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Development and Validation of the Comprehensive Health Activities Scale: A New Approach to Health Literacy Measurement

LAURA M. CURTIS,

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

WILLIAM REVELLE,

Department of Psychology, Northwestern University, Evanston, Illinois, USA

KATHERINE WAITE AND,

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

ELIZABETH A. H. WILSON,

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

DAVID M. CONDON,

Department of Psychology, Northwestern University, Evanston, Illinois, USA

ELIZABETH BOJARSKI,

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

DENISE C. PARK,

Center for Vital Longevity, University of Texas at Dallas, Dallas, Texas, USA

DAVID W. BAKER AND, and

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine at Northwestern University, Chicago, Illinois, USA

MICHAEL S. WOLF

Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine at Northwestern University, Chicago, Illinois, USA

Abstract

Address correspondence to Laura M. Curtis, Health Literacy and Learning Program, Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, 750 N. Lake Shore Drive, 10th Floor, Chicago, IL 60611, USA. l-curtis@northwestern.edu.

Supplemental Material

Supplemental data for this article (Appendix: Item Response Theory information, discrimination, and difficulty results by task) can be accessed on the publisher's website.

Current health literacy measures have been criticized for solely measuring reading and numeracy skills when a broader set of skills is necessary for making informed health decisions, especially when information is often conveyed verbally and through multimedia video. We devised nine health tasks and a corresponding 190 item assessment to more comprehensively measure health literacy skills. A sample of 826 participants age 55-74 recruited from an academic General Internal Medicine practice and three Federally Qualified Health Centers in Chicago, Illinois completed the assessment. Items were reduced using hierarchical factor analysis and item response theory resulting in the 45-item Comprehensive Health Activities Scale (CHAS). All 45 items loaded on one general latent trait and the resulting scale demonstrated high reliability and strong construct validity using measures of health literacy and global cognitive functioning. The predictive validity of the CHAS using self-reported general, physical, and mental health status was comparable to or better than widely used measures of health literacy, depending on the outcome. Despite comprehensively measuring health literacy skills, items in the CHAS supported one primary construct. With similar psychometric properties, current measures may be adequate, depending on the purpose of the assessment.

The field of health literacy has developed considerably over the past two decades, with numerous research studies linking crude measures of reading ability and numeracy with a variety of health outcomes. A continued criticism of current health literacy measures is the notion that health literacy refers solely to reading and numeracy skills when, in fact, the conceptual framework of health literacy reflects a far broader set of skills (Baker, 2006; Jordan, Osborne, & Buchbinder, 2011; Nielson-Bohlman, Panzer, & Kindig, 2004). In addition, stimuli that are frequently presented to individuals for existing tests rely heavily on measuring one's ability to process health information using a print or text-based medium. While patients surely must be able to read information in print form and perform basic calculations to effectively engage in the healthcare system, they must also retain information in support of self-care, listen and process spoken communication, navigate new technologies, and problem solve in new or changing situations.

Despite these criticisms of the most common tests used in health literacy investigations, their predictive validity is undeniable (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004; Institute of Medicine, 2004). Regardless, new health literacy tests continue to emerge; some improve upon the delivery of the assessment (E. A. Hahn et al., 2004), shorten the administration time (Arozullah et al., 2007; Lee, Bender, Ruiz, & Cho, 2006), or expand the conceptual understanding of health literacy (McCormack et al., 2010; Osborn, Davis, Bailey, & Wolf, 2010). While these measures all hold merit and over time may gather evidence equivalent to commonly used assessments (i.e. TOFHLA, REALM, NVS) to support their predictive validity, ultimately they all depend on document-based text, charts, and graphs, either via pencil and paper tests or their electronic versions (i.e. web based). These new tools, along with current measures, may serve well as a proxy for identifying those who have difficulty with document or web based tasks, but may not be informative for more challenging or perhaps less familiar activities one may encounter in healthcare. In addition, print materials are often not available and patients, especially those with limited reading ability, often rely on recall of verbal instructions given in an encounter. A measure that more broadly reflects the vast array of current tasks faced by patients and families when

accessing, understanding, and applying health information could better guide health systems in matching service demands to patient abilities.

