HHS Public Access

Author manuscript

Am J Geriatr Psychiatry. Author manuscript; available in PMC 2022 September 01.

Published in final edited form as:

Am J Geriatr Psychiatry. 2021 September ; 29(9): 972–981. doi:10.1016/j.jagp.2020.12.007.

Aging and Functional Health Literacy: A Population-Based Study

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Abstract

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AUTHOR CONTRIBUTIONS

Mary Ganguli made substantial contributions to the conception and design of the work, the acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Tiffany Hughes** made substantial contributions to the conception of the work, the interpretation of data for the work; revising the work critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Yichen Jia** made substantial contributions to the analysis, and interpretation of data for the work; revising the work critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Jennifer Lingler** made substantial contributions to the conception and design of the work, interpretation of data for the work; revising it critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Erin Jacobsen** made substantial contributions to the acquisition, analysis, and interpretation of data for the work; revising it critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Chung-Chou H. Chang** made substantial contributions to the analysis, and interpretation of data for the work; revising it critically for important intellectual content; and gave final approval of the version to be published. She agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Objectives.—To investigate functional health literacy and its associated factors among older adults drawn from a disadvantaged area.

Design.—Cross-sectional epidemiologic study.

Setting.—Population-based cohort randomly selected from the voter registration lists.

Participants.—1066 individuals aged 65+ years.

Measurements.—The Short Test of Functional Health Literacy in Adults (S-TOFHLA); demographics; self-rated health; number of prescription drugs; modified Center for Epidemiologic Studies- Depression scale (mCES-D); Mini-Mental State Examination (MMSE); Wechsler Test of Adult Reading (WTAR); Clinical Dementia Rating (CDR®); cognitive domain composite scores; independence in Instrumental Activities of Daily Living (IADLs) and medication management; health services utilization (emergency/urgent care visits and hospitalizations).

Results.—Low (inadequate or marginal) S-TOFHLA scores were obtained by 7.04% of the sample. In unadjusted analyses, participants with low S-TOFHLA scores were significantly more likely than those with higher scores to be older, male, non-White, with lesser education and lower household income, to have lower scores on the WTAR, the MMSE, and all cognitive domains; to be more dependent in IADLs and be taking more prescription drugs. In a multiple regression model including all covariates, only older age, male sex, and lower reading level were independently associated with inadequate or marginal S-TOFHLA scores.

Conclusions.—In a population-based sample of older adults, low functional health literacy was associated with age, sex, education, and reading ability. Basic functional health literacy is essential for understanding health information and instructions. Clinicians should formally or informally assess health literacy in their older patients to ensure effective communication and enhance health outcomes.

Keywords

S-TOFHLA; community-based; epidemiology

INTRODUCTION

Under the US government's Healthy People 2020 initiative, health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions" (1) and listed as a key issue in the "health and health care" domain of the social determinants of health. In 2006, the US Department of Education and the National Center for Health Statistics released the results of the National Assessment of Adult Literacy (NAAL). (2) On the NAAL's measure, 29% of Americans aged 65+ years had "below basic" health literacy. Women had higher average health literacy than men; White and Asian/Pacific Islanders had higher health literacy than other racial/ethnic groups; older adults, individuals with lesser education, and those with worse self-rated health had lower health literacy than their comparison groups. Several studies of older adults have found cognitive impairment to be associated with lower health literacy. (3–6)

In geriatric psychiatry settings, low health literacy could affect older patients' ability to understand and follow health care providers' explanations and recommendations, increasing risk of non-adherence (7). Low health literacy could be a barrier to meaningful participation in joint decision-making. It could impair the effectiveness of health education about, for example, depression or cognitive impairment; about prescription drugs and over-the-counter supplements, including drug side effects and interactions; or the benefits of psychotherapy or exercise.

The relationship of health literacy with cognitive impairment and dementia could be bidirectional. Cognitive impairment can lower older adults' ability to follow health care advice and recommendations. However, health literacy could potentially also contribute to limited understanding of health guidance and lead to poor health practices, such as poor diet and exercise patterns and failure to control diabetes and hypertension. It could thus be "upstream" of known risk factors for cognitive impairment and dementia. Lower health literacy and decline in health literacy have in fact been shown to predict incident Alzheimer's disease (AD) dementia. (6, 8) Disentangling these complex relationships could allow us to optimally consider health literacy in prevention and intervention strategies.

We report here a cross-sectional study of health literacy among older adults in a population-based study. We describe our experience with a brief (7 minute) standard test, the Short Test of Functional Health Literacy in Adults (S-TOFHLA) and describe factors associated with performance on this scale. We also provide population-based norms on this S-TOFHLA according to age, gender, and education, for use in comparisons with other populations and in calibrating the scale for clinical and research use.

