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VALIDATION OF THE WRITTEN ADMINISTRATION OF THE SHORT LITERACY SURVEY

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Abstract

Most health literacy assessments are time consuming and are administered verbally. Written self-administration of measures may facilitate more widespread assessment of health literacy. The aim of this study was to determine the inter-method reliability and concurrent validity of the written administration of the three subjective health literacy questions of the Short Literacy Survey (SLS). The Rapid Estimate of Adult Literacy in Medicine (REALM) and the shortened Test of Functional Health Literacy in Adults (S-TOFHLA) were the reference measures of health literacy. 299 participants (52±13 years old, 56% female, 67% white) completed the written and verbal administrations of the SLS June-December 2012. Inter-method reliability was demonstrated when: a) the written (median=14, IQR: 12–15) and verbal SLS (median=14, IQR: 11–15) did not differ (Wilcoxon signed rank test, $p=0.085$); and b) written and verbal scores were highly correlated (Spearman's $\rho=0.788$, $p<0.001$). The written items were internally consistent (Cronbach's $\alpha=0.733$). The written total score successfully identified persons with 6th grade equivalent for literacy on the REALM (AUROC = 0.753) and inadequate literacy on the S-TOFHLA (AUROC = 0.869). The written administration of the SLS is reliable, valid, and is effective in identifying persons with limited health literacy.

Keywords

health literacy; renal disease; survey research; scale development; validation

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CONFLICT OF INTEREST

The authors have no conflicts of interest.

INTRODUCTION

The concept of health literacy, the ability to understand health-related information, is an integral component of a patient's success in managing disease, providing self-care, and ultimately in improving their health (Berkman, Davis, & McCormack, 2010). In the United States, an estimated 90 million people have low general literacy and nearly 36% of adults exhibit low *health* literacy (Kutner, Greenberg, Jin, & Paulsen, 2006). Targeted interventions to increase health literacy may improve patient care, increase healthcare system efficiency, decrease costs, and ultimately improve patient outcomes (Villaire & Mayer, 2009).

Inadequate health literacy is prevalent among persons with hypertension and diabetes (Williams, Baker, Parker, & Nurss, 1998), conditions that often lead to kidney disease. Similar to other chronic diseases, kidney transplant candidates and recipients must manage the complexities of a multifaceted and dynamic system of medical care that includes: medication compliance, regular physician visits, early rejection symptom recognition, and laboratory monitoring. Despite the intensity and frequency of kidney transplant patients' engagement with the healthcare system, little is known about their health literacy (Devraj & Gordon, 2009).

Health literacy is commonly assessed using validated measures that focus on word recognition and reading comprehension. The Rapid Estimate of Adult Literacy in Medicine (REALM) is a list of 66 words that are graded on correct pronunciation when read aloud by participants, therefore requiring interviewer administration (Davis et al., 1991). The Test of Functional Health Literacy in Adults (TOFHLA) is a 22-minute fill-in-the-blank measure of reading comprehension. The shortened form, the S-TOFHLA, requires up to seven minutes to complete (Parker, Baker, Williams, & Nurss, 1995). These assessments of health literacy have limited applicability in routine clinical use due to the length of time for administration. Additionally, they are cumbersome and expensive because they are typically administered in person by paid research personnel.

Due to an increased interest in screening for limited health literacy in the clinical setting, three brief screening questions called the Short Literacy Survey (SLS) were developed and validated (Chew, Bradley, & Boyko, 2004). The SLS was validated in relation to the S-TOFHLA, and has been effective in identifying patients of low health literacy in both general medicine and surgical clinics (Chew, Bradley, Flum, Cornia, & Koepsell, 2004; Chew, et al., 2008; Peterson et al., 2011; Wallace et al., 2007; Wallace, Rogers, & Weiss, 2008). The initial development and validation of the SLS with the S-TOFHLA required verbal administration of the questions (Bass, Wilson, & Griffith, 2003; Chew, Bradley, & Boyko, 2004). Although the SLS has previously been administered in a written format, there have been no reports of its performance when directly compared to verbal administration (McNaughton, Collins, & Kripalani, 2011; Peterson, et al., 2011). While there is concern that patients with limited literacy may have difficulty completing a written health literacy scale (McNaughton, Collins, et al., 2011), the resource advantages of written, self-administered screening questions warrant their investigation and potential use.

