persons, and understanding drug risks. All answer choices were multiple choice or true/ false, and each item was scored as correct or incorrect. Because of the difference in number of items across the domains of literacy, health and financial literacy scores were expressed as the percent correct (from 0 to 100) out of total items within each domain, and total literacy was the mean of these two percentages. The test–retest reliability for the total literacy score over a 1-year interval was observed as adequate (Intraclass Correlation Coefficient = .75; Lohr, 2002). We have previously shown that this measure of literacy is related to engagement in health promoting behaviors, functional status, aspects of physical and mental health, financial and health care decision making, and cognitive decline in the same cohort of older persons (J. S. Bennett et al., 2012; Boyle et al., 2013; James et al., 2012).

Assessment of Cognition

A battery of 21 cognitive performance tests was administered by trained technicians supervised by a board-certified clinical neuropsychologist. Measures of cognitive function assessed a broad range of cognitive abilities (D. A. Bennett et al., 2006; D. A. Bennett et al., 2012). Two of the 21 tests, the Mini-Mental Status Examination and the Complex Ideational Material, are used for descriptive and clinical diagnostic purposes only. Raw scores on the remaining 19 tests were converted to *z* scores using the mean and standard deviation from the baseline evaluation. A global cognition score was calculated by averaging the *z* scores across these 19 measures of cognitive function as previously reported (Wilson, Barnes, & Bennett, 2003). Episodic memory measures included Word List Memory, Word List Recall, and Word List Recognition from the procedures established by the Consortium to Establish A Registry for Alzheimer's Disease (CERAD) and immediate and delayed recall of Logical Memory Story A and the East Boston Story. Semantic memory measures included Verbal Fluency, Boston Naming, subsets of items from Complex Ideational Material, and the National Adult Reading Test. Working memory measures included the Digit Span subtests (forward and backward) of the Wechsler Memory Scale-Revised and Digit Ordering. Measures of perceptual speed included the oral version of the Symbol Digit Modalities Test, Number Comparison, Stroop Color Naming, and Stroop Word Reading. Measures of visuospatial ability included Judgment of Line Orientation and Standard Progressive Matrices. A composite score for five cognitive systems (episodic memory, semantic memory, working memory, perceptual speed, visuospatial ability) was created by averaging the *z* scores of all measures within a system, as previously reported (Wilson et al., 2003).

Other Covariates

Age (based on date of birth and date of literacy assessment), sex, and education (years of schooling) were self-reported and included as covariates because prior work has established these as being linked to literacy (Lusardi & Mitchell, 2007b, 2008a, 2008b; Sudore et al., 2006).

Ethical Statement

All procedures were conducted in accordance with the ethical rules for human experimentation that are stated in the Declaration of Helsinki and were approved by the Institutional Review Board of Rush University Medical Center.

Statistical Analyses

Descriptive and bivariate statistics characterized the two groups (MCI and non-cognitively impaired). Chi-square tests were used for categorical variables and *t* tests were used for continuous variables. For the *t* tests, if variances were found to be different between groups, the Satterthwaite variance estimate was used instead of the Pooled variance estimate. Analyses of covariance were then performed to examine the associations between MCI and literacy (total, financial, and health); persons without any cognitive impairment were the reference group. All models included terms to control for the potentially confounding effects of age, education, and sex. Next, a series of linear regression models were conducted only in MCI individuals to explore the associations between cognition and five cognitive systems (episodic memory, semantic memory, working memory, perceptual speed, and visuospatial ability) with literacy. Analyses were conducted in SAS version 9.3 software.

Results

Descriptive Statistics

The mean age was 81.75 years (*SD* = 7.63, range = 58.81–100.78), the mean education was 15.22 years (*SD* = 3.08, range = 0–28), 75.75% were women, and 91.92% were White. As shown in Table 1, bivariate analyses showed that participants with MCI were older on average and performed significantly lower on total literacy as well as financial and health literacy compared with persons with no cognitive impairment (NCI). As expected, they also exhibited lower functioning in all five systems of cognitive function.

Relation of MCI to Literacy

First, to examine whether MCI was associated with lower literacy, we conducted a set of linear regression models that examined the relation of MCI with literacy; these and all subsequent analyses controlled for age, education, and sex. As shown in Table 2, the presence of MCI was associated with lower total, financial, and health literacy scores. To clarify this, the presence of MCI was equivalent to about 16 additional years of age for total literacy, about 14 additional years of age for financial literacy, and about 18 additional years of age for health literacy. In models with interaction terms between MCI and age, education, and sex, there was a significant interaction of education and MCI status for total and financial literacy, such that the association of MCI and literacy was weaker for persons with higher education.

Relation of Specific Cognitive Abilities With Literacy Among Persons With MCI

Given that the clinical diagnosis of MCI was associated with poorer literacy, we next examined the relation of the severity of cognitive impairment with literacy. Results from linear regression models examining the relation between global cognition and literacy adjusted for age, sex, and education among participants with MCI are presented in Table 3. Global cognition was associated with total, financial, and health literacy, suggesting that more severe cognitive impairment is related to a lower level of literacy among individuals with MCI.

