The Association Between Age and Health Literacy Among Elderly Persons

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Objective. To examine why older age groups have worse functional health literacy.

Methods. Home interviews were conducted with community-dwelling elderly persons (n = 2,774) to determine demographics, years of school completed, newspaper reading frequency, chronic diseases, and health status. Participants completed the Short Test of Functional Health Literacy in Adults (S-TOFHLA, range 0–100) and the Mini Mental State Examination (MMSE).

Results. Mean S-TOFHLA scores declined 1.4 points (95% CI 1.3–1.5) for every year increase in age (p < .001). After adjusting for sex, race, ethnicity, and education, the S-TOFHLA score declined 1.3 points (95% CI 1.2–1.4) for every year increase in age. Even after adjustment for performance on the MMSE, the S-TOFHLA score declined 0.9 points (95% CI 0.8–1.0) for every year increase in age (p < .001). Differences in newspaper reading frequency, visual acuity, chronic medical conditions, and health status, did not explain the lower literacy of older participants.

Discussion. Functional health literacy was markedly lower among older age groups even after adjusting for differences in MMSE performance, newspaper reading frequency, health status, and visual acuity. Future studies should prospectively examine whether functional literacy declines with age and whether this is explained by declines in cognitive function.

Prior studies have shown that reading skills are worse among older age groups (Gazmararian et al., 1999; Kirsch, Jungeblut, Jenkins, & Kolstad, 1993; Williams et al., 1995). In the National Adult Literacy Study (NALS), a cross-sectional study of the United States population, the proportion of Americans who read at the lowest reading level (level 1) increased from 16% among those 45–54 years old to 26% among those 55–64 years old, to 44% among those age 65 and older (Kirsch et al., 1993). Moreover, a recent cross-sectional study of community-dwelling elderly persons enrolled in a Medicare managed care program found that the negative association between reading skills and age persisted even beyond age 65 (Gazmararian et al., 1999). Poor reading skills among older populations has tremendous importance because of this group’s high prevalence of chronic disease and their need to understand health-related information.

These cross-sectional studies suggest that reading ability may deteriorate with age. Reading is a complex cognitive process that requires adequate vision, concentration, word recognition, working memory, and information processing. Deficits in any of these areas may affect reading comprehension, and the prevalence of these problems may increase with age. For this project, we hypothesized that several specific health and behavioral domains could explain why older cohorts have worse reading ability: a higher prevalence of dementia or cognitive impairment, a higher prevalence of chronic diseases that may impair cognitive function, worse physical health, worse mental health, a higher prevalence of sensory impairment (i.e., worse visual acuity), and lower frequency of reading behaviors (i.e., less frequent reading of books and newspapers). The rationale for examining each of these will be briefly discussed.

The incidence and prevalence of dementia increases dramatically in those older than age 65 (Evans et al., 1989; Graham et al., 1997). Moreover, there is a substantial prevalence of cognitive impairment that is not due to dementia (Graham et al., 1997; Willis, 1996). For example, the Canadian Study of Health and Aging (Graham et al., 1997) found that 16.8% of Canadians aged 65 and older had evidence of cognitive impairment that was not due to dementia, and the prevalence of this was twice that for all types of dementia combined (8.0%). Although individual word recognition may be relatively preserved even in patients with dementia (Cummings, Houlihan, & Hill, 1986; Friedmann, Ferguson, Robinson, & Sunderland, 1992; Fromm, Holland, Nebes, & Oakley, 1991; O’Carroll, 1995; Paque & Warrington, 1995), true comprehension of written materials is a complex cognitive task that may be adversely affected by even mild degrees of cognitive impairment. Thus, the higher prevalence of dementia and cognitive impairment among older persons may explain much of their lower reading scores.
Similarly, the increasing prevalence of chronic diseases in late middle-age (National Center for Health Statistics, 1999), particularly hypertension, could adversely affect the reading skills of older adults. Hypertension, diabetes, and hypercholesterolemia may all lead to cerebrovascular disease and stroke, which obviously can affect reading ability. Moreover, several studies have shown that individuals who have hypertension are more likely to have a decline in cognitive function, even in the absence of a stroke (Desmond, Tatemichi, Paik, & Stern, 1993; Glynn et al., 1999; Tzourio, Dufouil, Ducimetiere, & Alperovitch, 1999). Similarly, chronic obstructive pulmonary disease (COPD) can cause reduced blood oxygen levels, and this has been associated with worse cognitive function (Etter et al., 1999). Thus, the higher prevalence of hypertension and other chronic diseases among older age groups could affect reading ability by negatively influencing cognition.