We devised a broad range of cognitively challenging, yet routine healthcare scenarios common for the aging population in an attempt to more comprehensively assess individual health literacy skills. Both information presentation format as well as the abilities necessary to obtain, process, understand, and apply this information were considered in the creation of this tool, herein referred to as the Comprehensive Health Activities Scale (CHAS).

Information was presented in form of print documents, common artifacts (i.e. pill bottles), and verbal communication either replicated as spoken from a medical professional or given via a streaming health education video. In addition to addressing reading and numeracy abilities using print documents and pill bottles as in the commonly used assessments, the addition of spoken communication and multimedia video allowed us to also measure comprehension and recall of verbal information without written support documents, as is often necessary in medical encounters. As such, the variety of tasks was intended to not only more accurately reflect current patient roles in healthcare, but to also expand the range of difficulty of items.

Given that causal mechanisms linking health literacy to health outcomes presently remain unclear, not only could the CHAS more precisely identify requisite health skills, but also aid our thinking in how best to devise interventions that can simplify tasks and improve individuals' self-care performance. We review the development and psychometric validation of the CHAS, including construct validity mapped to the three most common health literacy measures and a widely used test of global cognitive function. Its predictive validity was examined by mapping CHAS scores to general health status and functional health status measures including physical health status, depression, and anxiety while comparing its performance to that of current literacy measures in healthcare.

METHODS

Sample

We recruited 826 participants ages 55-74 from one academic General Internal Medicine clinic and four Federally Qualified Health Centers (FQHCs) between August 2008 and October 2010 as part of the Literacy and Cognitive Functioning study (LitCog) funded by the National Institute on Aging (NIA). A total of 3176 patients were identified through electronic health records as initially eligible to participate by age and were notified of the study by mail and contacted via phone. A sample of 1904 eligible patients were reached by research staff and initial screening deemed 244 subjects as ineligible due to severe cognitive or hearing impairment, limited English proficiency, or not being connected to a clinic physician (defined as < 2 visits in two years). In addition, 794 refused, 14 were deceased, and 20 were eligible but had scheduling conflicts. The final sample included 832 participants, for a determined cooperation rate of 51 percent following American Association for Public Opinion Research guidelines (American Association for Public Opinion Research, 2004).

Procedure

Subjects completed two structured interview sessions with trained research assistants, 7-10 days apart, each lasting approximately two and a half hours in length. These analyses include assessments from the first interview including basic demographic information, socioeconomic status, comorbidity, functional health status, three measures of health literacy, and a comprehensive assessment of performance on everyday health tasks. Northwestern University's Institutional Review Board approved the study and patients provided written informed consent prior to participation.

Instrument Development

Nine different scenarios depicting health-related tasks common for the aging population were developed by members of our research team, including experts in the fields of health literacy, test development, medicine, and cognitive psychology. Most were created prior to this study and have been piloted and tested (Davis, Wolf, Bass, Middlebrooks, et al., 2006; Davis, Wolf, Bass, Thompson, et al., 2006; E. Hahn; Heinemann, Deutsch, Mallinson, & Gershon; Weiss et al., 2005; Wilson et al., 2010; Wolf, Baker, & Makoul, 2007). The development of the verbal tasks, which were created for this study, is described in more detail elsewhere (McCarthy et al., 2012).

Information was presented to participants using print documents, prescription medication bottles, spoken health communications, and multimedia video as described in Table 1. Each scenario was followed by a series of questions asking them to demonstrate comprehension and/or use of the material and artifacts and rated as correct or incorrect by trained interviewers. Verbatim answers were also recorded and reviewed by the team if the interviewer was in question about a particular response. On average, all scenarios in the CHAS take roughly 60 minutes to administer. Tasks within each of these scenarios included simple retrieval of print information, recall of verbal and multimedia information, demonstration of understanding information from pill bottles, as well as more complicated tasks requiring calculation, multistep commands, and/or reasoning. This methodology was adapted from similar prior studies by the research team, methods from cognitive psychology, and national literacy and health literacy assessments such as the National Adult Literacy Study (NALS), National Assessment of Adult Literacy (NAAL), and Health Activities Literacy Scale (HALS) (Kirsch, 1993; Kutner, Greenberg, Jin, & Paulsen, 2006; Rudd, Kirsch, & Yamamoto, 2004; Willis, Jay, Diehl, & Marsiske, 1992).