This aim of this study was to validate the written administration of the SLS among patients being evaluated for kidney transplantation and their healthy caregivers at a single transplant center. We hypothesized that the written administration of the SLS would be effective in identifying patients and caregivers with limited health literacy, and that it would compare favorably to the survey's verbal administration.

METHODS

The study cohort consisted of a convenience sample of patients and caregivers who were recruited at the time of initial evaluation for kidney transplantation at a single center between June and December of 2012. Potential participants were approached in a group setting at the time of the kidney transplantation education session. At our transplant center, adult caregivers are required to attend this session, which lasts approximately 1.5 hours and occurs at the beginning of the evaluation daylong process between 7:30 and 9:00 in the morning. Between two and sixteen patients and caregivers were present on a given day. Patients and caregivers were approached at the conclusion of the education session with information about the study and were offered the opportunity to participate. Those willing to participate underwent the informed consent process. Patients had a rigorous schedule of appointments on the evaluation day that included the education session, a physician visit, chest x-ray, lab-work, meeting with a financial counselor and an appointment with a social worker. For this reason, study-related activities were conducted at a time that was convenient for the participants.

Participants were interviewed by a single research investigator in private offices at the transplant center or in the general surgery or general medicine clinics. All participants were interviewed individually and were alone in the room with the interviewer. Due to the considerable time constraints of the evaluation day, the order of the interview (whether the patient or caregiver was interviewed first) and the order in which participants completed the written and verbal questionnaires varied unsystematically and according to convenience. In most instances, while one member of the pair was being interviewed, the other was completing the written survey material. Occasionally both members of the pair completed the written material prior to the interview. The order of completion of written surveys and the interview process was recorded for all but five participants. The order of verbal administration of the three surveys was consistent in every interview, with the REALM being completed first followed by the verbally administered version of the SLS and the S-TOFHLA. The packet of written surveys included a demographic questionnaire and the written SLS. Completion of written surveys took approximately 15 minutes and the total time for the entire study was approximately 30 minutes. The REDCap secure online data management resource was used for data storage.

Participants

All adult English-speaking patients being evaluated for kidney transplantation and caregivers age 18 years or older were eligible to participate. Participants were not compensated. This study was approved by the Institutional Review Board and all participants provided written informed consent.

Main Measures

The following three SLS items were administered in the same order to all participants in both the written and verbal formats. The three questions were: 1) “How often do you have someone help you read hospital materials?”; 2) “How confident are you filling out medical forms by yourself?”; and 3) “How often do you have problems learning about your medical condition because of difficulty understanding written information?” (Chew, Bradley, & Boyko, 2004). For questions 1 and 3 the 5-point Likert scale answers were: “all of the time; most of the time; some of the time; a little of the time; none of the time.” The answer “always” was assigned a value of 1 and “never” was assigned a value of 5. The response options for question 2 were: “extremely; quite a bit; somewhat; a little bit; not at all.” This item was reversed scored with “extremely” being assigned a value of 5 and “not at all” a value of 1. The answers to the three questions were summed to determine the continuous SLS total score, which ranged from 3 to 15. A lower score indicated lower health literacy.

