Assessment of Health Literacy as a Predictor of Asthma Exacerbation Among Puerto Rican Veteran Patients

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Researchers from the VA Caribbean Healthcare System in San Juan, Puerto Rico, aimed to determine the value of health literacy as a prognostic factor for asthma exacerbations. They evaluated the clinical application of the Newest Vital Sign as an assessment tool of health literacy and compared it with the Spanish version of the Test of Functional Health Literacy in Adults in a sample of the Puerto Rican veteran population.

Asthma affects about 5% to 10% of the adult population in the U.S., and the prevalence of this condition has been increasing steadily in other industrialized countries.[1] Asthma represents a significant health care burden and about 4,000 preventable deaths in the U.S.[2] In Puerto Rico, the reported prevalence of asthma has been documented to be up to 32% among children.[3] Likewise, the island also has the highest self-reported prevalence of asthma among adults, 15.9%.[4] It has been noted that inadequate health literacy (HL) correlates with poor general knowledge of asthma and improper metered-dose inhaler (MDI) use.[5]

Health literacy is the ability to obtain, process, and understand basic health information and services needed to make appropriate health decisions and follow instructions for treatment.[6] Health literacy is influenced by multiple factors, including the patient's own literacy, race, age, socioeconomic status, culture, personal experience of health issues, and disease complexity.[7] Poor HL is associated with an increase in medical costs and an inefficient use of services.

Several HL screening instruments have been designed; however, their use is primarily for research. Among these instruments most frequently used are the Test of Functional Health Literacy in Adults (TOFHLA) and its shortened version (S-TOFHLA).[8] The TOFHLA has been validated in English and in Spanish. The S-TOFHLA consists of 2 passages of hypothetical medical instructions. Each passage has several blank spaces representing missing words. Subjects are given 4 possible words per blank space, which they can use to fill in the spaces. Subjects then circle the correct missing word. For each correct answer, a score of 1 is given. Patients with a score ≥ 23 are considered to have adequate HL. Those with a score < 23 are considered to have marginal or inadequate HL.

Recently, a new rapid HL assessment tool, the Newest Vital Sign (NVS), was validated for both English and Spanish languages.[9] In the NVS, the subject is given a specially designed ice-cream nutritional label to review and asked a series of questions about it. Six questions are asked, and each correct answer receives a score of 1. Patients with a score ≥ 4 are considered to have adequate HL. Patients with a score < 4 are considered to have limited HL. The NVS takes 3 minutes to administer. However, further studies with this assessment tool on specific medical conditions are needed.

MATERIALS AND METHODS

This research study was a single center, single interview, retrospective record review study. It was approved by the VA Caribbean

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Healthcare System (VACHS) Institutional Review Board. Subjects were recruited from the Asthma and Allergy Clinic at the VACHS during their routine scheduled visits.

Subjects were enrolled if (1) they were adult veterans attending asthma and allergy clinics at the VACHS; (2) they were willing to give written informed consent; (3) they had pulmonary function tests (PFTs) demonstrating airflow reversibility in the 5 years before being seen in the clinics; and (4) they had visual acuity (VA) sufficient enough to read the study instruments. Subjects were excluded if (1) their medical record was not available for review; (2) they had a history of active or previous smoking; (3) they were blind or had severe cognitive impairment; and (4) their first language was not Spanish. Spanish is the main, preferred language spoken by the overwhelming majority of the VACHS patients. Therefore, all study subjects were administered the NVS and the S-TOFHLA in their corresponding Spanish versions.

After obtaining informed consent, the subjects were evaluated with the Spanish language version of the Mini-Mental State Examination. Those with advanced cognitive impairment, identified by a score ≤ 9 of 30, were not eligible to participate in the study.

Visual acuity was evaluated using the Rosenbaum Pocket Vision Screener. The Rosenbaum card is the most widely used handheld card to measure near VA. The card was held under adequate light 14 inches from the eye. Vision was recorded separately for each eye with and without glasses. Those subjects with a VA of ≥ 20/100 were interviewed, using the validated HL assessment tools S-TOFHLA (lic. 073/07) and the NVS, both in Spanish.

