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Parents' Use of Technologies for Health Management: A Health Literacy Perspective

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Abstract

OBJECTIVE: Parent use of technology to manage child health issues has the potential to improve access and health outcomes. Few studies have examined how parent health literacy affects usage of Internet and cell phone technologies for health management.

METHODS: Cross-sectional analysis of data collected as part of a randomized controlled experiment in 3 urban pediatric clinics. English- and Spanish-speaking parents (n=858) of children

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Nicole Meyers: Ms. Meyers participated in the design of the study, assisted in analysis and interpretation of the data, drafted the initial manuscript, and approved the final manuscript as submitted.

Alexander Glick: Dr. Glick helped conceptualize and design the study, was involved in the analysis and interpretation of the data, critically revised the manuscript for important intellectual content, and approved the final manuscript as submitted.

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≤8 years answered questions regarding use of and preferences related to Internet and cell phone technologies. Parent health literacy was measured using the Newest Vital Sign.

RESULTS: The majority of parents were high Internet (70.2%) and cell phone (85.1%) utilizers (multiple times a day). 75.1% had limited health literacy (32.1% marginal, 43.0% low). Parents with higher health literacy had greater Internet and cell phone use (*adequate vs. low*: AOR=1.7[1.2–2.5]) and were more likely to use them for health management (AOR=1.5[1.2–1.8]); those with higher health literacy were more likely to use the Internet for provider communication (*adequate vs. marginal vs. low:* 25.0 vs. 18.0 vs. 12.0%, p=0.001) and health-related cell phone apps (40.6 vs. 29.7 vs. 16.4%, p<0.001). Overall preference for using technology for provider communication was high (~70%) and did not differ by health literacy, although Internet and cell phone apps were preferred by higher literacy parents; no differences seen for texting.

CONCLUSIONS: Health literacy-associated disparities in parent use of Internet and cell phone technologies exist, but parents' desire for use of these technologies for provider communication was overall high and did not differ by health literacy.

Keywords

Health literacy; technology; parents

INTRODUCTION

Leveraging health information technology-based strategies has been promoted as a way to improve healthcare quality, support disease management, enhance patient safety, and reduce health care costs.[1–4] These strategies include electronic health records, personal health tools such as mobile health applications, as well as the range of technological tools used for health information exchange, through interfaces like computers, tablets, and cell phones. The rate of parent use of electronic systems for child health management is high; a recent survey found that nearly half of caregivers used the Internet frequently to obtain information about their child's health.[5] Technology-enhanced modes to facilitate communication with healthcare providers, such as texting, have been found to improve pediatric health outcomes.[6,7]

It is well-recognized that differences exist in the adoption and use of health-related technologies by age, gender, income, education level, race, and language.[8–10] To date, there has been limited research investigating how parents with low health literacy use these technologies. Defined as "the degree to which individuals have the capacity to obtain, process, and understand health information and services needed to make appropriate health decisions,"[11] health literacy likely plays an important role in the adoption and use of health information technology. Health literacy is also considered to be an important mediator of income and race/ethnicity-associated health disparities.[12] Prior research has found that those with lower health literacy are less likely to own a computer or cell phone, have an e-mail account[13], utilize mobile health apps[14], engage in patient portals[15], and use the Internet to obtain health information.[16] This research has predominantly focused on older adults[16,17] or a particular disease cohort[13]; few studies have addressed parent health literacy and the use of

technology by parents either generally or more specifically for health management. This is an important area of research, as low health literacy affects 1 in 3 US parents[18], and children of these parents already face disparities in health outcomes.[19,20] The National Academy of Medicine warns of the potential for worsening disparities with the rise in technology use, as those with low health literacy may be the ones least able to benefit from these new health technologies.[21]

In this study, we examined the relationship between parents' health literacy and their use of the Internet and cell phones for general purposes, use of these technologies specifically for health management, and preferences related to use of these technologies for healthcare provider communication. Insight into parents' usage of and preferences related to these technologies can guide the development of future interventions to promote child health.

