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Understanding Health Information Seeking Behaviors of Adults with Low Literacy, Numeracy, and Problem Solving Skills: Results from the 2012 US PIAAC Study

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Abstract

Literacy, numeracy, and problem solving in technology-rich environments (LNPS) skills are important for health – LNPS is linked with health through accessing, interpreting, and using health information which leads to increased health knowledge and further impact on health behaviors. In order for adults to participate in their health care, they must have adequate functional health literacy, which is driven by the ability to seek and then use health information. There is limited understanding about health information seeking behaviors (HISB) for adults with low LNPS. The purpose of this study is to gain an understanding about which demographic, health behavior, and facilities in English factors influence health information seeking behaviors (HISB) in adults ages 16-65 who have low level LNPS.

Methods and Data Source: We ran several sets of analyses on the 2012 US PIAAC Data using SAS v. 9.1.3 (Cary, NC). Our population was stratified into 3 specific domains – Literacy, Numeracy, and Problem Solving – with low level proficiency levels based on OECD convention. Outcome variables are sources of health information – Print Media, Internet, Radio/TV, Family/Friends/Co-Workers, and Health Professionals. Predictor variables are Gender, Age, Race, Educational Attainment, Health status, Use of Preventive Health Measures and Facilities in Reading, Writing, Speaking, and Understanding Spoken English. All appropriate weighting and imputation macros derived by the OECD were utilized, and frequencies and logistic regressions were conducted.

Results: Within the Literacy and Numeracy domains, our study population used oral communication sources (Radio/TV, Health Professionals, Friends/Family/Co-Workers) more often than printed communication sources (Print Media, Internet). Those in the Problem Solving domain used the Internet more than those in the Literacy and Numeracy domains. Varying combinations of demographic, health behavior, and facilities in English were significant for each source of health information depending on the cognitive domain. However, there was no predictive consistent pattern across domains or across health information sources.

Significance: People with low level LNPS who seek health information report better health than those who do not seek health information, regardless of information source. HISB is also complex and individualized. There are differences in HISBs among those with low level Literacy, Numeracy, and Problem Solving proficiency levels based on both sources used and different demographic, health behavior, and facilities in English variables. People also use multiple sources for health information. Those who actively seek health information are more likely to be active participants in their health care outcomes, a key construct in high quality health care. Understanding the multifaceted nature of HISB can help researchers and practitioners develop targeted and sustainable interventions to increase HISB.

Introduction

Patient-centered care (PCC), in which patients and their providers work together to make decisions about health care and disease management, is considered one of the key components of high-quality healthcare (IOM, 2013). For patients to participate in their care, they must have adequate functional health literacy, which enables them to use health information in this dyadic communication framework (Rubin, 2014; Parker et al., 1995). A critical first step in having functional health literacy is the ability to access and identify information that can be used for the more complex and situational demands of health care (Rubin, 2014, IOM, 2013; Alharbi, Ekman, Olsson, Kudas & Calsrom, 2012).

Studies indicate that there are many predisposing characteristics to individual health literacy, including age, education level, literacy level, pre-existing health conditions, and race (Dutta-Bergman, 2004; Berkman et al., 2011; Anker, Reinhart, & Feeley, 2011). Women, for example, interact more often with the health care system than men (Berkmann, DeWalt, Pignonne, et al., 2004), yet those with low literacy levels are less likely to use preventive health services (National Women's Health Resource Center, 2004). Older adults and those with less than a high school diploma are less likely to be knowledgeable about both preventive measures and management of sick behaviors because they are less likely to seek health information and more likely to miscommunicate with their health providers (McCray, 2005). Results from the 2003 NAALS study indicate that adults who were White or Asian/Pacific Islander had higher average health literacy levels than Blacks, Hispanics, American Indians, and Multiracial adults (2006). These individual factors and characteristics are important to study in a holistic manner since they each affect health outcomes in a different way.

Adults with lower literacy and numeracy skills have significantly lower health literacy and poorer health outcomes (Koo, Krass, & Aslani, 2006; Birru et al., 2004; Berkman et al., 2011). Adults of all literacy and numeracy levels face challenges in making choices about their health behaviors. For example, knowledge, motivation, self-efficacy and self-regulation are some personal characteristics that can enhance or impede behavior change (Mann, deRidder & Fujito, 2013). In addition to these personal factors, adults who have low level literacy and numeracy levels may have difficulty accessing, understanding, and communicating important health information (Berkman, et al., 2011), which further inhibits their ability to make health changes or participate in their health care.

The implications of low health literacy have come to the attention of the healthcare community over the last 20 years, and as a result increasing attention has been paid to the readability levels of printed materials (Berkman et al., 2011). The simultaneous increase of health information on the Internet confounds this advance because the high literacy, numeracy, and computer skill demands of health-related websites create problems for those who have low literacy, numeracy, or computer skills (Birru et al., 2004). Challenges in oral communication exist as well; the complexity of medical language, discordance between language and literacy skills of patients and providers, and intercultural communication issues add to the difficulty adults with low levels of literacy have in participating fully in their health care (McCray 2005, Roter, 2011). Numeracy creates different challenges as adults struggle to understand medical statistics, medication dosage requirements, and basic health concepts such as daily nutritional values (Berkman et al., 2011; Parker et al., 1995; Rothman et al., 2006). Multiple health information sources are also used, often simultaneously, which can create conflicting reliability, relevance, and information overload.

The Program for the International Assessment in Adult Competencies (PIAAC) data present a unique opportunity to understand how directly assessed skills in the cognitive domain areas of literacy, numeracy, and problem solving in technology rich environments (LNPS) interact with background and demographic factors that may inform how individuals function in society. The PIAAC is an international survey conducted under the auspices of the Organization for Economic Cooperation and Development (OECD). Representative (minimum) samples of 5,000 adults between the ages of 16 and 65 were surveyed in each of the 24 participating countries (OECD, 2013). Each domain (Literacy, Numeracy, and Problem Solving in Technology Rich Environments) is divided into proficiency levels; adults at each proficiency level have a 67% chance of completing all test items located at that score cut point (OECD, 2013). Literacy and Numeracy proficiency levels are reported in 5 levels (Below Level 1, Level 1, Level 2, Level 3, and Level 4/5) and Problem Solving in Technology Rich Environments is reported in 4 levels (Below Level 1, Level 1, Level2, and Level 3), each on a 500-point scale.

Each country was allowed to add 5 minutes of questions to their background questionnaire. The United States included questions relating to health status, health information seeking behaviors, and use of preventive health measures. This broad look at self-reported health behaviors allows us to consider differences across demographic factors, educational attainment, self-reported facilities in reading, writing, and speaking/understanding spoken English and specific cognitive domain skills. This may provide important data to inform targeted interventions within each domain for health promotion, health education, and participatory health decision making. These differences also help us understand how to help adults become more health literate which can lead to better health outcomes through improved integration and application of written and oral educational and promotional materials, health directives, and communication with health providers (U.S. Department of Health and Human Services, 2010).

Health literacy is an interactive and iterative process, with a key tenet of matching the literacy content of health information with the literacy skill level of the individual. Numeracy is also a critical component of health information, since adults with low numeracy skills may not be able to process and understand numbers and statistics in a health context such as dosing information on prescription labels (Brown et al., 2011; Goodman, Finnegan, Mohadjer, Kenzke & Hogan, 2013). The growth of the Internet as a source of health information has been exponential (Manyika & Roxburgh, 2011; Fox, Duggan & Purcell, 2013). Adults with low problem solving skills in technology rich environments may not be able to access information or navigate through electronic sources of health information (OECD, 2013). We use the PIAAC proficiency levels to understand the health information seeking behavior of people with low level LNPS. Acquiring this knowledge can generate important opportunities for those who create and deliver health information, education, and messaging because it enables them to more successfully match the LNPS content in the supply of health information and health education to the LNPS demands of health information users (Baker, 2007; Rothman et al., 2006; Hibbard, Peters, Dixon & Tusler, 2007; Rubin, 2014). Decreasing the gap between what is written and said and what is read, heard and understood helps reduce knowledge barriers and may enhance positive health outcomes for adults with low LNPS (Rubin, 2014; Rothman et al., 2006; Epstein et al., 2005; Parker et al., 1995).

The United States spent $2.6 trillion on health care in 2010 (Emanuel, 2011); it is estimated that 40% of that amount, almost $1 trillion, is wasted. Overtesting, lack of patient compliance, hospital readmissions, and unnecessary emergency room visits are four of the top

contributors to this inefficiency (Kavilanz, 2009). Poor communication and understanding contribute to all of these. Adults who have low LNPS have difficulty accessing, understanding, and communicating important health information (Berkman et al., 2011). These barriers impact access to health care, health outcomes, patient safety, engagement and participation in society, and the development of individual and family potential (NCES, 2013). Few studies have assessed how individuals varying in LNPS levels engage in health information seeking behaviors (HISB). Knowing how adults with low LNPS engage in HISB is important because those who actively seek health information from a variety of sources are likely to be more cognitively and psycho-socially prepared to engage in medical decision-making and with the medical system (Lambert & Loiselle; 2007; Case, 2012). The PIAAC data present a unique opportunity to understand how a holistic set of demographic traits, self-reported background questions, and cognitive skills measured by direct assessments in literacy, numeracy, and problem solving relate to the choices that adults make in seeking health information.

To this end, we explored how individuals with low level LNPS seek health information by asking the following research questions:

Research Question 1: "What sources do people with low level LNPS utilize when seeking health information?"