METHODS

Participants

Participants were from the Monongahela-Youghiogheny Healthy Aging Team (MYHAT) study which focuses on the epidemiology of mild cognitive impairment and dementia. MYHAT is based on an age-stratified randomly selected population-based cohort drawn from an economically distressed, post-industrial region of southwestern Pennsylvania. Participants initially enrolled in the original MYHAT cohort between 2006–2008 if they met the eligibility criteria of being 65 years and older, living within selected geographic areas, and residing independently in the community at the time of recruitment. Individuals were excluded if they were too ill to participate, had vision or hearing impairment severe enough to preclude neuropsychological testing, or had decisional incapacity. (9) Of 2036 individuals who qualified, the full evaluation described below was administered to 1982 without substantial cognitive impairment, defined as age-education corrected Mini Mental State Examination (MMSE) (10, 11) scores <21. A new sub-cohort of 709 participants meeting the same criteria, aged of 65–74 during 2016–2019, was enrolled to replenish the original cohort; of these, 703 underwent the full assessment. All participants were invited to undergo annual reassessment which took place in overlapping data collection cycles.

The annual MYHAT assessment (12) includes, but is not limited to, demographic characteristics, neuropsychological testing, self-reported health history, health-related

behaviors, and health service utilization. The S-TOFHLA assessment of functional health literacy (see next section) was added to the MYHAT protocol for all participants in 2017 when the new sub-cohort was in its first assessment cycle. Thus, different participants were in different annual cycles when they first completed the S-TOFHLA. All procedures were approved by the University of Pittsburgh Institutional Review Board for human subjects protection; all participants provided written informed consent.

Health Literacy

Health literacy was assessed using the S-TOFHLA (13) designed to evaluate reading comprehension in the healthcare setting. The maximum test time is 7 minutes, with a possible total score ranging from 0–36. Scores 0–16 are considered inadequate functional health literacy, 17–22 marginal functional health literacy, and 23–36 adequate functional health literacy. While allowing participants to take as much time as they chose, we used the score based on responses up to the 7-minute point.

Demographic characteristics

1. Age (continuous variable),
2. Sex (women vs. men),
3. Education (less than high school vs. high school vs. more than high school),
4. Race (White vs. non-White).
5. Annual household income reported by participant, categorized as <$15,000 vs. ≥ $15,000; 24 participants declined to answer this question, 22 said they did not know, and in one case (a nun) the question was not applicable.

Health Status

1. Self-rated health: poor/fair vs. good vs. very good/excellent.
2. Number of regularly taken prescription drugs (0 vs. 1–4 vs. ≥ 5),
3. Depression symptoms on the modified Center for Epidemiological Studies -Depression scale (mCES-D)(9, 14): (0 vs. 1–4 vs. ≥5)

Health Service Utilization

1. Emergency department or urgent care visits over the preceding year: 0 vs 1 vs ≥ 2.
2. Inpatient hospital admissions over the preceding year: 0 vs 1 vs ≥ 2.

Cognitive Function

1. MMSE: ≤ 27 vs ≥ 28. (10)
2. Cognitive domain composite scores: <1.5 standard deviations (SD) below the age-sex-education mean for attention, language, memory, executive function, and visuospatial domains. (15)

3. Basic literacy/ reading ability measured by the Wechsler Test of Adult Reading (16) (WTAR): mean scores.

Independence in Everyday Functioning

1. Instrumental Activities of Daily Living (IADLs) (17) in which dependent on others: 0, 1–2, ≥ 3.
2. Medication management: (restricted to those taking prescription and physician-ordered over the counter medications and excluding those living in group setting where medications are managed by staff).
    a. Having vs. not having a system for managing own medications.
    b. Overall compliance with/ adherence to prescriptions and physician-ordered OTC, based on interviewer's impression.

Clinical Dementia Rating

The Clinical Dementia Rating Staging Instrument (CDR®) is scored as 0 (no dementia), 0.5 (mild cognitive impairment, 1 (mild dementia), 2 (moderate dementia), and 3 (severe dementia). (18, 19) Scores were categorized for these analyses as 0, 0.5, and ≥1.