Asthma exacerbation information from the 2 years before the HL evaluation was obtained from medical records at the VACHS. This information was also corroborated at the clinic interview. Asthma exacerbation was defined as a complex of respiratory symptoms, which included > 1 of the following: cough, wheezing, dyspnea, or chest tightness that required hospital admission or an emergency department (ED) visit. The study flowchart is shown in Figure 1 (see page 16).

Information regarding the PFT and the medication used to manage the subjects' asthma was also collected. The calculated HL based on the S-TOFHLA and the NVS was compared with the number of asthma exacerbations found within the retrospective record review.

A sample of 262 patients was required to obtain a power of 80% with a type I error of .05. This was to allow a deviation from the theoretical probability of about 10%. A statistical analysis was performed with a Student's *t* test and a chi-square test. Microsoft Excel and SigmaStat were used for these analyses.

RESULTS

A total of 250 patients were screened from February 2008 to April 2009. Thirty-two subjects were enrolled in the study. The Table shows the study population demographic characteristics, including PFT, their asthma medication use, exacerbations, and hospitalizations. The mean age of the

Table. Study Population Characteristics (n = 32)

Characteristics	All patients	S-TOFHLA			
		Adequate HL (n = 22)	Marginal HL (n = 3)	Inadequate HL (n = 7)	*P* value
Age, y ± SD	66.8 ± 13.4	65.3 ± 12.60	72.3 ± 9.10	75.0 ± 9.70	.027
Male (%)	97	95	100	100	
Weight (lbs ± SD)	184.4 ± 33.9	182.1 ± 39.6	211.0 ± 47.6	178.3 ± 24.0	.709
Height (in ± SD)	66.2 ± 5.80	67.4 ± 2.70	57.7 ± 11.90	67.0 ± 3.50	.956
FEV_1 prebronchodilator (L ± SD)	1.69 ± 0.53	1.79 ± 0.38	1.45 ± 0.43	1.66 ± 0.91	.861
FEV_1 postbronchodilator (L ± SD)	2.14 ± 0.54	2.21 ± 0.37	1.69 ± 0.46	2.13 ± 0.70	.797
FVC prebronchodilator (L ± SD)	2.78 ± 0.55	2.84 ± 0.36	2.47 ± 0.36	2.81 ± 0.74	.968
FVC postbronchodilator (L ± SD)	3.27 ± 0.78	3.37 ± 0.64	2.42 ± 0.79	3.23 ± 0.71	.337
MMSE (score ± SD)	26.4 ± 3.1	27.9 ± 1.6	26.7 ± 1.5	23.4 ± 3.4	.025
Medications (% ± SD)					
Inhaled steroids	96.0 ± 18.0	100	67.0 ± 58.0	100	
Long-acting beta agonist	75.0 ± 44.0	81.0 ± 40.0	0	86.0 ± 38.0	.812
Leukotriene modifiers	56.0 ± 50.0	69.0 ± 48.0	0	57.0 ± 53.0	.758
Systemic steroids	0				
Theophylline	0				
Antihistamine	34.3 ± 48.0	44.0 ± 51.0	0	43.0 ± 53.0	.758
Nasal steroids	63.0 ± 49.0	69.0 ± 48.0	67.0 ± 58.0	57.0 ± 53.0	.758
Total no. of above medications ± SD	3.25 ± 1.2	3.6 ± 1.1	1.3 ± 0.6	3.4 ± 1.0	.954
H2 blocker	22.0 ± 42.0	25.0 ± 45.0	0	14.0 ± 38.0	.484
PPI	47.0 ± 51.0	50.0 ± 52.0	33. 0 ± 58.0	43.0 ± 53.0	.742
Total no. of asthma exacerbations	94	58	10	26	