METHODS

Setting, Participants and Recruitment

This was a secondary cross-sectional analysis of data collected from the SAFE Rx for Kids study[22,23], a randomized controlled experiment to identify aspects of medication labels/dosing tools that could be altered to reduce the frequency of parent dosing errors. Questions about technology were included at the end of the parent survey to inform the development of future technology-based strategies to improve parent-provider communication of medication instructions. Subjects were recruited from three urban pediatric outpatient clinics: Bellevue Hospital Center (affiliated with NYU School of Medicine), Gardner Packard Children's Health Care Center (Stanford), and Children's Hospital of Atlanta at Hughes Spalding (Emory). Institutional review boards at each site approved the study.

Research assistants (RAs) consecutively approached parents/legal guardians at each site during regular clinic hours. Eligible subjects were English- or Spanish-speaking parents/legal guardians ≥18 years old of a child ≤8 years old who was presenting for care in the pediatric clinic. Full inclusion/exclusion criteria and their rationale have been previously reported[22,23]; parents were excluded if their visual acuity was worse than 20/50 (assessed by the Rosenbaum vision screener), their hearing was impaired or if their child was being seen for an urgent issue. RAs obtained written, informed consent from all participants.

Assessments

Interviews were conducted in English or Spanish depending on caregiver preference. RAs assessed parent and child sociodemographics and other characteristics, followed by a health literacy assessment. The interview concluded with a series of questions regarding parents' technology use and preferences related to healthcare provider communication; these questions were adapted from prior studies[17,24] and were piloted to ensure understandability by our target population. Details on the number recruited, excluded and enrolled in the SAFE Rx for Kids study have been previously reported.[22] A nominal incentive was provided to study participants.

Primary Outcome Variables: General Internet and cell phone use, Internet and cell phone use for health management, and preferences related to Internet and cell phone use for healthcare provider communication

General Internet and cell phone use.—Parents were asked a series of questions related to frequency of their use of the Internet and cell phones. Questions included: “In a typical week, how often do you get on the Internet?” and “In a typical week, how often do you use your/the cell phone a) to go on the Internet?, b) for email?, and c) for texting?”, with answer choices of: “Many times a day”, “Once a day”, “A few times a week”, “Once a week”, “Less than once a week”, and “Never”. Composite variables were created for high utilizers of the Internet and cell phones. Those parents who used the Internet (or their cell phone to get on the Internet) many times a day were categorized as *high Internet utilizers*. Parents who used their cell phone many times a day (to go on the Internet, for email or for texting) were categorized as *high cell phone utilizers*. Parents were also asked (answer choices: Yes/No): “Do you have an e-mail address?” and “Does your/the cell phone have apps like a Facebook app?”.

Internet and cell phone use for health management.—Parents were asked: “In a typical week, how often do you use the Internet to find health information?”, with answer choices of “Many times a day”, “Once a day”, “A few times a week”, “Once a week”, “Less than once a week”, and “Never”. Parents were also asked (answer choices: Yes/No): “Do you use the Internet to communicate with your healthcare providers, such as your doctor or pharmacy?”, and “Do you have apps that help you track or manage your health, for example, apps to help you lose weight, or apps to help keep track of medications?”.

Preferences related to Internet and cell phone use for healthcare provider communication.—Parents were asked the following questions (answer choices: Yes/No): “If you could, would you like to be able to communicate with your doctor a) over the Internet?, b) through text messages?, and c) through cell phone apps?”.

Predictor Variable: Health literacy

Health literacy was measured using the NVS, a validated screening tool.[25] Scores were categorized as “low” (0 to 1 out of 6), “marginal” (2 to 3), or “adequate” (4 to 6) health literacy.

Sociodemographic Characteristics and Child Health Status

Parent sociodemographic characteristics assessed included age, gender, relationship to child, ethnicity/race, language, country of birth, marital status, education level, and income. Child characteristics assessed included gender, age, and chronic disease status (questions adapted from the Children with Special Health Care Needs screener[26]).

Statistical Analyses

All analyses were performed using SPSS version 23.0 (Armonk, NY) and STATA version 12.0 (College Station, TX). Chi-square and Fisher’s exact tests were used to examine unadjusted associations between parent health literacy and the primary outcome variables.