Each participant’s health literacy was assessed with the REALM and the S-TOFHLA by trained study personnel. Both the REALM and S-TOFHLA were scored on a continuous scale and categorical scale based on the original publication of each scale (Baker, Williams, Parker, Gazmararian, & Nurss, 1999; Davis, et al., 1991; Parker, et al., 1995). The REALM was scored on both continuous (range 0–66) and ordinal scales (three grade range equivalent levels: 6th grade or below (0–44), 7th–8th grade (45–60), high school (61–66)) (Davis, et al., 1991). The S-TOFHLA was also scored on both a continuous (range 0–36) and ordinal scale (three levels: Inadequate (continuous score 0–16), Marginal (17–22), Adequate (23–36)) (Baker, et al., 1999; Parker, et al., 1995). The REALM and S-TOFHLA classifications used by Chew et al. in the original validation of the verbal SLS were used for validation of the written administration of the SLS in this study (Chew, Bradley, & Boyko, 2004; Chew, et al., 2008). Inadequate health literacy was defined as a continuous score of 0–16 (inadequate) for the S-TOFHLA and the continuous score of 0–44 (6th grade or below) for the REALM.

Participant Characteristics

Participant characteristics were collected by direct report and included: age, sex, race, ethnicity, educational attainment, employment status, and estimated annual household income. Income was classified as six categories using the 2011 U.S. Census Bureau data quintiles plus the top 5% income stratum.

Analysis

Statistical analyses were performed using STATA® v. 12.1, College Station, Texas and SPSS® Statistics v. 21, copyright IBM®. Demographic data of patients and caregivers were analyzed using t-tests and chi-squared tests. The distribution of health literacy scores was negatively skewed towards adequate health literacy; therefore the Wilcoxon rank-sum test was used to test the differences in the continuous health literacy scores between patients and caregivers. In order to address lack of randomization of order of administration, a secondary repeated measures analysis of variance was used to test whether the order (written/verbal or verbal/written) and role (patient or caregiver) were associated with the degree of agreement (paired difference) between verbal and written SLS total scores. The within-subjects effect of administration format reflected whether written and verbal scores differed significantly

(i.e., the degree of agreement). The score difference by order of administration and score difference by role interaction effects reflected whether the difference between written and verbal SLS total scores differed systematically on the basis of role and order of administration.

The inter-method reliability of the two SLS administration methods was determined in the total sample by testing: a) the difference between written and verbally administered SLS scores, and b) the strength of the association between the two administration methods. The Wilcoxon signed rank test was used to test whether continuous scores differed by administration method, with a small difference that was not statistically significant being interpreted as evidence of reliability. Associations between written and verbal total scores (reliability coefficients) were expressed as Spearman's correlation coefficient, with both statistical significance and the magnitude of the coefficient providing complementary evidence of reliability. The overall internal consistency reliability of the verbal and written SLS total scores was tested using Cronbach's alpha and the alpha to remove statistic was inspected to assess the impact of deleting any item.

Concurrent validity of the written SLS total scores in relation to the REALM and S-TOFHLA was expressed as validity coefficients (Spearman's rho). The area under receiver operating characteristic (AUROC) curve analysis was used to test the predictive ability of the written SLS total score to identify the participants categorized as having a REALM score 6th grade and a S-TOFHLA score of inadequate.

Sample Size and Power Calculations

Reliability and validity coefficients, when statistically significant, were interpreted on the basis of their magnitude. It was expected that the inter-method reliability of written and verbal SLS scores would be statistically significant and high ($r \geq 0.70$). Power computations were based on sample size requirements for patients and caregivers separately. One hundred participants were required to detect a small minimum effect of administration method on continuous SLS scores (average within-subjects difference = 0.2 SD, non-directional $\alpha = 0.05$) with power of 80% for a paired test. Additionally, it was anticipated that validity coefficients would be modest, with values greater than or equal to 0.25 (a moderate effect). Approximately 120 participants in each of the two groups would provide adequate power to detect a moderate correlation at the 0.05 alpha level within each participant group (power = 80%) and in the combined sample (power = 98%).