Statistical Analyses

For the unadjusted descriptive analyses, Fisher's exact test for categorical variables and two sample t for continuous variables, and Wilcoxon rank sum test with continuity correction if they were not normally distributed, were used to compare the characteristics of participants with Adequate vs. Marginal / Inadequate functional health literacy. (Table 1)

To assess factors associated with health literacy adjusting for other covariates, we first used backward selection to find the most important covariates, and then fit a multiple logistic regression model limited to those covariates, with the outcome variable being S-TOFHLA score categorized as Adequate health literacy vs. Inadequate/Marginal health literacy, treating the latter as the reference group. (Table 2)

To generate population-based norms on the S-TOFHLA, we calculated mean (SD), median (50^{th} %ile) and 5^{th} %ile scores within age/sex/education subgroups of MYHAT participants free of dementia (CDR=0). We also calculated internal consistency by Kuder-Richardson (KR-20) coefficient. (20)

All statistical analyses were performed using R. (21)

RESULTS

Participant Characteristics

The S-TOFHLA was completed by 1066 participants during 2017–2019 when 391 original MYHAT participants were in their annual cycles 10–13, and 675 new participants in their annual cycles 1–3. Participants had an average age of 74.3 (SD 7.73) years, 643 (60.32%)

were women, 1001 (93.90%) were White, and their median educational level was partial college.

The mean (SD) S-TOFHLA score was 32.64 (SD 5.27) with a median score of 35. Among the 1066, 991 (92.96%) had adequate functional health literacy, 46 (4.32%) had marginal functional health literacy, and 29 (2.72%) had inadequate functional health literacy.

In unadjusted comparisons (Table 1), participants with inadequate or marginal STOFHLA scores were significantly older than those with adequate functional health literacy. They were significantly more likely to be men, to be non-White, have lower levels of education, and lower annual household income. Those with lower health literacy were more likely to report taking four or more prescription drugs and to be dependent in more IADLs. They were more likely to perform poorly on the WTAR, MMSE and in all cognitive domains. There was no significant difference between the two health literacy subgroups with respect to self-rated health, depressive symptoms, health services (hospital admissions and emergency department /urgent visits), or medication management and adherence.

In the multiple logistic regression model with backward selection, adjusting for all covariates, (Table 2), only greater age, male sex, and lower reading level (WTAR) were significantly associated with inadequate or marginal functional health literacy.

In *post hoc* analyses, inadequate or marginal health literacy was found in 0% of 5 participants on sedative-hypnotics, 5.6% of 54 participants on anti-anxiety drugs, 6.8% of 234 participants on antidepressants, 18.8 % of 16 individuals on antipsychotics, and 27.3% of 11 participants on anti-dementia drugs.

For reference by other users, we provide population-based S-TOFHLA norms by age, sex, and education categories (Table 3). Internal consistency (KR-20) on the S-TOFHLA was high at 0.81538.

DISCUSSION

In a population-based cohort of older adults from an economically distressed region, 93% demonstrated adequate functioning on the S-TOFHLA, a standard short test of functional health literacy. About 4% had marginal health literacy and 3% had inadequate health literacy. Those with marginal or inadequate performance, in unadjusted analyses, were significantly more likely than those with adequate functional health literacy to be male, older, less well educated, non-white, with lower annual household income. They were also more likely to be dependent in everyday activities, to perform more poorly on tests in all cognitive domains and on a reading level test, and to have higher dementia ratings, than those with adequate health literacy. They were also likely to take more prescription medications, but this association lost statistical significance after correction for multiple comparisons. However, in the multivariable model, only greater age, male sex, and lower reading level remained independently associated with lower health literacy.

The 2003 National Assessment of Adult Literacy (NAAL) (2) used a comprehensive assessment of multiple aspects of health literacy. In the adult US population as a whole,

29% of older adults had “less than basic” health literacy, compared to 10–14% of all age groups between 18 and 65. Different measures of the same broad construct will yield different results in different populations. A roughly equivalent proportion in MYHAT would have been obtained at the 30th %ile score of 33/36 on the S-TOFHLA, just above the mean score of 32.6. While it would be reasonable to define low health literacy as “below average” scores, here we have used the standard S-TOFHLA thresholds for marginal and inadequate performance. More pragmatically, we provide population-based norms on the test for reference by others who might use this scale in research and clinical settings. However, our findings regarding factors associated with low health literacy are similar to those of the NAAL where health literacy was lower among men, among those with lesser education, and with worse self-rated overall health. (2)

Like our study, NAAL (2) and a study of AARP Medicare Supplement beneficiaries (22) found that men had significantly lower health literacy than women. Possibly, women consume more health-related information than men, whether from their health care providers or from peers or published material. Other studies did not report gender effects. Unlike NAAL and several other studies, (5, 23, 24) we did not find significantly lower health literacy among non-White participants than among White participants; however, only 6% of our study cohort is non-White.

