Development of a Word Recognition Instrument to Test Health Literacy in Dentistry: The REALD-30 – A Brief Communication

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Abstract

Objective: *This study aims to develop and pilot test a dental word recognition instrument.* ***Methods:*** *The development of our instrument was based on the Rapid Estimate of Adult Literacy in Medicine (REALM), an efficient word recognition instrument used to assess health literacy in the medical arena. Our instrument, Rapid Estimate of Adult Literacy in Dentistry (REALD-30), consisted of 30 common dental words with various degrees of difficulty. It was administered to 202 English-speaking adults recruited from outpatient medical clinics. We examined the instrument's internal reliability using Cronbach's alpha and its validity by correlating the REALD-30 score to two dental outcomes (perceived dental health status and oral health-related quality of life) and medical health literacy.* ***Results:*** *REALD-30 scores were significantly correlated with REALM scores. REALD-30 was significantly related to perceived dental health status in the bivariate analysis. It also was significantly related to oral health-related quality of life in a multivariate analysis. In contrast, medical health literacy was not related to either of the dental outcome measures.* ***Conclusions:*** *The new REALD-30 instrument displays good reliability but only partial validity. Results suggest that dental health literacy may be distinct from medical health literacy and may have an independent effect on dental health outcomes.*

Key Words: dental health literacy, dental care, oral health-related quality of life, health literacy

Introduction

Approximately 90 million adult Americans with low literacy skills struggle to understand basic health information including consent forms, verbal instructions, and drug labels (1). Research in medical settings consistently demonstrates the importance of literacy for patient adherence to medical instructions and increased positive health outcomes. The importance of literacy, however, has received little attention in dentistry beyond the readability testing of educational materials (2).

An important step in investigating the relationship between literacy and dental health outcomes is to determine what literacy means and how it can be measured. Literacy has taken on several definitions; the most common being the ability to read and write. It would seem self-evident that the highest grade level achieved would be correlated with reading ability. However, research shows a low correlation between years of schooling and literacy (3), with literacy being several grades below the attained educational level. Thus, educational attainment, although easy to assess, can be a poor proxy for literacy and does not accurately reflect an individual's ability to understand and use written information.

Measuring Health Literacy in Medicine. The Rapid Estimate of Adult Literacy in Medicine (REALM) (4) and the Test of Functional Health Literacy in Adults (TOFHLA) (5) are the two most commonly used instruments for measuring health literacy in medicine. REALM is a word recognition test designed to be used in public health and primary health care settings to identify patients with low reading abilities. TOFHLA measures comprehension in addition to word recognition.

Dental Health Literacy. Currently, no methods are available for assessing dental health literacy, nor is there a clear consensus on whether one is needed. As a result, little has been reported on health literacy in dental settings. The limited research that has been done focuses mostly on assessing the reading level of dental educational materials and consent forms (3). According to the results of this research, many dental reading materials are presented at a reading level beyond the 12th grade and many use dental terms that are unfamiliar to patients. Conceivably, these reading materials do not convey the necessary health information to a significant segment of

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the general population, particularly dental patients with low literacy. A key question is whether the concepts and instruments of health literacy developed for use in the medical care setting are applicable to dental care.

To explore this question, we developed an instrument to assess dental health literacy based on the design of REALM and make comparisons to the two commonly used medical instruments. Dental health literacy is defined by the National Institute of Dental and Craniofacial Research Working Group on Functional Health Literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions" (6). Our work is based on the premise that dental health literacy is important because it is positively correlated with dental health outcomes, such as dental health status and oral health-related quality of life, and that these associations can be used to validate any new instrument that might be developed. In addition, we believe that a dental health instrument is needed because the medical and dental care systems differ on a number of characteristics that are related to dental literacy. People's amount and types of exposures to each health care system differ throughout their lives, which will result in differences in medical and dental literacy. The new instrument that we developed is named the **R**apid **E**stimate of **A**dult **L**iteracy in **D**entistry that contains 30 test items (therefore the abbreviation **REALD-30**). In the remainder of the article, we report on our pilot work that developed and tested this instrument.

Materials and Methods

Sample and Survey Method. Subjects were recruited from the Ambulatory Care Center (ACC) at the University of North Carolina Hospital System. Our plan was to recruit 200 subjects to ensure sufficient statistical power in the analysis. For the convenience of the participants, interviews were conducted at the ACC. Participants received $20 cash for their participation.