FEV_1 = forced expiratory volume in 1 second; HL = health literacy; MMSE = Mini-Mental State Examination; NVS = Newest Vital Sign; PPI = proton pump inhibitor; SD = standard deviation; S-TOFHLA = shortened Test of Functional Health Literacy in Adults.

patients was 66.8 years, and only 1 of the 32 (3%) patients was female. Evaluation of the PFTs showed no difference among the pre- or post-bronchodilator forced expiratory volume in 1 second (FEV_1) compared with the degree of HL as measured by either of the screening tools. The average prebronchodilator FEV_1 and forced vital capacity (FVC) among the enrolled patients were 1.69 and 2.78, respectively. The average post-bronchodilator FEV_1 and FVC were 2.14 and 3.27, respectively.

All the patients were on short-acting bronchodilator therapy to be used as needed. As expected, the most common medication prescribed, other than short-acting bronchodilators, was inhaled steroids. Ninety-six percent of the patients were on inhaled steroids, and there was no statistical difference in the number of subjects on inhaled steroids between the different groups. Overall, there was no statistical difference in the medications used to treat asthma or related diseases among the different classifications of HL.

Of the 32 patients enrolled in the study, 69% were classified as having adequate HL, 9% as having marginal HL, and 22% as having inadequate HL

	NVS		
	Adequate HL (n = 6)	Limited HL (n = 26)	*P* value
	55.7 ± 22.8	69.3 ± 9.0	.204
	100	96	
	182.3 ± 42.2	184.9 ± 32.6	.894
	66.8 ± 2.10	66.0 ± 6.40	.607
	1.59 ± 0.88	1.71 ± 0.44	.768
	2.11 ± 0.77	2.14 ± 0.50	.926
	2.86 ± 0.7	2.77 ± 0.52	.773
	3.26 ± 0.90	3.27 ± 0.78	.981
	27.8 ± 2.0	26.0 ± 3.3	.114
	100	96.1 ± 19.6	.625
	83.3 ± 40.8	73.0 ± 45.2	.601
	83.3 ± 40.8	50.0 ± 51.0	.138
	66.7 ± 51.6	26.9 ± 45.2	.065
	66.7 ± 51.6	61.5 ± 49.6	.815
	4.0 ± 0.9	3.1 ± 1.2	.0613
	33.3 ± 51.6	19.2 ± 40.2	.451
	50.0 ± 54.8	46.2 ± 50.8	.865
	17	77	

(Figure 2a, page 17). These results contrasted with the results of HL based on the NVS in which only 19% of the patients were classified as having adequate HL, and 81% were classified as having less than adequate or limited HL (Figure 2b, page 17).

On evaluation of the asthma exacerbation episodes, which required hospitalization or an ED visit in the 2 years before the study enrollment, there was a tendency toward increased asthma exacerbations in subjects with a lower HL. Based on the S-TOFHLA classification of HL, patients with adequate HL had an average of 2.64 exacerbations, those with marginal HL had an average of 3.33 exacerbations, and those with inadequate HL had an average of 3.71 exacerbations. However, this tendency was not statistically significant (Figure 3a, page 17). Similar to the S-TOFHLA, the NVS showed a slight tendency toward increased asthma exacerbations in subjects with lower HL. Subjects with adequate HL had an average of 2.83 exacerbations, and those with limited HL had an average of 2.96 exacerbations (P = .943) (Figure 3b, page 17).

DISCUSSION

Several studies have documented a worse outcome and higher morbidity rate for patients with limited or inadequate HL; this has been proven correct for patients with glaucoma and diabetes.[10,11] There have been some studies that have demonstrated a relationship between low HL and poor asthma outcome.[12-14] However, to the best of these researchers' knowledge, no studies have been conducted in a population of Puerto Rican origin.

This pilot study shows a slight tendency toward an inverse relationship between asthma exacerbations and HL in a population with known health disparities. This tendency was independent of the HL screening tool used. However, this finding lacks statistical significance, primarily due to the small sample size, since it is below 13% of the calculated power. This topic deserves further investigation and correlation with possible confounders in a multivariate regression analysis.

