Satisfaction with Internet access, cancer information-seeking and digital health technology use: Assessment using the 2022 Health Information Trends Survey

Maria Andrea Rincon, Richard P. Moser, Kelly D. Blake

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Abstract

Background: Broadband Internet plays an increasingly important role in supporting healthcare delivery and enhancing access to care and health information. Although access to broadband has the potential to alleviate inequities in healthcare, the digital divide negatively impacts cancer across the continuum, from access to prevention information, to early diagnostics and treatment, and survival outcomes. While subscription to broadband services has been previously assessed, satisfaction with individual at-home internet connection is a lesser known, important indicator of access to health information online and digital health technology use.

Objective: To assess disparities in perceptions of the quality of at-home Internet connection and its association to cancer health information-seeking experiences and use of digital health technologies in a nationally representative sample of US adults.

Methods: Secondary analysis of data from NCI's Health Information National Trends Survey 2022 (HINTS 6, n= 6,252) was employed in this study. The primary predictor, satisfaction with at-home Internet, a novel item on HINTS 6, was dichotomized into "high" (extremely satisfied, very satisfied) and "low" (somewhat satisfied, not very satisfied, not at all satisfied) satisfaction. Outcomes variables included four items of cancer information-seeking experiences and 2 items on access to telehealth appointments and patient portals over the past 12 months. Adjusted logistic regression models ($P<0.05$) were performed, and included the following variables: age, gender, race/ethnicity, educational attainment, annual household income, health insurance access and geography.

Results: Those reporting low satisfaction with their home Internet had higher odds of agreeing that searching for cancer information took a lot of effort (OR 1.77, 95% CI 1.31-2.37) and that they felt frustrated (OR 1.63, 95% CI 1.25-2.12). Additionally, those reporting lower satisfaction had higher odds of agreeing that they were concerned about the quality (OR 1.60, 95% CI 1.20-2.13) and had difficulty understanding (OR 1.56, 95% CI 1.13-2.15) cancer information they searched for. Respondents reporting lower satisfaction with their home Internet had lower odds of accessing their online medical portal at least once (OR 0.69, 95% CI 0.50-0.95) and of receiving care from a healthcare provider using telehealth over the past 12 months (OR 0.73, 95% CI 0.58- 0.92). Younger age, lower educational attainment and identifying as a racial/ethnic minority (NH-Asian/NH-Other) were associated with more challenges in their cancer information-seeking experiences. Lower education and household income were associated with lower odds of accessing patient portals, while younger age and lacking health insurance were associated with decreased odds of having a telehealth appointment.

Conclusions: Satisfaction with at-home Internet connection, a novel HINTS 6 item, is directly correlated with cancer information-seeking experiences and utilization of widely available health technology. These findings underscore the value of widespread, high quality internet services towards the successful implementation of healthcare technology and better patients experiences in health information-seeking.

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Secondary analysis of data from NCI's Health Information National Trends Survey 2022 (HINTS 6, n= 6,252) was employed in this study. The primary predictor, satisfaction with at-home Internet, a novel item on HINTS 6, was dichotomized into "high" (extremely satisfied, very satisfied) and "low" (somewhat satisfied, not very satisfied, not at all satisfied) satisfaction. Outcomes variables included four items of cancer information-seeking experiences and 2 items on access to telehealth appointments and patient portals over the past 12 months. Adjusted logistic regression models (P<0.05) were performed, and included the following variables: age, gender, race/ethnicity, educational attainment, annual household income, health insurance access and geography.

Results

Those reporting low satisfaction with their home Internet had higher odds of agreeing that searching for cancer information took a lot of effort (OR 1.77, 95% CI 1.31-2.37) and that they felt frustrated (OR 1.63, 95% CI 1.25-2.12). Additionally, those reporting lower satisfaction had higher odds of agreeing that they were concerned about the quality (OR 1.60, 95% CI 1.20-2.13) and had difficulty understanding (OR 1.56, 95% CI 1.13-2.15) cancer information they searched for. Respondents reporting lower satisfaction with their home Internet had lower odds of accessing their online medical portal at least once (OR 0.69, 95% CI 0.50-0.95) and of receiving care from a healthcare provider using telehealth over the past 12 months (OR 0.73, 95% CI 0.58- 0.92). Younger age, lower educational attainment and identifying as a racial/ethnic minority (NH-Asian/NH-Other) were associated with more challenges in their cancer information-seeking experiences. Lower education and household income were associated with lower odds of accessing patient portals, while younger age and lacking health insurance were associated with decreased odds of having a telehealth appointment.

Conclusion

Satisfaction with at-home Internet connection, a novel HINTS 6 item, is directly correlated with cancer information-seeking experiences and utilization of widely available health technology. These findings underscore the value of widespread, high quality internet services towards the successful implementation of healthcare technology and better patients experiences in health information-seeking.