In addition, physical health status declines with age (Ware, 1993). The worse physical health of the oldest old could affect their cognition (Hultsch, Hamer, & Small, 1993) or decrease their ability to concentrate on complex cognitive tasks such as reading. Similarly, depression may impair concentration, and it also may be a risk factor for cognitive decline (Devanand et al., 1996). Thus, worse physical and mental health among older cohorts could contribute to the negative association between age and reading ability. In addition, several studies have shown that sensory impairments may affect cognition (Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1994; Marsiske, Klumb, & Baltes, 1997; Salthouse, Hancock, Meinz, & Hambrick, 1996). For example, individuals in the Berlin Aging Study with worse visual acuity had lower perceived competence with basic activities of daily living (Marsiske et al., 1997). Corrected visual acuity has also been found to be associated with working memory, associative learning, and concept identification (Salthouse et al., 1996), leading investigators to postulate that all of these may be related to a general reduction in nervous system functioning. Thus, an increasing prevalence of sensory abnormalities among elderly persons could affect reading ability directly through decreased ability to read printed words or indirectly through an association with worse cognitive function.

Finally, some experts have suggested that reading ability may decline if people do not use their reading skills frequently enough. For example, after the NALS results were released in 1993, Secretary of Education Richard Riley commented that “Americans should consider going back to school and getting a tuneup” (Joseph, 1993, p. A01). Support for the notion of “use it or lose it” comes from studies showing that individuals who continued to perform intellectually engaging activities had less cognitive decline (Hultsch, Hertzog, Small, & Dixon, 1999). Therefore, if people tend to read less as they grow older, this could contribute to cognitive decline and worse reading scores among elderly persons. It is also possible that frequent reading could help preserve reading skills independently of any effect on cognition.

If the association between age and literacy is not explained by dementia, chronic medical problems, worse physical and mental health status, sensory impairments, or lack of use of reading skills, this suggests reading ability may decline as a consequence of the aging process itself. Studies have shown that the ability to complete complex cognitive tasks, especially those that require effortful processing of information, declines with age (Craik & Byrd, 1982; Craik & Jennings, 1992; Park, 1999). We undertook this study to examine what cognitive, health, and behavioral factors were associated with functional health literacy among elderly persons and to determine whether the negative association between age and functional health literacy persists after adjusting for cognitive dysfunction (as measured by the Mini Mental State Examination [MMSE]; Folstein, Folstein, & McHugh, 1975), chronic medical problems, physical functioning, mental health, corrected visual acuity, and self-reported frequency of reading the newspaper. Functional health literacy is the ability to read and comprehend health-related information such as prescription bottles, appointment slips, and instructions for procedures or diagnostic tests.

**METHODS**

Patient enrollment and data collection for this study have been described in detail previously (Gazmararian et al., 1999). New Prudential SeniorCare enrollees in Cleveland, Houston, Tampa, and South Florida (including Ft. Lauderdale and Miami) were eligible for participation. We sent a letter of introduction describing the study and ensuring confidentiality to each member who was at least 65 years of age 3 months after enrollment. One week later, interviewers called each enrollee to determine eligibility. Individuals who indicated they were not comfortable speaking either English or Spanish; were blind or had a severe vision problem that could not be corrected with glasses; or did not know what year or month it was, what state they lived in, what year they were born, or their address were ineligible.

Eligible individuals who agreed to participate in the study completed a 1-h face-to-face interview in their home. The survey consisted of questions to determine demographics, self-rated health, chronic conditions, depression, social support, and health behaviors. We also asked respondents “how often do you read the newspaper?” and coded responses as never, once a month, once a week, two to four times per week, or five or more times per week. For analysis, we collapsed the intermediate categories to create categories of never, four times per week or less, and five or more times per week. We administered the MMSE using a standardized format with a maximum score of 30.