Research Question 2: "When looking at Gender, Age, Race, Educational Attainment, Health Status, Use of Preventive Measures and Facilities in Reading, Writing, and Speaking/Understanding Spoken English, which of these factors predict different health information sources for people with low level LNPS?"

Methods

Study Population

Data for this study were acquired from the 2012 PIAAC dataset using the United States country-specific background questionnaire administered to a representative sample of 5,000 adults between the ages of 16 and 65. The background questionnaire was given in both English and Spanish depending on the respondent's language.

Eligibility

Our sample (n= 2,270 for Literacy, n=2,810 for Numeracy, and n=2,270 for Problem Solving) included all PIAAC participants who scored at Literacy and Numeracy proficiency levels of Below Level 1, Level 1, Level 2 and who scored at Problem Solving proficiency levels of Below Level 1 and Level 1. Our proficiency level groupings followed the OECD reporting convention (OECD, 2013). Literacy, Numeracy, and Problem Solving skill proficiency levels were defined according to the classifications by the United States Department of Education at Below Level 1 (scores of 0-175), Level 1 (176-225), and Level 2 (226-275) for Literacy and Numeracy, and Below Level 1 (scores of 0-240), and Level 1 (241-290) for Problem Solving (OECD, 2013). We further combined Below Level 1, Level 1, and Level 2 within the Literacy and Numeracy domains; these groupings are called "Low level Literacy" and "Low level Numeracy". We combined Below Level 1, and Level 1 within the Problem Solving domain and called the grouping "Low level Problem Solving".

The above described proficiency levels were created for each imputation of the PIAAC as recommended by the PIAAC analytic staff. In this study, participants were only included only if there was no missing data in any of the dependent and independent variables under study in order

to avoid separation of the data. We evaluated each domain independently, however, participants may have had some combination of low level Literacy, Numeracy and Problem Solving; we did not study those who had only low Literacy, only low Numeracy or only low Problem Solving.

Variables

Dependent Variables

Sources of health information were our outcome variables. Participants were asked "How much information about health issues do you get from…". The responses, "A lot", "Some", "A Little", and "None" were coded on a Likert Scale from 1-4..There were eight different outcome source variables – newspapers, magazines, Internet, radio, television, books or brochures, family members/friends/co-workers, and health professionals. Individuals in our sample answered each survey question independently; each individual could have selected from 0 to 8 sources of health information. The variables were collapsed into five outcome categories: Print Media (newspapers, magazines, books or brochures), Internet, Radio/TV (radio, television), Family Members/Friends/Co-Workers, and Health Professionals. We created dichotomous variables from the Likert Scale responses: "A Lot" or "Some" were coded as "Uses This Source" and "A Little" or "None" were coded as "Does Not Use This Source". Participants who selected "A Lot" or "Some" in any of the original variables for Print Media (newspapers, magazines, books or brochures) were considered as "Uses This Source" while those who selected "A Little" or "None" in any of the original variables were considered as "Does Not Use This Source"; the same is true for any of the dichotomous variables that were collapsed from multiple questions in the background questionnaire. We considered retaining "A Lot" and "None" as separate categories, however, the frequency of those categories was too low and the analysis would not have been informative or broadly generalizable.

Independent Variables

We were interested in several demographic variables (Gender, Age, Race, Educational Attainment), self-reported health variables (Health Status, Use of Preventive Health Measures) and self-reported facilities in English (Reading, Writing, Speaking/Understanding Spoken English).

Demographic:

Gender was determined using the PIAAC variable GENDER_R. With regard to Age, we utilized the PIAAC AGE10LF variable code, which breaks age groups into 24 and under, 25-34, 35-44, 45-54, and 55-65. We used the PIAAC RACETHN_4CAT race variable with 4 categories: White, Black, Hispanic, and Asian/Other. For Educational Attainment, we were interested in those with and without a high school diploma, and used the PIAAC B_Q01aUS_C variable to make that determination, creating a dichotomous variable to indicate whether or not a person had a high school diploma.

Self-Reported Health Variables:

We were interested in self-reported health status and use of preventive health measures. Self-reported Health Status was reported as "Excellent", "Very Good", "Good", "Fair" and "Poor" on a Likert Scale from 1-5; we created dichotomous variables from these responses, coded as "Excellent/Very Good/Good" and "Fair/Poor". We considered only analyzing Excellent and Poor, however, the frequency of those categories was too low and the

analysis would not have been informative. Additionally, while this may have provided empirically sound data, we felt that this would generalize the results to a population that is too heterogeneous, i.e., inclusive of a range from those whose health status may have ranged from Fair to Excellent at any time in the present or past.

The other variable was Use of Preventive Health Measures. There were a series of questions relative to preventive measures to which participants answered either "Yes" or "No" ("In the past year have you had a…" flu shot, mammogram, pap smear, screen for colon cancer, dental visit, vision check, screen for prostate cancer, screen for osteoporosis). We measured "Any" versus "None"; if a participant had used any of the preventive measures, they were coded as "Any Preventive Measure"; otherwise if they had no preventive measures, they were coded as "No Preventive Measures". We felt that this accommodated for preventive measures that may have been directed toward women only (e.g., pap smear), men only (e.g., prostate cancer screen), or those of a certain age only (e.g., osteoporosis screen).

Self-Reported Facilities in English

We used three broad measures of self-reported facilities in English - Reading Writing, and Speaking/Understanding Spoken English. These variables represent different cognitive and affective constructs. Adults who have low LNPS may have strengths or weaknesses in any or all of them, which may further inhibit or enhance their HISB. Self-reported Facility in Reading English was reported as "Very Well", "Well", "Not Well", "Not at All" on a Likert Scale from 1-4; we created dichotomous variables from these responses with "Very Well" or "Well" as "High" and "Not Well" or "Not at All" as "Low". We used the same scoring for writing in English. There were two oral variables in the PIAAC dataset – Speaking and Understanding Spoken English. With regard to these facilities, we determined a high correlation between speaking and understanding spoken English (ϕ=.85, p<.001), so we created a single variable, Facility in Spoken English, to measure this construct. If Self-reported Facility in Speaking or Understanding Spoken English was reported as "Very Well" or "Well", we considered the response as "High"; if reported as "Not Well" or "Not at All", we considered the response as "Low".

Statistical Analyses

We ran several sets of analyses using SAS v. 9.1.3 (Cary, NC) after downloading the PIAAC U.S. Public Use File Number 2014045 from the National Center for Education Statistics and creating the abovementioned variables (SAS, 2002-2004; U.S Department of Education, 2013). All appropriate weighting macros derived by PIAAC were utilized in order to provide population-level results adjusted for the sampling methods used in the study. By using random selection methods at each stage of sampling, this four-stage stratified area probability sample provided reliable statistics for the US population from the sampled data (OECD, 2013).

The proficiency scoring categories were created for each imputation of the PIAAC as recommended by the PIAAC analytic staff. In addition, according to NCES Statistical Standards and IES Data Security's rules, sample frequencies were rounded up to the nearest 10s. Weighted frequencies and binary univariate logistic regressions were conducted. The regression models produced by SAS provided estimated odds ratios (ORs) with confidence interval of 95% as well as significance ($p \leq .05$).

Results

Before specific research questions are addressed, we looked at characteristics of our sample. Frequencies are stratified according to each domain - Literacy, Numeracy, and Problem Solving and are listed in Appendix Table 1.

Significant differences in population distribution were generally found in all variables between Literacy and Problem Solving and Numeracy and Problem Solving. Significant differences in population distributions between Literacy and Numeracy were found in Gender (more men in Low Level Literacy and more women in Low Level Numeracy, (χ^2 =4.1 (1), $p \leq$ .05). Age was also a variable with statistical significance in distribution between Literacy and Numeracy (χ^2 =14.1(4), $p \leq .05$). Adults ages 55-65 were more likely to be in the low level Literacy domain than adults ages 24 and younger while a higher proportion of adults ages 24 and younger were in the low level Numeracy domain. Differences in sample distribution between all variables within the 3 domains are shown in Appendix Table 2.

Research question 1 *asks* 'What sources do people with low level LNPS utilize when seeking health information?' To answer this question, we consider weighted frequencies and odds ratios.

Table 1 shows the frequencies of utilization of health information source by cognitive domains. Radio/TV were the most used source for those with low level Literacy and Numeracy and the Internet and Health Professionals were the most used sources for those with low level Problem Solving. Overall, Radio/TV was the most frequently used source and Print Media was the least.

