Patient Education and Counseling xxx (2019) xxx–xxx

Contents lists available at ScienceDirect

Patient Education and Counseling

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

Literacy skills, language use, and online health information seeking among Hispanic adults in the United States

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ARTICLE INFO

Article history:
Received 16 September 2019
Received in revised form 9 February 2020
Accepted 21 February 2020

Keywords:
Digital divide
Social determinants of health
Latinos
eHealth

ABSTRACT

Objective: 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.
Methods: Data for Hispanics ages 25–65 (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).
Results: 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.
Conclusion: Literacy skills and language use appear to be separate contributors of online health information seeking among Hispanic adults.
Practice implications: Online health information providers should be aware of literacy skills and Spanish language use as barriers to online health information seeking among Hispanics, particularly those who have both limited literacy skills and predominantly Spanish language use.
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1. Introduction

In the context of a digital age, online platforms are increasingly becoming a common source of health information [1]. Using the Internet for seeking health information can improve patients' engagement and competence with health decision-making, as well as facilitate communication between health care providers and patients [1,2]. For instance, those who use the Internet for health information can benefit from exposure to online forums, which may complement other sources of health information such as health care providers. Furthermore, the use of online sources can provide patients with a broader knowledge base of medical conditions, preventative strategies, and treatment options [1–3]. While there are several potential benefits for using the Internet for health information seeking, there are also concerns about the quality of information available [2,3]. However, despite being a potential source of misleading information, the Internet is a valuable source of health information when used in conjunction with other sources such as health care providers [1–4].

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, such as older adults and individuals with lower education attainment [4–7]. Indeed, there is substantial evidence of a 'digital divide' in the use of the Internet for health information [4–9]. 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.) [9–14].

The digital divide particularly affects Hispanics — one of the fastest growing ethnic groups in the U.S. [4,11,14]. Despite a recent increase in the use of the Internet by this group [10], Hispanics in the U.S continue to be less likely to use the Internet for health information than other racial and ethnic groups [4,11,14]. This trend is largely attributed to factors associated with lower English-language proficiency and socioeconomic status (e.g., access to computers and Internet) [13–15]. Indeed, 73 % of Hispanics speak a language other than English at home and only 31 % report speaking English very well [16]. Notably, a digital divide exists even among

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https://doi.org/10.1016/j.pec.2020.02.030
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Please cite this article in press as: R.J. Millar, et al., Literacy skills, language use, and online health information seeking among Hispanic adults in the United States, Patient Educ Couns (2020), https://doi.org/10.1016/j.pec.2020.02.030

Hispanics. Those with low English language proficiency and those who report speaking Spanish as a primary language have been found to use the Internet less than their English proficient counterparts [11,13,14]. In addition, higher socioeconomic status (e.g., educational attainment, income), are strong predictors of Internet use for health information among Hispanics [12,15]. Evidence of within-group differences warrants further investigation of the correlates of Internet health information seeking among Hispanics.

Internet health information seeking requires the skills necessary to locate and assess the credibility of information sources [1]. Berland and colleagues report that the comprehension of most web-based health information, both in English and Spanish, requires a high reading level, sometimes collegiate [15]. Since 50 % or more of online information is in English [17], 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 communication models designed to reach Hispanics- a vulnerable groups of health information consumers [4–6]. Standardized measures of literacy can assess different levels of proficiencies (e.g., reading comprehension), which may help identify low skill individuals and may inform the development of health information content targeted for these individuals. Furthermore, as the U.S. becomes more culturally diverse, performance-based measures of literacy may facilitate comparison across groups, where self-reported measures may be culturally biased by self-perceptions as well as social desirability.

Given the prevalence of a digital divide, there have been a growing number of studies that examine correlates of online health information seeking among Hispanics and other minority groups [4–8]. However, most investigations of online health information seeking among Hispanics in the U.S. have focused on self-reported English proficiency, while systematically assessed and psychometrically valid measures of general English literacy have been largely overlooked. To our knowledge, no study has examined the link between performance-based literacy skill measure such as the one in PIAAC, self-reported language use, and online health information seeking using nationally representative data of Hispanics in the U.S. The Organisation for Economic Co-operation and Development's (OECD) Program for the International Assessment of Adult Competencies (PIAAC) provides an excellent opportunity to examine these associations using nationally representative data, including the systematic assessment of literacy skills performance [18,19]. Most web-based health information requires that consumers locate, understand and evaluate written text [15]. PIAAC's literacy skills assessment measures respondents' ability to process written text information through tasks of varying complexity [20].

