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Canadian Association for the Study of Adult Education (CASAE)

260 Dalhousie Street

Suite 204

OTTAWA, ON K1N 7E4

Telephone: 613.241.0018 FAX: 613.241.001

Email: casae.aceea@csse.ca

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ASSOCIATION BETWEEN LITERACY SKILLS, LANGUAGE USE, AND ONLINE HEALTH INFORMATION SEEKING AMONG HISPANIC AMERICANS

Roberto J. Millar[1,2], Shalini Sahoo[1,2], Takashi Yamashita[1], & Phyllis A. Cummins[3]

[1]University of Maryland, Baltimore County, MD (U.S.A.)
[2]Univeristy of Maryland, Baltimore, MD (U.S.A.)
[3]Miami University, Oxford, OH (U.S.A.)

Abstract

Online health information is underutilized among Hispanics with low English proficiency in the U.S. This study examines the association between a unique measure of general English literacy, language use, and online health information seeking among Hispanic adults. Data for Hispanics ages 25 to 65 (N = 700) come from the 2012/2014 Program for International Assessment of Adult Competencies (PIAAC). Binary logistic regression models were used to predict online health information seeking as a function of literacy skill scores (0 – 500 points) and primary language use (Spanish vs. other). Literacy (Odds-Ratio = 1.012, $p < 0.001$) was a positive predictor, while speaking Spanish at home (Odds-Ratio = 0.352, $p < 0.01$) was a negative predictor of online health information seeking. Literacy skills and language use appear to be separate contributors of online health information seeking among Hispanic adults. Adult educational research and practice should consider literacy skills and English language use as separate and important predictors of online health information seeking among Hispanics in the U.S.
Keywords: Social determinants of health, Latinos, eHealth, digital divide

INTRODUCTION

The Internet is a common source of health information (Jacobs, Amuta, & Jeon, 2017). Using the Internet for health information can improve patients' engagement and competence with health decision-making (Jacobs et al., 2017; Tonsaker, Bartlett G, & Trpkov, 2014). For instance, the Internet may complement other sources of health information by exposing consumers to a broader knowledge base of medical conditions, preventative strategies, and treatment options (Jaccobs et al., 2017; Tonsaker et al., 2014). While there are several potential benefits for using the Internet for health information seeking, there are also concerns about the quality of information available (Tan & Goonawardene, 2017; Tonsaker et al., 2014). However, despite being a potential source of misleading information, the Internet is generally considered a valuable source of health information when used in conjunction with other sources (e.g., health care providers) (Jacobs et al., 2017; Peña-Purcell, 2008; Tan & Goonawardene, 2017).

While the Internet may serve as an important information source, it may also help propagate inequalities in access to health information, particularly among racial/ethnic minorities and other vulnerable populations (Choi & Dinitto, 2013; Kontos, Blake, Chou, & Prestin, 2012; Nguyen, Mosadeghi, & Almario, 2017). Indeed, there is substantial evidence of a 'digital divide' in the use of the Internet for health information (e.g., Peña-Purcell, 2008; Kontos et al., 2012). The lower use of online platforms for health information by those of low socioeconomic status (e.g., educational attainment), older adults, immigrants, individuals with limited English proficiency, and racial/ethnic minorities is well documented in the United States (U.S.) (Bjarnadottir, Millery, Fleck, & Bakken, 2016; Brown, Lopez, & Lopez, 2016; De Jesus & Xiao, 2012; Gonzalez, Sanders-Jackson, & Emory, 2016).This digital divide particularly affects Hispanics --- one of the fastest growing ethnic groups in the

U.S. (Gonzalez et al., 2016). Despite a recent increase in the use of the Internet (Brown et al., 2016), Hispanics in the U.S continue to be less likely to use the Internet for health information than other racial/ethnic groups (De Jesus & Xiao, 2012; Peña-Purcell, 2008). This trend has been largely attributed to factors associated with Hispanics' relative lower English-language proficiency (Berland et al., 2001; Bjarnadotti et al., 2016). Estimates suggest that 73% of Hispanics speak a language other than English at home, presumably Spanish, and only 31% report speaking English very well (U.S. Census Bureau, 2015).