Recently, Adams and colleagues evaluated the association of HL and asthma outcome.[15] They also used the NVS as the HL assessment tool. In their study, 2,842 patients were assessed for a history of asthma. The researchers found that asthma prevalence was not associated with the level of HL. However, the outcome of those patients with asthma and low HL was worse. Patients with asthma who had inadequate HL experienced more awakenings at night, more hospitalizations, and more days lost from usual activities compared with their counterparts who had adequate HL. When compared with the current study's findings, the Adams and colleagues study is limited by the self-reported nature of their sample. The current study's subjects had a physiological profile (PFT) with documented reversible obstructive airway disease.

There are significant issues remaining about the use of an HL screening tool in clinical practice. This study shows important classification differences among the 2 screening tools used. The S-TOFHLA has been used more than the NVS, but the length of administration of the test makes it impractical for the daily clinical arena. The NVS confers the advantage that it also evaluates the numerical aspect of the HL. In the current population, the NVS seems to identify more patients with adequate HL than does the S-TOFHLA.

Poor HL is associated with increased medical costs and inefficient uses of services. Howard and colleagues reported a significant increase in emergency service expenses and a trend toward higher total medical costs in patients with inadequate HL among a group of elderly subjects enrolled in a Medicare-managed care plan.[16] Inadequate HL has also been shown to correlate with poor knowledge of asthma and improper MDI use.[5] However, Kutner and colleagues found that by providing a

