Health literacy

ABCs or 123s? The independent contributions of literacy and numeracy skills on health task performance among older adults

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ABSTRACT

Objective: To investigate the relationship between literacy and numeracy and their association with health task performance.
Methods: Older adults ($n = 304$) completed commonly used measures of literacy and numeracy. Single factor literacy and numeracy scores were calculated and used to predict performance on an established set of health self-management tasks, including: (i) responding to spoken information; (ii) comprehension of print and (iii) multimedia information; and (iv) organizing and dosing medication. Total and sub-scale scores were calculated.
Results: Literacy and numeracy measures were highly correlated ($rs = 0.68$; $ps < 0.001$). In multivariable models adjusted for age, gender, race, education, and comorbidity, lower literacy ($\beta = 0.44$, $p < 0.001$) and numeracy ($\beta = 0.44$, $p < 0.001$) were independently associated with worse overall task performance and all sub-scales (literacy range, $\beta = 0.23$–0.45, $ps < 0.001$; numeracy range, $\beta = 0.31$–0.41, $ps < 0.001$). Multivariable analyses with both constructs entered explained more variance in overall health task performance compared with separate literacy and numeracy models (8.2% and 10% respectively, $ps < 0.001$).
Conclusion: Literacy and numeracy were highly correlated, but independent predictors of health task performance. These skill sets are complementary and both are important for health self-management.
Practice implications: Self-management interventions may be more effective if they consider both literacy and numeracy skills rather than focusing on one specific ability.

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1. Introduction

Limited health literacy is associated with adverse health outcomes including worse functional health status [1–4], greater hospitalization rates [5–7], and increased all-cause mortality [8–10]. The strongest evidence exists for a relationship between health literacy and the performance of health tasks; including the interpretation of health text and labels [11,12], safe use of medication [13–15], and preventive screenings [16,17]. The construct has been defined by the Institute of Medicine as: 'the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions' [18].

There is debate surrounding what the construct represents and how to measure it [2,19]. The World Health Organization's definition put forth by Nutbeam states that functional literacy is the ability to read and write in a medical context [20]. However, this neglects the important contribution of numeracy, which is often needed to perform and execute basic health tasks. As a very basic example, when patients prepare for a colonoscopy they must be able to read and comprehend the preparatory instructions, but also calculate the dose of laxative and time it appropriately with food [11]. Subsequent publications from Nutbeam have included numeracy skills within the definition of health literacy [21], but it

is clear that empirical data are needed to further understand the role of numeracy within the concept of health literacy.

Multiple definitions of numeracy exist [22]. Here, we shall use the broad definition used by Reyna and colleagues, 'the ability to understand and use numbers'. Numerical health data are rarely presented in isolation, and are instead often embedded within qualitative text. For example, disease incidence data in patient information leaflets [23], or drug side-effects on medicinal labels [12]. The close interaction between the concepts has led some investigators to refer to numeracy as 'quantitative literacy' [24,25]. This conceptual distinction further emphasizes the need for empirical data in this area.

Within the most comprehensive systematic review of health literacy research, literacy and numeracy were examined separately [26]. Berkman and colleagues reported that no firm conclusions could be made about the association between numeracy and most of the health outcomes investigated. However, several reviews and theoretical frameworks have argued for the importance of numeracy in specific medical decision-making tasks [22,27–29]. For example, low numeracy has been associated with poorer risk estimation [30], greater susceptibility to biases and framing effects [31,32] and less trust in numerical information [32]. While these cognitive mechanisms may not be considered clinical outcomes, they are pathways through which numeracy can influence health and wellbeing.

The issue is further complicated by the inclusion of numeracy components within health literacy measures. Several health literacy measures exist, but the most common are the Rapid Estimate of Adult Literacy in Medicine (REALM) [33], the Test of Functional Health Literacy in Adults (TOFHLA) [34], and the Newest Vital Sign (NVS) [35]. While the REALM reflects the ability to read in a medical situation, success on the TOFHLA and NVS depends on both numeracy and literacy skills. Research examining the unique and combined contribution of literacy and numeracy to health outcomes is lacking.

