

The Relationship of Health Literacy With Use of Digital Technology for Health Information: Implications for Public Health Practice

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Objective: An understanding of the association of health literacy with patterns related to access and usage of digital technologies and preferences for sources of health information is necessary for public health agencies and organizations to appropriately target channels for health information dissemination. **Design:** A cross-sectional telephone survey was conducted in New York State. Health literacy was assessed using the Morris Single-Item Screener, a self-report question. A weighted analysis was conducted utilizing Stata/SE. **Participants:** The final sample size of New York State residents used for analysis was 1350.

Results: In general, self-report health literacy did not predict digital technology use (ie, Internet and smartphone use, text messaging) but was associated with certain digital activities. People with low self-report health literacy were less likely to use search engines ($P = .026$) but more likely to get health information from social networking sites ($P = .002$) and use health-related phone apps ($P = .046$). With respect to health information seeking, those with lower self-report health literacy reported greater difficulty with their most recent search for health information. Furthermore, they were more likely to prefer text messages ($P = .013$) and radio ($P = .022$), 2 text-limited communication channels, to receive health information than those with higher self-report health literacy. **Conclusions:** While self-report health literacy does not appear to influence access to and use of digital technologies, there is a strong association with experiences searching for health information and preferences for health information sources. Public health agencies and organizations should consider the needs and preferences of people with low health literacy when determining channels for

health information dissemination. They should also consider implementing interventions to develop health information-seeking skills in populations they serve and prepare information and materials that are easily accessible and understandable.

KEY WORDS: health department, health information, health literacy, Internet, media, New York

Adoption of new technologies has become widespread in recent years. Roughly 85% of American adults use the Internet, and about 90% of American adults own a cell phone, 58% of which are

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smartphones.¹ Previously analyzed data show that numbers are similar in New York State (NYS) for Internet use (85%) and cell phone ownership (90%).² As digital technology adoption rates increase, digital sources have become a popular way to retrieve health information. National studies have shown that approximately 72% of Internet users have searched for a health-related topic online³ and 52% of smartphone owners have searched for health information using their phone.⁴ In NYS, age was the most important predictor for explaining differences in access to and use of technologies such as the Internet and cell phones; educational attainment and income were also important predictors for Internet access and use.²

Originally, there was much concern over variations in access to technology among different population groups, now referred to as a first-level digital divide.⁵ More recently, the focus has been on use of the technology as opposed to access. Experts now refer to a second-level divide related to capability of usage and a third-level divide, which concerns usage outcomes.^{5,6} There is a growing need to focus on how well individuals are able to understand and utilize health information obtained individually through digital sources to make decisions about their health and health behavior and to navigate the health care system.⁷

Health literacy has been defined as “the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions.”^{8(p16)} Low health literacy has been found to affect health outcomes and has been associated with high health system costs.^{9,10} Having adequate health literacy skills is also crucial for successful health information seeking, yet research concerning the association of health literacy and health information seeking is limited.¹¹ A qualitative study of patients with arthritis found that those with high health literacy were more likely to use the Internet for health-related sources.¹² This same study, along with another study using a national survey of older adults,¹³ found that those with low health literacy were less likely to engage in health information-seeking behavior. A recent review found that only 4 studies have looked specifically at low health literacy and online health information seeking; a summary of results suggest that those with low health literacy report issues evaluating and trusting information obtained online.¹¹

eHealth literacy is closely related to health literacy. It specifically concerns the use of digital technology for health and has been defined as “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem.”¹⁴ Studies have found that those with greater eHealth literacy are more likely to use the Internet and social media for health information¹⁵ and have greater success and bet-

ter outcomes with health information searches online.¹⁶ Even among college students, there are many with low eHealth literacy skills,¹⁷ suggesting the need to focus on skill-building interventions in this area.