Internet health information seeking requires the skills necessary to locate and assess the credibility of information sources (Jacobs et al., 2017). Berland and colleagues (2001) report that the comprehension of most web-based health information, both in English and Spanish, requires a high reading level, sometimes collegiate. Since 50% or more of online information is in English (Web Technology Surveys, 2019), English literacy is highly relevant to online health information seeking. However, measures of general English literacy skills (i.e., reading comprehension) have been widely understudied among Hispanic adults and, more specifically, research has rarely pulled apart the unique contributions of English literacy skills from self-reported everyday language use (i.e., Spanish vs. English). A better understanding of the association between literacy skills, language use, and online health information seeking has to potential to improve health education initiatives designed to reach Hispanic Americans.

METHODOLOGY

Data

Data come from the U.S. public use files of the 2012/2014 Program for the International Assessment of Adult Competencies (PIAAC), a collaborative effort by Organisation for Economic Co-operation and Development nations (NCES, 2019). The PIAAC is designed to assess a range of competencies and includes sophisticated measures of general literacy (see the section below for more details). The PIAAC uses a complex sampling method to provide nationally representative data. The present study focuses on Hispanic adults between the ages of 25 and 65 (N = 700), life stages where formal education and initial literacy skill development has generally taken place.

Measures

Outcome-*Internet use for health information.* In PIAAC, the respondents were asked "how much information about health issues do you get from the Internet?" The original response categories were none, a little, some, and a lot. Given the skewed distribution of responses, we dichotomized this variable as 1= some & a lot or 0= none & a little.

Predictors-*Literacy skills.* We use PIAAC's assessment of literacy skills as an indicator of respondents' English literacy. PIAAC defines literacy skills as "understanding, evaluating, using and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential" (PIAAC Literacy Expert Group, 2019). PIAAC assesses English literacy skills based on participants' performance on a set tasks ranging in difficulty. For instance, a task low in complexity may ask respondents to access and identify information from a text, such as identifying how many cups of flour are instructed in a recipe, or the start time for a movie. More complex tasks may require that respondents integrate and relate different parts of a text, such as identifying implied cause-effect relationships or drawing assumptions of equivalency from different written texts. Based on the performance on these tasks, a set of ten plausible values are statistically estimated. Literacy skills range from 0 to 500, with higher values indicating greater literacy skills. A more detailed description of the literacy assessment is published elsewhere (PIAAC Literacy Expert Group, 2019). *Language use*. Speaking Spanish at home serves as a proxy for respondents' use of the Spanish language in everyday life. We dichotomized language most

often spoken at home to reflect whether a respondent spoke Spanish at home (1= Spanish at home or 0 = English and other language).

Covariates- We coded sex as 1= female and 0= male and age in five-year intervals (e.g., 25–29). Based on a skewed distribution of educational attainment, we dichotomized education as 1= postsecondary education or higher (i.e., associate, bachelor's, and graduate degree) vs. 0= less than a postsecondary education (i.e., high school diploma and less than high school). Income was recorded based on quintiles (1–5: lowest income to highest income). In the PIAAC, the income question was administered only to those who were employed; to avoid missing values in income, we assigned non-employed (both unemployed and out of labor force) to the lowest income quintile. A dichotomous measure denotes whether a respondent had health insurance (i.e., 1= insured or 0= uninsured). We dichotomized self-rated health as 1= good health (excellent, very good, good) or 0= poor health (fair, poor) because of the low number of fair and poor health responses. Finally, we include a measure of nativity to indicate whether respondents are 1= U.S.-born or 0=foreign-born.

Analysis

We computed weighted descriptive statistics for all variables by online health information seeking and by Spanish language use. We then used the IDB Analyzer version 4.0.14, developed by the International Association for the Evaluation of Educational Achievement (IEA), to estimate binary logistic regression models of Internet use for health information as a function of literacy skills scores and language spoken at home. The IDB Analyzer is software that creates macro programs that incorporate plausible values, sampling weights (SPFWT0), and replicate weights (SPFWT1-SPFWT80) for common statistical packages (IEA, 2017; NCES, 2019). We constructed a set of unadjusted models to establish baseline associations, and then included all covariates in a fully adjusted model. We conducted additional sensitivity analyses in which we used a series of literacy skill levels (i.e., 6, 5, 3, 2 levels) provided by the PIAAC and OECD, rather than a continuous literacy skills score (range 0-500). Results from these sensitivity analyses were consistent with our initial findings and therefore not included, but available upon request. We determined the predictive accuracy of models using the area under the receiver operating characteristics (ROC) curve (Swets,1988). As a general guideline, a ROC curve between .70 to .90 represents appropriate model accuracy (Swets,1988). We carried out all analyses using SAS version 9.4 and used a *p*-value of 0.05 as criterion for statistical significance (SAS Institute Inc, 2013).