Measurement

Health literacy—Health literacy was assessed by the Test of Functional Health Literacy in Adults (TOFHLA), Rapid Estimate of Adult Literacy in Medicine (REALM), and the Newest Vital Sign (NVS) (Davis et al., 1993; Parker, Baker, Williams, & Nurss, 1995; Weiss, et al., 2005). The TOFHLA uses actual materials that patients might encounter in healthcare to test their reading fluency. It takes approximately 20 minutes to complete, and consists of two parts: a 50 item reading comprehension section using the Cloze procedure and a 17 item numeracy assessment. Total scores are weighted for possible scores ranging from 0-100 and can be interpreted as inadequate (0-59), marginal (60-74), or adequate (75-100) literacy.

The REALM is a word-recognition test where patients are asked to read aloud as many words as they can from a list of 66 health related terms arranged in order of increasing difficulty. Scores are based on the total number of words pronounced correctly, with dictionary pronunciation being the scoring standard and interpreted as low (0-44), marginal (45-60), or adequate (61-66) literacy. Finally, the NVS is a screening tool used to determine risk for limited health literacy. Patients are given a copy of a nutrition label and asked six questions about how they would interpret and act on the information. Scores are classified as high likelihood (0-1) or possibility (2-3) of limited literacy, and adequate literacy (4-6).

Global cognitive functioning—The Mini Mental Status Exam (MMSE) was used to measure global cognitive functioning (Cockrell & Folstein, 1988). Total scores range from 0-30 and can be classified into severe (0-17), mild (18-23), and no (24-30) cognitive impairment.

Functional health status—Self-reported health (SRH) status was determined by asking participants to rate their overall health as excellent, very good, good, fair, or poor. SRH was then dichotomized as excellent, very good, or good vs. fair or poor. Physical health status was assessed using the SF-36 physical functioning subscale, with scores ranging from 0-100 (Ware Jr, Kosinski, & Keller, 1994). Depression and anxiety were measured using the emotional health short form measures from the Patient-Reported Outcomes Measurement Information System (PROMIS) (Hays, Bjorner, Revicki, Spritzer, & Cella, 2009; Teresi et al., 2009). Scores on the depression scale range from 8 to 40 and the anxiety scale from 7 to 35.

Analyses

Item response variability—Across the nine health scenarios, 190 items were initially scored as correct or incorrect. Frequencies of correct responses were calculated and tetrachoric correlations were computed to examine the pattern of correlations between the dichotomous items. If items are too highly correlated, the estimate of reliability is inflated and assumptions of Item Response Theory (IRT) are violated (Cattell, 1978; Reeve & Fayers, 2005). Items with fewer than 5% or greater than 95% correct, or that were highly correlated with other items (> 0.80) were examined and those found to be too easy, difficult, or redundant with other items were either eliminated or rescored by combining with similar items. In addition, when participants were asked to recall a list of items, different ways of scoring (either giving a point for each item listed or based on the total number recalled from the list, e.g. 3/5 or 4/5) were examined.

Factor structure—We hypothesized a general non-specific factor would account for substantial variance in all items with the possibility of lower order factors. We examined the factor structure of the items by determining the number of components that minimized the average squared partial correlation using Velicer's Minimum Average Partial (MAP) criteria and by using the Very simple structure (VSS) algorithm which compares the fit of the simplified factor matrix to one that uses only the largest factor loadings (W. Revelle & Rocklin, 1979; Velicer, 1976). Based on these results, we then ran omega analyses, a method of hierarchical factor analysis that uses the Schmid-Leiman transformation to first

estimate a general factor followed by evaluation of the lower level factor loadings after accounting for variation by the general factor. (McDonald, 1999; W. Revelle & Zinbarg, 2009; Schmid & Leiman, 1957). We compared the fit of these models using the root mean squared error of approximation (RMSEA) as well as the root mean square residual (RMSR). A model with low RMSEA (<0.06) and RMSR (<0.08) is considered to adequately fit the data (Hu & Bentler, 1999).