Numeracy, often seen as a component of health literacy, has been defined as “the degree to which individuals have the capacity to access, process, interpret, communicate, and act on numerical, quantitative, graphical, biostatistical, and probabilistic health information needed to make effective health decisions.”^{18(p375)} A national study examined the association between numeracy and health information seeking for young adults; those with lower numeracy were more likely to report that their most recent health-related Internet search was both frustrating and took a lot of effort.¹⁹

Given the limited research in this area, there is a need for studies to more closely examine the link between health literacy and health information seeking. This relationship is important to understand for public health departments and organizations to inform best methods (media channels and technologies) for disseminating information in a way that makes it accessible to people of all health literacy levels. Understanding the link between health literacy, consumer engagement, and communication channels is an important dimension of public health policy, programming, and practice. To explore this association in more detail, the NYS Department of Health Office of Minority Health and Health Disparities Prevention, in partnership with the University at Albany School of Public Health and Bassett Research Institute, incorporated self-report health literacy questions into its NYS Media and Technology Use Survey.² This article addresses the research questions outlined as follows:

Research Question 1: How is self-report health literacy associated with the level of access to digital technologies including computers, the Internet, cell phones, smartphones, and texting?

Research question 2: How is self-report health literacy associated with the frequency of engaging in various Internet and cell phone activities?

Research question 3: How is self-report health literacy associated with health information-seeking experiences?

Research question 4: How is self-report health literacy associated with preferences for receiving health information?

● Methods

The NYS Media and Technology Use Survey is a cross-sectional telephone survey of a sample of NYS residents, aged 18 years and older. It was created to

assess the media and technology access of NYS residents, along with health information-seeking patterns and preferences. Institutional review board approval was obtained through the university at Albany Office of Regulatory and Research Compliance. This study was considered exempt from full review. More details can be found in the original study article.²

Sample

We contracted with Siena Research Institute to conduct the survey. It purchased phone number lists generated using a random digit dialing methodology from Survey Sampling International. Random digit dialing was used for the landline sample to ensure selection of both listed and unlisted telephone numbers, whereas the cell phone sample was retrieved from dedicated wireless telephone exchanges from within NYS.

The aim of the survey was to describe technology use, health information-seeking patterns, and preferences for receiving health information among a sample of NYS residents with oversampling of rural and Hispanic/Latino populations to facilitate future analyses of these subgroups. These subgroups are priority populations to the Office of Minority Health and Health Disparities Prevention due to disparate health outcomes and a need to develop and disseminate effective health messages. To ensure a sufficient number of rural respondents, a component of the landline sample targeted the 24 NYS counties not situated in a Metropolitan Statistical Area. Oversampling of Hispanic/Latino respondents was accomplished through a similar targeted random sampling of landlines in census tracts with at least a 20% concentration of Hispanic residents. Some rural and Hispanic/Latino respondents were also identified in the statewide sample of landlines as well as the cell phone sampling. The sampling plan from these multiple frames produced a study population of 1350 adults, with 483 identified through their cell phones. This article reports on data from all 1350 people in the sample.

Measures

Although learning about the health literacy skills of respondents was of interest, the use of a telephone survey did not allow for the administration of standard interviewer-administered health literacy tools, such as the Rapid Estimate of Adult Literacy in Medicine.²⁰ The Morris Single-Item Literacy Screener (How often do you need to have someone help you when you read instructions, pamphlets, or other written material about a health topic?)^{21,22} was used to classify respondents into lower and higher health literacy groups. This question has been evaluated as a single-item self-report question

that does a reasonable job of detecting problems reading health information.²² Those who responded *sometimes, often, or always* were classified as low health literacy (20% of the current study sample) per the suggested scoring.²²

In addition, the survey asked about health information seeking including whether individuals have ever used the Internet to look up health information for themselves or someone else. Respondents were asked to think about their most recent Internet search for health-related information and to indicate their level of agreement (*strongly agree, somewhat agree, somewhat disagree, strongly disagree*) with the following statements: (1) It took a lot of effort to get the information needed; (2) You felt frustrated during your search for information; (3) You were concerned about the quality of information; and (4) The information you found was hard to understand.²³ Additional information about the content of the survey and characteristics of the study population is published elsewhere.²

Analysis

Because of the complex sampling strategy, we conducted a weighted analysis utilizing Stata/SE. For this sample, we derived weights to adjust for the sampling procedures (which led to some individuals having greater or lesser probability of being included in the survey). We then used a second stage of weighting to adjust the distribution of the sample's sociodemographic characteristics to match the characteristics of the population of NYS residents aged 18 years and older. Data were weighted for age, sex, region, rural status, race, ethnicity, education, and cell phone status. Data were not weighted for income, and many respondents did not report income. We used χ^2 tests to compare respondent groups and multivariate logistic and ordinal regressions to run adjusted models. Adjusted models accounted for the following variables in addition to self-report health literacy: education, age, sex, ethnicity, race, survey language, income, employment, and geographic area.

