Applied Nursing Research 46 (2019) 50–56

Contents lists available at ScienceDirect

Applied Nursing Research

journal homepage: www.elsevier.com/locate/apnr

Concurrent validity and acceptability of health literacy measures of adults hospitalized with heart failure

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ARTICLE INFO

Keywords:
Health literacy
Health literacy measurement
Heart failure
STOFHLA
Newest vital sign
Literacy screener
Acceptability

ABSTRACT

Objectives: To test concurrent validity and acceptability of the Single Item Literacy Screener (SILS), Test of Functional Health Literacy (S-TOFHLA) and the Newest Vital Sign (NVS) in hospitalized adults with heart failure (HF).

Background: Health literacy is not routinely evaluated in adults hospitalized with HF. Low health literacy is linked to poor HF self-care and hospital readmissions.

Methods: SILS, NVS and S-TOFHLA were completed by 85 patients with HF. Measures were examined for internal consistency reliability and acceptability. The NVS and S-TOFHLA were correlated with the SILS to establish concurrent validity.

Results: The NVS ($\alpha = 0.70$) and S-TOFHLA ($\alpha = 0.88$) were reliable. The SILS significantly correlated with the S-TOFHLA ($r = -0.308$). The S-TOFHLA ($M = 6.16$) and NVS ($M = 6.10$) were acceptable measures.

Conclusion: The S-TOFHLA and NVS were reliable and acceptable measures of health literacy in hospitalized HF population. The SILS correlated with the S-TOFHLA and may predict low health literacy when hospitalized. NVS total scores in this population aligned with the recent NAAL survey. Hospitalized adults with HF agreed to share the health literacy scores with their providers.

1. Introduction

Heart failure (HF) is a predominant diagnosis with approximately 6.5 million afflicted in the United States alone and projected to increase by 46% by 2030 (American Heart Association, 2018). The cost of HF in 2012 was $30.7 billion and predicted to reach $69.8 billion by 2030, despite national efforts to curtail expenses (American Heart Association, 2018; Heidenreich et al., 2013). A considerable portion of HF expenditure is for emergency department visits and readmissions to acute care hospitals within 30 days of hospitalization (Bennett et al., 2005; Hernandez et al., 2010, Calvillo-King et al. (2013). These visits are often attributed to difficulties in performing adequate HF self-care behaviors (Riegel et al., 2009; Riegel, Jaarsma, & Stromberg, 2012). Health literacy is one factor linked to poor self-care (Lee, Arozullah, & Cho, 2004; Van der Vaart et al., 2012; Westlake, Sethares, & Davidson, 2013).

Health literacy is the capacity to obtain, process and understand health information and services needed to make appropriate health decisions (Institution of Medicine, 2004). Although research shows that illness and hospitalization can greatly impact health literacy and the comprehension of HF education necessary to sustain self-care in the community (Evangelista et al., 2010), health literacy is not routinely assessed. Measuring health literacy during hospitalization may contribute to a more accurate measure of capacity for HF self-care education prior to discharge home. Identification of a feasible measure of health literacy for those hospitalized with HF may contribute to patient-centered, tailored education that proves more cost–effective and focuses on improving patient outcomes following an acute HF exacerbation.

In 2012, in an effort to reduce costly readmission rates, the Centers for Medicare and Medicaid Services introduced the *Readmissions Reduction Program*, directing new reimbursement policies that include decreasing payments to hospitals for HF readmissions (CMMS;, 2013). Subsequently, healthcare system and provider focused interventions addressing discharge enhanced the transition home for some p (Coleman, Parry, Charmers, & Min, 2006; Jack et al., 2009; Naylor et al., 2004), however, the impact of individual patient characteristics on HF self-care education following urgent care and hospitalization

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https://doi.org/10.1016/j.apnr.2019.02.007
Received 12 October 2018; Received in revised form 28 December 2018; Accepted 10 February 2019

remains a poorly understood component in the HF readmission equation. Current research reports 55.4% of patients with HF are discharged home without post-acute care services following hospitalization (Dolansky et al., 2010). Therefore, many patients with HF are expected to perform highly complex, HF self-care behaviors without the support of post-acute care services (Riegel et al., 2009; Riegel, Lee, & Dickson, 2011). Non-adherence to HF self-care can significantly contribute to HF urgent care and hospital readmission (Hope, Wu, Tu, Young, & Murray, 2004; Murray et al., 2009; Paul, 2008) and in several studies, self-care adherence to the prescribed HF regimen was associated with reduced all-cause mortality and decreased hospital readmissions (Baker et al., 2007; Ditewig, Blok, Havers, & van Veenendaal, 2010; Jovicic, Holroyd-Leduc, & Strauss, 2006; Koelling, Johnson, Cody, & Aaronson, 2005; McAlister, Stewart, Ferrua, & McMurray, 2004; Riegel et al., 2011; van der Wal, van Veldhuisen, Veeger, Rutten, & Jaarsma, 2010).

2. Health literacy

A number of national organizations provide guidelines for consistent HF education to prevent readmission and improve outcomes but fail to include health literacy measurement as a component of discharge education (Hunt et al., 2009; Francis et al., 2010; Paul, 2008). Patient understanding, retention and ability to make adequate decisions using HF self-care knowledge is variable depending on individual patient characteristics (Riegel et al., 2012). A major characteristic contributing to effective knowledge of HF self-care is health literacy (Evangelista et al., 2010; Riegel et al., 2009).