Items with factor loadings greater than 0.3 on the common latent variable were retained (Nunnally & Bernstein, 1984; Tabachnick & Fidell, 2001). A second omega analysis was run to determine whether the remaining items measure a latent variable in common and the extent to which this latent variable accounts for the variance in the scale scores (Cronbach, 1951; McDonald, 1999; W. Revelle & Rocklin, 1979; W. Revelle & Zinbarg, 2009). Omega hierarchical (ω_H) estimates the degree to which the test measures a single primary latent variable, omega total (ω_T) estimates the reliable variance in a test, and Cronbach's α measures the internal reliability of the test (W. Revelle & Zinbarg, 2009; Zinbarg, Revelle, Yovel, & Li, 2005). Diagnostic statistics were conducted to examine the quality of the omega solution including comparison of the relative size of the g factor eigen value to the other eigen values.

Item Response Theory (IRT)—The psychometric properties of the remaining items were further assessed using Item Response Theory (IRT). IRT allows one to evaluate the ability of a test to discriminate between respondents with different levels of an underlying trait. The probability of a person with a given level of ability answering an item correctly was modeled using a 2-parameter logistic model. The discrimination parameter (α) represents the strength of the relationship between a particular item and an underlying trait and indicates how effectively an item can differentiate between participants at different levels of the latent trait. It typically ranges from 0.5 to 2.5 with more effective items having larger values (Reeve & Fayers, 2005). The information for an item is maximized at the point at which 50% of the respondents answer the item correctly and is the best estimate for an item's difficulty (β). Items tend to range between -3 (extremely easy) and 3 (extremely difficult). Although calculated using factor analysis of the tetrachoric correlations, the IRT and factor analysis parameters are just transforms of each other (Kamata & Bauer, 2008; McDonald, 1999).

When forming a test and evaluating the items within a test, the most useful items are the ones that give the most information about a person's score. Since the test information is just the sum of the item information, one can design a measure that provides maximum information at a particular point by including items of a specific difficulty, or to have relatively uniform information across a range of abilities by including items across all difficulties. The test information curve (TIC), a graphical representation of the information function for all the items in the test across the range of difficulty, was used to display the information of the test as a whole. Information for each item at each level of difficulty was provided in the appendix to allow one to determine the amount of information and from that the reliability ($1-1/\text{information}$) for a subset of items. Psychometric analyses were done using omega and irt.fa functions from the psych package version 1.1-12 (W Revelle, 2011) in

the open source data analysis and statistical system R version 2.14.1 (R Development Core Team, 2011).

Scoring—An overall score was created based on the items that loaded on the general factor. Scores were calculated as the percent correct out of the total possible multiplied by 100 and were not calculated for participants missing more than half of the items on a particular scale.

Construct and predictive validity testing—Construct validity was assessed by examining correlations between the CHAS score and patients' scores on the TOFHLA, REALM, NVS, and the MMSE. For predictive validity, the ability of our measure to predict physical health and blood pressure control was tested using linear and logistic regression, respectively, controlling for age, sex, race, marital status, and total number of chronic conditions. Similar models were run for the literacy measures and the MMSE in order to compare the predictive validity of the CHAS to that of these four measures. For the continuous physical health, anxiety, and depression outcomes, standardized betas were calculated in order to compare the strength of association between the CHAS, health literacy, and MMSE estimates despite differing units of measurement. In addition, the amount of variance explained by the CHAS score was compared to the amount explained by the literacy measures and the MMSE using the Vuong Test, a likelihood-ratio based approach for non-nested models (Vuong, 1989). For the dichotomous outcome of SRH status, models were similarly assessed by comparing the equality of the area under the receiver operating characteristic (ROC) curves for each model. Scoring and validity testing of the CHAS was done in STATA version 12.1.

RESULTS

Sample

The sample of 826 participants included in these analyses is described in Table 2. Two thirds of participants (68%) were female, and the majority either African American (43%) or non-Hispanic white (50%). Participants were socially and economically diverse by years of schooling, household income, employment, marital status, and living situation. Individuals on average had two comorbid chronic conditions ($M=1.9$, $SD=1.4$), and were taking a mean of 3.6 prescription medications ($SD=3.1$).

