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Health literacy is an important predictor of health behavior and health outcomes, yet its measurement remains challenging. This study assessed health literacy measurement tools among college students to provide recommendations for future research. A sample of 122 college students completed a survey including the Single Item Health Literacy Screener (SILS) as well as three additional health literacy assessments. These included the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen), Newest Vital Sign (NVS), and Short Test of Functional Health Literacy in Adults (S-TOFHLA). All scored high on the S-TOFHLA, but participants with lower health literacy emerged with the SILS (21%), REALM-Teen (17%), and NVS (13%). Logistic regression analysis identified race, home language, and father's education as predictors of low health literacy, but this varied by tool. The sensitivity of the four measurement tools also varied. Continued assessment of existing tools and exploration of new measures can advance the study of health literacy and health behavior.

Keywords

health literacy, measurement, college, health behavior

A Comparison of Health Literacy Measurement Tools in a Sample of College Students

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Abstract

Health literacy is an important predictor of health behavior and health outcomes, yet its measurement remains challenging. This study assessed health literacy measurement tools among college students to provide recommendations for future research. A sample of 122 college students completed a survey including the Single Item Health Literacy Screener (SILS) as well as three additional health literacy assessments. These included the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen), Newest Vital Sign (NVS), and Short Test of Functional Health Literacy in Adults (S-TOFHLA). All scored high on the S-TOFHLA, but participants with lower health literacy emerged with the SILS (21%), REALM-Teen (17%), and NVS (13%). Logistic regression analysis identified race, home language, and father's education as predictors of low health literacy, but this varied by tool. The sensitivity of the four measurement tools also varied. Continued assessment of existing tools and exploration of new measures can advance the study of health literacy and health behavior.

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Introduction

Health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Ratzan & Parker, 2006). College students are navigating a pivotal stage marked by increased independence and reduced parental oversight and are making health decisions for the first time (Rosario et al., 2017), which has significant implications for health behavior.

Risky or health-promoting behaviors are associated with health literacy in this cohort. Health literacy has been found to be associated with self-rated health (Sarhan et al., 2021; Storey et al., 2020), wellness maintenance (Barsell et al., 2018), obesity and smoking (Sansom-Daly et al., 2016), substance use (Barsell et al., 2018; Yangyuen et al., 2021), knowledge about vaccines (Albright & Allen, 2018), HPV knowledge (Kitur et al., 2022), contraception use (Thongnopakun et al., 2018), eating fruits and vegetables (Oberne et al., 2022), and trust in COVID 19 information and prevention behaviors in college students (Chen et al., 2023; Patil et al., 2021). The study of health literacy and health behavior requires the measurement of health literacy. Yet, there are numerous tools which all measure different constructs of health literacy, making it challenging to identify which one to use. In addition, some can be self-administered while others need to be given in person.

One commonly used tool is the Test of Functional Health Literacy in Adults (TOFHLA), which measures a person's ability to read and comprehend health information (Parker et al., 1995). The Shortened Functional Health Literacy in Adults (S-TOFHLA) is 10 minutes shorter than the TOFHLA (Baker et al., 1999). Both the long (Ickes & Cottrell, 2010) and short version (Dolezel et al., 2020) have

been used with college students. Another skill-based tool is the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen) (Davis et al., 2006), which is modeled after the Rapid Estimate of Adult Literacy In Medicine (REALM). It also has a short version called the REALM-TeenS (Manganello et al., 2017). The REALM-Teen was validated with teens through age 19, and has been used with teens older than that (up to 21) (Dharmapuri et al., 2015), making it a reasonable choice to use with college students. The Newest Vital Sign (NVS) is a simple and quick health literacy measure based on a nutrition label for ice cream and administered in either English or Spanish (Weiss et al., 2005). This tool has been used in several studies of college students (Avci et al., 2019; Mackert et al., 2017; Mas et al., 2014; Noblin et al., 2022), and though typically administered in person, other administration methods have also been found acceptable for college students (Mackert et al., 2017).

In addition to skills-based assessments, there are self-report questionnaires to assess health literacy. The Single Item Health Literacy Screening (SILS) is one question that measures the need for help with reading health-related materials (Morris et al., 2006). It has been used in studies with college students (Al Maamari et al., 2023). Others include the Ishikawa 14 Item Health Literacy Scale (HLS-14) (Ishikawa et al., 2008), the Health Literacy Assessment Scale for Adolescents (HAS-A) (Manganello et al., 2015), and the Health Literacy Questionnaire (HLQ) (Osborne et al., 2013), which has been used in several studies with college students (Kühn et al., 2022).