Health literacy is a broad concept encompassing various skills including reading comprehension such as locating and interpreting information in documents (print literacy); basic numerical knowledge such as interpreting food labels, trending body weight, and following prescription labels (numeracy); and listening, speaking and decision making (oral literacy) (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). Health literacy impacts successful navigation of complex healthcare systems and communication with multiple healthcare providers. The widespread prevalence of low health literacy was reported in the most recent national survey entitled *National Assessment of Adult Literacy* (NAAL). Although the majority of Americans scored within the *intermediate* health literacy range, 43% of the population, approximately 75 million adults, scored at *basic and below basic* health literacy levels. The NAAL report further indicated those with lower health literacy scores were predominantly male, were over 65 years of age, completed less formal education, and had Medicare, Medicaid, or no health insurance (Kutner, Greenberg, Jin, & Paulsen, 2006).

Clinicians in hospital-based settings have a key role in assessing patient knowledge and skills needed to successfully manage self-care and health outcomes following hospital discharge (Baur, 2011). A gap exists in the literature documenting clinician appraisal of health literacy, knowledge of strategies to improve health literacy, and tailoring discharge teaching to patient health literacy level. Although various instruments measuring health literacy appear in the literature, many are quite lengthy for clinical settings, present significant patient and provider burden, and lack data supporting usage across patient populations and settings (Johnson & Weiss, 2008; Mancuso, 2009; Shaw, Armin, Torres, Orzech, & Vivian, 2012). Many health literacy measurements narrowly estimate single domains of health literacy, including the well published, *Rapid Estimate of Adult Literacy in Medicine* (REALM), which measures only reading ability. Few measurements incorporate other aspects contributing to health literacy, including listening, decision making, and numeracy (the ability to use and understand numbers), important for successful behaviors necessary in HF self-care (Moser et al., 2012; Riegel et al., 2011).

Numerous health literacy measures are available in the literature; however, few agree on the criteria for selecting appropriate measures for specific groups such as HF populations (Powers, Trinh, & Bosworth, 2010). For the purpose of this study, the *Short Test of Functional Health literacy in Adults (S-TOFHLA) (Brief)*, the most often studied measure, the Newest Vital Sign (NVS) a relatively new instrument which examines nutrition labels, and Single Item Literacy Screener (SILS) will be used. The measures were selected based on their established psychometric properties and broader definition of health literacy, including reading and numeracy domains. The SILS was included to compare its efficacy and concurrent validity with the NVS and the S-TOFHLA in identifying risk for low health literacy. The aim of this study was to evaluate the acceptability of two valid and reliable health literacy measures: the NVS, the S-TOFHLA and concurrent validity with the SILS in community dwelling adults hospitalized with HF.

3. Methods

3.1. Study design and subjects

This cross-sectional study tested the internal consistency reliability and acceptability of the S-TOFHLA and NVS, and established concurrent validity with the SILS for measuring health literacy in 85 hospitalized adults diagnosed with HF from three non-teaching, community hospitals in the northeast. All patients were > 18 years of age, screened for sensory impairment by the Snellen chart for vision and Hearing Handicap Inventory for the Elderly-Screening version (HHIE-S) for hearing difficulty (Nondahl et al., 1997), dementia, and depression. The HF diagnosis was verified by the Framingham Diagnostic Criteria (McKee, Castelli, McNamara, & Kannel, 1971) prior to data collection. Participants were excluded from the study if unable to read English, failed sensory screening (unable to read Snellen chart with correction and scored below 8 on the HHIE-S), had an active mental illness including acute delirium and dementia, or currently resided in long-term care. Informed consent and data collection were completed in one 45-min interview. The study was approved by the university and hospital IRB committees and patients provided written informed consent in addition to participating in *teach-back* method to verify patient understanding of study (Kripalani, Bengtzen, Henderson, & Jacobson, 2008).

3.2. Measurements

Age, gender, ethnicity, education level, marital status, and socioeconomic status were obtained by interview. Depression and dementia risk were evaluated using the PHQ2 (Kroenke, Spitzer, & Williams, 2003) and the Mini Cog (Borson, Scanlan, Brush, Vitallano, & Dokmak, 2000) tests respectively. HF diagnostic criteria and comorbid disease was verified by an IRB approved patient medical record review.

3.2.1. Short test of functional health literacy

The S-TOFHLA, is a shortened version of the TOFHLA. The S-TOFHLA has a self-administered reading component consisting of two passages followed by 36 questions and four interviewer-administered numeracy items. It uses a *cloze* procedure in which every fifth to seventh word in the passage is omitted and the participant selects a response for the missing word. The raw scores of the S-TOFHLA (0–100 points) are converted into three categories: *inadequate* (0–53 points), *marginal* (54–66 points), and *adequate* health literacy (67–100 points) (Baker, Williams, Parker, Gazmararian, & Nurss, 1999).

The reliability coefficient for the S-TOFHLA is reported to be $\alpha = 0.98$ for all items combined (Baker et al., 2002). The reading component of the S-TOFHLA correlates highly with the widely used Reading Estimate of Adult Literacy in Medicine (REALM) (Spearman co-efficient = 0.81). The numeracy component of the S-TOFHLA correlates moderately with the REALM (Spearman coefficient = 0.61), which is expected, the REALM does not contain numeracy components (Jordan, Osborne, & Buchbinder, 2011). The S-TOFHLA instrument takes < 10 min to administer, however, in this study participants received additional time to complete the instrument based on recommendations by Kirk et al. (2011) and Robinson et al. (2011). Both of these authors

recommend providing additional time for individuals with chronic illness due to high incompletion rates.

3.2.2. Newest vital sign

The Newest Vital Sign (NVS) is a screening measure of health literacy requiring participants to read and interpret numerical facts by reading a standard nutritional label (Weiss et al., 2005). The questions measure the participant's ability to make mathematical calculations, be mindful of certain ingredients that maybe potentially harmful, and make decisions based on the information provided on the nutrition label (Weiss et al., 2005).