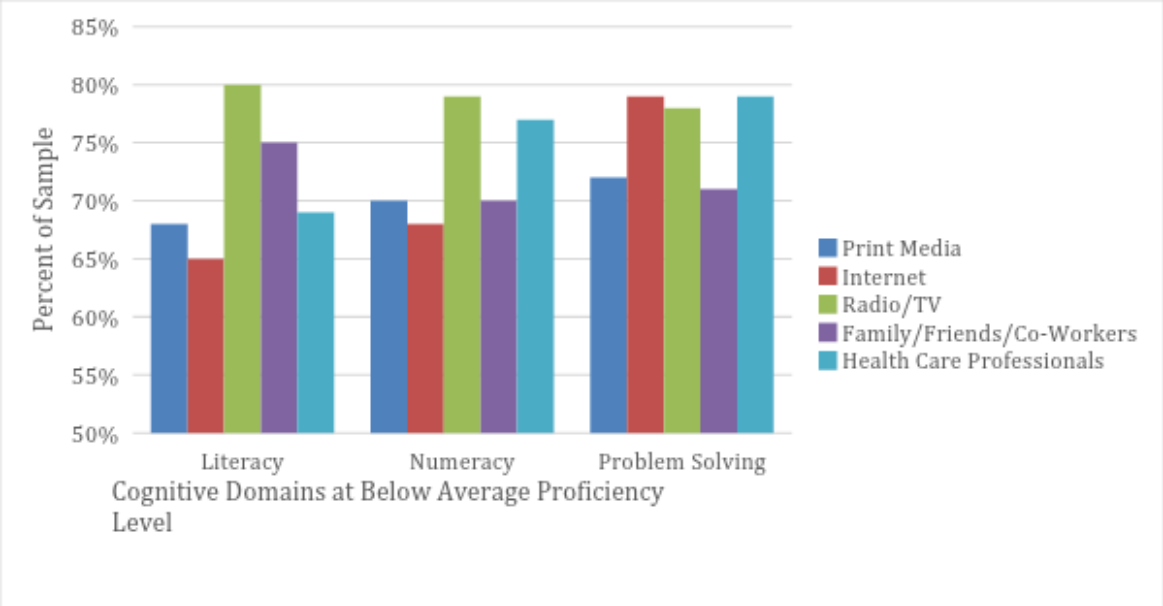
Table 1. Use of Health Information Sources by Cognitive Domain

	LITERACY	NUMERACY	PROBLEM SOLVING
Print Media	68%	70%	72%
Internet	65%	68%	79%*
Radio/TV	80%*	79%*	78%
Friends/Family/Co-Workers	75%	70%	71%
Health Professionals	68%	77%	79%*

**Most used source/sources of health information*

Figure 1 highlights the use of difference health information sources by cognitive domain. There is a correlation among all of the health information sources (Print Media, Internet, Radio/TV, Family/Friends/Co-Workers and Health Professionals), and they are all significantly associated as shown in Appendix Table 3.

Figure 1. Use of Health Information Sources by Cognitive Domain



Participants used multiple health information sources. Within the Literacy domain, for example, Radio/TV was used most often (Table 1, Figure 1). According to results shown in Table 2, that means that those who are in low level Literacy and who use Radio/TV are 3.5 times more likely to use Print Media as their secondary source of health information while those in low level Problem Solving are only 2.8 times more likely. All of these relationships are significant as shown in Appendix Table 3.

Table 2
Odds Ratios (OR) for Most Likely Sources of Co-Used Health Information

Source of Health Information	Most Likely Additional Source of Health Information	Domain Odds Ratios		
		Literacy	Numeracy	Problem Solving
Print Media	Internet	3.6*	3.7*	3.4*
Internet	Print Media	3.6*	3.7*	3.4*
Radio/TV	Print Media	3.5*	3.3*	2.8*
Friends/Family/Co-Workers	Health Professionals	2.6*	2.7*	2.1*
Health Professionals	Internet	3.4*	3.3*	3.2*

**Significance at p<.05*

Figures 2 – 6 illustrate the likelihood of using multiple sources in addition to an individual source. All of the results are significant ($p<.05$) except for the Problem Solving domain interaction between Health Professionals and Radio/TV.

Figure 2. Likelihood of Using Different Health Information Sources in Addition to PRINT MEDIA

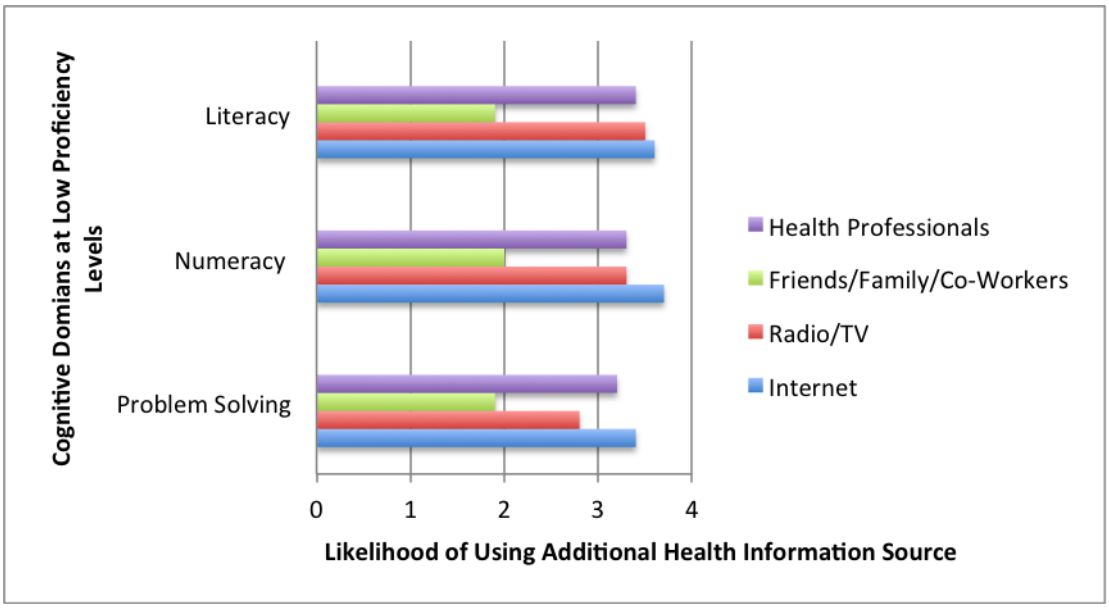


Figure 3. Likelihood of Using Different Health Information Sources in Addition to INTERNET

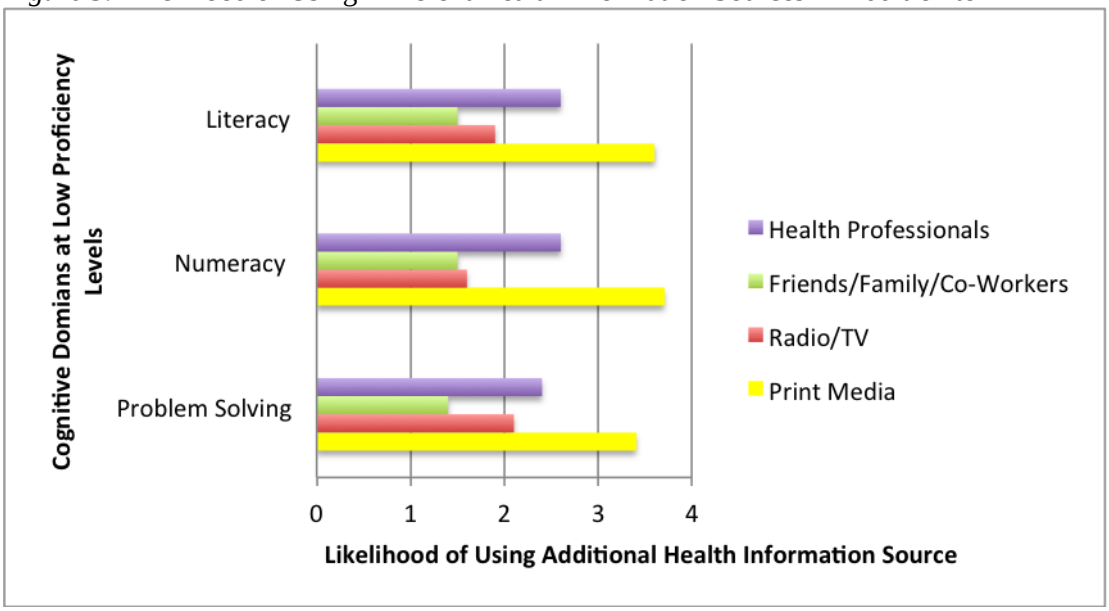


Figure 4. Likelihood of Using Different Health Information Sources in Addition to RADIO/TV

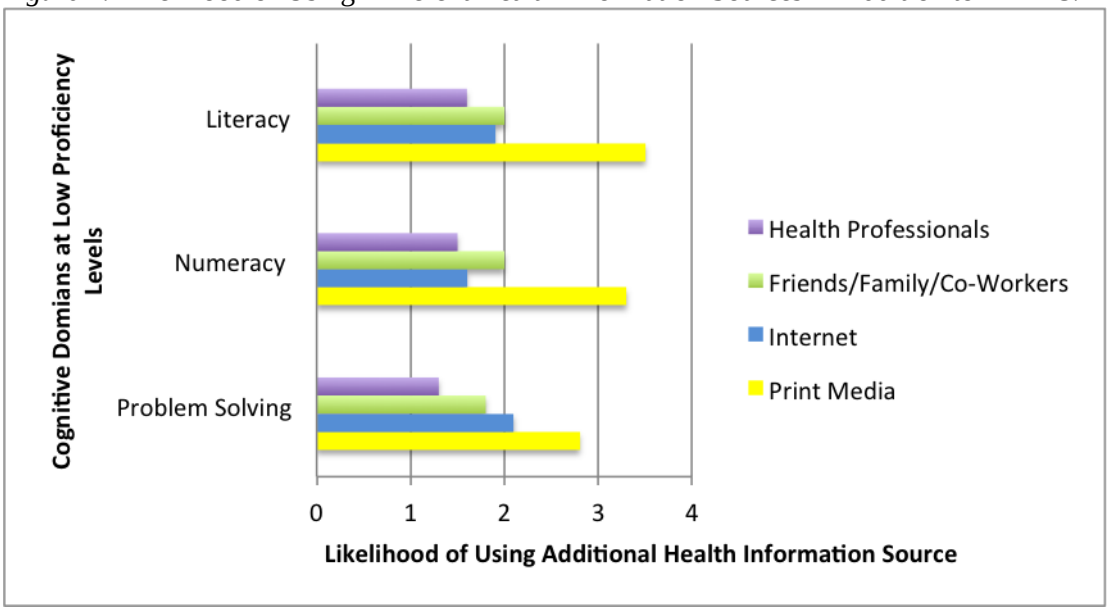


Figure 5. Likelihood of Using Different Health Information Sources in Addition to FRIENDS/FAMILY/CO-WORKERS