Multiple logistic regression analyses were performed using generalized estimating equations to account for repeated measures related to models for each of the 3 outcome variable categories related to overall use, use for health management, and preferences for healthcare provider communication: 1) high Internet/cell phone use (high utilizer of Internet/cell phone, e-mail account, cell phone with apps), 2) current Internet/cell phone use for health management (any use of Internet to find health information, any use of Internet to communicate with health care providers, having apps on cell phone to help track or manage health) and 3) preferences related to Internet/cell phone use for healthcare provider communication (desire to communicate with doctor over Internet, through texts, through cell phone apps). The following potential confounders were selected *a priori* based on literature review and controlled for in each model: child age, parent age, race/ethnicity, language, country of birth, income, education, and site.[15–17]

As language, income, and health literacy were all independently associated with Internet/cell phone use and technology use for health management in adjusted analyses, and health literacy has been previously identified as a potential mediator of language- and income-associated disparities, path analyses were used to examine whether health literacy mediated the relationship between language and income, and these dependent outcomes of interest. Specifically, we used Baron and Kenny criteria[27] to assess whether the following criteria were met using logistic regression models with generalized estimating equations: 1) language was associated with dependent variables of interest, 2) language was associated with health literacy, 3) health literacy was associated with dependent variables of interest adjusting for language, and 4) the degree to which the association between language and dependent variables of interest was attenuated when health literacy was included in the model. Similar analyses were performed to examine whether the associations between income and dependent variables of interest were mediated by health literacy.

A 2-tailed p value<0.05 was considered significant for all analyses.

RESULTS

Between August 26, 2013 and May 19, 2014, a total of 1133 participants were enrolled during the time period when technology questions were included as part of the survey protocol (questions were later removed from the survey to reduce parent burden); of this group, 57 (5.0%) never reached the technology questions due to time constraints, as these questions were at the end of the survey. Of the remaining participants, 858 (79.9%) participants fully completed the survey questions regarding Internet and cell phone use and preferences. Of these, 853 completed the NVS and were included in our final analyses. The majority of parents/caregivers were Hispanic or Black (87.3%) and had an annual household income of <$40,000 (79.1%) (Table 1).

The majority of parents had limited health literacy (32.1% low, 43.0% marginal). Mean (SD) health literacy score was 2.4 (1.6).

Internet and cell phone usage was high among our study population with nearly all parents reporting using the Internet weekly or more frequently (96.6%), and using cell phones for e-mail (79.5%), Internet (90.6%) and texting (94.9%) weekly or more frequently.

The majority (89.6%) of parents had used the Internet to find health information. Fewer parents used the Internet to communicate with healthcare providers (17.8%) or had cell phone apps to manage their health (28.1%) (Table 2).

Desire to communicate with doctors using technologies such as the Internet, text messages, and cell phones apps was high across the study population (~70% of individuals for each; Table 2).

Parent Health Literacy and Internet/Cell Phone Use

Parents with higher health literacy were more likely to be high utilizers of the Internet and cell phones ($p<0.001$ for all) (Table 2). In adjusted analyses, those with higher health literacy had higher rates of Internet/cell phone use overall (*adequate vs. low*: adjusted odds ratio (AOR)=1.7[95% confidence interval: 1.2–2.5]; *marginal vs. low*: AOR=1.6[1.3–2.2]). English language and higher income were also associated with greater utilization of Internet/cell phones; these relationships were not mediated by health literacy (Table 3).

Parent Health Literacy and Internet/Cell Phone Use for Health Management

Parents with higher health literacy were more likely to use the Internet to find health information, use the Internet to communicate with providers, and have cell phone apps to track/manage health ($p<0.01$ for all comparisons of *adequate vs. low* health literacy groups) (Table 2). In adjusted analyses, parents with higher health literacy were more likely to use Internet/cell phones for health management (*adequate vs. low*: AOR=1.5[1.2–1.8]; *marginal vs. low*: AOR=1.2[1.02–1.4]). Those in the higher income and English language groups were more likely to utilize Internet/cell phones for health management; these relationships were not mediated by health literacy (Table 3).

Parent Health Literacy and Preferences Related to Internet/Cell Phone Use for Healthcare Provider Communication

In unadjusted analyses, parents with higher health literacy were more likely to want to use the Internet to communicate with doctors and use cell phone apps to communicate with doctors ($p=0.001$ and $p=0.02$ for comparisons between *adequate vs. low* health literacy groups). There were no significant differences by health literacy in parent preference to communicate with doctors via text messages (Table 2). In the overall adjusted model, there was no statistically significant difference in parents' desire to utilize Internet and cell phones for healthcare provider communication by health literacy level (Table 3).