Key words: digital health, cancer, health information-seeking, telehealth, EHR

Introduction

Background

Broadband Internet, also known as high-speed Internet, which is measured by established upload and download speeds, allows users to access needed information and services with greater efficiency

compared to dial-up services [1]. Access to high-speed Internet plays such a critical role in our daily lives that it has been deemed a “super determinant of health” due to its direct impact on other social determinants of health; it can also influence health behaviors, such as using telemedicine to connect specialists to patients in remote, underserved locations [2-4]. Understanding the importance of broadband access, financial incentives such as the Centers for Medicare & Medicaid Services (CMS) EHR Incentive Program, also known as Meaningful Use (MU) Program were implemented to support widespread implementation of Internet-driven resources throughout health systems [1, 5-7]. These systems were tested by the COVID-19 pandemic which placed an unprecedented burden across healthcare providers and systems worldwide, leading to reliance on health information technology resources, including a rise in the use of telehealth to provide care for those seeking care or infected, and sustain care for chronically ill patients, including those with cancer [8-10].

Studies examining the digital divide suggest that lack of access to broadband Internet presents a significant barrier to access, implementation, and ease of using digital health technologies. A recent study assessing disparities in access to electronic health records using data from the American Community Survey found respondents from neighborhoods where less than 85% of the neighborhood had broadband access were significantly less likely to access their EHR [11]. Furthermore, assessment of broadband capacities has found that areas with the highest broadband availability have significantly greater use of telehealth services, compared to the neighborhoods with lower broadband access [12, 13].

Lack of access to online information is especially problematic for cancer survivors who have unique information needs. A 2023 study using a 17-item Digital Inequity Index (DII) on esophageal cancer outcomes found increasing digital inequity, both infrastructural and sociodemographic, was associated with decreased survival and long-term follow-up, lower odds of receiving chemotherapy, and higher odds of late-stage diagnosis [14]. High-speed Internet connectivity is particularly relevant to remote areas that experience high cancer rates, such as rural Appalachia [15-17]. Unequal access

to care among rural cancer patients has resulted in consistently worse outcomes compared to their urban counterparts, even as diagnostics and treatments modalities improve [18-20]. While the incorporation of telehealth services and use of digital health technology has been proposed to reduce such disparities, lack of broadband Internet in many of these regions may hinder the potential of these interventions. A study on the relationship between broadband access and use of telemedicine found that in counties classified as “fully rural” (i.e. non-metropolitan counties without urban areas, based on USDA Rural-Urban Continuum Codes), broadband availability was associated with access to telemedicine, with counties with low broadband access showing 34% fewer visits per capita compared to counties with greater broadband access [21]. This reduction was also seen in the results of a cross-sectional survey that showed that cancer patients who lacked at-home broadband access were likely to report lower scores related to their comfort with technology [22].

Given the importance of broadband Internet to health, understanding who has access and who does not is critical. However, most people are not aware of their Internet upload and download speeds, and so their perceptions of the quality of their internet may be a more important indicator of access [23, 24]. Quality of Internet connection can pose significant barriers to implementation of remote health services. A retrospective analysis of telehealth services in Wisconsin homes during the COVID-19 pandemic showed that more than 15% of telehealth appointments with poor Internet quality failed to connect, and over 1 in 20 encounters overall were converted into telephone-only appointments [25].

Objectives

The objective of the current study was to assess disparities in perceptions of the quality of at-home Internet connection using a novel item addressing respondent satisfaction with at home Internet connection at a population level in a representative sample of US adults. Our primary aims were to determine differences in self-reported satisfaction with at home Internet connection by sociodemographic characteristics, including age, educational attainment, and rural/urban household

designation, and to document the association between Internet satisfaction and cancer health information-seeking experiences, use of digital health technologies, telehealth utilization, and electronic health records access in this population.

Methods

Data Source

Data from the National Cancer Institute's Health Information National Trends Survey (HINTS) , collected between March and November 2022, were used (HINTS 6). Supplementary table 1 provides a description of the dataset, using the Preferred Reporting Items for Complex Sample Survey Analysis (PRICSSA), an itemized checklist that provides guidance to researchers on reporting the use of complex sample survey data for research studies [26].

Predictors and Outcomes

Our primary predictor variable, satisfaction with at-home Internet connection, was measured using one item from HINTS 6: "How satisfied are you with your Internet connection at home to meet health-related needs?", with a 5-point scale response, ranging from "extremely satisfied" to "not at all satisfied." For the purpose of our analysis, responses were reverse coded and dichotomized into "high satisfaction" (extremely satisfied, very satisfied) and "low satisfaction" (somewhat satisfied, not very satisfied, not at all satisfied). For the outcomes of cancer information-seeking experiences, four items were included. "Based on the results of your most recent search for information about cancer, how much do you agree or disagree with each of the following statements?" 1) "It took a lot of effort to get the information you needed;" 2) "You felt frustrated during your search for the information;" 3) "You were concerned about the quality of the information;" and 4) "The information you found was hard to understand." Each of these items included a 4-scale response, ranging from "strongly agree" to "strongly disagree." Items were recoded as dichotomous variables, with the agreement category including "strongly agree" and "somewhat agree" and the disagreement category including "strongly disagree" and "somewhat disagree" responses. Responses to the 4 items

described above were limited to participants who replied “yes” to previous question : “Have you ever looked for information about cancer from any source?”