Almost all previous studies, including those restricted to older adults, have found higher age to be associated with lower health literacy, to varying degrees. (5, 22, 25, 26) One systematic review (26) found that older age was strongly related to health literacy when assessed by means of reading comprehension, reasoning, and numeracy skills, but only weakly associated when health literacy was evaluated by medical vocabulary. These findings were interpreted as reflecting the relative stability with aging of crystallized intelligence, in contrast to fluid cognitive abilities. Another study (5) found that influence of age on health literacy was reduced by 75% when controlling for cognitive ability.

All studies that examined education and literacy found them to be associated with health literacy, (3, 23–25, 27, 28) as did our study. A study examining data from two randomized controlled trials of blood pressure control, (27) found that education was related to better recall of health information. In NAAL (23), health literacy mediated education-related disparities in self-rated health, influenza vaccination, mammography, and dental care. One study (5) found that controlling for cognitive ability reduced the influence of education on literacy by 40%. It is intuitive not only that test performance is affected by education but also that the ability to understand and implement health information would be enhanced by a richer educational background.

The health literacy measure that we used, the S-TOFHLA, primarily measures reading comprehension. A Brazilian study even suggested that the S-TOFHLA itself could serve as a measure of overall literacy. (29) The concept of “literacy” has grown beyond reading and reading comprehension to include entities such as health literacy and financial literacy which are sometimes included within the same comprehensive measure. (6) One study found that higher health and financial literacy were associated with better health care and financial decision-making. (30) One group proposed the concept of “financial health literacy,” at

the intersection of financial literacy and health literacy, and identified four domains of ability: managing health care expenses, paying medical bills, determining health needs and understanding treatment options; and making sound health care decisions based on available financial resources. (22) Potentially illustrating this concept, Medicare beneficiaries with inadequate health literacy were found more likely than those with adequate health literacy to choose a lower-premium, lesser-coverage plan over a plan with higher premium and more coverage, assigning different ranks to the importance of various attributes of the plans (31). Notably, NAAL found lower health literacy among Medicare and Medicare beneficiaries and the uninsured. (2)

Some studies of health literacy have focused on assessing health knowledge and health-related vocabulary. A study of the S-TOFHLA in relation to a measure of health information comprehension (4) concluded that knowledge contributes to health literacy and can compensate for deficits in information processing capacity. In one study, (32) older patients with lower health literacy had lesser knowledge of the names and purposes of their medications. In a systematic review (33) of “literacy” (knowledge and attitudes) about Alzheimer’s disease (AD) among individuals at elevated risk of developing AD, understanding and appraisal of AD risk were found to be highly variable and influenced by many factors including cognitive dysfunction.

As regards health status, before adjustment for covariates, we found lower health literacy was associated with taking a larger number of prescription medication, but not with worse overall self-rated health, hospital admissions, or emergency/urgent care visits. In NAAL, worse self-rated health was linked with lower health literacy. (2) One review indicated that individuals with low health literacy experienced poor physical and/or cognitive health. (17) In a study of older adults with heart failure, (24) individuals with inadequate health literacy had more comorbidities, lower patient satisfaction, lower compliance with preventive services, and higher health care utilization and expenditures. A *post hoc* analysis of data from a randomized controlled trial of heart failure found that individuals with better health literacy showed better adherence to cardiovascular drug regimens.(28) Lower health literacy predicted greater morbidity and mortality in rural heart failure patients in another study. (34). Although we found no association with depression, we did find a higher than average proportion with lower health literacy among those taking anti-psychotic drugs and anti-dementia drugs than in the cohort as a whole, implicating the diagnostic categories in which health illiteracy might be the most affected.

Regarding cognition, previous studies found that lower health literacy was associated with lower word knowledge (reading and vocabulary), executive function, and episodic memory; (3) that memory and verbal fluency were strongly associated with health literacy, independently of education; (28) that cognitive ability accounted for 24% of the variance in health literacy and also reduced the effects of age and education. (5) One group evaluated the language processing mechanisms that underlie health literacy. (4) They found that both health knowledge and language processing capacity mediated the association between health literacy and recall of health information; further, processing capacity was less likely to be associated with recall among those with higher levels of knowledge. In our study, participants with lower health literacy scores performed worse on the Wechsler Test of Adult

Reading, in all domains of cognitive function, and obtained higher dementia ratings. While WTAR represents pre-morbid reading ability which likely contributes to worse performance on the S-TOFHLA, the direction of the other associations cannot be determined from these cross-sectional data. Possibly, diminished cognitive test performance, as also the Clinical Dementia Rating, reflects incipient dementia which could reduce functional health literacy. Those responsible for addressing the health needs of patients with mild cognitive impairment and dementia should bear reduced health literacy in mind when giving these patients instructions and recommendations. Conversely, low health literacy could cause failure to understand and adhere to health recommendations, e.g. for managing chronic diseases like diabetes and hypertension, and thus increase risk of cognitive decline and dementia. Limited health literacy has been found to be an important risk factor for "likely dementia" (as ascertained from health records), particularly in non-carriers of *APOE*4* alleles. (35) Lower health literacy (6) and faster decline in literacy (8) were associated with increased risk of developing mild cognitive impairment, cognitive decline, and AD dementia.