The last section of the survey assessed the enrollee’s health literacy using the short version of the Test of Functional Health Literacy in Adults (S-TOFHLA; Baker, Williams, Parker, Gazmararian, & Nurss, 1999). The S-TOFHLA uses actual materials that patients might encounter in the health care setting to test their reading ability. The reading comprehension section is a 36-item test using the modified Cloze procedure; that is, every fifth to seventh word in a passage is omitted and four multiple choice options are provided (Taylor, 1953). Participants read the passage and select the multiple choice option that best completes the blank given the context of the surrounding phrases. The reading comprehension section measures the ability to read and understand prose passages selected from instructions for prep-
erarchical linear regression modeling. For this, we conducted a series of linear regression models. We included variables based on previous literature or a priori hypotheses, as described in the introduction, and included the variables regardless of statistical significance. The baseline model included age alone. The second model added gender, race, and years of school completed. In the third model, we added the MMSE score as an independent variable, and the fourth model added health indicator variables for chronic diseases, physical functioning and mental health, and vision. We included the following chronic medical conditions: hypertension, diabetes, coronary artery disease, chronic obstructive pulmonary disease (COPD, including chronic bronchitis, emphysema, or asthma), and prior stroke. We measured physical functioning using the SF-36 physical functioning subscale, a 10-item measure ranging from 0 to 100 that captures physical limitations, (with 100 indicating no physical limitations; Ware, 1993). We measured mental health using the SF-36 mental health subscale, a five-item measure ranging from 0 to 100 that indicates self-reported mood and anxiety (with 100 indicating perfect mental health; Ware, 1993). We entered vision as an indicator variable for 20/70 to 20/100 vision. The fifth and final model added newspaper reading frequency. As we added additional variables into successive models, we analyzed (a) the statistical significance of the new variables in the model and (b) whether the relationship between the S-TOFHLA score and age changed compared to the previous model. For all analyses, we used a $p$ value of .05 to determine statistical significance.

**Results**

We contacted a total of 7,471 enrollees by telephone 3 months after they enrolled in Prudential SeniorCare. Of these, 3,390 refused to participate, 737 did not meet eligibility criteria, and 3,344 completed the in-home interview. We excluded another 557 individuals from this analysis because they did not complete the S-TOFHLA $(n = 84)$, their native language was Spanish $(n = 300)$, or they had missing data on other key variables $(n = 186)$. Thus, 2,774 participants were available for this analysis. Nonresponders were more likely to be aged 85 or older (7.5% vs. 5.4%) and more likely to be men (45.2% vs. 42.6%). Nonresponders also lived in ZIP code areas with a higher median per capita income (27.8% lived in an area with a median per capita income of greater than $17,842 per year vs. 10.7% of respondents), and higher educational attainment.

The mean age of participants was 73.1 ($\pm$ 6.3), 58.9% were women, 84.1% were White, and 31.7% did not complete high school. Two thirds (67.9%) said they read the newspaper five times per week or more, but 8.5% said they never read the newspaper. A total of 46.4% had hypertension, 14.7% had diabetes, 23.1% had coronary artery disease, 13.4% had chronic obstructive pulmonary disease, 8.8% had suffered a stroke, and 11.0% had vision of 20/70 or 20/100. The mean physical functioning score on the SF-36 ($\pm SD$) was 72.9 (27.2), and the mean mental health score was 81.3 (18.2). Older age groups were more likely to be women, White, and have less than a high school education, poor vision, and worse physical functioning and mental health scores. Cognitive function was also substantially
lower for older participants. The mean MMSE scores (± SD) for the five age groups were 26.5 (2.8), 26.0 (3.1), 25.5 (3.1), 24.9 (3.4), and 23.5 (4.1) for participants aged 65–69, 70–74, 75–79, 80–84, and 85 or older respectively (p < .001). Chronic disease prevalence and frequency of reading the newspaper were similar across age groups, although the proportion of participants who said they never read the newspaper increased with age.

There were dramatic differences in functional health literacy across age groups. Mean S-TOFHLA scores were 81.9, 75.6, 69.9, 60.8, and 48.6 for participants aged 65–69, 70–74, 75–79, 80–84, and 85 or older, respectively (p < .001). When stratified by the number of years of school completed, all educational strata showed similar differences in mean S-TOFHLA scores across age groups (Figure 1). Performance on the MMSE was also highly correlated with functional health literacy (Spearman correlation coefficient 0.58). The mean S-TOFHLA scores (± SD) by MMSE quartiles (highest to lowest) were 89.8 (13.1), 79.3 (20.2), 72.2 (22.8), and 47.2 (27.4). Functional health literacy was also positively associated with self-reported frequency of reading a newspaper. The mean S-TOFHLA score (± SD) was 52.1 (30.8) for those who said they never read the newspaper, 70.4 (25.8) for those who read the newspaper less than four times per week, 77.1 (23.9) for those who read the newspaper five or more times per week, respectively (p < .001). Individuals who reported hypertension, diabetes, and a history of a stroke also had slightly lower S-TOFHLA scores, although participants with chronic obstructive pulmonary disease had slightly higher scores. Blacks and Hispanics had lower mean S-TOFHLA scores than Whites, but there was no difference between men and women.