Item Response Variability

The percent correct for the initial 190 items was generally high with an average of 65 ($SD=23$). Many items were highly correlated with tetrachoric correlations ranging from 0.04 to 0.99. The twenty-two items correctly answered by less than 5% or more than 95% of respondents or had correlations > 0.80 with other items were examined. These items were either eliminated or rescored by combining with similar items, and listed items were scored based on the total number recalled leaving a total of 70 remaining items.

Factor Structure

Very simple structure (VSS) and Velicer's Minimum Average Partial (MAP) criterion indicated a strong first factor with the possibility of 4 additional factors in the remaining 70 items. Therefore, we ran an omega analysis extracting one general factor and 4 lower level factors. Items with factor loadings ≥ 0.3 on the common latent variable were retained, resulting in 92% reliable variance (ω_T) and 92% internal consistency (α) in the remaining 45 items. This common latent trait accounted for 79% of the variance in the items (ω_H). With this general factor partialled out, less than one third of the items ($n=12$) also loaded on one of the 4 lower level factors (≥ 0.3). The Eigen values for these factors were much smaller when compared to that for the common latent variable (1.0, 0.8, 0.9, 0.9 for factors 1-4, respectively compared to 8.0) and while the fit is slightly better for the 4-factor omega model, the difference is negligible (4 factor: RMSEA=0.02, RMSR=0.03; 1 factor: RMSEA=0.03, RMSR=0.05). These results suggest a strong primary factor underlying responses in this sample with little influence from additional sub-factors.

Item Response Theory (IRT)

With support for a strong primary dimension and unidimensionality of the items, assumptions for IRT analyses were satisfied (Reeve & Fayers, 2005). Overall test information is displayed in Figure 1 indicating the test is able to discriminate well across all ability levels, but more so at middle to lower ability levels. Information for each of the 45 items is displayed in the Appendix. Item information in each column was summed in order to calculate test reliability ($1 - 1/\text{Information}$) for subsets of items, in this case partitioned by information presentation modality. Using this table, one can similarly calculate information and reliability for any subset of items.

Construct and Predictive Validity

The CHAS score correlated highly with current measures of health literacy and the MMSE, being more closely related to the TOFHLA and the NVS ($r = 0.81$ and $r = 0.75$, respectively), compared to the REALM and the MMSE ($r = 0.68$ for both; Table 3). Regarding predictive validity, the CHAS assessment was significantly associated with self-reported health (Odds Ratio (OR) = 1.03; 95% Confidence Interval (CI) 1.02, 1.04; $p < 0.001$), physical health ($\beta = 0.10$; 95% CI 0.04, 0.16; $p = 0.002$), depression ($\beta = -0.06$; 95% CI -0.09 , -0.04 ; $p < 0.001$), and anxiety ($\beta = -0.03$; 95% CI -0.05 , -0.01 ; $p = 0.01$). The amount of variance in physical health and in anxiety explained by the CHAS was not significantly better or worse than that of current health literacy and global cognitive functioning measures (all $p > 0.20$). However, the CHAS did explain significantly more variance in the depression outcome than the REALM (Vuong Z-statistic 2.67; $p < 0.01$). In addition, the CHAS similarly explained variance in SRH to the TOFHLA and the REALM, but significantly more variance than the NVS (Areas under the ROC curve (AUC) 0.84 vs. 0.83; $p = 0.04$) and the MMSE (AUC 0.84 vs. 0.82; $p = 0.02$).

DISCUSSION

The meaning and measure of health literacy has been and continues to be a frequently discussed issue in the field as well as the subject of many ongoing studies. In the

development of the CHAS, we intentionally designed the measure to tap into a far broader set of health skills than simply navigating text in prose selections or documents including tables and graphs and instead focused on realistic, complex health-based scenarios that patients often experience. In our study, the CHAS demonstrated high reliability, strong construct validity with the three most commonly-used health literacy measures, and strong predictive validity with all self-reported general, physical, and mental health status measures. While some items provided more information than others, all seem to get at the same latent trait of health literacy skills. Yet, we openly ask the question as to whether the CHAS, as a more dynamic assessment tool, should replace existing health literacy tests despite requiring more time and resources to administer. There are several important factors to consider in seeking out answers as to how to best assess the construct of health literacy.