Intervention strategies to mitigate issues with literacy are likely to be different from those addressing numeracy problems. For example, where a patient with poor literacy is experiencing difficulty, a response may be to simplify the text [36–38] or deconstruct the task to increase the ease of completion [39,40]. In contrast, if numeracy is the issue, effective strategies may include altering the presentation of numerical data [41,42] or providing decisional support [31,43,44]. To advance health literacy research and intervention strategies, further investigation is required into the independent contributions of literacy and numerical abilities on health self-management.

Existing studies have examined the role of both literacy and numeracy measures on health-related outcomes. For example, in a cohort of inpatients hospitalized with acute coronary syndromes and/or acute decompensated heart failure, higher subjective numeracy and higher objective health literacy were independently associated with lower odds of making post-discharge medication errors [45]. In a cohort of acute heart failure patients, low subjective numeracy was associated with having an unplanned return to hospital within 30 days of discharge, but subjective literacy was not [46]. The independent contribution of both measures was not addressed in the same statistical model. Finally, among a sample of type 1 and 2 diabetics, objective numeracy was associated with self-efficacy for diabetes self-management, but there was no association with objective health literacy [47]. These inconsistent findings, the reliance on subjective measures, and the heterogeneous outcomes assessed suggest further research is warranted.

The literacy and cognitive function among older adults (LitCog) cohort provides an opportunity to investigate this area as several measures of objective literacy and numeracy were recorded at baseline [48]. This sample is particularly relevant as health literacy has been shown to decrease with age, while the likelihood of engaging in health self-management tasks increases [49]. Using this sample of older American adults, we investigated the relationship between literacy and numeracy as well as their unique and combined association with performance on an established set of health self-management tasks.

2. Methods

2.1. Sample

A full description of the recruitment procedures and methods has been published elsewhere [48]. Briefly, the LitCog sample was recruited between August 2008 through October 2010 from one academic primary care clinic at Northwestern Memorial Hospital and four federally qualified health centers (FQHC's) in Chicago. Participants were eligible if they: (1) spoke English (2) were between the ages 55–74, and (3) lacked any hearing, visual or cognitive impairment. Northwestern University's Institutional Review Board approved the project. A total of 828 participants were enrolled at baseline. For this sub-study, the first 321 participants enrolled onto LitCog were asked to complete an additional numeracy scale. Seventeen people refused to complete at least one literacy or numeracy assessment, providing a total sample of 304 participants to be included here.

2.2. Procedure

In-person structured interviews were held in a private room at Northwestern Memorial Hospital or at one of the four FQHCs. Two sessions were undertaken lasting 2.5 hours and spaced 7–10 days apart. Trained interviewers administered a series of assessments and questionnaires related to literacy, numeracy, performance on common health tasks, and participant characteristics. Prior to the interview, prospective participants were told that the study includes people who have been seen at the clinics in the Access Community Health Network and their doctor agreed that they were eligible to take part. They were informed that the overall aim of LitCog was to aid the creation of better health learning tools to assist patients with their day-to-day healthcare. Free parking or travel reimbursement was provided to encourage participation.

2.2.1. Literacy assessments

A single factor score for literacy was computed using three different assessments. This was done to provide one factor that could represent the multitude of skills that the following measures assess under the umbrella term 'literacy'. The Rapid Estimate of Adult Learning in Medicine (REALM) assesses correct pronunciation of a list of 66 words related to healthcare [33]. The American version of the National Adult Reading Test (AM-NART) was also used and involves reading a list of 45 non-medical words [50]. For the REALM and the AM-NART, the interviewer records correct pronunciation. The final literacy assessment was the reading component of the Test of Functional Health Literacy in Adults (TOFHLA-R) [34]. This assessment uses the cloze procedure, whereby every fifth to seventh word in a passage of increasingly difficult health-related text is missing. Participants are required to fill in missing words using multiple choice response options. One point is awarded for each correct selection from the multiple choices, and score are transformed to range from 0 to 50. The TOFHLA-R does not measure pronunciation, but instead assesses medical vocabulary knowledge and the ability to quickly manipulate sentences to ensure comprehension.