Clinicians can administer the NVS in the clinical setting in approximately three minutes. The scoring of the instrument is based on six questions. A total score of 0–1 points suggests a *high likelihood of marginal/inadequate literacy*, 2–3 points suggests the *possibility of marginal/inadequate literacy*, and a score of 4–6 points *indicates adequate literacy*. The authors of the NVS (Weiss et al., 2005) reported acceptable reliability, with a Cronbach's alpha of 0.76 and good criterion validity when compared with the Test of Functional Health Literacy (TOFHLA), ($r = 0.59$, $p < .001$). The area under the ROC curve predicting TOFHLA scores was 0.88. The sensitivity and specificity for identifying low literacy in those with scores under 2 points (limited health literacy) were 72% and 87%, respectively. The NVS is moderately correlated with the S-TOFHLA ($r = 0.61$), a higher correlation than the REALM ($r = 0.41$), which requires no reading comprehension or numeracy components (Jordan et al., 2011), these studies were completed in outpatient settings.

3.2.3. Single-item literacy screener

The Single-item Literacy Screener is a brief instrument developed to identify limited reading ability. The SILS performed moderately well in primary care settings in adults (Morris, MacLean, Chew, & Littenberg, 2006). This item asks, "*How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacist?*" Responses range from 1 = *Never* to 5 = *Always*. The cutoff point of 2 captures all patients potentially requiring additional assistance understanding health related information (Cornett, 2009). Current literature reported the sensitivity for detecting limited reading ability as 54% and the specificity as 83%, with an area under the receiver operating curve (ROC) of 0.73% (Morris et al., 2006).

3.2.4. Acceptability

At the conclusion of the study, participants completed an appraisal of the NVS and the S-TOFHLA. The seven-question, author developed instrument surveyed the acceptability of each health literacy measure (Table 1). Participants answered "yes" or "no" to questions, and scores were summed to obtain instrument acceptability scores. The range of scores was 0–7, with 0 representing low acceptability and 7 high acceptability. Acceptability included items such as *the [test] questions were easy to answer*, *the [test] was too long*, and *I would be comfortable sharing the results with my provider*.

3.3. Statistical analysis

All quantitative data were analyzed using SPSS version 22.0 for Windows, p values of < 0.05 were considered statistically significant. Descriptive statistics were used to describe the patient characteristics, study variables and acceptability. To evaluate the internal consistency reliability of the NVS and S-TOFHLA, Cronbach's alpha coefficient was computed. To evaluate concurrent validity between the self-report SILS, with the S-TOFHLA and NVS, Pearson correlations were calculated and reported: the SILs with S-TOFHLA and SILs with NVS. The magnitude and significance of the correlation coefficient are reported. Participant acceptability of the NVS and S-TOFHLA measurements was measured using means and standard deviations of instrument evaluation items.

Table 1
Health literacy participant evaluation instrument.

	Yes	No
Newest Vital Sign		
1. Overall, it was a good tool.		
Newest Vital Sign Written Format		
2. I had no trouble understanding the NVS.		
3. The NVS was easy to read		
4. The questions in the NVS were easy to answer.		
5. I think the NVS was too long.		
6. I did not know what most of the questions meant.		
7. I would be comfortable sharing the results of this test with my provider.		
Other Comments:		
S-TOFHLA		
1. Overall, it was a good tool.		
S-TOFHLA Written Format		
2. I had no trouble understanding the S-TOFHLA.		
3. The S-TOFHLA was easy to read		
4. The questions in the S-TOFHLA were easy to answer.		
5. I think the S-TOFHLA was too long.		
6. I did not know what most of the questions meant.		
7. I would be comfortable sharing the results of this test with my provider.		
Comments:		

4. Results

The sample ($N = 85$) was predominantly male (67%), non-Hispanic white (95%), 76–90 years of age (48%), and resided alone (34%). Only 20% of the sample reported not completing high school and the rest completed high school or additional years of college and 21% reported having 'less than enough' means to meet their monthly expenses (Table 2). Fifty-two percent reported a hospitalization within 12 months and 64% hospitalized within the preceding 24 months. A

Table 2
Demographic characteristics of participants ($N = 85$).

Characteristic	*N*	%
Age (years)		
≤65	11	13
66–75	33	39
76–90	41	48
Ethnicity		
White Non-Hispanic	81	95
Portuguese	3	3.5
Primary Language		
English Primary Language	77	90
English Not Primary Language	8	10
Education Level		
< 8th Grade	6	7
Some High School	11	13
High School Graduate	36	42
Some College	16	19
College Graduate	16	19
Marital Status		
Single	8	9
Divorced	8	9
Married	46	54
Widowed	24	28
Household		
Lives Alone	29	34
Lives with 1 Person	37	44
Lives with 2 ≥	19	22
Socioeconomic Status		
Enough Means	61	72
More than Enough Means	6	7
Not Enough Means	18	21

Table 3
Heart failure characteristics of participants (N = 85).

Characteristic	*n*	%
Years with Heart Failure		
< 1 Year	26	31
13–24 Months	7	8
3–5 Years	7	8
> 5 Years	33	39
Unsure	12	14
New York Heart Association Classification		
Class I	2	2
Class II	24	28
Class III	46	54
Class IV	13	15
Ejection Fraction		
< 40 Systolic HF	33	39
> 40 Diastolic HF	40	48
Not Available	12	14
PHQ2-Depression Screen		
0–3	57	67
4–6	28	33

majority reported HF symptoms within NYHA Class III (54%) and Class IV (15%), and 49% reporting three or more comorbidities. Depression was evident with 33% of patients reporting depressive symptoms as measured with the PHQ2 within the past two weeks (Table 3).