Finally, to determine whether the effect of cognition on literacy was of a general nature or was driven by specific cognitive abilities, we conducted a series of linear regression analyses to examine the associations between five specific cognitive systems (episodic memory, semantic memory, working memory, perceptual speed, and visuospatial ability) and literacy among persons with MCI. Episodic memory, semantic memory, and perceptual speed were associated with total literacy (Table 3). Episodic memory, semantic memory, working memory, and perceptual speed were associated with financial literacy. Episodic memory, semantic memory, perceptual speed, and visuospatial ability were associated with health literacy. Semantic memory explained the most variance in literacy, as indicated by a greater R^2 change than any other cognitive system measured, but explained at most about 15% of the variance.

Discussion

In a community-based sample of more than 700 participants free of dementia, we found that MCI was associated with lower performance on a measure of literacy, including both financial and health literacy. An interaction was observed such that more years of education reduced the association of MCI and total and financial literacy. Furthermore, among persons with MCI, more severe global cognitive impairment was associated with poorer literacy. The association of cognition with literacy appears to be of a fairly general nature, although semantic memory accounted for the most variance in literacy. Together, these results suggest that MCI deleteriously affects literacy, a resource critical for health and well-being in old age, but that education buffers this effect to some degree.

This work makes three contributions to the literature. The first contribution is the main discovery that MCI is associated with lower literacy in financial and health matters. Relevant to the current study, our group has previously shown that higher literacy has been linked with more health promoting behaviors, less disability, and better mental health in old age (D. A. Bennett et al., 2012). We have also shown that cognitive decline impairs financial and health literacy among non-demented older adults (Boyle et al., 2013). This study extends our previous work by showing that a clinical diagnosis of MCI, which is based on evidence of deteriorated cognition, is associated with poorer literacy in financial and health matters. Literacy is often considered a relatively stable construct throughout adulthood. However, our results suggest that decline of cognitive abilities in old age degrades financial and health literacy. Because lower literacy is associated with worse decision-making abilities in old age (James et al., 2012), our findings have particular importance because older adults are constantly faced with major decisions in financial and health matters that could have a significant impact upon their independence and well-being. The consequences of poor financial and health literacy of older adults with MCI could be far-reaching, the burden being displaced upon family members, medical or financial systems, and society.

The second contribution of this study is the finding that education mitigates the effect of MCI on total and financial literacy. Lower educational attainment has been linked with poorer financial literacy (Lusardi & Mitchell, 2008a) as well as health literacy (Sudore et al., 2006). Our results extend this understanding and suggest that, at least for financial matters, higher education may provide a buffer against the negative effects of MCI upon literacy. One possible explanation for this is that greater educational attainment results in greater cognitive reserve (Stern, 2009), and this may in turn have some kind of beneficial effect on literacy, though it is unclear why this might be preferential to financial literacy versus health literacy. Our results also suggest that, for those with low education, being diagnosed with MCI in later life may have a particularly negative relationship with total and financial literacy. Future studies are needed to explore whether interventions might be effective in preserving or increasing total or financial literacy in adults with low education.

The third contribution of the present study is the finding that the association between MCI and literacy is of a fairly general nature across cognitive domains, although semantic memory abilities may be most strongly linked to literacy. In cognitive neuroscience, semantic memory abilities have been historically viewed as the basis for retrieval of conceptual knowledge pertaining to specific categories of information (Tranel, Damasio, & Damasio, 1997). Literacy has been defined as the ability to identify, understand, and use information to function effectively in multiple contexts. The cognitive neuroscience view of semantic memory fits well within this conceptualization and may explain why this cognitive system may be particularly relevant to developing and maintaining literacy in financial and health matters in old age. Future work is needed to determine whether a specific decline in semantic memory might play a role in reducing financial and health literacy among older adults with MCI. Although some may conceptualize literacy as a form of semantic memory, it should be noted that although semantic memory explained the most variance in literacy, it still only accounted for about 15% of the variance. This is notable in that it stresses the importance of considering factors other than cognition when trying to understand the determinants of poor literacy in MCI.

The strengths of this study include the use of a sizable and well-characterized community-based cohort, standardized diagnostic classification, the use of a literacy measure that assesses financial and health knowledge, and incorporation of a broad battery of cognitive measures that allowed for global and system-specific considerations. Weaknesses included the use of a cross-sectional design and the selected nature of study participants. The results of this study support the notion that MCI is associated with poorer financial and health literacy in matters highly relevant to independence and well-being in old age, greater years of education may mitigate this effect, and severity and type of cognitive impairment may play a role. Future research is needed to determine what role, if any, neuropathological biomarkers of disease and dementia might play in diminishing financial and health literacy among older adults with MCI.

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Table 1

Descriptive Statistics by Group.