Bodie and Dutta's Integrative Model of eHealth use guide this research [21]. This model links social disparity at the population level (i.e., minority membership) with individual-level characteristics related to online health information usage (i.e., literacy skills, language use), thus providing a framework for this research [21]. The model suggests that sociodemographic factors are linked to health behaviors (e.g., health information seeking) through literacy, motivation, and ability [21]; the use of internet-based health information is driven by differential opportunities based on race/ethnicity, literacy, and other skills related to the use of technology. Drawing from their model, Hispanics with higher English literacy skills and those who speak English regularly will have some of the skills necessary to utilize the internet as a source of health information. What remains unclear is whether these specific individual-level characteristics (i.e., literacy skills and everyday language use) are independently associated with Internet use for health information.

2. Methods

2.1. Data

We use data from the U.S. public use files of the 2012/2014 Program for the International Assessment of Adult Competencies (PIAAC), a collaborative effort by 24 Organisation for Economic Co-operation and Development (OECD) nations [18,19]. 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 [18,19]. 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.

2.2. Measures

2.2.1. Internet use for health information

In PIAAC, the respondents were asked "how much information about health issues do you get from internet?" The original response categories were none, a little, some, and a lot. Given the small number of responses across the four categories, this variable was dichotomized as (1 = some & a lot or 0 = none & a little).

2.2.2. Literacy skills

We use PIAAC's assessment of literacy skills as an indicator of respondents' proficiency with 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" [20]. PIAAC assesses English literacy skills based on participants' performance on a set tasks ranging in difficulty [20]. 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 [22]. 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 [22]. Finally, other tasks may require evaluation and reflection that draws from knowledge or ideas external to the text, such as reflecting on the author's purposefulness or persuasiveness [22]. Based on the performance on these tasks, a set of 10 plausible values are statistically estimated ranging from 0 to 500, with higher values indicating greater literacy skills. A more detailed description of the literacy assessment is published elsewhere [20].

2.2.2.1. Language use. Language most often spoken at home was dichotomized to reflect whether a respondent spoke Spanish at home (1 = Spanish at home or 0 = English and other language). Speaking Spanish at home serves as a proxy for respondents' self-reported use of the Spanish language in everyday life.

2.2.3. Covariates

Age was measured in five-year intervals (i.e., 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–65). Income was recorded based on quintiles (1–5: Lowest income to highest income). In PIAAC, the income question was administered only to those who were employed; to avoid missing values in income, non-employed (both unemployed and out of labor force) participants were

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assigned to the lowest income quintile. Approximately 35% of the sample was assigned to the lowest income quintile as a result of not being in employment. Sex was coded as (1 = female and 0 = male). Educational attainment was dichotomized to indicate a postsecondary education or higher (i.e., associate, bachelor's, and graduate degree) vs. less than a postsecondary education (i.e., high school diploma and less than high school). A question on health insurance was dichotomized to denote whether a respondent had health insurance or not (1 = insured or 0 = uninsured). Self-rated health was dichotomized 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 as well as the conceptual grouping (i.e., positive vs. negative health). Finally, we include a measure of nativity to indicate whether respondents are 1 = U.S.-born or 0 = foreign-born.

2.3. Analysis

We computed weighted descriptive statistics for all variables by online health information seeking behavior and by 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 [18,23]. We constructed a set of unadjusted models (Models 1, 2, 3) to establish baseline associations, and then included all covariates in a fully adjusted model (Model 4). 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) to identify potentially different trends. Results from these analyses were consistent with our initial findings and reported in the Appendix. We determined the predictive accuracy of models using the area under the receiver operating characteristics (ROC) curve [24]. As a general guideline, a ROC curve between .70–.90 represents appropriate model accuracy [24]. We carried out all analyses using SAS version 9.4 and used a p-value of 0.05 as criteria for statistical significance [25].

3. Results

Table 1 presents weighted descriptive statistics for the analytic sample by Internet use for health information. A majority (68 %) 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 seeking 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. Little over a majority (53 %) of respondents reported speaking Spanish at home. Furthermore, those who reported speaking Spanish at home have, on average,

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), Mean (*SE*)	228.565 (3.388)	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)
Sex, % (*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)
Secondary	80.399 (1.088)	71.148 (1.855)	94.253 (1.713)
Health insurance, % (*SE*)			
Has health insurance	59.279 (2.828)	65.720 (3.331)***	49.627 4.729)
Does not have 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 the bivariate significance test, either *t*-test or chi-square test) n.s. = not significant; SE = standard error.

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

Variables	Full sample (N = 700)	Spanish Use at Home 371	Other Language at Home 329
Literacy skills (0–500), Mean (*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)
Secondary	80.399 (1.088)	87.207 (1.880)	72.857 (2.483)
Health insurance, % (*SE*)			
Has health insurance	59.279 (2.828)	48.938 (3.366)***	70.836 (4.666)
Does not have 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 the bivariate significance test, either *t*-test or chi-square test) n.s. = not significant; SE = standard error.

lower literacy scores than those who do not (202 vs. 259; $t = -13.04$, $df = 699$; $p < 0.001$). 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 %).