We measured a variety of tasks including retrieval and comprehension of print information, recalling spoken and multimedia information, medication organization, and tasks requiring calculation and multi-step commands, but all items mapped to a single latent factor, suggesting measurement of the same construct. In other words, one's ability to comprehend print information may be similar to his or her ability to retain information from spoken and multimedia sources. While the REALM, TOFHLA, and NVS may be highly criticized as very crude measures of health literacy that focus on reading comprehension and/or numeracy rather than the full range of skills necessary to function in the healthcare environment, they too are likely capturing this latent trait. Despite these criticisms, the ability of the REALM, TOFHLA, and NVS to predict outcomes is unquestionable. While we expected our more comprehensive assessment to have considerably greater predictive validity, this was not the case; the CHAS performed comparably, if not only slightly better than current measures. Considering brevity when measuring health literacy, which is essential in research and clinical settings, these more crude assessments may be adequate as measures of a health literacy construct.

Existing health literacy tests offer validated thresholds for identifying at-risk individuals, which can be valuable in both a research and clinical setting. However, if the intent is to learn precisely how to revise an existing healthcare task or process, the CHAS items and/or its approach might be able to offer more assistance. By determining which items are more difficult at varying levels of ability, tasks or processes can be simplified in order to make them clearer for the targeted population. For example, the most difficult items in the CHAS were related to recalling information from a multimedia video. If clinics use videos to educate patients about their condition or how to perform tasks at home, providing tangible supports for participants to take with them may support recall of this information (Wilson, et al., 2010). In addition, if researchers want to test an intervention designed to improve a specific task or skillset (e.g. accurately taking medication), a measure testing that particular skill would be beneficial.

In both research and clinical settings, there are requisite attributes that are important to consider for any standard assessment. As such, practical limitations of the CHAS include technology and stimuli requirements (i.e. pill bottles and dosing trays) as well as the time it takes to complete all nine tasks. However, this item-level analysis identifies the most informative items and tasks in the CHAS and these results, in turn, could be used to inform

the development of adaptive procedures for CHAS administration. Because all items measure the same latent trait, it doesn't matter which tasks are chosen as long as the items provide information for the targeted individuals, allowing for practical flexibility in assessment administration. Using portions of the CHAS specific to what a patient might be expected to perform in a clinical context could appear more relevant and less as a test of ability, and thereby reduce stigma. For example, presenting patients with diabetes with the hypothetical blood sugar monitoring task would be a more intuitive choice rather than to give a patient a list of words to pronounce or to read a Medicaid application.

In addition, the tasks and scoring criteria of the CHAS will be publicly available for others to use and could potentially be administered online. The verbal and multimedia tasks are already presented to patients on a laptop computer and while paper documents were used for the majority of tasks, information could be presented in the same way on the screen as other new measures have demonstrated (E. A. Hahn, et al., 2004; McCormack, et al., 2010). Further research is needed to determine whether this manner of administration would affect the psychometric properties of this assessment.

While we believe the CHAS has applicability for individuals across all age groups, our sample was limited to older patients by its development being linked to the larger LitCog study. However, the stimuli provided reflects tasks that would be quite common for those with some level of comorbidity or familiarity with the healthcare system. Future investigations should evaluate the CHAS among a more diverse sample in terms of age and healthcare experience. In addition, more objective health outcomes including blood pressure control, hospitalizations, and emergency department visits from patients' medical records will be used to determine further predictive validity once data become available.

CONCLUSION

While the intent of this study was to more comprehensively measure aspects of health literacy that current measures might potentially be missing, such as understanding of oral instructions and multimedia learning, our evidence suggests that a more comprehensive measure may not be necessary depending on the purpose of the assessment. Yet these findings are important in that we offer a framework of the degree of complexity for many common health activities, offering insight into the most pressing targets for simplifying healthcare. Whether or not any new tool will replace the current gold standards will largely be determined by the availability of evidence supporting their use, access and feasibility. Even the most impressive psychometric properties cannot ensure widespread adoption if a health literacy assessment is not publicly available and/or cannot be easily administered in diverse clinic settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Test information curve for the Comprehensive Health Activity Scale

Table 1

Description of Health Scenarios.