RESULTS

Two hundred eighty-six pairs of patients and caregivers (572 potential participants) were approached at the time of kidney transplant evaluation from June to December 2012 and 332 (58%) consented to participate. Of those that consented, a total of 33 participants were excluded due to vision problems ($n=4$), scheduling difficulties ($n=12$) or incomplete data ($n=17$). A total of 299 participants (148 patients and 151 caregivers) who completed the written and verbal version of the SLS and at least one of the reference measures of health literacy were included in the analysis (Figure 1). Basic demographic data of those who declined to participate is not available. However, the demographic characteristics current

sample is comparable to those reported in other clinics at our medical center (Wallston et al., 2014). Imputation of missing data was not attempted because missing rates were low due to the participants having completed the assessments with study personnel present. The basic demographic characteristics and available health literacy measures among those who did not have complete data on core measures did not differ from those with complete data.

The study sample was predominantly white (67%) and female (56%). A higher proportion of caregivers were female when compared to the patient sample ($p<0.001$). Employment status also varied between patients and caregivers, with patients being more likely to be disabled ($p<0.001$). The majority of participants (68%) completed the written version of the SLS first (Table 1). Repeated measures analysis of variance ($n=294$) demonstrated that the mean difference between written and verbal SLS total scores (estimated difference 0.2 points, 95% CI -0.381 to 0.780 , $p=0.248$, $F=1.339$, all effects with 1 and 291 degrees of freedom) was not related to role (role by difference interaction effect $p=0.735$, $F=0.114$) or order of administration (order by difference interaction effect $p=0.359$, $F=0.842$). Therefore, the remainder of the analyses was conducted using pooled data.

Inter-Method Reliability

The data were not normally distributed, with the majority of persons having adequate health literacy. Median written ([14, IQR=3 (12–15)] and verbal [median=14, IQR=4 (11–15)] SLS total scores did not differ (Wilcoxon test $p=0.085$). The written and verbal SLS scores were also highly correlated (Spearman's $\rho=0.788$, $p<0.001$).

Internal Consistency Reliability

The written SLS score had high internal consistency reliability (Cronbach's $\alpha = 0.733$), which was similar to that of the SLS verbal score (Cronbach's $\alpha = 0.794$). Deleting any one of the three items resulted in a reduction in internal consistency reliability, with alphas if items were removed ranging from 0.639 to 0.656 for written administration and from 0.694 to 0.763 for verbal administration.

Concurrent Validity

The concurrent validity of the written SLS was determined in relation to the REALM and S-TOFHLA (Spearman's ρ 0.297 and 0.250 respectively). Similarly, the written SLS total score correctly identified patients with a REALM score of 6th grade equivalent ($n=23$, 8%) (AUROC = 0.753) and participants with S-TOFHLA score of inadequate or 16 ($n=12$, 4%) (AUROC = 0.869).

Predictive Validity: Areas under the Receiver Operating Characteristic Curve

The AUROC for each question was also determined (Figures 2–3, Table 2). The AUROCs of the total written SLS score were comparable to the total verbal SLS score (Figures 4–5, Table 2).

DISCUSSION

In summary, written administration of the SLS is reliable and valid, as demonstrated in this sample of kidney transplant patients and their healthy caregivers. The written SLS is internally consistent. Each of the three questions contributes to the effectiveness of the total score as a screening measure of limited health literacy.

This study was initially powered to assess the reliability and validity of written versus verbal administration of the SLS separately in the patients and caregivers. After the initial repeated measures analysis of variance demonstrated no significant effect of role (either patient or caregiver) on the difference between written and verbal scores, data from all participants were pooled for the remainder of the analyses. This approach increased the generalizability of findings to both kidney transplant candidates and healthy adults and resulted in an ability to detect very small differences between the written and verbal administration methods.