To determine independent predictors of the S-TOFHLA score and whether the relationship between S-TOFHLA and age was explained by differences in cognitive function, reading frequency, or health status, we conducted a series of hierarchical linear regression models (Table 1). With only age in the model (Table 1, Model 1), the S-TOFHLA score was 1.4 (95% CI 1.3–1.5) points lower for each 1-yr increase in age. After we adjusted for gender, race, ethnicity, and years of school completed, the S-TOFHLA score was 1.3 points (95% CI 1.2–1.4) lower for every year increase in age (Table 1, Model 2). The addition of performance on MMSE items (Table 1, Model 3) moderately attenuated the relationship between age and functional health literacy; after we adjusted for MMSE performance, the S-TOFHLA score was 0.9 points (95% CI 0.8–1.0) lower for every year increase in age (p < .001). The relationship between age and functional health literacy did not change after we adjusted further for chronic diseases, physical functioning, mental health, and corrected visual acuity (Table 1, Model 4) and newspaper reading frequency (Table 1, Model 5). In the final model, gender, race, years of school completed, reading frequency, diabetes, mental health, and vision were also significantly associated with functional health literacy as measured by the S-TOFHLA.

**Discussion**

Functional health literacy was markedly lower among older age groups even after we adjusted for all of the variables that we hypothesized might explain this relationship. Although cognitive function was strongly related to both age and functional health literacy, the inclusion of the MMSE score in multivariate models attenuated the relationship between literacy and age by only 31% (i.e., the beta coefficient for age decreased from 1.3 to 0.9; Table 1, Models 2 and 3). As we hypothesized, mental health, visual acuity, and frequency of reading the newspaper were all positively associated with functional health literacy. Nevertheless, the inclusion of these variables in multivariate models did not affect the relationship between age and functional health literacy. In contrast to previous studies of the relationship between chronic diseases (i.e., hypertension and COPD) and cognition, the presence of chronic medical conditions was not associated with functional health literacy with the exception of a weak negative association with diabetes. Even after we adjusted for all covariates, older participants had worse reading ability, the S-TOFHLA score being almost 10 points lower with every decade increase in age.

The persistent association between older age and worse functional health literacy in multivariate analysis raises the possibility that the lower reading ability of older cohorts is due to age-related changes in cognitive function that are not captured by the MMSE. Previous research has shown that the ability to perform cognitive tasks requiring effortful or controlled processing of information declines markedly with age (Craik & Byrd, 1982; Craik & Jennings, 1992; Park, 1999). During these tasks, there is a conscious search for information from memory, active mental manipulation of information, and conscious attempts to solve a problem. The ability to complete these tasks may be related to an individual’s working memory, which is the capacity to process, store, and retrieve information (Park, 1999; Baddeley, 1992). Moreover, older adults have more difficulty completing tasks that require reasoning or inferences from information presented to them (Salthouse, 1992). Reading comprehension of health-related material such as the prescription...
bottles used in the S-TOFHLA is likely to place significant demands on all of these mental faculties. Age-related declines in cognitive function, even in the absence of dementing illnesses, may explain the association between increasing age and lower functional health literacy.

There are other possible explanations for our findings. First, older individuals perform cognitive tasks more slowly (Salthouse, 1996), and this could have affected our measurements of functional health literacy. Because the reading comprehension portion of the S-TOFHLA is timed, part of the relationship between age and functional health literacy could have resulted from older participants being unable to complete the test in the allotted time. To evaluate this possibility, we conducted two additional analyses using only (a) the numeracy items (which had no time limit) and (b) the first reading comprehension passage (which consisted of only 16 items written at a forth-grade level). Both of these found a similar relationship between age and reading ability, indicating that this was not due to differences in the speed of completing the tasks. It is also possible that older individuals became fatigued by the interview conducted prior to administering the S-TOFHLA. The average time to complete the interview and the S-TOFHLA was 58 min for those aged 85 and older compared to 53 min for those aged 65–69, so it appears unlikely that our findings are explained to a large degree by differences in the time required to complete the interview and resultant fatigue.