RESULTS

Table 1 presents weighted descriptive statistics for the analytic sample by Internet use for health information. Approximately half (48%) of respondents are 39 years or younger, a large proportion (42%) are in the lowest income and have less than a postsecondary level of education (80%). Most (59%) have health insurance, report good health (78%), and are not born in the U.S (73%). A majority (n= 476) of respondents report using the Internet for health information seeking. While the average literacy score for the entire sample is about 229 out of 500, those who report using the Internet for health information have, on average, higher literacy scores than those who do not (249 vs. 197; t = 10.51; df=699; $p < 0.001$). Table 2 presents weighted descriptive statistics for the analytic sample by language use. A majority (n=371) of respondents report speaking Spanish at home. Furthermore, those who report speaking Spanish at home have, on average, lower literacy scores than those who do not (202 vs. 259; t=-13.04, df=699; $p <$ 0.001).

Table 1. Weighted Descriptive Statistics for Hispanics Ages 25 to 65 Years Old by Internet use for Health Information

Variables	**Full sample (N =700)**	**Internet use for Health Information (n=476)**		**No Internet use for Health Information (n=224)**
Literacy skills (0-500), M (*SE)*	228.565 (3.38)	249.377 (3.261)	***	197.382 (4.610)
Language use at home, % *(SE)*				
Spanish	52.894 (3.261)	37.642 (3.469)	***	75.723 (3.967)
Other	47.106 (3.261)	62.358 (3.469)		24.277 (3.967)
Age-group (years), % *(SE)*				
25-29	17.016 (1.534)	23.785 (2.081)	***	6.872 (1.969)
30-34	15.572 (1.233)	19.141 (2.166)		9.973 (1.829)
35-39	16.761 (1.485)	14.956 (2.445)		19.466 (2.265)
40-44	11.691 (1.091)	10.955 (1.624)		12.794 (3.330)
45-49	12.495 (1.292)	11.652 (1.965)		13.759 (1.721)
50-54	10.930 (1.530)	10.646 (2.263)		11.357 (1.863)
55-59	8.509 (0.953)	5.819 (1.280)		12.540 (2.123)
60-65	7.126 (1.067)	3.047 (0.979)		13.238 (2.537)
Income quintile, % *(SE)*				
1st quintile	41.902 (2.919)	38.175 (3.073)	***	47.445 (4.481)
2nd quintile	23.139 (2.182)	20.339 (2.064)		27.304 (4.046)
3rd quintile	15.744 (2.019)	16.852 (2.338)		14.097 (3.195)
4th quintile	10.860 (1.588)	14.358 (2.400)		5.657 (2.083)
5th quintile	8.355 (1.231)	10.276 (1.914)		5.496 (1.523)
Gender, % *(SE)*				
Female	51.650 (1.249)	53.495 (1.930)	n.s.	48.885 (3.372)
Male	48.350 (1.249)	46.505 (1.930)		51.115 (3.372)
Education, % *(SE)*				
Postsecondary	19.601 (1.088)	28.852 (1.855)	***	5.747 (1.713)
Less than postsecondary	80.399 (1.088)	71.148 (1.855)		94.253 (1.713)
Health insurance, % *(SE)*				
Health insurance	59.279 (2.828)	65.720 (3.331)	***	49.627 4.729)
No health insurance	40.721 (2.828)	34.280 (3.331)		50.373 (4.729)
Health Status, % *(SE)*				
Good health	77.976 (1.639)	84.708 (1.963)	***	67.888 (3.276)
Poor health	22.024 (1.639)	15.292 (1.963)		32.112 (3.276)
Nativity, % *(SE)*				
U-S. born	44.193 (2.255)	54.610 (2.967)	***	28.585 (2.870)
Foreign-born	55.807 (2.255)	45.390 (2.967)		71.415 (2.870)

Note: Literacy skills score was estimated using ten plausible values. Sampling and replicate weights were applied. Sample sizes are the unweighted values. *** $p < 0.001$ (based on t-test or chi-square tests) n.s. = not significant; M= mean; SE = standard error.