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 the 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, measured on a dichotomous scale (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. **$p < 0.01$, ***$p < 0.001$.

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4. Discussion and conclusion

4.1. Discussion

The current research examines whether literacy skills and Spanish language use are independently associated with online health information seeking among Hispanic adults in the U.S. Consistent with the empirical and conceptual scholarship [4,12,15,21], our findings suggest that greater literacy skills are associated with online health information seeking, whereas speaking Spanish at home was negatively associated. These findings provide evidence of disparities in access to online health information in terms of literacy skills performance and Spanish language use.

English literacy skills and Spanish language use appear to be independent contributors for Hispanics' use of the Internet for health information. Previous research has shown the linkages between education, English proficiency, and online health information seeking among Hispanics [3,9,10]. Furthermore, Bodie and Dutta's Integrative Model of eHealth Use points to literacy and other individual-level skills like familiarity with technology as critical continuators to the use of the Internet for health [21]. To our knowledge, however, no study has considered how and whether performance-based assessments of literacy skills and language use operate independently from each other to influence online health information seeking.

Although Hispanics are particularly impacted by the digital divide when compared to other race/ethnic groups, our findings shed a light on the within-group digital divide — Hispanics with lower literacy skills and those who primarily speak Spanish are at an even greater risk of being left behind as we transition into a digital era. Our findings suggest that promoting literacy skills and English language use may help reduce Hispanics' health information disparities [1,7,15]. Furthermore, providers of online health information should be aware of limited English literacy skills and Spanish language use as distinct barriers for Hispanic health information users, and focus efforts towards making online health information accessible to these at-risk individuals. For instance, online health information providers can use existing translation services (e.g., Google Translate) and audio/video tools for relaying health information for those with low English literacy skills and Spanish language users.

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 reflected the theoretical propositions from the Bodie and Dutta's model. Second, we cannot rule out possible omitted variable bias. For instance, traditional demographic characteristics such as total household income, marital status and living arrangements could have provided additional insights to the online help seeking behaviors; however, such measures were not available in the PIAAC. Third, 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 of use) in order to more accurately capture language use in everyday life. Fourth, 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, detailed analysis of unique sub-groups (e.g., Mexicans, Puerto Ricans, Cubans) was not possible due to limited sample sizes. Future research should address the sub-groups differences in the context of literacy, language use, and online health information seeking. Findings from our study can only be applicable to the general Hispanic adult populations and should not be extended to specific sub-groups.

4.2. Conclusion

Online health information seeking is an increasingly common health-promoting practice. However, our findings suggest that poor literacy skills and Spanish language use can limit Hispanics' use of online health information. Given the projected increase of Hispanics in the U.S., patient education interventions should focus their attention towards culturally relevant 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 optimal methods to disseminate health information (e.g., translation, audio/visual tools) to Hispanics with low literacy and limited English language use, considering the two as distinct barriers to online health information seeking.

4.3. Practice implications

This study contributes to practice and communication models in health care in several ways. To our knowledge, this is one of the first studies to simultaneously examine the associations between literacy skills, language use, and online health information seeking among a nationally representative sample of Hispanic adults. Our findings indicate that literacy skills and language use play different roles in online health information seeking. Hispanic adults who have lower English literacy skills and primarily speak Spanish at home may be at greater risk of missing important health information through the internet. Findings illustrate potential avenues (i.e., literacy skill development, promotion of bilingualism, development of accessible online health information) to focus efforts towards reducing health information disparities in a digital era. Literacy skills development and language use interventions are potential avenues to increase online health information seeking among Hispanics. Moreover, health information developers and providers may need to be aware of these barriers and develop communication strategies (e.g., translated, audio/visual) that target low literacy and Spanish-speaking individuals in an effort to help disseminate health information to these at-risk populations.

Credit author statement

Roberto J. Millar and Shalini Sahoo designed the research, conducted the data analysis, and wrote a substantial portion of the text. Dr. Takashi Yamashita assisted with the data analysis and wrote a part of the results and discussion sections. Dr. Phyllis A. Cummins was involved in the conceptualization of the project, wrote a part of the introduction section, and contributed to the discussion section. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. I attest to the fact that all authors listed in this cover letter have read the manuscript, attest to the validity and legitimacy of the data and its interpretation and agree to its submission to *Patient Education and Counseling.*

Acknowledgements

The research reported here was partially supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A170183 to the University of Maryland, Baltimore County and Miami University.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pec.2020.02.030.

Please cite this article in press as: R.J. Millar, et al., Literacy skills, language use, and online health information seeking among Hispanic adults in the United States, Patient Educ Couns (2020), https://doi.org/10.1016/j.pec.2020.02.030

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Please cite this article in press as: R.J. Millar, et al., Literacy skills, language use, and online health information seeking among Hispanic adults in the United States, Patient Educ Couns (2020), https://doi.org/10.1016/j.pec.2020.02.030