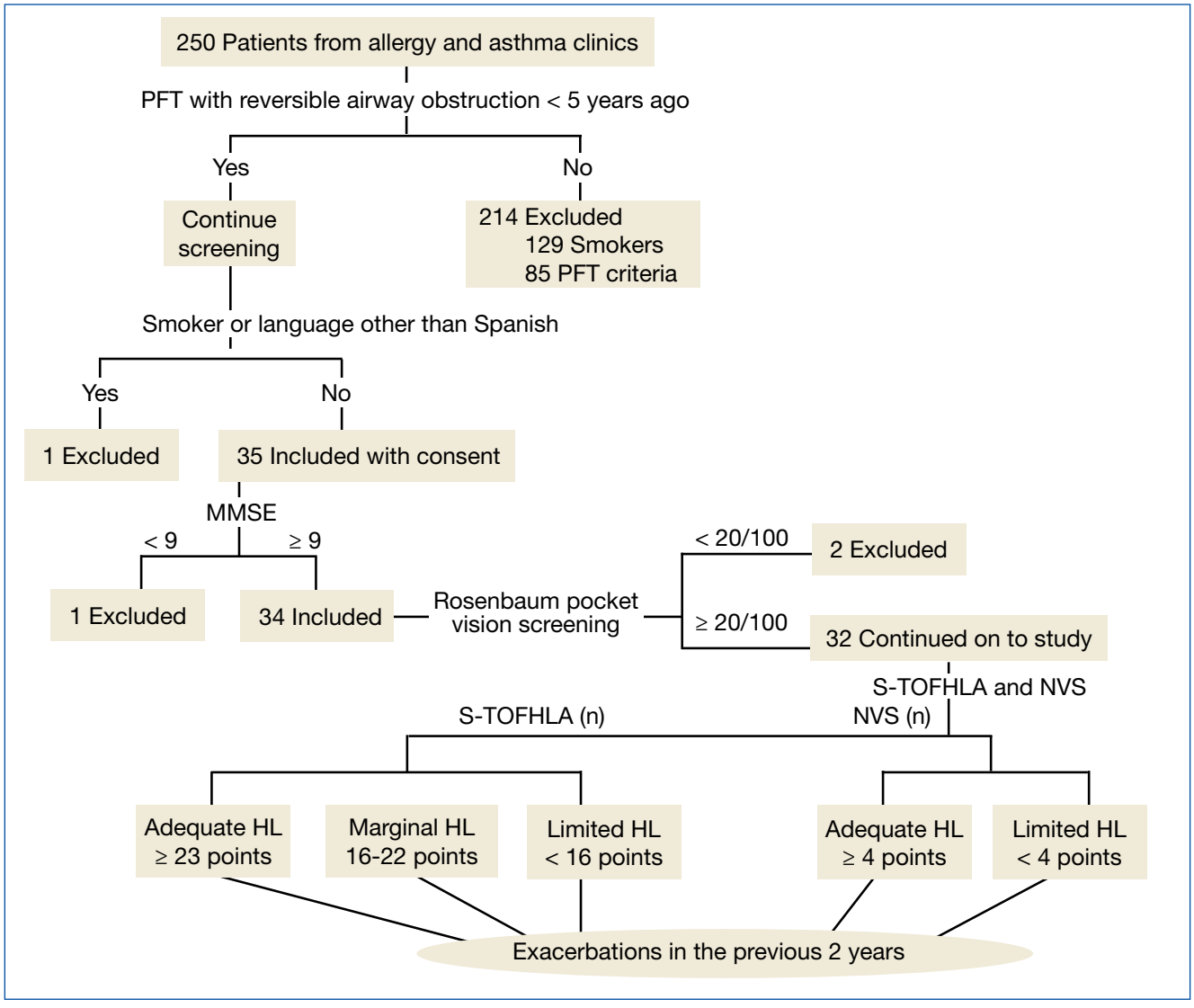

Figure 1. Study Flowchart.

HL = health literacy; MMSE = Mini-Mental State Examination; NVS = Newest Vital Sign; PFT = pulmonary function test; S-TOFHLA = shortened Test of Functional Health Literacy in Adults.

30-minute, guideline-based written and oral discussion about the asthma discharge regimen to patients hospitalized with exacerbated bronchial asthma, inadequate HL was not associated with a difficulty in learning or retaining instructions about the discharge regimen or appropriate MDI techniques.[17] However, before a general recommendation can be made about a routine asthma education program, studies to measure cost-effectiveness of this strategy are needed.

LIMITATIONS

In addition to the sample size, this study had several other limitations. The number of asthma exacerbations is underestimated, since only those that required an ED visit or hospitalization were considered. Therefore, the majority of the exacerbations might not have been taken into account. On the other hand, since the evaluation of asthma exacerbations is retrospective and based on a record review, the recall bias may have been diminished.

About 80 million adults in the U.S. are thought to have limited HL, which puts them at risk for poorer health outcomes. Rates of limited

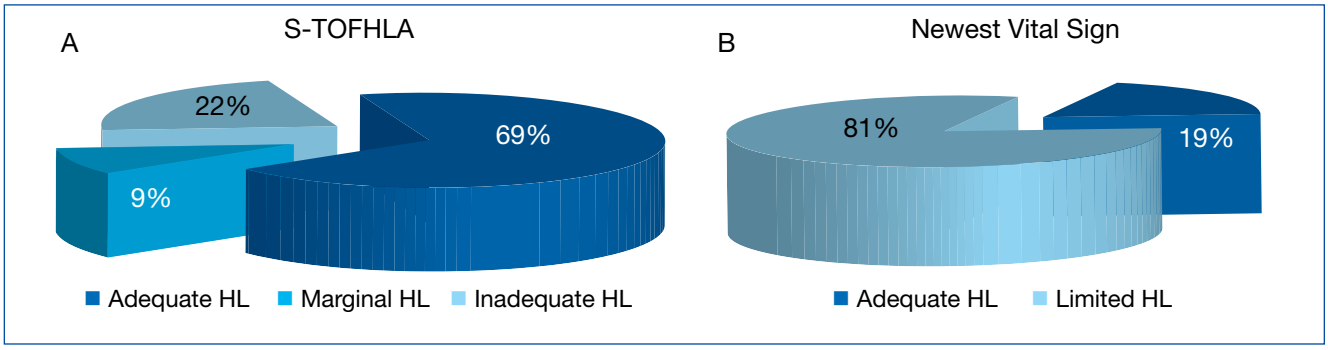

Figure 2. Population Health Literacy Classification Based on S-TOFHLA and the Newest Vital Sign.
HL = health literacy; S-TOFHLA = shortened Test of Functional Health Literacy in Adults.