In testing inter-method reliability, a Spearman's rho or correlation coefficient of > 0.700 indicates a high level of correlation. In this participant population, the continuous SLS written and verbal scores were highly correlated (Spearman's rho = 0.788, $p < 0.001$). Our findings with respect to the concurrent validity of the written administration of the SLS are consistent with prior work in health literacy. McNaughton et al. validated the verbally administered SLS in an emergency room setting and reported validity coefficients between the SLS, and the REALM (Spearman's rho = 0.26) and S-TOFHLA (Spearman's rho = 0.33) (McNaughton, Wallston, Rothman, Marcovitz, & Storrow, 2011). Similar concurrent validity coefficients were observed in our participants completing the written SLS (REALM rho = 0.297; S-TOFHLA rho = 0.250).

The results of the AUROC were comparable to findings from the original SLS comparison to the S-TOFHLA. In the initial validation of the verbal administration of the SLS in English, each of the three questions had correctly identified an inadequate literacy score on the S-TOFHLA (score ≤ 16) with an AUROC ranging from 0.76 – 0.80 (Chew, Bradley, & Boyko, 2004). This is similar to our written total score area under the AUROC of 0.869, and the AUROC of individual questions of the written administration of the SLS in our study (range 0.73 – 0.83). In a validation study of the Spanish administration of the SLS, the AUROCs of each question were also similar to those observed in our study (range 0.65–0.76) (Sarkar, Schillinger, Lopez, & Sudore, 2011).

In other areas of medicine, surveys designed for verbal administration have been also validated for written administration and vice versa. In psychology, the written Trail Making Test was validated in an oral format to avoid influence of potential psychomotor difficulties that might skew written results (Mrazik, Millis, & Drane, 2010). A screening test for symptoms of eating disorders known as the SCOFF was validated in written format with the intention of use for screening in an occupational health or more widespread distribution (Perry et al., 2002). Our validation of the written SLS may encourage earlier and more comprehensive health literacy screening.

There are some inherent limitations to this study. First, performing the written and verbal administrations of the SLS in close temporal proximity increased the risk of test/re-test

recall bias. Ideally, participants would have been randomized to the order of administration, but this was not possible due to the practical constraints presented by the tight schedule of the transplantation evaluation process. However, the order of written and verbal SLS administration was recorded and its effect was not statistically significant.

A second limitation, as with any cohort study, is the possibility of a participation bias. The demographic characteristics of persons who were approached but declined to participate are not available for the purpose of this study. This could limit the generalizability of the results if reliability and validity were to be related to demographic characteristics. Those who chose not to participate may have had a higher rate of limited literacy. However, the proportion of participants with limited literacy in our sample is consistent with the proportion of limited health literacy at this center's diverse outpatient clinics (Wallston, et al., 2014), and is consistent with a prior study of kidney transplant recipients in which only 9% of transplant recipients had limited literacy (Gordon & Wolf, 2009). Our patient sample's racial characteristics are consistent with that of the transplant center patient population, which supports our sample's representativeness. While this study was limited to potential kidney transplant candidates, we expect that the results of this study can be generalized to other solid organ transplant patients. Additionally, inclusion of the caregivers increases the applicability of the results to the general population. Further research is needed to describe the relationship between health literacy, listing for kidney transplantation, post-transplant outcomes and living donation (Kazley, Simpson, Chavin, & Baliga, 2012).

CONCLUSION

In conclusion, this study validated the written administration of a survey designed to evaluate health literacy, which increases the circumstances of its use and may allow for earlier identification of patients with limited health literacy. In patients undergoing evaluation for kidney transplantation, identification of limited candidates with limited health literacy may allow for targeted interventions and assistance in the early stages of the evaluation and transplantation process. Furthermore, the inclusion of caregivers in this validation study supports the reliability and validity of the written administration of the SLS in more general populations.

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Figure 1.

Enrollment chart of study participants and diagram of study procedures. Fifty-eight percent of persons approached were enrolled in the study.

Figure 2.