Descriptive statistics of HL total scores on the SILS, NVS, and S-TOFHLA are reported in Table 4. On the SILS, 37% responded *always*, *often* and *sometimes* needing assistance in reading material from their doctor or pharmacist, suggesting inadequate health literacy using the SILS screening instrument. Similarly, 17% of the participants scored within the 0–1 range, suggesting *limited health literacy* when completing the NVS. Whereas, 8% of the participants scored within the *inadequate functional health literacy* level, 5% within the *marginal functional health literacy* level, and 87% in the *adequate functional health literacy* level using the S-TOFHLA instrument.

The Cronbach's alpha coefficient was computed to assess internal consistency reliability of the Newest Vital Sign and the S-TOFHLA. In this study, the Cronbach's alpha coefficients for the six-item Newest Vital Sign was $\alpha = 0.70$ and the 40 item S-TOFHLA (combined numeracy and prose items) was $\alpha = 0.88$ The reporting of reliability coefficients is inconsistent in the health literacy literature (Altin, Finke, Kautz-Freimuth, & Stock, 2014). Coefficient alphas in this study were acceptable and consistent with those reported by Peterson et al. (2011) and Robinson et al. (2011) in the HF population. Both the NVS and S-TOFHLA demonstrated adequate internal consistency reliability in the hospital setting. As expected, the instrument with more items, S-TOFHLA, had a higher level of reliability (Tavakol & Dennick, 2011).

Table 4
Health literacy measurement total scores.

Characteristic	*n*	%
Single-Item Literacy Screener:		
How often do you need to have someone help you read instructions or pamphlets, or other written material from your doctor or pharmacist?		
Always	6	7
Often	11	13
Sometimes	14	17
Rarely	15	18
Never	39	46
Newest Vital Sign Total Scores:		
0–1 Limited health literacy	13	17
2–3 Possible limited health literacy	32	38
4–6 Adequate health literacy	39	46
S-TOFHLA Total Scores:		
0–53 Inadequate Functional health literacy	7	8
54–66 Marginal Functional health literacy	4	5
67–100 Adequate Functional health literacy	74	87

Total scores from the screening instrument (SILs) underwent correlation testing to examine concurrent validity between the SILS and the multi-question measurements: the NVS and the S-TOFHLA. The SILS was found to be significantly and negatively correlated with the S-TOFHLA ($r = -0.308$, $p = .004$) but not significantly correlated with the NVS ($r = -0.186$, $p = .089$). Negative correlations are expected due to the fact that higher scores on the SILs suggest lower levels of health literacy.

At the conclusion of the study, each participant completed an appraisal of the NVS and the S-TOFHLA. No acceptability scores were obtained on the SILS in this study because of its ease of use and minimal patient burden. The mean acceptability scores for the S-TOFHLA ($M = 6.16$, $SD = 1.27$) and the NVS ($M = 6.10$, $SD = 1.30$) were highly comparable.

5. Discussion

Although racially homogeneous, this sample of patient with HF were demographically similar to those conducted in hospital settings targeting other medical diagnoses (Baker et al., 2002; Mitchell, Sadikova, Jack, & Paasche-Orlow, 2012; Morris, Grant, Repp, MacLean, & Littenberg, 2011), however, this sample was better educated and reported higher incomes than previously studied urban populations, which may explain the higher literacy levels on the S-TOFHLA requiring mainly reading skill.

In this sample of hospitalized patients, 39% were hospitalized within 24 months and 31% within 12 months following a hospital discharge; these findings are consistent with national HF readmission rates (Medicare Payment Advisory Commission, 2008). Similarly, a majority of the sample reported severity of HF symptoms within NYHA Class III (54%) and Class IV (15%), and 49% reporting greater than three or more comorbidities which complicates discharge education and disease management in the community. In addition, depression was evident with 33% of patients reporting depressive symptoms which further impacts ability to comprehend and perform adequate HF self-care at home (Riegel et al., 2011).

6. Health literacy scores

6.1. S-TOFHLA

Health literacy scores measured using the S-TOFHLA were high, with only 8% of the sample in the *inadequate health literacy* level and 5% in the *marginal health literacy* level (Table 4). These total scores are significantly different from health literacy scores reported in one study where up to 60% of inpatients were classified as having *limited health literacy* using the S-TOFHLA (Morris et al., 2011). These findings indicate higher S-TOFHLA scores than those reported in the literature, where the prevalence of low health literacy averaged 39% in a systematic review of studies of adults with HF (Cajita, Cajita, & Han, 2015). Although education, primary language, and ethnicity were similar in both study populations, Morris et al. (2011) did not measure cognition and vision, which could subsequently increase the number of participants with limited health literacy. The extended time given to complete the health literacy measurements in this study might have created a ceiling effect with a clustering of higher scores, specifically in the S-TOFHLA total scores.

6.2. NVS

When health literacy was measured using the NVS, a numeracy-based screening instrument, 17% had *limited health literacy* and 38% had *possible limited health literacy* (Table 4). These findings were more consistent with literacy levels previously reported in hospitalized adults measured by the S-TOFHLA (Morris et al., 2011),In comparing the total

scores between the S-TOFHLA and the NVS, the NVS scores were lower as expected with a screening instrument, indicating that these well-educated, patients with HF had difficulty with the HL instrument (NVS) requiring substantial mathematical computation. HF self-care including medication management, sodium restrictions and weight management require numerical literacy to adequately perform HF self-care.