To be eligible for participation in the study, subjects had to be: a) English speaking; b) at least 18 years of age but younger than 80 years; c) without cognitive impairment; d) without vision or hearing problems; and e) without obvious signs of drug or alcohol intoxication. Eligible individuals who agreed to participate were asked to complete an in-person verbally administered survey. Written consent was obtained prior to the interview. To ensure that each participant, regardless of his or her literacy level, understood and was willing to participate in the study, the consent form was read to all participants. The research protocol was approved by the University of North Carolina School of Public Health Institutional Review Board.

Instrument Development. We followed a disease-specific framework that included etiology, anatomy, prevention, and treatment categories to guide us in the selection of words for initial development of the REALD. All words were taken from the American Dental Association *Glossary of Common Dental Terminology* (www.ada.org). Additionally, we included commonly used words or terms from brochures and written materials provided to dental patients at the University of North Carolina at Chapel Hill Dental Clinics, Orange County Health Department, and the North Carolina Oral Health Section. As the purpose was to develop an instrument suitable for easy use in clinical and community settings, REALD was limited to 30 words. Similar to the design of REALM, the words in READL-30 were arranged in order of increasing difficulty, based both on average word length, number of syllables, and difficult sound combinations, and on the results from 10 initial pretest interviews. Standard pronunciations were taken from the *American Heritage Dictionary*. Investigators reached agreement on the content of REALD-30 and pronunciation of words. The list of words in READL-30 was designed to be read aloud by subjects to interviewers. In scoring READL-30, one point was assigned for each word pronounced correctly and summed to get the overall score. The total score had a possible range of 0 (lowest literacy) to 30 (highest literacy).

Variable Measures. In addition to the READL-30, each subject also completed an interview that included the TOFHLA, REALM, and questions regarding sociodemographic information, dental health status, use of dental services, and oral health-related quality of life. READL-30, REALM, and TOFHLA were all scored on a continuous scale of 0 to 30, 0 to 66, and 0 to 100, respectively. Where possible, survey questions were derived from previously developed and tested questionnaires used in research on dental health issues. Subjects' ratings of self-perceived dental health status were assessed on a five-point Likert scale (excellent, very good, good, fair, and poor). The question related to use of dental services was: "When was the last time you visited a dentist? (within the past year; within 2 years; within 5 years; greater than 5 years; or never)." Subjects also completed the short-form Oral Health Impact Profile (OHIP-14) (7). The OHIP-14 consists of 14 questions regarding the extent to which oral health problems affect the subjects' overall quality of life. We also obtained information on demographic characteristics including educational attainment (number of years of school completed), marital status (1 = married, 0 = otherwise), gender (1 = male, 0 = female), and age (years).

Interviewer Training. Seven interviewers were presented with a training manual that contained the data collection protocol, consent form, and survey questions. Following the training session, 15 pretest interviews were completed to refine the data collection methods and to calibrate the interview protocol.

Tests of Instrument Validity and Reliability. The assumption of unidimensionality of the instrument was examined using methods sug-

gested by Hambleton and Rovinelli (8). The eigenvalue plot of the inter-item correlation matrix was generated using tetrachoric correlations in STATA 8 software (STATA Corporation, College Station, TX). The eigenvalue is the variance in a set of variables explained by a factor or component, which in our case is dental health literacy. We tested the hypothesis that dental literacy was unidimensional. Eigenvalues were examined to determine whether a dominant first factor was present among the words included in the REALD-30. Eigenvalues of greater than one were examined and deemed a factor.

Convergent validity of REALD-30 was tested by examining the association of REALD-30 scores to those derived from the REALM and the TOFHLA using Pearson's correlation. Predictive validity was determined by assessing whether the REALD-30 was associated with health outcomes at a statistically significant level. We hypothesized that dental health literacy would be related to our two dental outcome measures – self-reported dental health status and oral health-related quality of life – after controlling for gender, age, educational attainment, marital status, and past dental visits. The test of predictive validity was conducted using logistic regression analysis for self-reported dental health status (excellent or good versus other) and a linear ordinary least squares regression for OHIP-14. Multivariate models were developed based on review of literature of factors related to health literacy. We also tested the relationship of medical health literacy (REALM, TOFHLA) and dental outcomes in regression analysis. Internal reliability was assessed using Cronbach's alpha. All data were analyzed using STATA 8 statistical software.

Results

Descriptive Statistics. Over the 5-month study period, 202 adults were recruited into our study. Slightly more than half were female [56.4 percent, standard deviation (SD) = 0.5 percent]. Three-fifths of the sample was married (61.4 percent, SD = 2.5 percent). The average education level was 12th grade and the average age was 44.7 years (SD = 14.6). The mean REALD-30 score was 19.8 (SD = 6.4) and the mean REALM and TOFHLA scores were 58.7 (SD = 10.5) and 79.8 (SD = 14.7), respectively. Health literacy scores did not vary significantly by interviewer. Nearly one-half of the sample reported that their dental health was good or excellent and two-thirds reported that they had visited the dentist in the last year.