DISCUSSION

This is the first study, to our knowledge, to investigate the association between parents' health literacy and their usage of and preferences related to Internet and cell phones, especially for health management. Overall, usage of the Internet (nearly 100%), e-mail

(95%), and cell phones (97% use cell phones for texting) was common, although parents with higher health literacy used these technologies more frequently. Use of the Internet to find health information was a common practice across health literacy levels (90%), but use of the Internet to communicate with healthcare providers and having cell phone apps to manage health was less common (~20–30% of parents). Parents with higher health literacy were more likely to use the Internet to search for health information and for healthcare provider communication, and to have health-related cell phone apps. Desire to communicate with doctors using the Internet and cell phones was high across health literacy groups, with no difference in desire to use texting for communication by health literacy.

The high rates of Internet, e-mail, and smartphone use (85% with apps) we found in our study are consistent with research demonstrating increasing access to digital technologies, even among disadvantaged populations.[28,29]

Our study population also reported a desire to communicate with providers using digital technologies, including the Internet, text messaging and cell phone apps. This might reflect a growing acceptance of these technologies or preferences unique to a young parent population. In a study of a predominantly low-income, older adult population, only about 20% wished to receive health information by text and 14% by the Internet.[30] Use of patient portals has been promoted as a means for secure communication with providers, leveraging the use of the Internet with the potential for portal linkage to a cell phone app.[31] To date, however, the availability of text messaging functionality linked to patient portals is more limited; such functionality involving protected health information will need to adhere to secure messaging standards.[32] Special considerations related to portals will also need to be addressed with respect to pediatric populations, particularly in relation to adolescent populations and parent access to potentially sensitive communications about issues like substance use, pregnancy and sexually transmitted diseases.[33]

Despite the overall positive trends in use of various technologies, there were notable differences by health literacy level. Prior studies have found that those with lower health literacy have limited engagement with the Internet and mobile technologies, although these studies focused on older adult populations rather than parents of young children.[13,16,17]

Parents with low health literacy in our study were less likely to be high utilizers of the Internet or cell phones, and less likely to have e-mail. These trends were consistent with a prior study showing health literacy-associated differences in the use of the Internet and e-mail among adult patients with diabetes.[13] Our study findings demonstrating lower rates of e-mail use among parents of lower health literacy suggest that targeted efforts to increase experience with this mode of communication may be necessary.

Our study also found that parents with low health literacy were less likely to use the Internet and cell phone apps for health management than those with higher health literacy. Prior research has found that those with low health literacy are less likely to consider mobile health apps and patient portals easy to use.[14] The health literacy measure we used, the NVS, assesses reading, abstract reasoning, and numeracy skills[25]; limitations in these skills are likely to hinder one’s ability to utilize technology effectively for health management.

The fact that similar numbers of parents in groups of varying health literacy levels wanted to communicate with providers using text messages further confirms texting-based interventions as an effective means of communication, even for those with limited health literacy.[34,35] Our findings suggest that the use of the Internet as a mode of communication could place parents with low health literacy at a disadvantage, although a large percentage of low health literacy parents (66%) did state a preference for using the Internet to communicate with their providers.

In addition to heath literacy-associated disparities, we also found language-associated disparities in parents' use of technologies, consistent with prior research.[10] These findings underscore the need for improved usability of these technologies for non-English speaking parents. Higher income was also generally associated with greater use of Internet/cell phones and use of technologies specifically for health management, indicating a need to address the role of affordability in access to technologies.

We did not find that health literacy mediated language and income-related associations with technology use, indicating that these factors play important independent roles. This suggests that health literacy's impact extends beyond income and language barriers; rather, health literacy's impact on technology use and preferences likely relate to an individual's skills in navigating technologies for health management and information-seeking. This includes the ability to find high quality, easy-to-use and understandable health information on the Internet; navigation difficulties serve as a barrier to technology use, affect perceived benefits, and impact preferences related to use. Educational strategies that expose families to these technologies, and efforts to improve the navigability of these tools would likely be beneficial for parents across health literacy levels, but would especially benefit those with low health literacy.