● Results

With the weighted analysis, there were a similar number of men (48%) and women (52%) in the sample, and 50% reported being employed. Almost 60% of the sample was 18 to 49 years of age, and 25% of the sample was 60 years or older. Education levels were almost evenly distributed among 3 groups: at least a college education (35%); some college (31%); and a high school education or less (35%). The sample was diverse by income, with 26% reporting an income under \$25 000, 30% reporting

an income of \$25 000 to \$49 999, and 23% reporting income greater than \$75 000; 21% did not report income. Just over half of the sample reported living in urban areas (56%); the rest reported living live in suburban (33%) or rural (11%) areas. The majority of respondents were white (65%), with 16% black/African American, 8% Asian, and 10% other/multiple. Seventeen percent identified that they were of Hispanic, Latino/Latina, or Spanish origin. Respondents had the opportunity to take the survey in Spanish, and 4% chose this option.

Education ($P < .001$), income ($P < .001$), geographic area ($P < .001$), and employment ($P = .001$) were strong predictors of self-report health literacy. Having more years of education, greater income, living in suburban or rural areas, and being employed were associated with higher self-report health literacy.

Research question 1: How is self-report of health literacy associated with the level of access to digital technologies including computers, the Internet, cell phones, smartphones, and texting?

A majority of respondents reported having 1 or more working computers at home (82%) and high-speed Internet access (93%), and about half reported using the Internet several times per day (Table 1). While those with lower self-report health literacy were less likely to report positive responses to these questions in bivariate analysis, the statistical differences disappeared with multivariate analyses. Cell phone ownership was very common (90%), and many respondents had unlimited texting plans (79%) and smartphones (63%). For these cell phone variables, there were no differences by self-report health literacy.

Research question 2: How is self-report of health literacy associated with the frequency of engaging in various Internet and cell phone activities?

There were a number of differences by self-report health literacy in the bivariate analyses that were no longer statistically significant after adjustment for other demographics. Education and age were often the most significant predictors, whereas for some activities, factors such as sex and income were important. Self-report health literacy remained important for 3 factors. People with lower self-report health literacy were less likely to use a search engine to find information online ($P = .026$). They were more likely than people with higher self-report health literacy to get health information from social networking sites ($P = .002$) and to use health-related smartphone apps ($P = .046$). More details can be viewed in Supplemental Digital Content File 1 (available at: <http://links.lww.com/JPHMP/A186>).

Research question 3: How is self-report of health literacy associated with health information-seeking experiences?

Lower self-report health literacy was a key predictor for health information-seeking experiences. As seen in Table 2, differences by self-report health literacy status were statistically significant for both bivariate and multivariate analyses for the following variables related to the most recent search for health information: effort to get health information ($P = .031$), frustration with health information search ($P < .001$), concern about quality of health information ($P = .015$), and difficulty understanding health information ($P < .001$).

Research question 4: How is self-report of health literacy associated with preferences for receiving health information?

Respondents were also asked about preferences for receiving health information with the following question: "This survey is not providing any health information, but, if an organization like the Department of Health wanted to provide health information to people in your community, how would you prefer getting the information?" When comparing responses by self-report health literacy in bivariate analyses, respondents with lower self-report health literacy had a higher preference for cell phone text messages (35% vs 18%; $P = .001$) and a lower preference for Web sites (34% vs 53%; $P = .001$). They were also slightly more likely to prefer TV (45% vs 32%; $P = .012$) and radio (24% vs 19%; $P = .021$). When conducting multivariate analysis, the difference for texting preference remained. Respondents with lower self-report health literacy were still more likely to prefer texting ($P = .013$). Respondents also remained more likely to prefer radio ($P = .022$). Detailed findings can be viewed in Supplemental Digital Content File 2 (available at: <http://links.lww.com/JPHMP/A187>).