The advantages of improved health literacy, according to a systematic review and meta-analysis, could include improved health care decisions and communications, adherence to treatment recommendations, and improved health status, which in turn would reduce health care costs and improve satisfaction among both patients and health care providers. (25) The literature includes numerous suggestions for improving health literacy, including enhancing health care knowledge, (4) reducing the cognitive burden of health information, (28) helping at-risk older adults to find resources to improve their financial health literacy, (22) expanded educational or additional care coordination services, (24) and pharmacist interventions to improve medication adherence in patients with lower health literacy. (36) In 2010, the US Department of Health and Human Services Office of Health Promotion and Disease Prevention published a seven-point National Action Plan to Improve Health Literacy, which included strategies to be implemented in clinical care settings, at the community level, through broader public health partnerships, and in additional research. (1)

Three recommendations seem reasonable to consider for clinical geriatric practice at the local level. First, health care providers should screen their patients' health literacy, regardless of their cognitive status, and tailor their communications accordingly so to be optimally effective. Second, instructions and recommendations should minimize the cognitive challenges required to implement them, e.g., by avoiding technical language, using more visual aids and infographics. Third, standard health and safety information for both patients and the general public should be designed with an eye to health literacy. It may be relevant that in the NAAL survey, better health literacy was found among those who received their health information from written sources than from television or radio. (2)

Several available assessment tools have been reviewed elsewhere. (37, 38) Among them, the S-TOFHLA is a brief (7-minute) and relatively easy scale to administer. Although the standard instructions recommend cutting the test off at the 7-minute point, Robinson et al (34) found that giving a group of heart failure patients more time to complete the test improved their STOFHLA scores. In our cohort, when additional time was provided, scores

improved slightly among those aged 85+, and more substantially among those with less than high school education (data not shown).

Advantages of this study include the large cohort size and its population-based design, minimizing selection bias and rendering the results generalizable to the older population from which it was drawn. However, the majority of the sample is of European ancestry and our findings will need to be replicated in other samples with more diverse ethnic representation. Our study replicates and validates several earlier studies, also examining some variables not included in previous investigations. As is typical of population studies, we relied on self-report for several variables. Being cross-sectional data, they do not allow us to determine the directions of all the observed associations; following this cohort over time will allow us to determine whether heath literacy predicts health outcomes.

In conclusion, about 7% of our older population-based cohort had inadequate or marginal functional health literacy as measured by the S-TOFHLA. Age, sex, education, and reading level were associated with lower health literacy after adjusting for all covariates. As health literacy may influence health outcomes, it could be useful to assess in clinical settings and to take into account when designing health communications.

ACKNOWLEDGEMENTS

The authors thank Anran Liu for assistance with statistical analysis, all MYHAT project staff for their efforts. and all MYHAT project participants for the time and cooperation.

The work reported here was supported in part by research grant # R01 AG023651 from the National Institute on Aging, National Institutes of Health, US DHHS.

DISCLOSURE/CONFLICT OF INTEREST

Dr. Ganguli reports grants from National Institute on Aging, during the conduct of the study; honoraria from the Journal of the American Geriatrics Society, the Kaiser Permanente Research Affiliates Center for Health Research, Indiana University, and the Centre for Brain Research, Indian Institute of Science; and travel expenses from Mount Sinai Medical Center, the Alzheimer's Association, the University of Texas Health Sciences Center, San Antonio, the American Association for Geriatric Psychiatry, and the Marcus Institute for Aging Research, outside the submitted work. Dr. Chang reports grants from NIH during the conduct of the study. Dr. Hughes, Ms. Jia, Dr. Lingler, and Ms. Jacobsen report no conflicts with any product mentioned or concept discussed in this article.