Area under receiver operator characteristic curve (AUROC) for the three written SLS questions individually (dashed lines) and written SLS total score (solid line) predicting a) REALM score less than or equal to 6th grade (REALM score 0–44) and b) inadequate S-TOFHLA score (score 0–16).

Figure 3.

The area under receiver operator characteristic curve (AUROC) for the total written SLS (dashed line) and AUROC for the total verbal SLS (solid line) predicting a) REALM score less than or equal to 6th grade (REALM score 0–44) and b) inadequate S-TOFHLA score (score 0–16).

Table 1

Demographic characteristics of the cohort.

Variables n (%)	Total (n=299)	Patients (n = 148)	Caregivers (n = 151)	p-value
Age - Mean (SD)	52 (±13)	53 (±13)	52 (±12)	p = 0.817
Female	168 (56%)	67 (45%)	101 (67%)	p < 0.001
White	199 (67%)	98 (66%)	101 (67%)	p = 0.676
<u>Employment</u>				
Full time	113 (38%)	33 (22%)	80 (53%)	p < 0.001
Part time	23 (8%)	11 (7%)	12 (8%)	
Retired	43 (14%)	24 (16%)	19 (13%)	
Disabled	60 (20%)	51 (34%)	9 (6%)	
Unemployed	56 (19%)	28 (19%)	28 (19%)	
Other	4 (1%)	1 (1%)	3 (2%)	
<u>Education</u>				
Middle (6–8)	3 (1%)	3 (2%)	0 (0%)	p = 0.357
High (9–12)	84 (28%)	40 (27%)	44 (29%)	
Any College	184 (62%)	91 (61%)	93 (62%)	
Post-graduate	27 (9%)	14 (9%)	13 (9%)	
<u>Income</u>				
<\$20,000	61 (22%)	41 (29%)	20 (14%)	p=0.035
\$20,000 – \$39,000	78 (28%)	33 (24%)	45 (32%)	
\$40,000 – \$59,000	64 (23%)	31 (22%)	33 (23%)	
\$60,000 – \$99,000	46 (16%)	19 (14%)	27 (19%)	
\$100,000 – \$179,000	26 (9%)	14 (10%)	12 (8%)	
\$180,000	7 (2%)	2 (1%)	5 (4%)	
<u>Verbal SLS Administered First</u>	92 (31%)	46 (32%)	46 (31%)	p=0.937
<u>Health Literacy – Median (IQR)</u>				
Written SLS	14 (12–15)	14 (11–15)	14 (12–15)	p=0.261
Verbal SLS	14 (11–15)	13 (11–15)	14 (12–15)	p=0.100
REALM	64 (59–65)	64 (59–65)	64 (59–65)	p=0.716
S-TOFHLA	35 (33–36)	35 (33–35)	35 (34–36)	p=0.065

Table 2

AUROC and confidence intervals for the individual questions and total written and verbal scores when predicting REALM 6th grade and S-TOFHLA = inadequate.

<i>AUROC (CI)</i>	REALM 6th grade	S-TOFHLA Inadequate
<i>Written</i>		
1. Completing medical forms	0.740 (0.627 – 0.853)	0.817 (0.668 – 0.967)
2. Reading hospital materials	0.735 (0.620 – 0.849)	0.833 (0.715 – 0.952)
3. Understanding written information	0.639 (0.504 – 0.773)	0.726 (0.545 – 0.906)
Written Total Score	0.753 (0.637 – 0.870)	0.896 (0.760 – 0.979)
<i>Verbal</i>		
1. Completing medical forms	0.764 (0.661 – 0.868)	0.779 (0.636 – 0.922)
2. Reading hospital materials	0.742 (0.637 – 0.848)	0.781 (0.633 – 0.929)
3. Understanding written information	0.748 (0.646 – 0.850)	0.729 (0.569 – 0.889)
Verbal Total Score	0.792 (0.697 – 0.886)	0.799 (0.649 – 0.949)
<i>All p < 0.01</i>		