● Discussion

On the basis of study results, self-report health literacy has little impact on *access to* and *use of* digital technology. This finding contradicts other research, as a study of low-income adults found that people with low health literacy and numeracy were less likely to have access to certain digital technologies.²⁴ Another study of a sample of primary care patients also found health literacy-related disparities for technology access and use.²⁵ However, both studies used performance-based health literacy assessment tools as opposed to self-report. It may be that the way health literacy is measured could impact findings or that measures used

TABLE 1 ● Internet and Cell Phone Use and Access by Self-report Health Literacy (N = 1350 Except Where Noted) (Weighted Estimates)

	Total (N = 1350)	Lower Health Literacy (n = 250)	Higher Health Literacy (n = 1095)	Unadjusted <i>P</i> ^a	Adjusted ^b <i>P</i> ^a
One or more working computers at home: Yes	82%	70%	85%	<.001	.711
Broadband access (n = 1093): Yes	93%	89%	94%	.065	.249
Internet use				.003	.218
Several times a day	53%	40%	56%		
Once a day	12%	11%	12%		
Less than once per day	21%	29%	19%		
Never	15%	20%	14%		
Have cell phone: Yes	90%	88%	90%	.388	.409
Unlimited texting (n = 1197): Yes	79%	79%	79%	.973	.938
Cell a smartphone (n = 1197): Yes	63%	59%	64%	.314	.963

^a*P* values in bold text represent statistically significant differences.

^bAdjusted for education, income, employment, sex, age, race, ethnicity, geographic area, and survey language.

TABLE 2 ● Experiences With Most Recent Search for Health Information by Self-report Health Literacy (N = 1350) (Weighted Estimates)

	Total (N = 1350)	Lower Health Literacy (n = 250)	Higher Health Literacy (n = 1095)	Unadjusted <i>P</i> ^a	Adjusted ^b <i>P</i> ^a
Q14. Ever used the Internet to look for health information for yourself or someone else?	70%	60%	73%	.002	.731
Q15a. It took a lot of effort to get the information you needed				<.001	.031
Strongly agree	8%	16%	7%		
Somewhat agree	23%	38%	20%		
Somewhat disagree	30%	23%	21%		
Strongly disagree	39%	23%	42%		
Q15b. You felt frustrated during your search for the information				<.001	<.001
Strongly agree	8%	19%	6%		
Somewhat agree	17%	30%	14%		
Somewhat disagree	25%	24%	25%		
Strongly disagree	51%	27%	56%		
Q15c. You were concerned about the quality of the information				.006	.015
Strongly agree	19%	28%	17%		
Somewhat agree	35%	43%	33%		
Somewhat disagree	22%	13%	24%		
Strongly disagree	24%	15%	25%		
Q15d. The information you found was hard to understand				<.001	<.001
Strongly agree	5%	14%	4%		
Somewhat agree	15%	41%	10%		
Somewhat disagree	27%	26%	28%		
Strongly disagree	52%	19%	59%		

^a*P* values in bold text represent statistically significant differences.

^bAdjusted for education, income, employment, sex, age, race, ethnicity, geographic area, and survey language.

assess different skills, suggesting that additional work is needed to better understand this relationship.

Our findings also demonstrate that Internet and cell phone *activities* mainly varied by age and education, with a few exceptions. Those with lower self-report health literacy were less likely to report using search engines to find information online. Also of interest is that the lower self-report health literacy group was more likely to get health information from a social networking site as well as use a health-related app on a smartphone. We could find no other studies that looked at the link between health literacy and engagement in some of the activities included in our list, such as Facebook. Thus, these results are of great value to public health organizations.

While there has been a decrease in the digital divide with respect to *access*, there is evidence that there is a growing digital divide regarding *skills* and what people do with the information.²⁶ Our study results clearly support this. It appears that respondents have varying experiences when seeking health information online; while many are able to get health information when wanted and had a fairly easy time with health information searches, others are not as successful. Self-report health literacy was a key explanatory factor. The fact that health literacy remains significant even when accounting for traits such as income and education suggests that it is an important and unique component to consider.

When asked about receiving health information from organizations, those with lower self-report health literacy were more likely to prefer radio and text messages and slightly more likely to prefer television, channels that use limited text to provide information. While there was a lower preference for Web sites in the bivariate analysis, this difference disappeared when controlling for other factors. However, a number of studies show that Web site text can be quite complex,²⁷⁻²⁹ so ensuring that Web sites are easy to use and understand is an important consideration.