7. Reliability of health literacy measures

Although most patients with HF enter the hospital with acute symptoms and multiple comorbidities, the S-TOFHLA and the NVS were both reliable measures in this setting ($\alpha = 0.88$ and $\alpha = 0.70$, respectively). The Cronbach alpha coefficient should be greater than or equal to 0.70 (Polit & Beck, 2012). In this study, the NVS Cronbach alpha was 0.70. This finding is comparable to a previous report of a Cronbach's alpha of 0.76 (Osborn et al., 2007). Instruments with fewer than 10 items often have lower Cronbach values; however, this six-item measurement demonstrated acceptable internal consistency reliability in this population and setting.

The Cronbach alpha for the numeracy and prose items of the S-TOFHLA was 0.88. This value was consistent with previously reported reliability coefficient of 0.98 (Baker et al., 2002) from out-patient settings. The difference in reliability scores may be reflective of the population and in-patient setting; 69% reported symptoms consistent with the NYHA Class III and IV, 83% reported multiple comorbidities, and 52% were hospitalized within the previous 12 months.

Both measurements supported internal consistency reliability, with the S-TOFHLA supporting the higher level of reliability. Acceptable reliability is important; the instruments include both numeracy literacy and reading literacy items, both necessary to perform the successful HF self-care that requires active HF symptom monitoring and management (Riegel et al., 2009). The health literacy measurement literature is dominated by studies investigating single-domain (reading) health literacy measurements (Altin et al., 2014). More research is warranted to investigate the reliability of measures that include multiple health literacy domains.

8. Concurrent validity of health literacy measures

8.1. SILS and S-TOFHLA

The SILS was negatively correlated with the S-TOFHLA ($r = -0.308$, $p = .004$), a negative correlation implies the presence of a conceptual relationship between the measures and supports their synergy in assessing health literacy in hospitalized patients with HF. This study included both subjective and objective measures of health literacy in the acute hospital setting. Current research recommends a multi-dimensional approach to health literacy evaluation (Altin et al., 2014).

8.2. SILS and NVS

The SILS and the NVS were not significantly correlated ($r = 0.186$, $p = -0.089$), in part because they evaluate different health literacy domains. However, the use of the NVS in this clinical setting remains an option for further inquiry considering the importance of numeracy literacy in this population. The findings in this study supported the concurrent validity.

of using the SILS to screen for limited health literacy that may require further measurement with an objective, task-oriented measure such as the S-TOFHLA or the NVS in hospitalized patients. Understanding the relationship between a single-item, health literacy screener and multi-item measurements in hospitalized adults adds to the science of health literacy. Over time, the concept of health literacy as multi-dimensional and dynamic, warrants a more comprehensive measurement including multiple instruments to capture all aspects of health literacy (Altin et al., 2014).

Incorporating the SILS into the admission assessment for patients with HF would provide a rapid screen of health literacy. High scores on the SILS suggests low literacy levels and determines which patients are at risk and require tailored HF education. Consequently, the findings do not preclude using the two instruments together, for those with higher risk for low heath literacy.

9. Acceptability of health literacy measures

This was the first study to measure patient acceptability of health literacy measurements among patients with HF in the hospital setting. Patients with HF reported the NVS and the S-TOFHLA were acceptable measures to complete in the acute care setting. Acceptability of health literacy measures in the hospital setting is an important factor to consider when investigating health literacy instruments. Participant dislike or reluctance to participate in evaluation, may lead to increased non-response rates and poor reliability of the instruments.

Ryan et al. (2008) studied private and public medical practices for patient acceptability to undergo health literacy assessment in the clinic setting. Of those completing the measures, 98% agreed to participate in HL assessment and the majority of the participants agreed to share the findings with their providers. The acceptability of health literacy testing in this hospital-based sample support the findings of a previous study of health literacy measurement acceptability. These findings are important because they refute the supposition that patients are unwilling to participate in health literacy testing in the hospital setting.

10. Limitations of the study

The limitations of the study included a small, homogeneous sample (95% White, non-Hispanic) from three community hospitals in a relatively small geographic region. The hospital sites had little ethnic diversity and the interviews were conducted only in English. The generalizability of this study to a more ethnically diverse population is not valid. Further testing of the instruments in diverse populations is necessary.

The NVS and the S-TOFHLA assess the reading and numeracy domains of health literacy. The knowledge of health literacy has broadened over time to include reading comprehension, numeracy, and document literacy, as well as communication and decision making. Assessing health literacy in a multi-dimensional fashion is recommended by experts in the health literacy literature, including self-report and skill measurement.

Finally, the S-TOFHLA is a timed test and we allowed additional time to complete this self-administered test. However, we did not collect the total time needed for the adult with HF to complete the test. Knowing how much time is needed for participants to complete the test would assist healthcare providers to understand how much time would be needed to include this assessment in their busy practices.

11. Conclusion

Although the Institute of Medicine and the Joint Commission have both linked health literacy with improved patient outcomes, few healthcare settings routinely assess health literacy, and very few health care systems have integrated such measures into their standard of care. Health literacy screening in the HF population may determine who needs additional support at home to perform adequate self-care and who requires specialized HF education.

The S-TOFHLA and the NVS performed well with this population with good reliability and acceptability. The scores in the NVS were we more consistent with national health literacy trends from the most recent NAAL survey, related to the complexity of numeracy content in this measure. The S-TOFHLA scores were significantly higher in comparison to the national survey. This may be related to the higher level of

education in this sample and the lower complexity of numeracy questions in the S-TOFHLA when compared with the NVS. While the SILS significantly correlated with the S-TOFHLA, both literacy-based measures, this finding may indicate that the SILS be employed as a universal screening measure for all adults with HF, and the NVS or S-TOFHLA be completed as a measure for patients at risk of low health literacy measured by the SILS.