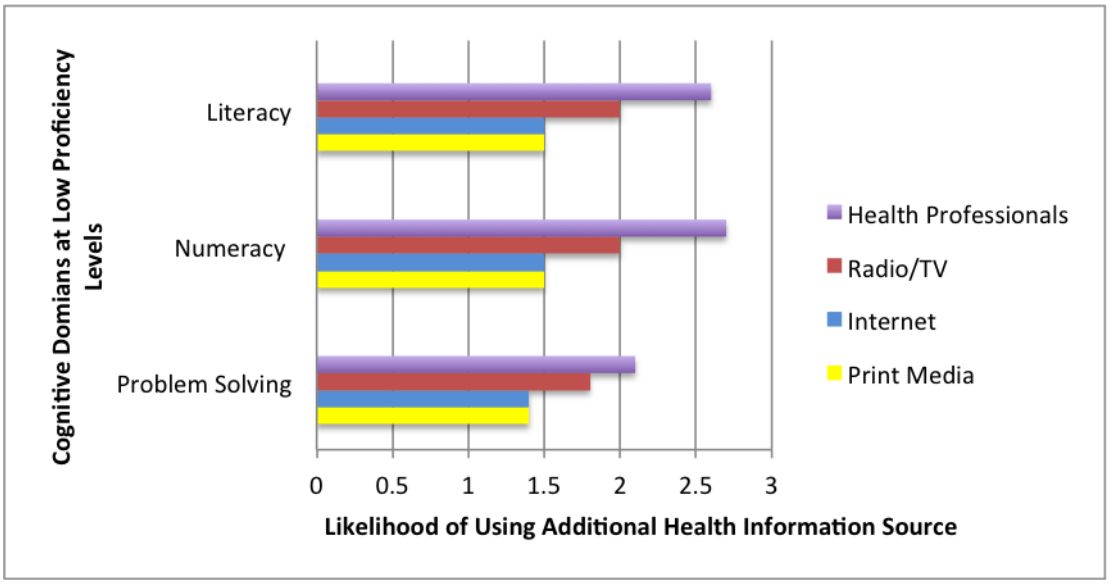
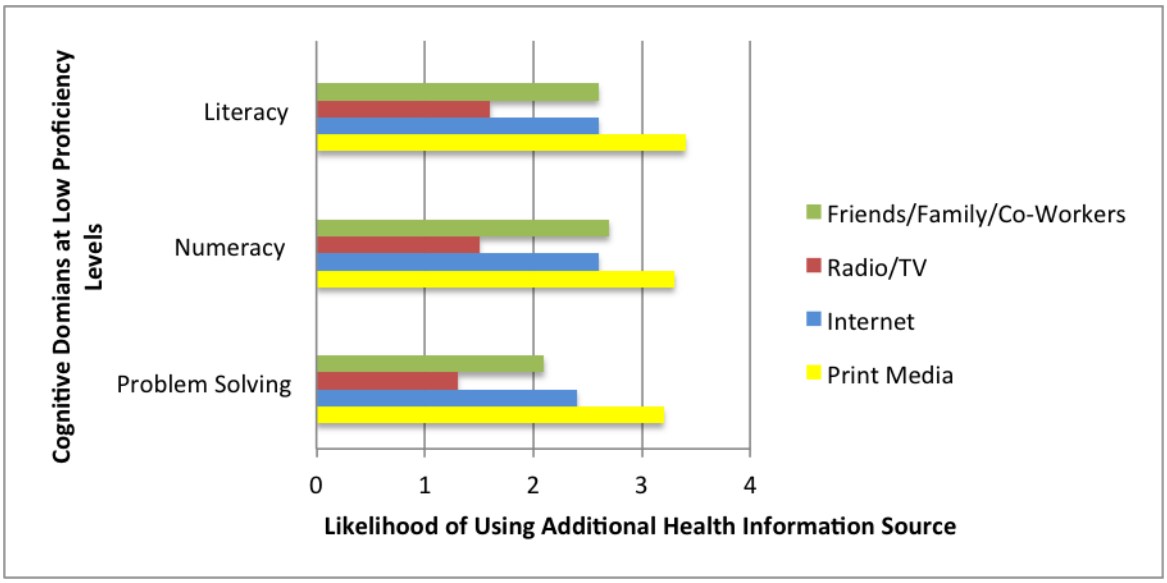


Figure 6. Likelihood of Using Different Health Information Sources in Addition to HEALTH PROFESSIONALS



Research Question 2 asks: "When looking at Gender, Age, Race, Educational Attainment, Health Status, Use of Preventive Measures and Facilities in Reading, Writing, and Speaking/Understanding Spoken English, which of these factors predict different health information sources for people with low level LNPS?" Key findings at $p \leq .05$ are discussed herein, and detailed Odds Ratios are shown in the Appendix, Table 4 with a summary shown below in Table 3.

Table 3. Significant Factors Predicting Use of Health Information Source, Domains with Significant Findings (Noted as L=Literacy, N=Numeracy, PS=Problem Solving)

	Print Media	**Internet**	**Radio/TV**	**Friends/ Family/Co-Workers**	**Health Professionals**
Gender (referent= male)	Female (L,N,PS)	Female (L,N,PS)	Female (PS)	--	Female (L,N,PS)
Age (referent=24 and younger)	55-65 (L, N, PS)	24 and younger vs 35-65 (L,N) 24 and younger vs 55-65 (PS)	35-54(L) 45-54(N) 35-65 (PS)	--	55-65 vs 24 and younger (L, N, PS)
Race	Black, Hispanic, Asian/Other vs non-Black,	Hispanic, Asian/Other vs non- Hispanic, Asian/Other (L)	Blacks vs Non-Blacks (L,N,PS) Hispanics vs non-Hispanics (L)	--	Blacks vs Non-Blacks (L,N,PS)

	Hispanic, Asian/Other (L,N,PS)		Asian/Other vs Non-Asian/Other (N)		
Educational Attainment	High School Diploma (L,N,PS)	High School Diploma (L,N,PS)	--	--	--
Health Status (Good vs Poor)	Good (L,N)	Good (L,N,PS)	Good (L,N,PS)	Good (L,N,PS)	Good (N, PS)
Preventive Measures	Use of Preventive Measures (L,N, PS)	Use of Preventive Measures (L/N,PS)	--	Use of Preventive Measures (L/N,PS)	Use of Preventive Measures (L/N,PS)
Facility in Reading English	High (L,N)	High (N)	High (N)	--	--
Facility in Writing English	--	High (L,N,PS)	--	High (N)	High (L,N,PS
Facility in Spoken English	--	--	--	--	--

Discussion

Health Information Seeking Behavior (HISB) is a complex process (Lambert & Loiselle, 2007). Our research demonstrated that for people with low level LNPS, HISB is determined by varying combinations of a person's background, health related behaviors, and perceived skills in English. Our study identified the sources that adults with low LNPS used when searching for health information. In addition, we identified what factors might individually or in combination predict the use of certain health information sources. Taken together, these findings provide guidance to those involved in health education, health promotion, and the delivery of health care, and shed light on the complex role HISB plays in health literacy and health behaviors.

Individuals at low level Literacy/Numeracy proficiency levels were more likely to use oral sources of health information (Radio/TV, Friends/Family/Co-Workers, Health Professionals) than written sources (Print Media, Internet). Written health information is often dense, complex, and scientific, even when presented in an easier to read format (Hibbard, Peters, Dixon & Tusler, 2007; Dutta-Bergman, 2004; Brown et al., 2011). Those who have weak skills in navigating complex written text and in applying multi-step processes to understand, evaluate, and apply what is read may have difficulty even accessing printed health materials (OECD, 2013). Health information is often replete with both text and numbers; therefore, it is not surprising to see that sources with written information are the least used by adults with these low level skills. Adults with such limitations may only be able to identify basic vocabulary, determine sentence meaning, perform the most basic mathematical operations, and identify

simple graphical elements according to directly assessed testing done in the PIAAC study (National Center for Education Statistics, 2013). On the other hand, one of the most commonly used health information sources for adults with low level Problem Solving is the Internet. Even though the tasks they can accomplish may be simple or one-dimensional according to directly assessed PIAAC testing, the ability to use available and familiar technology such as web browsers may lead to ease in finding information on a digital platform such as the Internet (National Center for Education Statistics, 2013).

Multiple Sources of Health Information

We demonstrated that individuals use multiple sources of health information, and those who do tend to report better Health Status. The Internet was most often combined with use of Print Media and Radio/TV while use of Friends/Family/Co-Workers was most often combined with Health Professionals. HISB, then, is not necessarily driven by comfort with or availability of one source or another, but rather by multiple sources through various modalities. Understanding how information sources and adults with low level LNPS interact with each other in HISB will provide a more comprehensive and holistic understanding of information acquisition. Individuals may understand different aspects of that health information differently, depending on whether it is media-related, people-related, actively sought, or passively sought (Anker et al., 2011; U.S. Department of Education, 2013; Wakefield et al., 2010; Salwen & Stacks, 2009).