Table 2. Weighted Descriptive Statistics for Hispanics Ages 25 to 65 Years Old by Language use at Home.

Variables	**Full sample**	**Spanish Use at Home**		**Other Language Use**
	(N =700)	**(n=371)**		**(n=329)**
Literacy skills (0-500), M (*SE)*	228.565 (3.388)	201.816 (3.631)	***	258.626 (3.053)
Internet use for health info, % *(SE)*				
Uses Internet	59.974 (2.168)	42.662 (2.837)	***	79.358 (2.938)
Does not use Internet	40.026 (2.168)	57.338 (2.837)		20.642 (2.938)
Age-group (years), % *(SE)*				
25-29	17.016 (1.534)	11.512 (1.371)	***	23.218 (2.814)
30-34	15.572 (1.233)	12.413 (1.225)		18.792 (2.415)
35-39	16.761 (1.485)	19.279 (2.348)		13.956 (2.150)
40-44	11.691 (1.091)	11.522 (2.241)		11.897 (1.555)
45-49	12.495 (1.292)	12.076 (2.113)		12.983 (2.563)
50-54	10.930 (1.530)	13.608 (1.868)		7.939 (1.779)
55-59	8.509 (0.953)	9.461 (1.542)		7.452 (1.610)
60-65	7.126 (1.067)	10.130 (1.866)		3.763 (1.382)
Income quintile, % *(SE)*				
1st quintile	41.902 (2.919)	45.341 (3.564)	***	38.033 (2.985)
2nd quintile	23.139 (2.182)	28.907 (3.218)		16.822 (2.437)
3rd quintile	15.744 (2.019)	15.204 (2.747)		16.361 (2.788)
4th quintile	10.860 (1.588)	7.110 (1.602)		15.003 (2.748)
5th quintile	8.355 (1.231)	3.437 (0.947)		12.781 (2.389)
Gender, % *(SE)*				
Female	51.650 (1.249)	53.865 (2.271)	n.s.	49.097 (2.657)
Male	48.350 (1.249)	46.135 (2.271)		50.903 (2.657)
Education, % *(SE)*				
Postsecondary	19.601 (1.088)	12.793 (1.880)	***	27.143 (2.483)
Less than postsecondary	80.399 (1.088)	87.207 (1.880)		72.857 (2.483)
Health insurance, % *(SE)*				
Health insurance	59.279 (2.828)	48.938 (3.366)	***	70.836 (4.666)
No health insurance	40.721 (2.828)	51.062 (3.366)		29.164 (4.666)
Health Status, % *(SE)*				
Good health	77.976 (1.639)	71.275 (2.506)	***	85.470 (2.046)
Poor health	22.024 (1.639)	28.725 (2.506)		14.530 (2.046)
Nativity, % *(SE)*				
U.S-born	44.193 (2.255)	13.947 (2.384)	***	78.216 (3.004)
Foreign-born	55.807 (2.255)	86.053 (2.384)		21.784 (3.004)

Note: Literacy skills score was estimated using ten plausible values. Sampling and replicate weights were applied.Sample sizes are the unweighted values. *** $p < 0.001$ (based on t-test or chi-square tests) n.s. = not significant; M=mean; SE = standard error.

Table 3 presents estimated odds ratios (OR) for weighted binary logistic regression models predicting Internet use for health information. In Model 1, literacy skills are a statistically significant predictor of using the Internet for health information (OR = 1.020, $p < 0.001$). A one-point increase in literacy skill score is associated with 1.020 times odds of reporting Internet use. Model 2 shows a statistically significant negative association between speaking Spanish at home and using the Internet for health information (OR = 0.194, $p < 0.001$); speaking Spanish at home is associated with 0.194 times odds of using this source of health information. Both associations remain significant in Model 3, where both predictors are included. A fully adjusted Model 4 shows that literacy skills and language use remain statistically significant predictors of Internet use even after accounting for covariates.