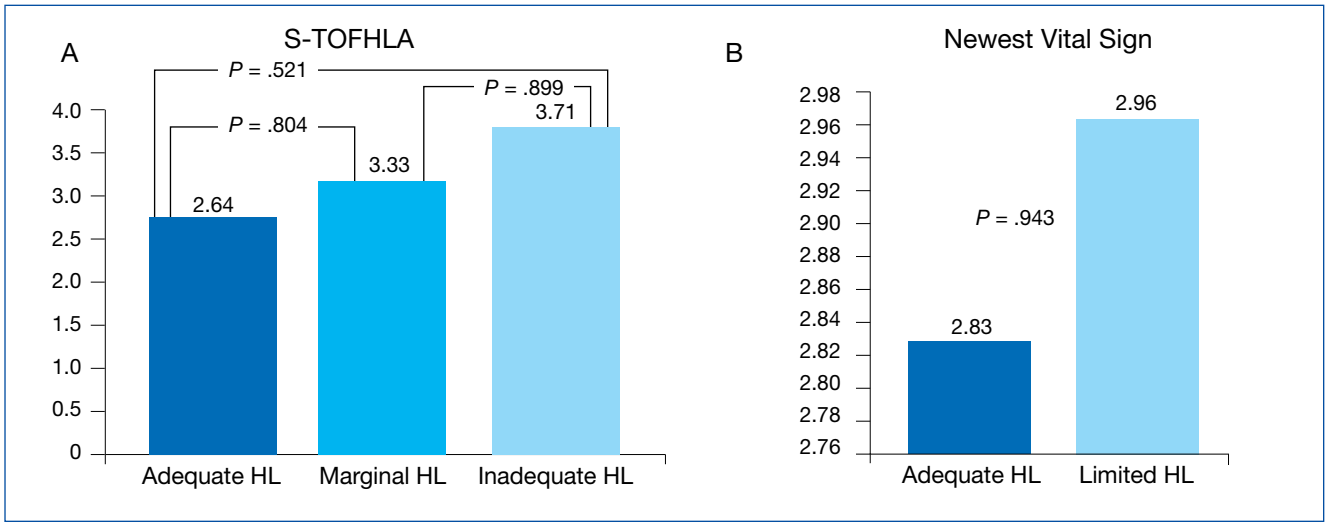

Figure 3. Number of Severe Asthma Exacerbations Based on Health Literacy Classifications.
HL = health literacy; S-TOFHLA = shortened Test of Functional Health Literacy in Adults.

HL are higher among the elderly, minority populations, people with low incomes, and those with lower than a high school education.[18] Numerous policy and advocacy organizations have expressed concern about barriers caused by low HL, notably the Institute of Medicine's report, *Health Literacy: A Prescription to End Confusion,* in 2004 and the U.S. Department of Health and Human Services' report, *National Action Plan to Improve Health Literacy,* in 2010.[19]

Evidence is emerging that lower HL can mediate racial disparities in health outcomes. This effect was demonstrated in several studies, each measuring a different outcome.[20-22] Similarly, the body of evidence concerning the relationship between aspects of HL and outcomes is very new and still inconclusive.[23] This pilot study may be the first step in developing a broader evidence base needed to understand this relationship in Puerto Ricans.

CONCLUSION

In this pilot study the researchers observed a tendency toward a direct relationship between inadequate HL and the frequency of asthma exacerbations as measured with a new HL assessment tool in a Puerto Rican population. Further studies in this area with a larger number of subjects are needed. Health literacy research may help to reduce health disparities.[24]

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