Print Media

Although the use of print media as a source of health information has fallen since 2007 (Tu, 2011), written materials are the most common source of health information, are widely and easily available, and are often distributed to patients who utilize the health care system. Our study found that use of printed materials has the broadest group of significant predictors of any health information source (see Appendix Table 4) – Gender, Age, Race, Health Status, Use of Preventive Measures, and Facility in Reading English. This indicates the importance of printed materials for adults across all low LNPS domains (Ryan et al, 2014).

We also demonstrated that adults who report good Health Status and Use of Preventive Measures in the low level Literacy and Numeracy domains were more likely to use Print Media. A variety of tools such as the CDC's Clear Communication Index and the AHQR's Health Literacy Toolkit have been developed to assess the readability and suitability of printed materials for adults with low literacy levels. Regardless of LNPS level, printed materials that are clear, concise, in plain language, and use simple graphics increase patient uptake and utilization of information (Hibbard, Peters, Dixon &Tusler, 2007; Parker et al., 1995, Rothman et al., 2006). In addition, printed materials are often kept for future reference, can be shared with those who may have a higher level of understanding, are used as teaching or reinforcement tools, and share information about available health services (Shieh & Hosei, 2008).

Hispanics and Asians favored Print Media and this may be because print materials are widely available in multiple languages (Sarkar, Schillinger, Lopez, & Sudore, 2010; Ye, Mack, Fry-Johnson,& Parker, 2012). This broad availability may inform this finding since the PIAAC survey question did not specify which language the health information was in. Older adults across LNPS domains also rely on Print Media for health information. Health professionals such as doctors, nurses, and pharmacists often provide health materials as part of providing health care (Schloman, 2014). Research suggests that health professionals are the most trusted source of

health information; therefore, receiving printed materials from a trusted source may make them more credible (Dutta-Bergman, 2003; Health Information National Trend Survey, 2010). This is also consistent with our findings that people ages 55-65 are more likely to use Health Professionals as a source of information.

The Internet

The Internet is considered the fastest growing source of health information (Manyika & Roxburgh, 2011; Fox, Duggan & Purcell, 2013); however, our results showed that only 2/3 of adults with low level Literacy/Numeracy use the Internet as a source of health information. The high literacy demands of health-related websites may create problems in understanding and application of information even for those who have a high school diploma (Birru, Monaco, Charles, Drew, Njie, Bierria, Detlefseon & Steinman, 2004). According to the directly assessed Literacy and Numeracy PIAAC testing, adults with low literacy and numeracy proficiencies are more likely to only be able to access and identify rather than integrate and apply information (OECD, 2013). The knowledge and use gap further created by the introduction of digital resources exacerbates challenges faced by those with low LNPS who may also have low digital literacy skills (Birru et al., 2004; Dutta-Berman, 2004; Fox, Duggan, & Purcell, 2013). In addition, health information that people acquire from the Internet is often neither complete nor accurate. Those with low LNPS may have difficulty interpreting information correctly as well as determining the validity and accuracy of what they read.

Adults with low LNPS may have difficulty searching for health information on the Internet for the following reasons: difficulty generating effective search terms, an aversion to using links on web pages, access to computers, and difficulty understanding how to use the information obtained (Fox, Duggan, & Purcell, 2013). Our finding that a high Facility in Reading English did not have significance in use of the Internet across all three domains is surprising since information on the Internet is largely text-based and must be read. This may be because many health-related websites and source materials have been translated into multiple languages and, at least for Hispanics and Asians in our study, reading in English does not matter. Interestingly, a high Facility in Writing English was significant in using the Internet across all 3 domains. Writing skills, including spelling and typing, are critical for digital literacy, and enhance use of the computer to access the Internet (Graham, MacArthur & Fitzgerald, 2013). It is also possible that those who are non-native English speakers have a low facility in writing English whereas their abilities to read in English are higher. They might not use the Internet because they cannot yet write confidently in English.

Radio/TV

Television and radio are ubiquitous sources of passive information and widely accessible to most Americans. Within these media, health information is shared through different modalities including public service announcements, paid advertisements, educational entertainment, and documentaries (Cutilli, 2010; Redmond, Baer, Clark, Lipsitz & Hicks, 2010). Our study suggests that Blacks with low level proficiency levels across all domains use Radio/TV as a health information source. This is not surprising since, according to the Nielson Company, Black Americans watch significantly more television than any other racial group (2013). Hispanics with low level Literacy /Numeracy skills also cite Radio/TV as a source of information. Because the PIAAC survey did not ask about source language, it is difficult to assess whether Hispanics used Spanish or English language Radio/TV as their source of information. In general, adults

passively acquire health information from Radio/TV as an unintentional result of simply leaving the radio or television on during the day (Longo et al., 2010), or they may turn to specific educational entertainment shows that specifically focus on health related topics. Studies indicate that passive acquisition of health information from Radio/TV may ebb and wane depending on disease state, amount of prior health knowledge, source credibility, and clarity of the information (Longo et al, 2010).

Friends/Family/Co-Workers

The only significant findings regarding the immediate social context was that those who report better Health Status and Use of Preventive Measures use Friends/Family/Co-Workers as a source of health information. This is true across all LNPS domains, and the percentage of use is also fairly consistent within domains (75% Literacy, 71% Numeracy, 70% Problem Solving). According to Redmond et al. (2010), interpersonal sources of health information are often associated with self-reported health behaviors. Social influence may be partially responsible for eliciting healthy behaviors because interpersonal communication can create shared norms around health behaviors (Lee, 2010).

Health Professionals

Our results indicate that people ages 55-65 are more likely than those 24 and younger to use Health Professionals as a source of information. Older individuals tend to have more chronic diseases, which facilitates the need for interaction with Health Professionals. Following from this, it is not surprising that those who report Use of Preventive Measures consider Health Professionals as a source of health information since health professionals are most likely to promote and/or provide these preventatives. Health Professionals can include doctors, nurses, allied health professionals, pharmacists, and others. They provide the majority of oral health communication with patients. Research indicates that healthcare professionals are the most trusted source of health information (Paradise & Garfield, 2013). Using health professionals as a source of information indicates that people are also utilizing some resources of the health care system, an important variable in having better health outcomes (Pardise & Garfield, 2013).

An interesting finding is that adults with low level LNPS who report having a high Facility in Writing English report using Health Professionals as a source of information. Past studies have shown that adults with poor writing skills cannot adequately fill out medical forms, apply for health insurance, or miss appointments (i.e., because they do not write them down) and therefore do not access the health care system as readily as those with adequate writing skills (Baker, 2007; Berkman, 2011; IOM, 2013; Parker et al., 1995; Schloman, 2004; Safeer & Keenan, 2005). Blacks are the only racial group with greater usage of Health Professionals. Prior studies have conflicting findings: some indicate that Blacks have less trust in the health care system which is further associated with less doctor-patient interaction (Musa, Schulz, Harris, Silverman & Thomas, 2009), while others indicate that Blacks seek more health information from physicians and nurses because they are more trustworthy and credible than other sources (Agada 1999, Powe, Caburnay, Cooper, & Cameron, 2013).

Implications

It is evident from this study that Health Information Seeking Behaviors (HISB) are both complex and subtle, and depend on a multitude of factors. One size doesn't fit all as was

evidenced by the varying combinations of a person's background, health related behaviors, and perceived skills in English as well as the use of multiple information sources as found in our study. This does not mean that continuing efforts to create health materials in appropriate readability levels should not continue. However, efforts must go beyond this.

Researchers and clinicians need to consider varying combinations of factors when developing health promotion and education interventions and materials for adults with low level LNPS. Materials should be developed at appropriate readability levels, however, additional focus must be placed on the health professionals themselves. Our study finds that people with low level LNPS who use health professionals as a source of information report better health status. It is challenging for health professionals to gain a patient's trust, reduce their anxiety, exchange appropriate information, manage uncertainty and enhance their participation in decision making during a brief health care visit. Health literacy and cultural sensitivity training should be included as part of all health professional training, whether as a discrete curricular objective or as a component of continuous and on going training with evaluation criteria to measure outcomes. While one obstacle lies in training, another lies in time. The current system leverages high volume throughput over quality interaction between patients and providers. Changes could be made in how health care professionals are reimbursed for evaluation and management of patients because the amount of time required to engage in participatory decision making may exceed the amount of time required for a physical exam, diagnosis and development of a treatment plan. Other resources like para-professionals or physician extenders could help address this need, and should be considered as a complementary solution.

Patients and caregivers seek different types and amounts of information depending on their specific contexts and needs (Lambert & Loiselle, 2007). Health needs also change over the course of a lifetime and it may be valuable to consider HISB as a continuum of information seeking rather than a discretely occurring behavior. Our results show differences in ages relating to use of different health information sources. In particular, those who are older and have low LNPS do not use the Internet as much as those who are young; they face a critical gap in accessing health information as more health professionals and consumer organizations and agencies rely on its use. Digital literacy includes both use of physical technology and having the literacy skills to search and access information including medical communication such as medical forms, insurance forms, Internet search terms, and screening guidelines. It is unlikely that older individuals with low LNPS will become proficient technology users. Health information must be provided through modalities that are useful for older adults with low LNPS such as print media and oral communication with health providers.