Table 3. Weighted Binary Logistic Regressions of Literacy Skills and Language use Predicting Internet use for Health Information Seeking in Hispanics (N = 700)

	Model 1 ***OR (SE)***	**Model 2** ***OR (SE)***	**Model 3** ***OR (SE)***	**Model 4** ***OR (SE)***
Literacy skills (0 – 500 points)	1.020 (0.002) ***		1.016 (0.003)***	1.012 (0.003) ***
Spanish use at home (vs. other)		0.194 (0.042)***	0.400 (0.108)***	0.352 (0.119) **
Age group (by 5-year interval)				0.789 (0.045) ***
Income (quintile)				1.019 (0.120)
Female (vs. male)				1.425 (0.385)
Postsecondary education (vs. less than)				3.938 (2.063) **
Health insurance (vs. no insurance)				1.359 (0.395)
Good health (vs. poor health)				1.375 (0.416)
U.S.-born (vs. foreign-born)				0.659 (0.255)
Area under the ROC curve	0.739 - 0.766	0.668	0.756 - 0.777	0.790 - 0.804

Note: Models predict the use of the Internet for health information seeking (i.e., 0 = no internet use, 1 = use of the internet). A one-unit increase represents a one-point increase in literacy skills score (range 0 - 500). Estimates were calculated using IDB Analyzer (Version 4.0.14), and plausible values and full sample replicate weights were applied. Range of area under the ROC curve provided for models that used individual plausible values for literacy skills. OR = odds ratio, SE = standard error, ROC curve = Receiver Operating Characteristics curve. $^{**}p < 0.01$, $^{***}p < 0.001$.

DISCUSSION

This research examined the independent associations of English literacy skills and Spanish language use for online health information seeking among a nationally representative sample of Hispanic adults in the U.S. Findings suggest that greater English literacy skills are associated with the use of the Internet for health information seeking, whereas speaking Spanish at home is negatively associated. These findings have important implications for the scholarship on adult education and learning in an era in which the Internet is an increasingly common source of health information (Jacobs et al., 2017).

Our research suggests that lower English literacy skills among Hispanic adults can serve as a barrier towards using online platforms for health information seeking. Similarly, using Spanish as a primary language in the home appears to be an additional barrier to Internet use for health information. These findings highlight important within-group differences; Hispanic Americans with low English literacy skills and those who predominantly use Spanish in the home may be an even greater risk of being impacted by a digital divide and being left behind as we transition into a digital era. Given the projected increase of Hispanics in the U.S. (Gonzalez et al., 2016), adult education interventions should focus their attention towards culturally relevant English literacy skills development and the promotion of English language in order to address health information disparities in this population. Moreover, online health information developers and providers can implement alternative methods to disseminate health information (e.g., translation, audio/visual tools) to Hispanics with low English literacy and those who predominantly speak Spanish, considering the two as distinct barriers to online health information seeking.

There are limitations worth noting. First, the cross-sectional nature of this analysis limits inference of direction and causal relationships between literacy, language use, and online health information seeking. Yet, our analyses reflect the theoretical propositions put forth in previous research on education and learning. Second, our measure of language use is limited to self-reported language most spoken at home. Future studies could use a more robust measure of language use (e.g., fluency, frequency) in order to more accurately capture language use in everyday life. Third, while we control for socioeconomic status (e.g., education, income), future studies should consider Internet access as a potential barrier to health information seeking. Finally, findings from our study can only be applicable to the general Hispanic adult populations and should not be extended to specific sub-groups (e.g., Mexicans, Puerto Ricans, Cubans).

Implications for Adult Education

Our research suggests that poor English literacy skills and Spanish language use can limit Hispanics' use of online health information. These findings illustrate potential avenues (i.e., literacy skill development, promotion of bilingualism) to focus educational efforts towards reducing health information disparities by race/ethnicity in a digital era. Adult education research and practice should consider literacy skills and Spanish language use as separate and important predictors of online health information seeking among Hispanics in the U.S. Literacy skills and language use should continue to be studied in relation to formal education, and as indicators of socioeconomic and behavioral outcomes (e.g., employment, health) beyond health information seeking.

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