Information Presentation: Task	Description
Print documents	
<i>Consent to a procedure</i>	Read a consent form given before an angiography and exhibit understanding of the procedure, potential complications, and physician responsibilities.
<i>Monitor blood sugar</i>	Calculate and interpret numeric information from a chart listing 7 days of recorded blood sugar levels before and after meals for a diabetic patient.
<i>Prepare for a procedure</i>	Review instructions for colonoscopy preparation, and demonstrate comprehension of patient duties prior to the procedure.
<i>Choose a facility</i>	Examine written text about pressure sore prevention, a chart comparing prevention at two nursing homes, and a map in order to select the best facility.
<i>Monitor condition</i>	Review and demonstrate understanding of a sheet about heart failure symptoms, monitoring, and self-care activities, as well as a calendar indicating weight and swelling status.
Medication bottles	
<i>Manage Prescription Medications</i>	Review prescription bottles from two hypothetical prescription medication regimens; pronounce the names of the medications, make inferences on usage, and dose both regimens over a 24-hour period using a medication box.
Spoken instructions	
<i>Understand new diagnosis</i>	Receive oral instructions from a physician regarding a diagnosis and course of treatment for GERD; answer questions to assess immediate and delayed recall about self-management.
<i>Recall home care instructions</i>	Listen to wound care instructions for a laceration upon discharge from the emergency department; recall information about follow-up appointments, frequency of dressing change, and signs of infection.
Multimedia video	
<i>Recall symptom prevention information</i>	Watch a video clip on identifying, monitoring, and controlling asthma triggers; recall information immediately following the video and at the end of the interview.

Table 2

Characteristics of Sample (N=826)

Variable	Summary value
Age, mean (SD)	63.1 (5.5)
Gender (%)	
Female	67.9
Race (%)	
Black	42.6
White	50.2
Other	7.2
Education (%)	
High school or less	27.1
Some College or technical school	22.0
College graduate	20.5
Graduate degree	30.4
Income (%)	
< \$10,000	12.2
\$10,000 - \$24,999	19.6
\$25,000 - \$49,999	15.3
> \$50,000	52.9
Employment Status (%)	
Full-time	20.3
Part-time	15.0
Not working	64.7
Chronic Conditions, (%)	
Hypertension	59.9
Diabetes	15.8
Coronary artery disease	6.9
Heart failure	5.0
Bronchitis or emphysema	13.2
Asthma	18.7
Arthritis	47.4
Cancer	7.4
Depression	20.5
Total number, mean (SD)	1.9 (1.4)
Number of prescription medications, mean(SD)	3.6(3.1)

Table 3
Validity of the Comprehensive Health Activity Scale and current measures of Health Literacy and Global Cognitive Function

	CHAS p	Construct Validity			Predictive Validity		
		SRH	OR (95% CI)	Physical Health β (95% CI)	Depression β (95% CI)	Anxiety β (95% CI)	β*
CHAS	---		1.03 (1.02, 1.04)	*** 0.10 (0.04, 0.16)	*** -0.06 (-0.09, -0.04)	*** -0.22	*** -0.11
Health Literacy							
TOFHLA	*** 0.81		1.03 (1.02, 1.04)	*** 0.09 (0.02, 0.17)	*** -0.05 (-0.08, -0.03)	*** -0.14	*** -0.07
REALM	*** 0.68		1.03 (1.01, 1.01)	*** 0.10 (-0.001, 0.19)	*** -0.03 (-0.06, 0.01)	*** -0.05	*** 0.02
NVS	*** 0.75		1.19 (1.06, 1.33)	*** 0.96 (0.36, 1.56)	*** -0.51 (-0.73, -0.28)	*** -0.17	*** -0.10
Global Cognitive Function							
MMSE	*** 0.68		1.14 (1.05, 1.25)	*** 0.63 (0.11, 1.16)	*** -0.42 (-0.61, -0.22)	*** -0.15	*** -0.07

Abbreviations: CHAS, Comprehensive Health Activity Scale; SRH, Self-Reported Health; OR, Odds Ratio; β, Unstandardized beta; CI, Confidence Interval; β*, Standardized beta; TOFHLA, Test of Functional Health Literacy in Adults; REALM, Rapid Estimate of Adult Literacy in Medicine; NVS, Newest Vital Sign; MMSE, Mini Mental Status Examination.

p<0.001

**
p<0.01

*
p<0.05