Utilizing reliable and validated health literacy measurements provide clinicians with evidence-based measurements to guide their interventions and improve patient and provider awareness of health literacy competency. Health literacy measurement development is needed to translate existing health literacy measures into additional languages, including emergent diverse populations who readily use healthcare systems.

References

Altin, S. V., Finke, I., Kautz-Freimuth, S., & Stock, S. (2014). The evolution of health literacy assessment tools: A systematic review. *BMC Public Health, 14*, 1207. https://doi.org/10.1186/1471-2458-14-1207.

American Heart Association (2018). Heart disease and stroke statistics—2018 update: A report from the American Heart Association. *Circulation, 137*, e67–e492 (doi:01.1161/CIR.0000000000000558).

Baker, D. W., Gazmararian, J. A., Williams, M. V., Scott, T., Parker, R. M., Green, D., ... Peel, J. (2002). Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *American Journal of Public Health, 92*, 1278–1283. https://doi.org/10.2105/ajph.92.8.1278.

Baker, D. W., Williams, M. V., Parker, R. M., Gazmararian, J. A., & Nurss, J. (1999). Development of a brief test to measure functional health literacy. *Patient Education and Counseling, 38*(1), 33–42. https://doi.org/10.1016/s0738-3991(98)00116-5.

Baker, D. W., Wolf, M. S., Feinglass, J., Thompson, J. A., Gazmararian, J. A., & Huang, J. (2007). Health literacy and mortality among elderly persons. *Archives of Internal Medicine, 167*, 1503–1509. https://doi.org/10.1001/archinte.167.14.1503.

Baur, C. (2011). Calling the nation to act: Implementing the national plan to improve health literacy. *Nursing Outlook, 59*, 63–69. https://doi.org/10.1016/j.outlook.2010.12.003.

Bennett, S. J., Lane, K. A., Welch, J., Perkins, S. M., Brater, D. C., & Murray, M. D. (2005). Medication and dietary compliance beliefs in heart failure. *Western Journal of Nursing Research, 27*, 977–993 (doi.org/10.1177%2F0193945905280253).

Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: An updated systematic review. *Annals of Internal Medicine, 155*, 97–107. https://doi.org/10.7326/0003-4819-155-2-201107190-00005.

Borson, S., Scanlan, M., Brush, M., Vitallano, P., & Dokmak, A. (2000). The mini-cog: A cognitive 'vital signs' measure for dementia screening in multilingual elderly. *International Journal of Geriatric Psychiatry, 15*, 1021–1027. https://doi.org/10.1002/1099-1166(200011)15:11<1021::aid-gps234>3.0.co;2-6.

Cajita, M. I., Cajita, T. R., & Han, H. R. (2015). Health literacy and heart failure: A systematic review. *Journal of Cardiovascular Nursing, 1*(1), https://doi.org/10.1097/jcn.0000000000000229.

Calvillo-King, I., Arnold, D., Eubank, K. J., Lo, M., Yunyongying, P., & Hahn, E. A. (2013). Impact of social factors on risk of pneumonia and heart failure: Systematic review. *Journal of General Internal Medicine, 28*, 269–282. https://doi.org/10.1007/s11606-012-2235-x.

Centers for Medicare and Medicaid Services (2013). Readmissions reduction program. Retrieved January, 2014, from http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html.

Coleman, E. A., Parry, C., Charmers, S., & Min, S.-J. (2006). The care transitions intervention: Results of a randomized controlled trial. *Archives of Internal Medicine, 166*, 1822–1828. https://doi.org/10.1001/archinte.166.17.1822.

Cornett, S. (2009). Assessing and addressing health literacy. *Online Journal of Issues in Nursing, 14*(3), https://doi.org/10.3912/OJIN.Vol14No03Man02.

Ditwig, J. B., Blok, H., Havers, J., & van Veenendaal, H. (2010). Effectiveness of self-management interventions on mortality, hospital readmissions, chronic heart failure hospitalization rate and quality of life in patients with chronic heart failure: A systematic review. *Patient Education and Counseling, 78*, 297–315. https://doi.org/10.1016/j.pec.2010.01.016.

Dolansky, M. A., Fang, X., Zullo, M., Shishehbor, M., Moore, S. M., & Rimm, A. A. (2010). Post- acute care services received by older adults following a cardiac event: A population-based analysis. *Journal of Cardiovascular Nursing, 25*(4), 342–349. https://doi.org/10.1097/JCN.0b013e3181c9fbca.

Evangelista, L. S., Rasmusson, K. D., Laramee, A. S., Barr, J., Ammon, S. E., Dunbar, S., ... Yancy, C. W. (2010). Health literacy and the patient with heart failure—implications for patient care and research: a consensus statement of the Heart Failure Society of America. *Journal of Cardiac Failure, 16*(1), 9–16.

Francis, G. S., Greenberg, B. H., Hsu, D. T., Jaski, B. E., Jessup, M., LeWinter, M., ... Yancy, C. W., Jr (2010). ACCF/AHA/ACP/HFSA/ISHLT 2010 clinical competence statement on management of patients with advanced heart failure and cardiac transplant. *Circulation, 122*, 644–672. https://doi.org/10.1161/CIR.0b013e3181ecbd97.

Heidenreich, P. A., Albert, N. M., Allen, L. A., Bluemke, D. A., Butler, J., Fonarow, G. C., ... Trogdon, J. G. (2013). Forecasting the impact of heart failure in the United States: A policy statement from the American Heart Association. *Circulation: Heart Failure, 6*, 606–619. https://doi.org/10.1161/HHF.0b013e318291329a.