	MCI	NCI	*t* or χ^2	*p*
n (%)	144 (20%)	586 (80%)		
M age (*SD*)	84.26 (6.14)	81.08 (7.84)	−5.25	<.01
M education (*SD*)	15.40 (3.01)	15.17 (3.09)	−0.81	.42
Female sex (%)	100 (69%)	453 (77%)	3.89	.05
White race (%)	134 (93%)	549 (94%)	0.25	.62
Episodic memory *z*-score mean (*SD*)	−0.42 (0.66)	0.53 (0.52)	16.25	<.01
Semantic memory *z*-score mean (*SD*)	−0.15 (0.63)	0.35 (0.55)	9.31	<.01
Working memory *z*-score mean (*SD*)	−0.24 (0.68)	0.24 (0.69)	7.49	<.01
Perceptual speed *z*-score mean (*SD*)	−0.35 (0.75)	0.26 (0.76)	8.56	<.01
Visuospatial ability *z*-score mean (*SD*)	−0.14 (0.88)	0.31 (0.64)	6.89	<.01
Global cognitive *z*-score mean (*SD*)	−0.31 (0.43)	0.38 (0.44)	16.25	<.01
Total literacy percent correct (*SD*)	60.9 (14.7)	70.1 (13.7)	7.16	<.01
Financial literacy percent correct (*SD*)	67.6 (17.5)	75.2 (15.0)	4.76	<.01
Health literacy percent correct (*SD*)	54.1 (17.4)	65.1 (17.8)	6.70	<.01

Note. *n* = sample size; MCI = mild cognitive impairment; NCI = non-cognitively impaired.

Table 2

Relation of MCI to Literacy.

Variable	Model term	Estimate (*SE*, *p*)		
		Model 1	**Model 2**	**Model 3**
Total literacy	Age	−0.57 (0.06, <.01)	−0.49 (0.06, <.01)	−0.50 (0.06, <.01)
	Education	1.51 (0.15, <.01)	1.55 (0.15, <.01)	1.37 (0.16, <.01)
	Male	4.41 (1.10, <.01)	4.87 (1.07, <.01)	4.63 (1.21, <.01)
	MCI		−8.44 (1.15, <.01)	−9.15 (1.38, <.01)
	MCI × Age			0.06 (0.18, .72)
	MCI × Education			0.98 (0.38, .01)
	MCI × Male			0.86 (2.54, .73)
Financial literacy	Age	−0.49 (0.07, <.01)	−0.42 (0.06, <.01)	−0.39 (0.07, <.01)
	Education	1.52 (0.17, <.01)	1.55 (0.16, <.01)	1.33 (0.18, <.01)
	Male	1.53 (1.18, <.01)	11.93 (1.15, <.01)	11.46 (1.31, <.01)
	MCI		−7.48 (1.24, <.01)	−8.04 (1.49, <.01)
	MCI × Age			−0.23 (0.19, .23)
	MCI × Education			1.15 (0.41, <.01)
	MCI × Male			2.00 (2.74, .47)
Health literacy	Age	−0.65 (0.08, <.01)	−0.57 (0.08, <.01)	−0.61 (0.09, <.01)
	Education	1.51 (0.21, <.01)	1.55 (0.20, <.01)	1.41 (0.22, <.01)
	Male	−2.71 (1.48, .07)	−2.20 (1.44, .13)	−2.21 (1.64, .18)
	MCI		−9.39 (1.55, <.01)	−10.26 (1.87, <.01)
	MCI × Age			0.36 (0.24, .14)
	MCI × Education			0.81 (0.52, .12)
	MCI × Male			−0.27 (3.44, .94)

Note. MCI = mild cognitive impairment.

Table 3

Relation of Specific Cognitive Function Measures to Literacy Among Individuals With Mild Cognitive Impairment.

Factor	Cognitive system	Estimate	*SE*	*p*	R^2 change
Total literacy	Global cognition	15.45	2.33	<.01	.159
	Episodic memory	5.73	1.56	<.01	.056
	Semantic memory	9.71	1.64	<.01	.148
	Working memory	2.90	1.55	.06	.012
	Perceptual speed	5.59	1.35	<.01	.075
	Visuospatial ability	0.62	1.28	.63	.029
Financial literacy	Global cognition	15.80	2.64	<.01	.117
	Episodic memory	5.67	1.74	<.01	.038
	Semantic memory	10.12	1.85	<.01	.117
	Working memory	4.01	1.71	.02	.018
	Perceptual speed	5.05	1.52	<.01	.041
	Visuospatial ability	0.36	1.42	.80	.028
Health literacy	Global cognition	15.09	3.34	<.01	.105
	Episodic memory	5.80	2.13	<.01	.038
	Semantic memory	9.30	2.36	<.01	.090
	Working memory	1.79	2.10	.40	−.002
	Perceptual speed	6.13	1.85	<.01	.062
	Visuospatial ability	0.88	1.75	.62	.011

Note. Estimated from separate linear regression models adjusted for age, sex, and education. Change in adjusted R^2 represents the amount of explained variance in the outcome variable associated with the cognitive variable after accounting for the effects of age, sex, and education.