REFERENCES

1. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion: National action plan to improve health literacy. 2010. Washington DC.
2. Kutner MGE, Jin Y, Paulsen C: The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy (NCES 2006–483). 2006. Washington DC.
3. Boyle PA, Yu L, Wilson RS, et al.: Cognitive decline impairs financial and health literacy among community-based older persons without dementia. Psychol Aging2013; 28:614–624 [PubMed: 23957225]
4. Chin J, Madison A, Gao X, et al.: Cognition and Health Literacy in Older Adults' Recall of Self-Care Information. Gerontologist2017; 57:261–268 [PubMed: 26209450]
5. Levinthal BR, Morrow DG, Tu W, et al.: Cognition and health literacy in patients with hypertension. J Gen Intern Med2008; 23:1172–1176 [PubMed: 18459011]
6. Wilson RS, Yu L, James BD, et al.: Association of financial and health literacy with cognitive health in old age. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn2017; 24:186–197 [PubMed: 27263546]

7. Freudenberg-Hua YKR, Alafris A, Mittal S, Kremen N, Jakobson E.: Medication Nonadherence in the Geriatric Psychiatric Population: Do Seniors Take Their Pills?, in Psychiatric Nonadherence. Edited by aDI Fornari V. Cham, Switzerland, Springer, 2019, pp 81–99
8. Yu L, Wilson RS, Han SD, et al.: Decline in Literacy and Incident AD Dementia Among Community-Dwelling Older Persons. J Aging Health2018; 30:1389–1405 [PubMed: 28645223]
9. Ganguli M, Gilby J, Seaberg E, et al.: Depressive Symptoms and Associated Factors in a Rural Elderly Population: The MoVIES Project. Am J Geriatr Psychiatry1995; 3:144–160 [PubMed: 28531017]
10. Folstein MF, Folstein SE, McHugh PR: "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res1975; 12:189–198 [PubMed: 1202204]
11. Mungas D, Marshall SC, Weldon M, et al.: Age and education correction of Mini-Mental State Examination for English and Spanish-speaking elderly. Neurology1996; 46:700–706 [PubMed: 8618670]
12. Ganguli M, Snitz B, Vander Bilt J, et al.: How much do depressive symptoms affect cognition at the population level? The Monongahela-Youghiogheny Healthy Aging Team (MYHAT) study. Int J Geriatr Psychiatry2009; 24:1277–1284 [PubMed: 19340894]
13. Baker DW, Williams MV, Parker RM, et al.: Development of a brief test to measure functional health literacy. Patient Educ Couns1999; 38:33–42 [PubMed: 14528569]
14. Radloff LS: The CES-D Scale: A self-report depression scale for research in the general population. Applied Psychological Measurement1977; 1:385–401
15. Ganguli M, Snitz BE, Lee CW, et al.: Age and education effects and norms on a cognitive test battery from a population-based cohort: the Monongahela-Youghiogheny Healthy Aging Team. Aging Ment Health2010; 14:100–107 [PubMed: 20155526]
16. Wechsler D: Wechsler Test of Adult Reading (WTAR), San Antonio, TX, The Psychological Corporation, 2001
17. Fillenbaum GG: Multidimensional Functional Assessment of Older Adults: The Duke Older Americans Resources and Services Procedures, Hillsdale, NJ, Lawrence Erlbaum Associates, Inc., 1988
18. Ganguli M, Chang CC, Snitz BE, et al.: Prevalence of mild cognitive impairment by multiple classifications: The Monongahela-Youghiogheny Healthy Aging Team (MYHAT) project. Am J Geriatr Psychiatry2010; 18:674–683 [PubMed: 20220597]
19. Morris JC: The Clinical Dementia Rating (CDR): current version and scoring rules. Neurology1993; 43:2412–2414
20. Kuder GF RM: The theory of the estimation of test reliability. Psychometrika1937; 2:151–160
21. Team RC [computer prgram]. Vienna, Austria: R Foundation for Statistical Computing 2020
22. MacLeod S, Musich S, Gulyas S, et al.: The impact of inadequate health literacy on patient satisfaction, healthcare utilization, and expenditures among older adults. Geriatr Nurs2017; 38:334–341 [PubMed: 28089217]
23. Bennett IM, Chen J, Soroui JS, et al.: The contribution of health literacy to disparities in self-rated health status and preventive health behaviors in older adults. Ann Fam Med2009; 7:204–211 [PubMed: 19433837]
24. Morrow D, Clark D, Tu W, et al.: Correlates of health literacy in patients with chronic heart failure. Gerontologist2006; 46:669–676 [PubMed: 17050758]
25. Chesser AK, Keene Woods N, Smothers K, et al.: Health Literacy and Older Adults: A Systematic Review. Gerontol Geriatr Med2016; 2:2333721416630492 [PubMed: 28138488]
26. Kobayashi LC, Wardle J, Wolf MS, et al.: Aging and Functional Health Literacy: A Systematic Review and Meta-Analysis. J Gerontol B Psychol Sci Soc Sci2016; 71:445–457 [PubMed: 25504637]
27. Ayotte BJ, Allaire JC,Bosworth H: The associations of patient demographic characteristics and health information recall: the mediating role of health literacy. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn2009; 16:419–432 [PubMed: 19424920]
28. Federman AD, Sano M, Wolf MS, et al.: Health literacy and cognitive performance in older adults. J Am Geriatr Soc2009; 57:1475–1480 [PubMed: 19515101]