Of interest is the finding that those with self-report health literacy are more likely to prefer getting health information from text messages. Our study findings are consistent with others such as one conducted by the Pew Research Center, which found that text messaging is widely used across a broad range of ethnicities, income, and age groups.³⁰ Text messages use plain language and short sentences to organize information.^{31,32} This preference may also be attributed to reliance on informal sources such as family and friends and the interactive nature of texting.³² Text messages have been identified and utilized in clinical interventions as both feasible and appropriate for populations with lower health literacy.^{33,34} Findings may also indicate a preference for receiving information directly rather than

having to search for it. This is important to consider for public health departments and organizations. It is also possible that there is a difference in perception regarding the quality of information; perhaps, information received directly from an organization to a phone is seen as more credible than information searched for individually online. Some research has found that those with low health literacy are more likely to share cell phones, so they may not get the messages.³⁴ In our study, of the people who did not have their own cell phone, only 10 (6%) reported it was because they shared a phone with someone in their household, and of these, 3 had low health literacy.

This finding is useful in that text messaging is readily retrievable and has instant connectivity. In addition, applications such as WhatsApp allow for the exchange of messages at no cost. This is particularly beneficial for lower-income populations. The BBC World Service offers examples of how such technology can be useful for public health. Recently, they partnered with WhatsApp mobile technology to provide audio, text message alerts, and images to help people get public health information about Ebola in West Africa.³⁵ They also partnered with the app Viber to provide safety information to people affected by the Nepal earthquake.³⁶

Our findings inform a number of practices relevant to public health organizations, including federal agencies, state health agencies, and local health departments. When designing media campaigns, organizations may do better to implement their media campaigns using an array of channels (ie, not just social media). Further qualitative work may be useful to explore these preferences in depth. Intervention success may be impacted by health literacy as well. The use of digital technologies (ie, the Internet, phone apps, text messages) to deliver health information and engage people in interventions is becoming more common.³⁷⁻³⁹ The Internet is especially popular as an intervention tool as it can be accessed on various devices including desktops, laptops, smartphones, and tablets.^{38,40} Ensuring that people of all health literacy (and eHealth literacy) levels have access to such technology and feel confident using it is important.

It is also important to consider that messages must be designed with the knowledge that health literacy can impact understanding regardless of which technology or media channel is used. A recent report suggests using “universal precautions” when communicating with patients in a health care setting. Universal precautions are typically defined as “specific actions taken to minimize risk for everyone when it is unclear which patients may be affected.”⁴¹ Similar precautions should be taken when communicating with the public about health. Regardless of the medium used to convey the information (Web site, television, radio, etc), it is

important to ensure that the messages are presented in a simple, clear, and consistent way. For example, proper organization of relevant information, the use of visual aids, and the elimination of jargon are specific strategies that can be employed to achieve the goal of making health information accessible, useful, and understandable to the entire population.⁴² More work is needed to better understand which strategies are most effective when disseminating information at the population level.

While this study presents important findings, potential methodological limitations include bias due to selective sampling and/or participation and due to error in measurement of key concepts. With respect to sampling, the validity of results was supported by employing sampling frames for both landlines and cell phones and using a random process for sampling phone numbers. Sampling weights were derived both to correct for the complex sampling design and to align the study population with the sociodemographic composition of the adult NYS population, thereby compensating for different levels of participation by sociodemographic subgroups. In these analyses, health literacy is based on self-report in response to a single question. As described in the “Methods” section, the Morris Single-Item Literacy Screener was utilized. One limitation associated with using a single-item literacy screen is the potential for false-negatives, due to respondents not understanding the question, feeling ashamed, or not recognizing that they need help with reading.²² Nevertheless, the Morris Single-Item Literacy Screener and other self-report questions have been used in other state surveys⁴³ and allow for the evaluation of health literacy for larger samples.

Although there are a number of new and unique digital channels to reach people with, health literacy must be considered when public health departments and organizations are planning health information dissemination strategies. Our results provide important insight into the relationship between self-report health literacy, digital technology use, and health information seeking. Strategies that focus on making the experience of health information seeking easier, more useful, and generally more positive, especially for those with lower health literacy, may help mitigate the effects of negative long-term health outcomes associated with lower health literacy. With evolving technologies constantly creating new ways of getting health information, the demands required to use and understand these information sources will also be changing.⁴⁴ Even individuals with higher health literacy may need to learn new skills, require additional support, or could be overwhelmed at times.^{45,46} Continuing to develop and evaluate new strategies through additional research is critical to improving the

dissemination of health information by public health organizations.

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