Many basic and often repeated forms are filled with medical jargon that is meaningless to consumers. The health care industry – pharmaceutical companies, hospital, medical systems, and insurance companies – creates these documents, and has the ability to find ways to standardize and simplify information needs. While both reading and writing skills are important in seeking health information, our study shows that writing is significant when seeking information from two of the most common sources of health information – the Internet and Health Professionals. Medical history forms, insurance forms, informed consent forms, and other documents that contain blank spaces that are required to be filled in by the user are difficult for adults with low LNPS to fill out (Cornett, 2009). The health care industry could improve the meaning and usability of these documents by simplifying them and/or by providing assistance to those who may have difficulty filling out the forms. This might require additional sensitivity or cultural training for those who need to have medical forms filled in accurately and completely.

Additionally, accessing this information on the Internet requires basic typing skills. Adults with low skill levels may not have had exposure to computer keyboards, or may have difficulty in spelling that inhibits their writing. While attention to digital literacy skills in all educational, vocational, or extra-curricular settings (such as libraries) can help increase use of the Internet by those who may be inhibited by their low facilities in writing, the medical industry can find ways to simplify the documentation to begin with.

Those who are involved in Adult Basic Education (ABE) may be able to find ways to increase participation in HISBs. For example, curricular modifications could be made to enhance writing skills in a health-related context since our study finds they are significantly associated with use of the Internet and Health Professionals. Educational attainment is a significant factor for those who use the Internet and Print Media as sources of health information, but so are self-reported Facilities in Reading English and Writing English. While some ABE classes only cover reading, many others do try to cover other skills and topics such as computer skills, math, writing, health literacy, and financial literacy. There is, however, very little curricular guidance, professional development, and overall funding provided to ABE (Greenberg, 2008). Within this reality, teachers could still be encouraged to incorporate those skills that lead to increased use and understanding of health content and information. Increasing access to and comfort with computers can also be encouraged by also providing information to adult learners about using computers at public libraries. Reading, writing, and digital literacy may be remediable skills for adults in ABE programs; enhancing skill level and self-efficacy in these direct skill areas could enhance how adults with low LNPS seek health information. Additionally, as functional skill levels in reading, writing, and computer use increase, these adults may also be more able to acquire higher-level skills and move from low level LNPS levels to higher, more complex proficiency levels. Policy makers should consider enhanced funding for ABE in order to assist these adults with greater opportunities to engage in participatory health care.

Those with high school diplomas may be able to find health information, however their inability to use higher level skills may inhibit interpretation and use of that health information. Ultimately, higher levels of engagement in health care and better health outcomes stem from this more complex use of health information. Educational ability matters for health – studies show that education is linked with health through health knowledge and behaviors, literacy levels, employment status, insurance status and a variety of social and psychological factors (Egerter, Braveman, Sadegh-Nobari, Grossman-Kahn, & Dekker, M., 2009; OECD, 2013). Results from our study indicate that over 80% of adults in low level LNPS have a high school diploma. The goal of accessing health information is eventually using that information to make informed health decisions and lead to better health outcomes, however, if students are not taught health literacy as part of the K-12 curriculum, there will never be a health literate adult population. Teaching children health content, how to seek information to answer health questions, and how to engage in healthy behaviors could have a maximal impact on their success in not only health, but in life and work as well. Policy makers in K-12 education must consider health literacy as an integral part of an educational system's responsibilities to developing academic and life skills in their students.

Health information can be made simpler, more streamlined, more accessible, and more meaningful for adults with low LNPS. As shown through this analysis of the PIAAC data, there are a myriad of opportunities to be addressed. All stakeholders –researchers, clinicians, patients, caregivers, the health care industry, ABE and K-12 education policy makers – have a role to play in improving the health of individuals and society.

Limitations and Future Research

One limitation to this study is that we considered adults within each cognitive domain separately, i.e., we did not assess those who had any combination of low level literacy, numeracy and/or problem solving skills. We also dichotomized the outcome measures and only studied use vs non-use of a health information source. Measures of Health Status and Use of Preventive Measures were self-reported as were measures of Facility in Reading, Writing and Spoken English. We also were not able to discern if health information sources were in English or any other language. Our study also did not evaluate insurance-related access to the health care system, which could have created bias in participant responses. We did not consider native language status in our analysis as well. Additionally, the findings in this study addressed how adults source health information, not whether they understand and act on health information. Finallly, we did not study how our sample population compares to those who have higher-level LNPS proficiency skills.

It is also possible that people who are deficient in all three domains have different outcomes than people with low skills in only one domain, therefore, future research in understanding how people with deficiencies in just one, two, or all of the three PIAAC cognitive domains source health information could inform more targeted HISB interventions. Although the PIAAC data only provided self-reports of health status and preventive measures usage, it may be valuable to corroborate some of these findings with directly assessed health data such as that found in the CDC NHANES dataset and others. Self-reported facilities in reading, writing and spoken English do not align themselves with educational attainment; it would be valuable to understand where these discrepancies lie and perhaps uncover how other sources of learning that are reported in the PIAAC data affect HISB. Evaluating native-language statuses as well as language of written and oral health information are other opportunities to add to the body of health communications research specifically targeted at the non-native English speaking population. Further questions about how individuals use health information provides a rich area for additional research since simply accessing health information does not always lead to positive changes in health outcomes. Finally, since HISB are not limited to adults with low level LNPS skills only, evaluation of adults with higher-level LNPS as directly assessed by the PIAAC data can help researchers frame targeted and sustainable changes in development of health education as well as the delivery of health information and health promotion by health professionals, health education and promotion practitioners, and the health care system.

Appendix

Table 1
General Population Characteristics and Weighted Frequencies, 2012 US PIAAC DATA
Low Level Literacy, Numeracy, and Problem Solving Proficiency Levels

	Low level Literacy			Low level Numeracy			Low level Problem Solving		
Variable	n*	Weighted %	SE	n*	Weighted %	SE	n*	Weighted %	SE
Gender									
Male	1040	47.9%	0.9	1160	43.7%	0.7	950	45.2%	0.8
Female	1230	52.1%	0.9	1650	56.3%	0.7	1320	54.8%	0.8
Age									
Under Age 24	230	10.3%	0.9	310	11.5%	0.7	230	10.5%	1.0
25-34	460	20.4%	0.9	580	20.8%	0.7	500	21.5%	1.0
35-44	450	21.0%	0.9	550	20.5%	0.7	470	21.6%	0.9
45-54	550	25.0%	0.9	680	24.7%	0.7	550	25.0%	0.9
55-65	580	23.4%	0.7	690	22.5%	0.6	540	21.4%	1.0
Race									
White	1300	53.8%	1.2	1690	57.4%	1.1	1490	63.9%	1.5
Black	430	17.9%	0.6	530	17.6%	0.5	370	15.4%	0.7
Hispanic	380	20.7%	0.9	400	18.0%	0.8	240	12.7%	1.0
Asian/Other	170	7.6%	0.9	190	7.0%	1.0	170	8.0%	1.1
High School Diploma									
No	390	18.4%	0.6	410	15.8%	0.5	160	7.6%	0.5
Yes	1880	81.6%	0.6	2400	84.2%	0.5	2110	92.4%	0.5
Health Status									
Fair/Poor	530	22.0%	1.1	590	20.3%	1.0	330	13.8%	1.0
Excellent/Very Good/Good	1740	78.0%	1.1	2220	79.7%	1.0	1940	86.2%	1.0
Use of Any Preventive Health Measure									
Don't Use	440	20.5%	1.1	490	18.6%	1.0	340	15.9%	1.0
Use	1830	79.5%	1.1	2320	81.4%	1.0	1930	84.1%	1.0
Facility in Reading English									
Low	190	10.6%	0.9	200	8.8%	0.8	30	1.8%	0.3
High	2080	89.4%	0.9	2620	91.2%	0.8	2240	98.2%	0.3
Facility in Spoken English									
Low	110	6.5%	0.8	110	5.4%	0.7	20	0.9%	0.2
High	2160	93.5%	0.8	2700	94.5%	0.7	2260	99.1%	0.2
Facility in Written English									
Low	250	13.9%	0.9	260	11.5%	0.8	80	4.2%	0.5
High	2020	86.1%	0.9	2560	88.5%	0.8	2200	95.8%	0.5
Print Media									
Doesn't Use	720	31.7%	1.1	840	30.1%	0.9	630	27.7%	0.9
Uses	1550	68.3%	1.1	1970	69.9%	0.9	1650	72.3%	0.9
Internet									
Doesn't Use	800	35.4%	1.2	900	32.2%	1.0	460	20.6%	1.2

Uses	1470	64.6%	1.2	1910	67.8%	1.0	1820	79.4%	1.2
Radio/TV									
Doesn't Use	470	19.70%	0.9	610	21.2%	0.8	510	21.9%	0.9
Uses	1800	80.30%	0.9	2200	78.8%	0.8	1770	78.1%	0.9
Friends, Family, Co-Workers									
Doesn't Use	550	24.9	1.1	840	30.6%	1.0	640	28.7%	1.1
Uses	1720	75.1	1.1	1970	69.7%	1.0	1640	71.3%	1.1
Health Professionals									
Doesn't Use	690	31.2	1.2	630	23.0%	1.0	470	20.8%	1.0
Uses	1580	68.8	1.2	2180	77.0%	1.0	1810	79.2%	1.0