29. Brucki SMD, Mansur LL, Carthery-Goulart MT, et al.: Formal education, health literacy and Mini-Mental State Examination. Dement Neuropsychol2011; 5:26–30 [PubMed: 29213716]

30. James BD, Boyle PA, Bennett JS, et al.: The impact of health and financial literacy on decision making in community-based older adults. Gerontology2012; 58:531–539 [PubMed: 22739454]

31. Braun RT, Barnes AJ, Hanoch Y, et al.: Health Literacy and Plan Choice: Implications for Medicare Managed Care. Health Lit Res Pract2018; 2:e40–e54 [PubMed: 31294276]

32. Mosher HJ, Lund BC, Kripalani S, et al.: Association of health literacy with medication knowledge, adherence, and adverse drug events among elderly veterans. J Health Commun2012; 17Suppl 3:241–251 [PubMed: 23030573]

33. Rostamzadeh A, Stapels J, Genske A, et al.: Health Literacy in Individuals at Risk for Alzheimer's Dementia: A Systematic Review. J Prev Alzheimers Dis2020; 7:47–55 [PubMed: 32010926]

34. Robinson S, Moser D, Pelter MM, et al.: Assessing health literacy in heart failure patients. J Card Fail2011; 17:887–892 [PubMed: 22041324]

35. Kaup AR, Simonsick EM, Harris TB, et al.: Older adults with limited literacy are at increased risk for likely dementia. J Gerontol A Biol Sci Med Sci2014; 69:900–906 [PubMed: 24158765]

36. Noureldin M, Plake KS, Morrow DG, et al.: Effect of health literacy on drug adherence in patients with heart failure. Pharmacotherapy2012; 32:819–826 [PubMed: 22744746]

37. Chan RWY,Kisa A: A Scoping Review of Health Literacy Measurement Tools in the Context of Cardiovascular Health. Health Educ Behav2019; 46:677–688 [PubMed: 30829066]

38. Haun JN, Valerio MA, McCormack LA, et al.: Health literacy measurement: an inventory and descriptive summary of 51 instruments. J Health Commun2014; 19Suppl 2:302–333 [PubMed: 25315600]

HIGLIGHTS

This study addressed the distribution and associated factors of functional health literacy measured by the Short Test of Functional Health Literacy (S-TOFHLA) in an older, population-based cohort.

The main finding was that 7% of the older adults had inadequate or marginal health literacy. These individuals were older, male, and had low reading levels.

Clinicians should be aware of patients' functional health literacy and tailor their communications accordingly

Table 1.

Characteristics of the study sample by functional health literacy

Participants' Characteristics	All (N = 1066)	Inadequate or Marginal Functional Health Literacy (N = 75)	Adequate Functional Health Literacy (N = 991)	P-Value*†
Age at first STOFHLA, mean (SD)	74.3 (7.73)	82.17 (9.82)	73.67 (7.21)	<.001
Sex: Female, n (%)	643 (60.32)	33 (44.00)	610 (61.55)	0.003
Education: n (%)				<.001
< High School	33 (3.10)	15 (20.00)	18 (1.82)	
= High School	367 (34.43)	32 (42.67)	335 (33.80)	
> High School	666 (62.48)	28 (37.33)	638 (64.38)	
Race: White, n (%)	1001 (93.90)	60 (80.00)	941 (94.95)	<.001
Total Annual Household Income: ≥$15K vs <$15K; n (%)	922 (90.48)	56 (81.16)	866 (91.16)	0.017
Self-rated Health: n (%)				0.058
Poor or Fair	148 (13.90)	15 (20.00)	133 (13.43)	
Good	433 (40.66)	35 (46.67)	398 (40.20)	
Very Good or Excellent	484 (45.45,	25 (33.33)	459 (46.36)	
Depression symptoms : n (%)				0.731
0	681 (64.00)	46 (61.33)	635 (64.21)	
1–4	29 (27.26)	21 (28.00)	269 (27.20)	
≥ 5	93 (8.74)	8 (10.67)	85 (8.59)	
# Prescription Meds ≥ 4, n (%)	605 (56.81)	52 (69.33)	553 (55.86)	0.029
System for managing prescription medications: "yes," n (%)	856 (86.3)	59 (93.7)	797 (85.8)	0.117
Assessment of medication adherence "fully adherent" n (%)	945 (93.8)	63 (91.3)	882 (93.9)	0.541
Dependence in IADLs: n (%)				<.001
0	896 (84.05)	44 (58.67)	852 (85.97)	
1–2	131 (12.29)	17 (22.67)	114 (11.50)	
>= 3	39 (3.66)	14 (18.67)	25 (2.52)	
Mini Mental State Exam < 28, n (%)	399 (37.43)	58 (77.33)	341 (34.41)	<.001
CDR® >= 0.5, n (%)	157 (14.73)	33 (44.00)	124 (12.51)	<.001
Attention Composite < 1.5 SD, n (%)	89 (8.43)	25 (34.72)	64 (6.50)	<.001
Executive Function Composite < 1.5 SD, n (%)	86 (8.08)	33 (44.59)	53 (5.35)	<.001
Language Compo site < 1.5 SD, n (%)	86 (8.13)	27 (36.99)	59 (5.99)	<.001
Memory Composite < 1.5 SD, n (%)	67 (6.36)	18 (25.71)	49 (4.98)	<.001
Visuospatial Composite < 1.5 SD, n (%)	51 (6.44)	13 (29.55)	38 (5.08)	<.001
WTAR Standard Score, mean(SD)	106.4 (12.81)	92.1 (15.85)	107.4 (11.90)	<.001
Visits to emergency or urgent care during preceding year; n (%)				0.427