Depending on the measurement tool and sample, health literacy levels for college students have varied (Kühn et al., 2022; Rababah et al., 2019). Studies have also shown that some sociodemographic measures have been associated with health literacy in college students including gender (Kühn et al., 2022; Rababah et al., 2019; Uysal et al., 2020), age (Kühn et al., 2022; Rababah et al., 2019), ethnicity (Avci et al., 2019), father education (Kühn et al., 2022; Sarhan et al., 2021), language spoken at home (Mas et al., 2014), major (Joseph et al., 2016; Kühn et al., 2022; Rababah et al., 2019), socioeconomic background (Kühn et al., 2022) and international student status (Avci et al., 2019). However, no published study has compared predictors of low health literacy across multiple measurement tools.

Given the limited number of studies focused on health literacy and college students, having a better understanding of how the tools compare is important for both informing tool selection, and encouraging more health literacy research with this population. Therefore, this study aims to compare different measurement tools (NVS, S-TOFHLA, REALM-Teen & SILS) in a sample of college students to analyze similarities and differences in health literacy scores and sociodemographic factors associated with those scoring in the lower health literacy range.

Methods

Sample

This study was conducted at a Northeastern U.S. public university with 122 participants recruited through classes and flyers. Brief presentations were sent to faculty known to the lead investigator to inform students about the study, and flyers were physically placed around campus. Participants were at least 18 years of age and received ten dollars if they completed both the survey and assessments. The self-administered paper survey included questions asking about demographic information, self-report health literacy (SILS), health information seeking, and media use. This study was approved by the authors' Institutional Review Board.

Health literacy

To assess health literacy, three skill assessments were used. One was the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen), a word recognition test (Davis et al., 2006) of 66 words with points deducted for mispronunciation. The second tool was the Newest Vital Sign (NVS) (Weiss et al., 2005), a sample nutrition label to assess both reading and numeracy skills. REALM-Teen score of 62 or less (reading below a 10^{th} grade level per scoring instructions, n=21) or an NVS score of 3 or less (less than adequate literacy per scoring instructions, n=15) were categorized as low health literacy. The third tool was the S-TOFHLA consisting of prose (reading and comprehension) and numeracy questions (Parker et al., 1995). All college students scored high (26-36) on the S-TOFHLA, so data was excluded from analysis of association between sociodemographic factors and measurement tools. The SILS was a single self-report question asked in the survey: "How often do you have someone help you read information you get from your doctor?". Choosing "often" (1) or "sometimes" (2) was SILS negative and signified low health literacy while "rarely" (3) or "never" (4) was SILS positive meaning high health literacy (Morris et al., 2006).

Sociodemographics

Sociodemographic variables included race, gender, language spoken at home, parent level of education, health status and school year. Demographic data were binarized for modeling purposes. Race was classified as "White" and "non-White", gender as "male" and "female", language spoken at home as "English" and "non-English" and parent education level as "less than college degree" and "at least college degree". Health status combined "excellent", "very good" and "good" into one category, and "fair" and "poor" into another. The school year variable was not binarized, and college students could identify as either a "first year", "second year", "third year", or "fourth year or more".

Analysis

Microsoft Excel and STATA were used for data analysis. Spearman's Rho correlation coefficient and Fisher exact tests analyzed differences between groups, and logistic regression investigated the association between sociodemographic factors and health literacy levels. The dependent variable was health literacy classified as low or adequate based on scores. Demographic factors (e.g., race) were included as predictors in the logistic regression analysis. The logistic regression model and sociodemographic factors were analyzed for each of the three measures, REALM-Teen, NVS, and SILS.

Results

Table 1 presents sample demographics. The average age of participants was 19.6 with 35% of the sample being age 18.

The score distribution for the 122 college participants who took all health literacy assessments (NVS, REALM-Teen, SILS, and S-TOFHLA) is shown in Table 2. Students had varying scores based on tool. For the S-TOFHLA, 100% of college students scored in the highest range (23-36). The SILS had the highest percentage (21%) of college students with low health literacy (SILS 1 or 2). When comparing scores across all tools using Fisher exact tests, the highest overlap was seen with 4.9% of participants scoring low in both the SILS and NVS.

We also assessed the linear relationship between measurement tools. Using Spearman's rho, REALM-Teen had a significant positive association with NVS (r = .184, n = 122, p< .05) and S-TOFHLA (r = .250, n = 122, p< .05). The SILS had a

significant association with S-TOFHLA (r = .251, n = 122, p< .05).

When comparing health literacy scores with sociodemographic characteristics (Table 3), there was no significant association found for school year and low health literacy with SILS (p = 0.267), NVS (p = 0.535) and REALM-Teen (p = 0.629). Mother's education was not a significant predictor for low health literacy using SILS (p = 0.368), NVS (p = 0.159) and REALM-Teen (p = 0.218). There was also no significant association with health status and low health literacy for the SILS (p = 0.059), NVS (p = 0.115) and REALM-Teen (p = 0.586) or gender (NVS p=.372; REALM-Teen p=.608; SILS p=1.0).