There were limitations to our study. The outcomes were self-reported; parents' responses may not reflect their actual usage patterns. We asked a limited number of questions; for example, we did not ask about cell phone data plans or tablet use, nor did we ask if parents were offered access to patient portals. At the time of the study, portal access was not available at two of the sites and extremely limited at the third site. In addition, while we asked parents about their use of technology, we did not specifically ask parents about their technology use and preferences related to their child's health; we expect, however, that findings are very likely to generalize to, and have implications for, how parents navigate theses resources on behalf of their child. We only included English- and Spanish-speaking subjects as these were the predominant languages in our patient population. Finally, we enrolled caregivers who had brought their child for care at 3 university-affiliated pediatric clinics that serve predominantly low-income families, and thus our findings may not be fully generalizable to other populations.

CONCLUSION

The overall high rate of parent use of the Internet and cell phones, and parent desire to use these modalities for healthcare provider communication, even among individuals with low health literacy, highlights the promise of technology-based interventions in facilitating

access to and management of pediatric health information that can lead to improved child health outcomes. Significant differences in usage and preferences exist by parent health literacy level, however, and should be considered when developing technology-based interventions in pediatrics; for example, parents with low health literacy are less likely to use or want to use the Internet to communicate with healthcare providers. Continued study of trends and preferences around health technology utilization will be essential for ensuring that health disparities are not unintentionally exacerbated through the growing incorporation of technology-based strategies into routine clinical care.

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Abbreviations:

NVS	Newest Vital Sign
AOR	adjusted odds ratio

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WHAT'S NEW?

Parent technology access was high, but health literacy-associated disparities exist. Parents across health literacy levels want to communicate with providers using technology; while Internet and cell phone apps were preferred by higher literacy parents, no differences were seen for texting.

Table 1.

Characteristics of study population (n=858)

Child Characteristics	
Age in years, mean (SD)	1.9 (2.0)
Gender, n (%)	
Female	385 (45.1)
Chronic medical problem treated with medication, n (%)[a]	163 (19.9)
Parent Characteristics	
Age, mean (SD)	28.8 (7.1)
Gender, n (%)	
Female	762 (89.3)
Relationship to child, n (%)	
Mother	744 (87.2)
Marital Status, n (%)[b]	
Single	332 (39.2)
Income, n (%)[c]	
<$10,000	197 (23.2)
$10,000-$ 19,999	241 (28.4)
$20,000-$39,999	234 (27.5)
≥$40,000	114 (13.4)
Unknown/Missing	64 (7.5)
Country of Birth, n (%)	
Non-US Born	362 (42.4)
Race/Ethnicity, n (%)[c]	
Hispanic	428 (50.4)
Non-Hispanic	
White, non-Hispanic	37 (4.4)
Black, non-Hispanic	314 (36.9)
Other, non-Hispanic	72 (8.5)
Language, n (%)[d]	
Spanish	246 (28.8)
Education, n (%)[e]	
Less than HS Graduate	200 (23.5)
HS Graduate or Equivalent	307 (36.1)
Higher than HS Graduate	344 (40.4)
Health Literacy, n (%)[f]	
Low	274 (32.1)
Marginal	367 (43.0)

Child Characteristics	
Adequate	212 (24.9)
Site Characteristics	
Site	
Emory	319 (37.2)
NYU	255 (29.7)
Stanford	284 (33.1)

HS, High School. SD, standard deviation.

[a] Missing for 33 children

[b] Missing for 6 parents

[c] Missing for 3 parents

[d] Language of survey administration

[e] Missing for 2 parents

[f] Health literacy measured using Newest Vital Sign (NVS) [low=score 0–1; marginal=2–3; adequate=4–6]

Table 2.