*rounded to tens according to NCES Statistical Standards and IES Data Security Rules

Table 2
Differences between LNPS Domains for Gender, Age, Race, Educational Attainment, Health Status, Use of Preventive Measures, Facilities in Reading, Writing and Spoken English, Using Chi-Square Goodness of Fit Tests, df=1

	Literacy to Numeracy	Literacy to Problem Solving	Numeracy to Problem Solving
	$\chi 2$ (df)	$\chi 2$ (df)	$\chi 2$ (df)
Gender	4.1(1) *	.33 (1)	17.3(1)*
Age	14.1(4)*	24.0(4)*	20.9(4)*
Race	5.0(3)	63.7(3)*	38.7(3)*
Educational Attainment	3.2(1)	295.3(1)*	194.6(1)*
Health Status	12.9(1)	173.0(1)*	121.7(1)*
Use of Preventive Measures	.9(1)	20.3(1)*	4.8(1)*
Facility in Reading English	.5(1)	550.6(1)*	443.8(1)*
Facility in Spoken English	1.3(1)	335.3(1)*	238.2(1)*
Facility in Writing English	.5(1)	260.2(1)*	175.4(1)*

* $p \leq .05$

Table 3

Odds Ratio (OR) and Confidence Intervals (CI) for Use of Additional Health Information Source by Primary Source Stratified by Below Average Literacy,Numeracy, and Problem Solving Proficiency Levels

LITERACY	Print Media	Internet	Radio/TV	Friends/Family/ Co-Workers	Health Professionals
	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Print Media	---	3.6 (2.9, 4.5)*	3.5 (2.8, 4.5)*	1.9 (1.6, 2.3)*	3.4 (2.7, 4.2)*
Internet	3.6 (2.9, 4.5) *	---	1.9 (1.6, 2.4)*	1.5 (1.3, 1.8)*	2.6 (2.0, 3.4)*
Radio/TV	3.5 (12.8, 4.5)*	1.9 (1.6, 2.4)*	---	2.0 (1.5, 2.5)*	1.6 (1.2, 2.1)*
Friends/Family/Co-Workers	1.9 (1.6, 2.3)*	1.5 (1.3, 1.8)*	2.0 (1.5, 2.5)*	---	2.6 (2.1, 3.2)*
Health Professionals	3.4 (2.7, 4.2)*	2.6 (2.0, 3.4)*	1.6 (1.2, 2.1)*	2.6 (2.1, 3.2)*	---
NUMERACY	Print Media	Internet	Radio/TV	Friends/Family/ Co-Workers	Health Professionals
	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Print Media	---	3.7 (3.1, 4.5)*	3.3 (2.6, 4.1)*	2.0 (1.7, 2.4)*	2.0 (1.7, 2.4)*
Internet	3.7 (3.1, 4.5)*	---	1.6 (1.3, 1.9)*	1.5 (1.3, 1.8)*	2.6 (2.1, 3.3)*
Radio/TV	3.3 (2.6, 4.1)*	1.6 (1.3, 1.9)*	---	2.0, (1.7, 2.4)*	1.5 (1.2, 1.9)*
Friends/Family/Co-Workers	2.0 (1.7, 2.4)*	1.5 (1.3, 1.8)*	2.0 (1.7, 2.4)*	---	2.7 (2.2, 3.3)*
Health Professionals	3.3 (2.7, 4.0)*	2.6 (2.1, 3.3)*	1.5 (1.2, 1.9)*	2.7 (2.2, 3.3)*	---
PROBLEM SOLVING	Print Media	Internet	Radio/TV	Friends/Family/ Co-Workers	Health Professionals
	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Print Media	---	3.4 (2.6 4.3)*	2.8 (2.2, 3.5)*	1.9 (1.6, 2.3)*	3.2 (2.5, 4.0)*
Internet	3.4 (2.6, 4.3)*	---	2.1 (1.6, 2.8)*	1.4 (1.1, 1.8)*	2.4 (1.8, 2.3)*
Radio/TV	2.8 (2.2, 3.5)*	2.1 (1.6, 2.8)*	---	1.8 (1.5, 2.3)*	1.3 (.9, 1.8)
Friends/Family/Co-Workers	1.9 (1.6, 2.3)*	1.4 (1.1, 1.8)*	1.8 (1.5, 2.3)*	---	2.1 (1.7, 2.7)*
Health Professionals	3.2 (2.5, 4.0)*	2.4 (1.8, 2.3)*	1.3 (.9, 1.8)	2.1 (1.7, 2.7)*	---

* Significance at $p<.05$

Table 4

Odds Ratios(OR) for Gender, Age, Race, Educational Attainment, Health Behaviors, and Facilities in English on Sources of Health Information 2012 US PIAAC Data, Low level Literacy, Numeracy, and Problem Solving Proficiency Levels

PRINT MEDIA	LITERACY			NUMERACY			PROBLEM SOLVING		
	OR	95%CI	*p*	OR	95%CI	*p*	OR	95%CI	*p*
Gender (Female to Male)	1.7	1.3, 2.9	<.05*	1.8	1.4, 2.2	<.05*	2.1	1.7, 2.5	<.05*
25-34 vs under 24	0.9	.6, 1.2	0.45	0.8	.6, 1.1	0.12	0.9	.6, 1.2	<.05*
35-44 vs under 24	1.3	.8, 1.9	0.25	1.2	.8, 1.6	0.36	1.2	.8, 1.7	0.43
45-54 vs under 24	1.4	.9, 2.2	0.15	1.3	1.0, 1.8	0.09	1.3	.8, 1.9	0.37
55-65 vs under 24	1.9	1.3, 2.9	<.05*	1.8	1.3, 2.5	<.05*	2.3	1.4, 3.5	0.30
Black vs Non-Black	1.4	1.0, 2.0	.03*	1.5	1.1, 2.0	<.05*	1.6	1.2, 2.2	<.05*
Hispanic vs Non-Hispanic	2.1	1.6, 2.8	<.05*	2.0	1.5, 2.6	<.05*	1.9	1.4, 2.6	<.05*
Asian/Other v sNon-Asian/Other	1.9	1.2, 3.1	<.05*	1.9	1.3, 2.7	<.05*	2.4	1.4, 3.6	<.05*
High School Diploma (Yes to No)	2.5	2.0, 3.1	<.05*	2.5	2.0, 3.1	<.05*	2.1	1.5, 2.9	<.05*
Health Status (Good vs Poor)	1.4	1.1, 1.9	<.05*	1.3	1.0, 1.7	<.05*	1.3	1.0, 1.8	0.07
Uses Preventive Health Measures (Yes to No)	1.7	1.4, 2.1	<.05*	1.6	1.3, 1.9	<.05*	1.7	1.4, 2.1	<.05*
Facility in Reading English (Good to Poor)	2.4	1.4, 4.0	<.05*	2.3	1.4, 3.7	<.05*	4.1	.8, 19.6	0.08
Facility in Spoken English (Good to Poor)	0.8	.3, 1.8	0.57	0.8	.4, 1.8	0.62	0.4	.1, 2.1	0.26
Facility in Written English (Good to Poor)	1.2	.7, 2.0	0.50	1.2	.7, 2.1	0.43	1.0	.4, 2.1	0.90

INTERNET	LITERACY			NUMERACY			PROBLEM SOLVING		
	OR	95%CI	*p*	OR	95%CI	*p*	OR	95%CI	*p*
Gender (Female to Male)	1.6	1.3, 2.0	<.05*	1.6	1.3, 2.0	<.05*	1.5	1.2, 2.0	<.05*
25-34 vs under 24	0.7	.4, 1.1	0.14	0.7	.5, 1.1	0.16	1.0	.6, 1.5	0.82
35-44 vs under 24	0.5	.3, .8	<.05*	0.5	.3, .7	<.05*	0.8	.5, 1.3	0.46
45-54 vs under 24	0.4	.2, .6	<.05*	0.4	.3, .6	<.05*	0.8	.5, 1.2	0.24
55-65 vs under 24	0.2	.2, .4	<.05*	0.2	.2, .3	<.05*	0.6	.4, 1.0	<.05*
Black vs Non-Black	1.1	.8, 1.5	0.46	1.1	.8, 1.5	0.44	1.4	.9, 2.0	0.10
Hispanic vs Non-Hispanic	1.4	1.1, 1.9	<.05*	1.3	.9, 1.7	0.15	1.3	.9, 2.0	0.17
Asian/Other v sNon-Asian/Other	1.6	1.0, 2.7	.05*	1.4	.9, 2.3	0.17	1.7	.8, 3.5	0.15
High School Diploma (Yes to No)	2.8	2.0, 3.8	<.05*	2.8	2.1, 3.9	<.05*	2.1	1.4, 3.0	<.05*
Health Status (Good vs Poor)	1.8	1.4, 2.3	<.05*	1.8	1.4, 2.2	<.05*	1.4	1.1, 1.9	<.05*
Uses Preventive Health Measures (Yes to No)	1.6	1.2, 2.1	<.05*	1.5	1.2, 2.0	<.05*	1.6	1.2, 2.2	<.05*
Facility in Reading English (Good to Poor)	1.8	.9, 3.3	0.08	1.9	1.0, 3.6	<.05*	1.9	.7, 4.6	0.18