Hernandez, A. F., Greiner, M. A., Fonarow, G. C., Hammill, B. G., Heidenreich, P. A., Yancy, C. W., ... Curtis, L. H. (2010). Relationship between early physician follow-up and 30-day readmission among Medicare beneficiaries hospitalized for heart failure. *JAMA: The Journal of the American Medical Association, 303*, 1716–1722. https://doi.org/10.1001/jama.2010.533.

Hope, C. J., Wu, J., Tu, W., Young, J., & Murray, M. D. (2004). Association of medication adherence, knowledge, and skills with emergency department visits by adults 50 years or older with congestive heart failure. *American Journal of Health-System Pharmacy, 61*, 2043–2049. http://www.ajhp.org/, Accessed date: 7 March 2015.

Hunt, S. A., Abraham, W. T., Chin, M. H., Feldman, A. M., Francis, G. S., Ganiats, T. G., ... Oates, J. A. (2009). 2009 focused update incorporated into the ACC/AHA 2005 guidelines for the diagnosis and management of heart failure in adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines developed in collaboration with the International Society for Heart and Lung Transplantation. *Journal of the American College of Cardiology, 53*(15), e1–e90. https://doi.org/10.1016/j.jacc.2008.11.013.

Institute of Medicine (2004). *Health literacy: A prescription to end confusion.* Washington, DC: National Academies Press. Retrieved September, 2013, from https://www.iom.edu/Reports/2004/Health-Literacy-A-Prescription-to-End-Confusion.aspx.

Jack, B. W., Chetty, V. K., Anthony, D., Greenwald, J. L., Sanchez, G. M., Johnson, A. E., ... Culpepper, L. (2009). A reengineered hospital discharge program to decrease hospitalization. *Annals of Internal Medicine, 150*, 178–187. https://doi.org/10.7326/0003-4819-150-3-200902030-00007.

Johnson, K., & Weiss, B. D. (2008). How long does it take to assess literacy skills in clinical practice? *Journal of the Board of Family Medicine, 21*, 211–214. https://doi.org/10.3122/jabfm.2008.03.070217.

Jordan, J. E., Osborne, R. H., & Buchbinder, R. (2011). Critical appraisal of health literacy revealed variable underlying constructs, narrow content, and psychometric weaknesses. *Journal of Clinical Epidemiology, 64*, 366–379. https://doi.org/10.1016/j.jclinepi.2010.04.005.

Jovicic, A., Holroyd-Leduc, J. M., & Strauss, S. E. (2006). Effects of self-management intervention on health outcomes of patients with heart failure: A systematic review of randomized controlled trials. *BMC Cardiovascular Disorders, 6*, 43. https://doi.org/10.1186/1471-2261-6-43.

Kirk, J. K., Grzywacz, J. G., Arcury, T. A., Ip, E. H., Nguyen, H. T., Bell, R. A., ... Quandt, S. A. (2011). Performance of health literacy tests among older adults with diabetes. *Journal of General Internal Medicine, 27*, 534–540. https://doi.org/10.1007/s11606-011-1927-y.

Koelling, T. M., Johnson, M. L., Cody, R. L., & Aaronson, K. D. (2005). Discharge education improves clinical outcomes in patients with chronic heart failure. *Circulation, 111*, 179–185. https://doi.org/10.1161/01.CIR.0000151811.53450.B8.

Kripalani, S., Bengtzen, R., Henderson, L. E., & Jacobson, T. A. (2008). Clinical research in low-literacy populations: Using teach-back to assess comprehension of informed consent and privacy information. *IRB: Ethics and Human Research, 30*(2), 13–19. Retrieved August, 2013, from http://www.thehastingscenter.org/Publications/IRB/.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The patient health questionnaire-2: Validity of a two-item depression screener. *Medical Care, 41*, 1284–1292. https://doi.org/10.1097/01.mlr.0000093487.78664.3c.

Kutner, M., Greenberg, E., Jin, Y., & Paulsen, C. (2006). *The health literacy of America's adults: Results from the 2003 National Assessment of Adult Literacy (NCES 2006–483).* Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Lee, S. D., Arozullah, A. M., & Cho, Y. I. (2004). Health literacy, social support, and health a research agenda. *Social Science Medicine, 58*, 1309–1321. https://doi.org/10.1016/S0277-9536(03)00329-0.

Mancuso, J. M. (2009). Assessment and measurement of health literacy: An integrative review of the literature. *Nursing & Health Sciences, 11*, 77–89. https://doi.org/10.1111/j.1442-2018.2008.00408.x.

McAlister, F. A., Stewart, S., Ferrua, S., & McMurray, J. J. (2004). Multidisciplinary strategies for the management of heart failure patients at high risk for admission: A systematic review of randomized trails. *Journal of American College of Cardiology, 44*, 810–819. https://doi.org/10.1016/j.jacc.2004.05.055.

McKee, P. A., Castelli, W. P., McNamara, P. M., & Kannel, W. B. (1971). The natural history of congestive heart failure: The Framingham study. *New England Journal of Medicine, 285*, 1441–1446. https://doi.org/10.1056/nejm197112232852601.

Medicare Payment Advisory Commission (2008). Report to the Congress: Reforming the delivery system. Retrieved September, 2013, from http://www.medpac.gov/documents/Jun08_EntireReport.pdf.

Mitchell, S. E., Sadikova, E., Jack, B. W., & Paasche-Orlow, M. K. (2012). Health literacy and 30-day post-discharge hospital utilization. *Journal of Health Communication, 17*(sup3), 325–338. https://doi.org/10.1080/10810730.2012.715233.