Bivariate analyses for technology use and preferences by parent health literacy level

		Health literacy level					
	All parents (n=853)	**Low (n=274)**	**Marginal (n=367)**	**Adequate (n=212)**	**Marginal: Low p-value**	**Adequate: Low p-value**	**Overall p-value**
	n (%)	**n (%)**	**n (%)**	**n (%)**			
General Internet and Cell Phone Use							
High Internet utilized[a]	599 (70.2)	160 (58.4)	269 (73.3)	170 (80.2)	<0.001	<0.001	<0.001
High cell phone utilizer[b]	726 (85.1)	209 (76.3)	327 (89.1)	190 (89.6)	<0.001	<0.001	<0.001
Has e-mail address	808 (94.7)	247 (90.1)	352 (95.9)	209 (98.6)	0.006	<0.001	<0.001
Has cell phone apps[c]	721 (84.5)	213 (77.7)	324 (88.3)	184 (86.8)	0.001	0.02	0.001
Internet and Cell Phone Use for Health Management							
Uses Internet to find health information[d]	764 (89.6)	236 (86.1)	327 (89.1)	201 (94.8)	0.3	0.003	0.008
Uses Internet to communicate with healthcare providers	152 (17.8)	33 (12.0)	66 (18.0)	53 (25.0)	0.051	<0.001	0.001
Has cell phone apps to track/ manage health[c]	240 (28.1)	45 (16.4)	109 (29.7)	86 (40.6)	<0.001	<0.001	<0.001
Preferences Related to Internet and Cell Phone Use for Healthcare Provider Communication							
Would like to use Internet to communicate with doctor	615 (72.1)	182 (66.4)	263 (71.7)	170 (80.2)	0.2	0.001	0.003
Would like to use text messages to communicate with doctor	594 (69.6)	188 (68.6)	258 (70.3)	148 (69.8)	0.7	0.9	0.9
Would like to use cell phone apps to communicate with doctor	591 (69.3)	176 (64.2)	256 (69.8)	159 (75.0)	0.2	0.02	0.04

[a]Considered a high utilizer if use the Internet, including by cell phone, many times a day

[b]Considered a high utilizer if use cell phone many times a day for Internet, e-mail or texting

[c]Considered a smartphone owner

[d]Considered to use Internet for health information if *ever* does

Table 3.

Multivariate analyses for high Internet and cell phone use, Internet and cell phone use for health management, and preference for Internet and cell phone use for healthcare provider communication[a]

	High Internet and Cell Phone Use[b]			Internet and Cell Phone Use for Health Management[c]			Preference for Internet and Cell Phone Use for Healthcare Provider Communication		
	AOR	**95% CI**	**P-value**	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**
Health Literacy Level									
Adequate	1.7	1.2–2.5	0.003	1.5	1.2–1.8	0.001	1.3	0.9–1.9	0.2
Marginal	1.6	1.3–2.2	<0.001	1.2	1.02–1.4	0.03	1.1	0.8–1.5	0.5
Low	1.0	Ref	Ref	1.0	Ref	Ref	1.0	Ref	Ref
Language									
English	2.4	1.6–3.8	<0.001	1.4	1.1–1.8	0.003	1.5	0.5–2.3	0.1
Spanish	1.0	Ref	Ref	1.0	Ref	Ref	1.0	Ref	Ref
Income[d]									
≥$40,000	2.6	1.5–4.3	<0.001	1.4	1.1–1.9	0.004	1.3	0.8–2.1	0.2
$20,000439,999	1.4	0.98–2.0	0.06	1.2	0.96–1.4	0.1	1.3	0.9–1.9	0.1
$10,000-$ 19,999	1.3	0.9–1.8	0.2	1.2	0.98–1.4	0.1	1.4	0.99–2.0	0.06
<$10,000	1.0	Ref	Ref	1.0	Ref	Ref	1.0	Ref	Ref

AOR, adjusted odds ratio. CI, confidence interval.

[a]Adjusting for child age, parent age, race/ethnicity, language, country of birth, income, education, and site.

[b]In adjusted analyses, younger age also associated with high Internet and cell phone use (p<0.001). Health literacy did not mediate language- or income-associated effects on high Internet and cell phone use; while Spanish language was associated with lower health literacy, and health literacy was associated with high Internet and cell phone use, the relationship between Spanish language and technology use was not attenuated by addition of health literacy to the model.

[c]Health literacy did not mediate language- or income-associated effects on Internet and cell phone use for health management; while income was associated with lower health literacy, and health literacy was associated with use of Internet and cell phone for health management, the relationship between income and technology use for health management was not attenuated by addition of health literacy to the model.

[d]Income unknown category was included in analyses; no statistically significant associations with dependent variables of interest were found.