Facility in Spoken English (Good to Poor)	**1.1**	**.6, 2.0**	**0.71**	**1.1**	**.6, 2.0**	**0.75**	**0.3**	**.1, 1.1**	**0.07**
Facility in Written English (Good to Poor)	**3.1**	**1.7, 5.8**	**<.05***	**3.0**	**1.7, 5.5**	**<.05***	**2.6**	**1.3, 5.4**	**<.05***

RADIO/TV	**LITERACY**			**NUMERACY**			**PROLEM SOLVING**		
	OR	**95%CI**	***p***	**OR**	**95%CI**	***p***	**OR**	**95%CI**	***p***
Gender (Female to Male)	**1.2**	**1.0, 1.5**	**0.11**	**1.2**	**1.0, 1.4**	**0.07**	**1.6**	**1.0, 1.6**	**<.05***
25-34 vs under 24	**1.1**	**.7, 1.7**	**0.61**	**1.1**	**.8, 1.5**	**0.66**	**1.8**	**.9, 1.8**	**0.21**
35-44 vs under 24	**1.6**	**1.1, 2.4**	**.03***	**1.3**	**.9, 2.0**	**0.21**	**2.4**	**1.1, 2.4**	**<.05***
45-54 vs under 24	**2.0**	**1.3, 3.2**	**<.05***	**1.6**	**1.1, 2.2**	**<.05***	**2.2**	**1.2, 2.2**	**<.05***
55-65 vs under 24	**1.4**	**.9, 2.4**	**0.15**	**1.4**	**.9, 2.1**	**0.13**	**2.5**	**1.0, 2.5**	**<.05***
Black vs Non-Black	**1.4**	**1.0, 2.0**	**.05***	**1.8**	**1.3, 2.4**	**<.05***	**2.7**	**1.3, 2.7**	**<.05***
Hispanic vs Non-Hispanic	**1.5**	**1.0, 2.2**	**.04***	**1.4**	**1.0, 2.1**	**0.07**	**2.0**	**1.0, 2.0**	**0.07**
Asian/Other v sNon-Asian/Other	**1.5**	**.9, 2.4**	**0.14**	**1.7**	**1.1, 2.6**	**<.05***	**2.7**	**.9, 2.7**	**0.10**
High School Diploma (Yes to No)	**1.3**	**1.0, 1.7**	**0.08**	**1.1**	**.9, 1.5**	**0.36**	**1.5**	**.7, 1.5**	**0.99**
Health Status (Good vs Poor)	**1.4**	**1.1, 1.8**	**.02***	**1.3**	**1.0, 1.6**	**<.05***	**1.8**	**1.1, 1.8**	**<.05***
Uses Preventive Health Measures (Yes to No)	**1.0**	**.7, 1.4**	**0.97**	**0.9**	**.7, 1.3**	**0.66**	**1.2**	**.6, 1.2**	**0.36**
Facility in Reading English (Good to Poor)	**1.7**	**1.0, 3.1**	**0.07**	**1.8**	**1.0, 3.4**	**<.05***	**10.6**	**.8, 10.6**	**0.12**
Facility in Spoken English (Good to Poor)	**0.8**	**.4, 1.5**	**0.50**	**0.8**	**.4, 1.5**	**0.53**	**4.1**	**.1, 4.1**	**0.77**
Facility in Written English (Good to Poor)	**1.2**	**.7, 2.0**	**0.60**	**1.0**	**.5, 1.8**	**0.91**	**1.6**	**.3, 1.6**	**0.42**

FRIENDS/FAMILY/CO-WORKERS	**LITERACY**			**NUMERACY**			**PROBLEM SOLVING**		
	OR	**95%CI**	***p***	**OR**	**95%CI**	***p***	**OR**	**95%CI**	***p***
Gender (Female to Male)	**1.2**	**.9, 1.5**	**0.14**	**1.6**	**1.0, 1.6**	**0.07**	**1.3**	**1.0, 1.7**	**0.07**
25-34 vs under 24	**0.8**	**.5, 1.1**	**0.19**	**1.0**	**.5, 1.0**	**0.07**	**0.7**	**.4, 1.1**	**0.11**
35-44 vs under 24	**0.8**	**.5, 1.2**	**0.27**	**1.1**	**.5, 1.1**	**0.10**	**0.7**	**.4, 1.2**	**0.20**
45-54 vs under 24	**0.7**	**.5, 1.1**	**0.15**	**1.1**	**.5, 1.1**	**0.13**	**0.7**	**.5, 1.1**	**0.17**
55-65 vs under 24	**0.8**	**.5, 1.1**	**0.19**	**1.0**	**.5, 1.0**	**0.08**	**0.7**	**.4, 1.1**	**0.09**
Black vs Non-Black	**1.0**	**.7, 1.4**	**0.98**	**1.3**	**.8, 1.3**	**0.87**	**1.1**	**.8, 1.5**	**0.54**
Hispanic vs Non-Hispanic	**0.8**	**.6, 1.0**	**0.08**	**1.1**	**.6, 1.1**	**0.16**	**0.7**	**.5, 1.0**	**0.08**
Asian/Other v sNon-Asian/Other	**1.0**	**.7, 1.5**	**0.91**	**1.7**	**.8, 1.7**	**0.41**	**1.4**	**.9, 2.1**	**0.15**
High School Diploma (Yes to No)	**0.9**	**.7, 1.2**	**0.50**	**1.1**	**.7, 1.1**	**0.25**	**0.8**	**.6, 1.1**	**0.15**
Health Status (Good vs Poor)	**1.4**	**1.1, 1.8**	**<.05***	**1.9**	**1.2, 1.9**	**<.05***	**1.4**	**1.1, 1.8**	**<.05***
Uses Preventive Health Measures (Yes to No)	**1.6**	**1.2, 2.1**	**<.05***	**2.0**	**1.2, 2.0**	**<.05***	**1.6**	**1.2, 2.1**	**<.05***
Facility in Reading English (Good to Poor)	**0.8**	**.5, 1.4**	**0.48**	**1.3**	**.5, 1.3**	**0.36**	**0.6**	**.2, 2.1**	**0.41**

Facility in Spoken English (Good to Poor)	**1.2**	**.8, 2.0**	**0.39**	**2.1**	**.8, 2.1**	**0.29**	**1.5**	**.3, 6.9**	**0.57**
Facility in Written English (Good to Poor)	**1.5**	**1.0, 2.3**	**0.07**	**2.4**	**1.1, 2.4**	**<.05***	**1.2**	**.7, 2.1**	**0.51**
HEALTH PROFESSIONALS	**LITERACY**			**NUMERACY**			**PS-TRE**		
	Odds Ratios	**95%CI**	***p***	**Odds Ratios**	**95%CI**	***p***	**Odds Ratios**	**95%CI**	***p***
Gender (Female to Male)	**1.9**	**1.6, 2.3**	**<.05***	**1.8**	**1.5, 2.2**	**<.05***	**1.8**	**1.5, 2.2**	**<.05***
25-34 vs under 24	**0.8**	**.5, 1.3**	**0.40**	**0.8**	**.6, 1.1**	**0.18**	**0.9**	**.6, 1.2**	**0.40**
35-44 vs under 24	**1.3**	**.9, 1.8**	**0.19**	**1.0**	**.7, 1.9**	**0.75**	**1.2**	**.8, 1.8**	**0.30**
45-54 vs under 24	**1.5**	**1.0, 2.3**	**0.08**	**1.3**	**.9, 1.9**	**0.17**	**1.4**	**.9, 2.4**	**0.09**
55-65 vs under 24	**1.9**	**1.2, 3.0**	**<.05***	**1.7**	**1.2, 2.6**	**<.05***	**2.2**	**1.3, 2.7**	**<.05***
Black vs Non-Black	**1.9**	**1.3, 2.7**	**<.05***	**1.6**	**1.1, 2.3**	**<.05***	**1.8**	**1.2, 2.9**	**<.05***
Hispanic vs Non-Hispanic	**1.2**	**.9, 1.6**	**0.17**	**1.0**	**.8, 1.4**	**0.84**	**1.2**	**.8, 1.8**	**0.41**
Asian/Other v sNon-Asian/Other	**1.2**	**.8, 1.8**	**0.41**	**1.0**	**.6, 1.7**	**0.86**	**1.3**	**.8, 2.1**	**0.27**
High School Diploma (Yes to No)	**1.3**	**.9, 1.8**	**0.20**	**1.3**	**.9, 1.7**	**0.13**	**1.3**	**.9, 1.8**	**0.16**
Health Status (Good vs Poor)	**0.8**	**.6, 1.0**	**0.09**	**0.7**	**.6, .9**	**<.05***	**0.6**	**.4, .9**	**<.05***
Uses Preventive Health Measures (Yes to No)	**2.4**	**1,8, 3.2**	**<.05***	**2.3**	**1.8, 3.0**	**<.05***	**2.4**	**1.8, 3.1**	**<.05***
Facility in Reading English (Good to Poor)	**1.2**	**.6, 2.3**	**0.51**	**1.4**	**.7, 2.6**	**0.29**	**1.2**	**.2, 6.5**	**0.85**
Facility in Spoken English (Good to Poor)	**1.1**	**.6, 2.2**	**0.72**	**1.1**	**.6, 2.1**	**0.77**	**0.8**	**.1, 9.6**	**0.87**
Facility in Written English (Good to Poor)	**1.8**	**1.1, 3.1**	**.02***	**1.7**	**1.0, 2.7**	**<.05***	**2.5**	**1.1, 5.3**	**<.05***

***Significance at p<.05**

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