Analytic Results. The results of the factor analysis of the words in REALD-30 showed a clear dominance of a single factor and the presence of a second. The eigenvalue for the first factor (8.78) was more than four times larger than that of the second (2.10), which was four times that of the third factor (<0.5). After inspection of the scree plot that shows the sorted eigenvalues and application of the Kaiser criterion (9) of retaining only factors with eigenvalues greater than one, two factors were deemed dominant. Factor I with nine words accounted for 70.7 percent of the variance and included words such as sealant, braces, enamel, and fluoride. Factor II with eight words accounted for 16.9 percent and included words such as analgesia, periodontal, hyperemia, cellulitis, fistula, and malocclusion.

REALD-30 was significantly ($P < 0.05$) and positively correlated with the two health literacy instruments used in medicine. The correlations were 0.86 and 0.64 for REALM and TOFHLA, respectively, suggesting that REALD-30 has good convergent validity. Our hypotheses regarding the predictive validity of REALD-30 tested using multivariate regression were only partially supported (Table 1). As hypothesized, REALD-30 was positively associated ($P < 0.05$) with oral health-related quality of life. The correlation was independent of educational attainment ($P < 0.05$) and other covariates. In contrast, the REALD-30 was not associated with self-perceived dental health status at a statistically significant level.

To further examine validity, we repeated the multivariate regression analyses with either the REALM or TOFHLA scores as the main predictors (Table 2). Neither REALM nor TOFHLA was significantly correlated

Table 1
Multivariate Regression Results for Rapid Estimate of Adult Literacy in Dentistry (REALD-30) and Dental Outcomes (n = 202)

Outcome measures	Poorer oral health quality of life	Dental health status (good or excellent)
Dental literacy measure		
REALD-30 score	−0.14*	0.35
	(−0.25, 0.17)	(0.12, 0.88)
Control variables		
Dental visit (within the last year)	−0.31	0.56
	(−0.58, 0.67)	(0.28, 0.98)
Education (in years)	−0.15*	0.24**
	(−0.36, 0.41)	(0.09, 0.67)
Male	−0.27	−0.21
	(−0.45, 0.69)	(−0.44, 0.35)
Married	0.27	0.034
	(0.12, 0.86)	(0.020, 0.055)
Age (in years)	0.0008	−0.001
	(0.00069, 0.0016)	(−0.034, 0.0087)
Constant	8.68**	4.04**
	(5.67, 10.35)	(2.03, 6.78)

* Significance at $P < 0.05$ level; ** Significance at $P < 0.01$ level.
Confidence intervals are in parentheses.

Table 2
Multivariate Regression Results for REALM and TOFHLA and Dental Outcomes (n = 202)

Outcome measures	Poorer oral health quality of life	Dental health status (good or excellent)	Poorer oral health quality of life	Dental health status (good or excellent)
Medical literacy measure				
REALM score	0.0062 (0.0055, 0.069)	0.011 (0.008, 0.028)	Not included	Not included
TOFHLA score	Not included	Not included	0.012 (0.005, 0.086)	−0.0088 (−0.0075, 0.052)
Control variable				
Dental visit (within the last year)	−0.33 (−0.57, 0.85)	0.57 (0.23, 0.92)	−0.39 (−0.47, 0.28)	0.57 (0.21, 0.91)
Education (in years)	−0.30* (−0.59, 0.44)	0.26** (0.15, 0.47)	−0.31* (−0.82, 0.74)	0.30** (0.13, 0.68)
Male	−0.34 (−0.61, 0.41)	−0.17 (−0.29, 0.34)	−0.33 (−0.49, 0.21)	−0.19 (−0.61, 0.72)
Married	0.24 (0.10, 0.82)	0.044 (0.021, 0.099)	0.23 (0.19, 0.89)	0.027 (0.0091, 0.17)
Age	0.0099 (0.009, 0.021)	0.0011 (0.0008, 0.002)	0.012 (0.007, 0.069)	−0.001 (−0.0005, 0.092)
Constant	8.30** (5.67, 12.65)	−4.44** (−6.82, 1.92)	7.81** (2.55, 9.73)	3.42** (1.54, 6.30)

* Significance at $P < 0.05$ level; ** Significance at $P < 0.01$ level.
Confidence intervals are in parentheses.
REALM, Rapid Estimate of Adult Literacy in Medicine; TOFHLA, Test of Functional Health Literacy in Adults.

with either of the dental outcome measures in bivariate or multivariate analyses. Finally, READLD-30 showed good internal reliability; the Cronbach's α for the 30 words was 0.87.