For the NVS, the percentage of college students with low health literacy was approximately double for non-White students (17.95%) compared to White students (9.76%), though not statistically significant (p = 0.241). No significant association was present for race and low health literacy with SILS (p = 0.811). The REALM-Teen had a significant association with race. Non-White students were more likely to have low health literacy (43.59%) than White students (4.88%, p < .0001).

College students who did not speak English at home had higher levels of low health literacy (58.33% low vs 41.67% high) (p< 0.001) with the REALM-Teen but not for the SILS (p=.780) or NVS (p=.172).

Father's education had a significant association with low health literacy with the NVS (p = 0.003) and REALM-Teen (p = 0.040). For the NVS, low health literacy in those with fathers with less than a college degree or with college degree was 23.40% and 4.35% respectively. For the REALM-Teen, low health literacy in those with fathers with less than a college degree or with college degree was 25.53% and 10.14% respectively.

Table 1: *Demographic Information of Participants (N=122)*

Demographics	*N*	%
Race		
White	82	67.8
Non-White	39	32.2
Gender		
Male	36	29.5
Female	86	70.5
Home Language		
English	98	80.3
Non-English	24	19.7
School year		
1st year	44	36.1%
2nd year	28	23.0%
3rd year	32	26.2%
4th year+	18	14.8%
Father's education		
< College degree	47	40.52
≥ College degree	69	59.48
Mother's education		
< College degree	54	45.38
≥ College degree	65	54.62
Health status		
Poor/Fair	5	4.13
Good/Excellent	116	95.87

Table 2: *Health Literacy Score Distribution (N = 122)*

	Frequency	Percentage (%)
NVS		
0-1*	**2**	2
2-3*	**13**	11
4-6	**107**	88
REALM-Teen		
4th-5th grade*	**2**	2
6th-7th grade*	**3**	2
8-9th grade*	**16**	13
10th grade+	**101**	83
S-TOFHLA		
0-16*	**0**	0
17-22*	**0**	0
23-36	**122**	100
SILS		
SILS 1 or 2*	**25**	21
SILS 3 or 4	**97**	79

Note. NVS: Newest Vital Sign; SILS: Single Item Health Literacy Screening; REALM-TEEN: Rapid Estimate of Adolescent Literacy in Medicine; S-TOFHLA: Short Test of Functional Health Literacy in Adults
*Low health literacy

We ran logistic regression models using the sociodemographic variables to look for associations with the NVS, REALM-Teen and SILS. Students whose father had at least a college degree were 83% less likely to have low health literacy per the NVS than students whose father had some or less than college education (OR =.169; 95% CI = .036, 788; p=.024). Non-White students were 92% less likely to have adequate health literacy for the REALM-Teen compared to White students (OR= .08; 95% CI = .01, .46; p=.005). Students who used a language other than English at home were 94% less likely to have adequate health literacy in the REALM-Teen relative to those students who used English at home (OR= .07; 95% CI = .01, .32; p=.001). Other variables were not found to be significant predictors of low health literacy in the multivariate models.

Discussion

This study explored similarities and differences across health literacy measurement tools for college students and compared sociodemographic factors with health literacy scores. Health literacy levels varied across instruments, suggesting that the choice of a measurement tool is critically important. These results are similar to a 2021 French study of adolescents that compared the Health Literacy for School-Aged Children (HLSAC) scale, the Health Literacy Assessment Scale for Adolescents (HAS-A) and the 16-item European Health Literacy Survey questionnaire (HLS-EU-Q16) (Rouquette et al., 2022). In this study, all tools were found to be valid, but like ours, each resulted in different health literacy classification.

Table 3: *Results of Bivariate Analysis Comparing Health Literacy (N=122)*

	SILS			NVS			REALM-Teen		
Demographics	A.HL	L.HL	p	A.HL	L.HL	p	A.HL	L.HL	p
Race			.720			.201			.000*
White	79.27	20.73		90.24	9.76		95.12	4.88	
Non-White	82.05	17.95		82.05	17.95		56.41	43.59	
Gender			.853			.341			.529
Male	79.07	20.93		83.33	16.67		86.11	13.89	
Female	80.56	19.44		89.53	10.47		81.40	18.60	
Home Language			.780			.155			.000*
English	78.57	21.43		89.80	10.20		92.86	7.14	
Non-English	83.33	16.67		79.17	20.83		41.67	58.33	
School year			.267			.535			.629
1st year	72.73	27.27		90.91	9.09		84.09	15.91	
2nd year	78.57	21.43		82.14	17.86		85.71	14.29	
3rd year	90.62	9.38		84.38	15.62		75.00	25.00	
4th year+	77.78	22.22		94.44	5.56		88.89	11.11	
Father's education			.421			.003*			.028*
< College degree	82.98	17.02		76.60	23.40		74.47	25.53	
≥ College degree	76.81	23.19		95.65	4.35		89.86	10.14	
Mother's education			.289			.130			.150
< College degree	83.33	16.67		83.33	16.67		77.78	22.22	
≥ College degree	75.38	24.62		92.31	7.69		87.69	12.31	
Health status			.059			.115			.586
Poor	40.00	60.00		60.00	40.00		81.90	18.10	
Good	81.03	18.97		88.79	11.21		100	0.00	