Morris, N. S., Grant, S., Repp, A., MacLean, C., & Littenberg, B. (2011). Prevalence of limited health literacy and compensatory strategies used by hospitalized patients. *Nursing Research, 60*, 361–366. https://doi.org/10.1097/NNR.0b013e31822c68a6.

Morris, N. S., MacLean, C. D., Chew, L. D., & Littenberg, B. (2006). The single item literacy screener: Evaluation of a brief instrument to identify reading ability. *BMC Family Practice, 7*(21), 1–7. https://doi.org/10.1186/1471-2296-7-21.

Moser, D. K., Dickson, V., Jaarsma, T., Lee, C., Stromberg, A., & Riegel, B. (2012). Role of self-care in the patient with heart failure. *Current Cardiology Reports, 14*, 265–275. https://doi.org/10.1007/s11886-012-0267-9.

Murray, M. D., Tu, W., Wu, J., Morrow, D., Smith, F., & Brater, D. C. (2009). Factors associated with exacerbation of heart failure include treatment adherence and health

literacy skills. *Clinical Pharmacology & Therapeutics, 85*(6), 651–658. https://doi.org/10.1038/clpt.2009.7.

Naylor, M. D., Brooten, D. A., Campball, R. L., Maislin, G., McCauley, K. M., & Schwartz, J. S. (2004). Transitional care of older adults hospitalized with heart failure: A randomized, controlled trial. *Journal of the American Geriatric Society, 52*, 675–684. doi.org/10.1111/j.1532-5415.2004.52202.x.

Nondahl, D. M., Cruickshansks, K. J., Wiley, T. L., Tweed, T. S., Klein, R., & Klein, B. E. (1997). Accuracy of self-reported hearing loss. *Audiology, 37*, 295–301.

Osborn, C. Y., Weiss, B. D., Davis, T. C., Skripkauskas, S., Rodrigue, C., Bass, P. F., & Wolf, M. S. (2007). Measuring adult health literacy in health care: Performance of the newest vital sign. *American Journal of Health Behavior, 31*(Suppl. 1), S36–S46. https://doi.org/10.5993/ajhb.31.s1.6.

Paul, S. (2008). Hospital discharge education for patients with heart failure: what really works and what is the evidence? *Critical Care Nurse, 28*(2), 66–82. http://ccn.aacnjournals.org/content/28/2/66.full.pdf+html, Accessed date: October 2013.

Peterson, P. N., Shetterly, S. M., Clarke, C. L., Bekelman, D. B., Chan, P. S., Allen, L. A., & Masoudi, F. A. (2011). Health literacy and outcomes among patients with heart failure. *JAMA: The Journal of the American Medical Association, 305*, 1695–1701. https://doi.org/10.1001/jama.2011.512.

Polit, D. F., & Beck, C. T. (2012). *Nursing research: Generating and assessing evidence for nursing practice* (9th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.

Powers, B. J., Trinh, J. V., & Bosworth, H. B. (2010). Can this patient read and understand written health information? *JAMA: The Journal of the American Medical Association, 304*, 76–84. https://doi.org/10.1001/jama.2010.896.

Riegel, B., Jaarsma, T., & Stromberg, A. (2012). A middle-range theory of self-care of chronic illness. *Advances in Nursing Science, 35*, 194–204. https://doi.org/10.1097/ANS.0b013e318261b1ba.

Riegel, B., Lee, C. S., & Dickson, V. V. (2011). Self-care in patients with chronic heart failure. *Nature Reviews Cardiology, 8*, 644–654. https://doi.org/10.1038/nrcardio.2011.95.

Riegel, B., Moser, D. K., Anker, S. D., Appel, L. J., Dunbar, S. B., Grady, K. L., ... Whellan, D. J. (2009). State of the science promoting self-care in persons with heart failure: A scientific statement from the American Heart Association. *Circulation, 120*, 1141–1163. https://doi.org/10.1161/circulationaha.109.192628.

Robinson, S., Moser, D., Pelter, M. M., Nesbitt, T., Paul, S. M., & Dracup, K. (2011). Assessing literacy in heart failure patients. *Journal of Cardiac Failure, 17*, 887–892. https://doi.org/10.1016/j.cardfail.2011.06.651.

Shaw, S. J., Armin, J., Torres, C. H., Orzech, K. M., & Vivian, J. (2012). Chronic disease self-management and health literacy in four ethnic groups. *Journal of Health Communication, 17*(sup3), 67–81. https://doi.org/10.1080/10810730.2012.712623.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55.

Van der Vaart, R., Drossaert, C. H. C., Taal, E., ten Klooster, P. M., Hilderink-Koertshuis, R. T. E., Klaase, J. M., et al. (2012). Validation of the Dutch functional, communitive and critical health literacy scales. *Patient Education and Counseling, 89*, 82–88. https://doi.org/10.1016/j.pec.2012.07.014.

van der Wal, M. H., van Veldhuisen, D. J., Veeger, N. J., Rutten, F. H., & Jaarsma, T. (2010). Compliance with non-pharmacological recommendations and outcome in heart failure patients. *European Heart Journal, 31*(12), 1486–1493. https://doi.org/10.1093/eurheartj/ehq091.

Weiss, B. D., Mays, M. Z., Martz, W., Castro, K. M., DeWalt, D. A., Pignone, M. P., ... Hale, F. A. (2005). Quick assessment of literacy in primary care: The newest vital sign. *Annals of Family Medicine, 3*, 514–522. https://doi.org/10.1370/afm.405.

Westlake, C., Sethares, K., & Davidson, P. (2013). How can health literacy influence outcomes in heart failure patients? Mechanisms and interventions. *Current Heart Failure Reports, 10*, 232–243. https://doi.org/10.1007/s11897-013-0147-7.