This study has several important limitations. First, only 37% of all new enrollees participated in the study, and those who did not had slightly higher socioeconomic status based on their ZIP code. Although this implies that individuals with limited literacy are probably over-represented in our study, this should not bias our estimates of the relationship between age and functional health literacy unless the association between literacy and age is different among individuals who did not participate. Second, because this was a cross-sectional analysis we cannot reliably determine whether there is a causal relationship between increasing age and declining literacy. Third, this study was not designed to examine whether the age-related differences in reading ability result from declines in working memory. The MMSE items used in this analysis are coarse indicators of cognitive impairment, and additional studies are needed to examine the relationship between working memory and reading ability. Longitudinal studies of changes in individuals’ reading ability and working memory will probably be essential to untangle this relationship.

Although prospective studies are needed to determine whether an individual’s reading ability declines with age even in the absence of dementing illness, our results suggest that many middle-age adults with adequate or marginal functional health literacy may have progressive worsening of their reading ability that will make it increasingly difficult for them to understand typical written health-related information as they age. This has tremendous implications for our ability to instruct older adults about proper health be-

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Table 1. Adjusted Difference (SE) in Scores on the Short Test of Functional Health Literacy in Adults in Hierarchical Linear Regression Models

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
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<tr>
<td>Demographics</td>
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<td>Age</td>
<td>-1.4*** (0.1)</td>
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<td>Woman</td>
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<td>Education, 0–8 yr</td>
<td>-32.3*** (1.4)</td>
<td>-20.1*** (1.3)</td>
<td>-18.8*** (1.3)</td>
<td>-18.2*** (1.3)</td>
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<td>Education, 9–11 yr</td>
<td>-16.8*** (1.2)</td>
<td>-9.4*** (1.0)</td>
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<td>-8.6*** (1.0)</td>
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<td>Education, 12 yr</td>
<td>-7.1*** (1.0)</td>
<td>-4.8*** (0.9)</td>
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<td>-4.6*** (0.8)</td>
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<td>MMSE score</td>
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<td>SF-36 physical functioning</td>
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<td>Frequency of reading newspaper</td>
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<td>F</td>
<td>366.4***</td>
<td>193.1***</td>
<td>319.2***</td>
<td>175.8***</td>
<td>160.1***</td>
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<td>Adjusted R²</td>
<td>.12</td>
<td>.36</td>
<td>.51</td>
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Notes: Standard errors are in parentheses; n = 2,774.

The reference categories for categorical variables are male gender, White race, > 12 years of school completed, reads the newspaper five or more times per week, did not have the chronic disease listed, and had visual acuity of 20/50 or better. Age, Mini Mental State Examination (MMSE) score, and the SF-36 physical functioning and mental health subscales (0–100 range for both) were entered as continuous variables.

*p < .05; **p < .01; ***p < .001.
haviors, about vaccinations for pneumonia and influenza, about screening for breast cancer and osteoporosis, about management of chronic diseases such as congestive heart failure, or about how to choose a health care plan. Although much has been learned about how to communicate more effectively with older adults (Park, 1999), it is vital to further our understanding of this area, to develop innovative patient education tools, and to implement these in hospitals, clinics, and doctors’ offices.

If this apparent decline in reading ability with age reflects a more general diminution in information-processing and is not due to medical conditions, then the problem of communicating health information to older adults will not go away even with better prevention and control of cerebrovascular and dementing illnesses. Nevertheless, a decline in reading ability, like declines in cognition, may not be inevitable. Our finding that individuals who said they read the newspaper more frequently had better functional health literacy should raise a glimmer of hope that continued use of reading skills may help preserve literacy. Although functional health literacy was negatively associated with age even for individuals who read the newspaper on most days, longitudinal studies with much more detailed measures of reading behaviors are needed to determine whether frequent reading can prevent or slow declines in literacy. Previous studies suggest that continued involvement in intellectual and social activities may prevent cognitive decline (Bassuk, Glass, & Berkman, 1999; Hultsch et al., 1999), and some studies suggest that even short-term behavioral training may be able to prevent or slow cognitive decline (Plemons, Willis, & Baltes, 1978). In addition to improving cognitive function or slowing decline, these strategies could also help preserve reading ability.

Acknowledgments

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**Erratum**

In “Marital Quality and Psychological Adjustment to Widowhood Among Older Adults: A Longitudinal Analysis,” by Deborah Carr, James S. House, Ronald C. Kessler, Randolph M. Nesse, John Sonnega, and Camille Wortman, which appeared in the July issue (Vol. 55B, No. 4, pp. S197–S207), there was an error in the graph legend of Figure 2. The graph legend should have read: ◆ women, and □ men.