Discussion

Few studies have examined the role of literacy on dental outcomes and none have measured dental health literacy. Because considerable evidence has proven the link between medical health literacy and health outcomes and that improved health literacy can lead to a decrease in health disparities, more research on dental health literacy needs to be done.

This investigation was the first step in filling a large gap in the literature by exploring dental health literacy assessment through the development and testing of a screening instrument based on word recognition. Our findings indicated that READLD-30 had good internal reliability with a Cronbach's α of 0.87. This estimate is comparable with the reported reliability for REALM. We did not examine test–retest reliability. This performance characteristic should be considered in future work.

Results of our tests of the validity of READLD-30 were mixed. We hypothesized that READLD-30 would be correlated with other measurement tools for health literacy used in medicine. READLD-30 and REALM have a high degree of correlation, suggesting convergent validity. This finding is not surprising considering the similar testing methods employed by each instrument and that both are instruments designed to measure literacy. We also found that READLD-30 was correlated with TOFHLA, providing additional support for the convergent validity of READLD-30.

In tests of criterion-related predictive validity, we found that READLD-30 was associated with oral health-related quality of life, but not with perceived dental health status in our regression models. We had originally hypothesized that READLD-30 would be associated with both dental health outcome measures. Dental health status was assessed with a single question and was self-reported, which might have provided an inaccurate measure of the subject's clinical status. Although this single question is often used in health services research, its relationship to actual dental health status varies in studies of adults. Conversely, our measure for oral health-related quality of life was a 14-item scale that provides a more comprehensive and broader measure than self-perceived oral health status, including not only clinical conditions and their impact on one's life, but other factors such as use of dental care. Future investigations should include assessments of clinical status of study participants and its association to dental literacy.

READLD-30 contained only 30 words. We do not know if the instrument would perform better if additional words were included. More investigations should be done to test an instrument that contains a more comprehensive list of dental terms that represent more aspects of dental care. The results of our exploratory factor analysis indicated a clear dominant first factor and a presence of a

second. The meanings of these two factors could be explained in several ways, particularly in light of the definition of dental health literacy stated earlier as the "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions" (6). Perhaps the first factor measures one's capacity or ability to read and the second the set of skills unique to dentistry resulting from exposure to oral health information. An alternative interpretation of the factor analysis results is that the first factor represents prevention literacy (sealant, braces, enamel, and fluoride) and the second treatment or disease literacy (analgesia, periodontal, hyperemia, cellulitis, fistula, and malocclusion). Although further work is necessary to determine the meaning of the two factors, results do indicate that dental health literacy in not just a unidimensional concept. Because REALD-30 is a test of reading ability, it also is possible that the two factors are discriminating reading ability and difficulty of words. Additional work is needed to confirm and understand these domains.

It is unlikely that one instrument such as REALD-30 can adequately serve all the needs for a dental health literacy assessment instrument in dentistry. A word recognition test can provide a quick and easy assessment in patient care settings, while a reading comprehension test can serve many research and intervention purposes. Future work should focus on developing a comprehensive dental health literacy instrument that includes comprehension, numeracy, and verbal components.

Limitations. The results presented here should be considered in light of the study's limitations. First, we recognize that REALD-30, like the REALM, is a limited test of reading ability through assessments of word recognition. The words in REALD-30 are presented in singular fashion and not in any context of a sentence or paragraph and are not meant to determine comprehension. Future studies should investigate the development of a dental health literacy instrument that does not rely solely on this method to test dental health literacy. REALM has been criticized because of this limitation (10). Because we made the decision to base our initial instrument on the REALM by replacing it with dental terms, REALD-30 suffers from the same limitations.

A second limitation is that we collected data on a convenience sample of study subjects. Our sample was taken from a health clinic and may represent higher users of health care. Like most instrument development studies, we used a convenience sample mainly because of budgetary constraints. Future work should draw from a probability sample representative of a larger and more diverse population.

Lastly, we were unable to convert REALD-30 scores to grade-equivalent reading levels because an appropriate comparison instrument, such as the *Instrument for Diagnosis of Reading* and the *Wide Range Achievement Test-3*, was unavailable in our data to make the conversion. Future work should examine the direct relationship of dental health literacy and general literacy.

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