Participants' Characteristics	All (N = 1066)	Inadequate or Marginal Functional Health Literacy (N = 75)	Adequate Functional Health Literacy (N = 991)	P-Value*†
0	727 (68.2)	52 (69.3)	675 (68.1)	
1	259 (24.3)	15 (20.0)	244 (24.6)	
>=2	80 (7.5)	8 (10.7)	72 (7.3)	
Hospital admissions during preceding year, n (%)				0.199
0	873 (81.9)	56 (74.7)	817 (82.4)	
1	142 (13.3)	13 (17.3)	129 (13.0)	
>=2	51 (4.8)	6 (8.0)	45 (4.5)	

*For categorical variables, *P* values were calculated using Fisher's exact test. For age at first STOFHLA were calculated using 2 sample t test. For WTAR standardized score, the *P* value was calculated using Wilcoxon rank sum test with continuity correction.

†After applying the Bonferroni correction for multiple comparisons, the *P* value for statistical significance was (0.05/21 =) 0.0024.

SD: standard deviation

IADL: Instrumental Activities of Daily Living

CDR: Clinical Dementia Rating®

WTAR: Wechsler Test of Adult Reading

Table 2.

Associations between functional health literacy (inadequate or marginal vs. adequate) and participants' characteristics (backward selection multiple logistic regression)

Characteristics	Odds Ratio	95% CI	P-Value
Age at first S-TOFHLA	0.86	(0.82,0.91)	**<.001**
Sex: Female, (ref: Male)	3.65	(1.62,8.74)	**<.001**
Education (ref: < High School)			
= High School	1.83	(0.43,7.57)	0.41
> High School	3.09	(0.69,13.7)	0.14
Race (ref: Non-White)	2.1	(0.64,6.5)	0.21
Clinical Dementia Rating>= 0.5	0.47	(0.2,1.16)	0.09
Executive function composite < 1.5 SD	0.37	(0.14,1.01)	0.05
Visuospatial function composite < 1.5 SD	0.39	(0.14,1.09)	0.06
WTAR Standard Score	1.08	(1.04,1.12)	**<.001**

SD: standard deviations below the mean;

CDR: Clinical Dementia Rating® ;

WTAR: Wechsler Test of Adult Reading

Table 3:

Age, sex, and education norms on the S-TOFHLA (7-minute score) among study participants free of dementia (Clinical Dementia Rating = 0) (N= 909)

Age in years	Sex	Education Level	N	Mean	SD	Median (50th %ile)	5th %ile
65–74	Male	< High school	1	14	NA	14	14
		High school	65	32.22	4.46	34	21.4
		> High school	177	34.14	2.85	35	28.8
	Female	< High school	5	30.2	7.05	33	20.6
		High school	109	33.83	4.04	35	30
		> High school	228	34.73	1.87	35	32
75–84	Male	< High school	2	28.5	10.61	28.5	21.75
		High school	19	31.58	5.04	34	20.8
		> High school	51	33.53	3.38	34	26
	Female	< High school	5	27	6.28	28	21
		High school	68	33.49	3.77	35	25.35
		> High school	73	34.16	2.3	35	30
85+	Male	< High school	5	19.6	4.72	20	14
		High school	9	26.78	8.61	29	13.2
		> High school	24	27.67	8.6’	31.5	12.05
	Female	< High school	5	20.8	5.54	23	14.4
		High school	36	32.67	4.24	34	25
		> High school	27	30.93	5.66	33	19.3