Note. A.HL: Adequate health literacy; L.HL: Low health literacy. *$p < .05$

The S-TOFHLA was not sensitive at detecting low health literacy in this study, suggesting it may not be an appropriate tool for college students. All college students scored high on S-TOFHLA which is similar to another study where 99.2% of 245 students had adequate S-TOFHLA health literacy scores (Dolezel et al., 2020). The SILS had the greatest differentiation in health literacy, but of interest is that no sociodemographic factors were associated with low health literacy with the SILS, which was the one self-report tool.

Characteristics associated with low health literacy also varied across instruments, which means that health literacy predictors and potentially outcomes can vary based on what measurement tool is selected. For bivariate analysis, father's education level was most likely to influence health literacy scores (NVS and REALM-Teen). Language spoken at home predicted the REALM-Teen score, but this is to be expected given it is a pronunciation test. These predictors are consistent with previous research studying health literacy in college students (Mas et al., 2014; Sarhan et al., 2021). Race was also a predictor of the REALM-Teen score, which is a finding that could be further explored in the future. It is important to consider that these results do not mean people with these characteristics always have low health literacy. Instead, the results simply show, in this sample and with these four tools, what characteristics were associated with lower scores.

It is not surprising that differences appeared, since each of the tools measures a different health literacy skill. Because there is no one tool that measures the entire set of health literacy skills, researchers and practitioners need to select tools that measure the skills they are most interested in. For instance, the SILS is a one question self-report measure, so it does not assess math or reading skills directly. It is also a subjective measure, meaning, it is up to the respondent's interpretation of the question and their abilities. The subjective nature of the question could also explain why there are no sociodemographic characteristics associated with the results, as it accounts for lived experience. On the other hand, the REALM-Teen assesses pronunciation of common health related words, so it is not surprising that some sociodemographic characteristics are associated with the score. However, this tool does not assess knowledge of what the words mean, compared to the NVS that requires reading comprehension and math skills to answer the questions. Because all health literacy tools assess different skills in different ways, it is not surprising that they lead to different results for low health literacy. This study helps identify how they may differ, and whether the four tools used in this study are helpful for research with college populations. Understanding how all health literacy tools have different strengths and limitations (Levic et al., 2021) and considering how each tool can potentially lead to bias (Osborne et al., 2022) is also important when planning for health literacy assessments in health behavior research.

The study's strength lies in using four validated health literacy tools, but limitations include a cross-sectional design and small sample size. We used the REALM-Teen, but other studies of young adults use the REALM developed for adults. Because either tool can apply to college students, future work should help determine whether one tool is better than the other for this unique population. Conducting a study at more than one college could also lead to different results. Future research should consider assessing different health literacy measurement tools across multiple campuses and diverse populations.

Implications for Health Behavior Research

Health behavior researchers should consider including a measure of health literacy when conducting studies of health behavior for college students. The Newest Vital Sign has been used in several studies with college students and can be administered in different formats (Mackert et al., 2017), and based on our study results seems to be comparable to other tools in identifying students with lower health literacy. Programs and policies should also take into account the need to incorporate measure of health literacy into routine evaluations or other surveys being done with college students to help gauge the level of health literacy in this population and explore trends over time. Colleges should also think about how to incorporate health literacy education into their existing education efforts.

As there is no one health literacy measure that assesses the full scope of health literacy, researchers should carefully select tools that are most closely aligned with their research questions and are most appropriate for use with a college student population. Future research should explore new tools or combinations of tools for effective health literacy measurement in health behavior studies for college students, taking into account unique characteristics of this population (Kühn et al., 2022). Health behavior researchers should also assess whether bias exists in measurement tools and consider how to best measure health literacy for diverse populations (Osborne et al., 2022).

Discussion Questions

Our study shows that existing tools vary in their measurement of health literacy, and it has been widely discussed that these tools only measure certain aspects of health literacy. What new scales or instruments should be developed to improve upon the measurement of health literacy for college students?

Health literacy research among college students has been limited. How is health literacy related to health behavior among college students? How can we improve health literacy skills for this population?

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