To assess the association of satisfaction with at-home Internet and use of health information technology, two items from HINTS 6 were utilized. To determine use of telemedicine, we used the item that read: “In the past 12 months, did you receive care from a doctor or health professional using telehealth?” Valid, affirmative response options (“yes, by video”; “yes, by phone call [voice only no video]”; “yes, some by video and some by phone call”) were collapsed into a single category. Those who reported “no telehealth visits in the past 12 months” represented those in the negative category. Access to electronic health records or patient portals was examined through the item that read: “How many times did you access your online medical record or patient portal in the last 12 months?” Response categories with valid answers (“0”, “1 to 2 times”, “3 to 5 times”, “6 to 9 times”, “10 or more times”) were dichotomized into 2 categories: 0 and 1 or more times. Respondents who reported not having an online medical record or not having been offered one by a provider or insurer, and those with missing data, were excluded from the analysis.

Analysis

Due to the complex sampling structure of HINTS 6, all analyses included a final sample weight for population-level point estimates, and replicate weights to calculate accurate standard errors, where the latter used the Jackknife minus one replication method. Because dependent variables of interests were dichotomized, we employed multivariable logistic regression models to determine the association between satisfaction with at-home Internet connection and each of our outcomes: 1) Effort getting information needed (n= 2,318); 2) Frustration during search for information (n= 2,308); 3) Concern about the quality of information (n= 2,314); 4) Information was hard to understand (n= 2,308); 5) Accessing online medical record/patient portal in the last 12 months (n= 3,834); 6) Receiving care from a doctor or health professional using telehealth in the last 12 months (n= 4,391). Weighted logistic regression was also utilized to assess the association between the

sociodemographic variables included in the adjusted models (age, educational attainment, race/ethnicity, annual household income, access to health insurance, and USDA's 2013 urban/rural designation) and satisfaction with at-home Internet (high v. low satisfaction). Differences across sample sizes in the analytical models are present due to skip patterns and missing data in variables included within each model. All statistical analyses were conducted using SAS (version 9.4; SAS Institute).

Results

Sociodemographic sample characteristics

Socioedemographic predictors of satisfaction with at home Internet connection are included in Table 1. Age was inversely correlated with satisfaction, with all age categories reporting to be more satisfied with their at-home connection, compared to respondents 75 years and older. Respondents who reported educational attainment below a post-baccalaureate degree reported less satisfaction with their at home connection; this was statistically significant for those with a high school diploma (OR 0.52, 95% CI 0.34-0.82), some college (OR 0.49, 95% CI 0.34- 0.72) and a bachelor's degree (OR 0.65, 95% CI 0.47-0.90). The association between race/ethnicity and satisfaction with at-home Internet was significant among Non-Hispanic Asians, who reported less satisfaction compared to their Non-Hispanic White counterparts (OR 0.53, 95% CI 0.28-0.99). Satisfaction with at-home Internet across annual household incomes was significant among respondents reporting incomes of $20,000/year or less (OR 0.52, 95% CI 0.32-0.86) compared to $75,000 or more. Finally, living in a rural location was significantly associated with reporting lower satisfaction with at-home Internet connection, compared to respondents living in urban areas (OR 0.54, 95% CI 0.38-0.77).

Table 1. Weighted logistic regression results of high satisfaction with the Internet by sociodemographic characteristics (n=4,440)

	OR (95% C.I.)	***P***
Age		

Reference: 75+	1.0	-
18-34	2.75 (1.68, 4.52)	<.001
35-49	2.48 (1.72, 3.58)	<.001
50-64	2.01 (1.42, 2.85)	<.001
65-74	1.50 (1.06, 2.11)	.02
Educational attainment		
Reference: Post-baccalaureate degree	1.0	-
Less than high school	0.57 (0.27, 1.29)	.18
High school graduate	0.52 (0.34, 0.82)	.005
Some college	0.49 (0.34, 0.72)	<.001
Bachelor's degree	0.65 (0.47, 0.90)	.01
Race/ethnicity		
Reference: Non-Hispanic White	1.0	-
Non-Hispanic Black	0.92 (0.64, 1.32)	.63
Hispanic	0.77 (0.50, 1.18)	.22
Non-Hispanic Asian	0.53 (0.28, 0.99)	.05
Non-Hispanic Other	0.76 (0.41, 1.39)	.36
Health insurance		
Reference: Health insurance	1.0	-
No health insurance	0.95 (0.57, 1.57)	.83
Annual household income		
Reference: $75,000+	1.0	-
<$20,000	0.52 (0.32, 0.86)	.01
$20,000 to <$35,000	0.82 (0.55, 1.23)	.33
$35,000 to <$50,000	0.84 (0.57, 1.24)	.38
$50,000 to <$75,000	0.83 (0.53, 1.30)	.41
Geographic region of residence		
Reference: Urban/metro	1.0	-
Rural/non-metro	0.54 (0.38, 0.77)	.001

Cancer information-seeking

Table 2 presents the independent association between satisfaction with at-home Internet connection and cancer information-seeking experiences in multivariable models. Respondents who reported low satisfaction with their home Internet connection had higher odds of agreeing that it took a lot of

effort to get the cancer information they needed (OR 1.77, 95% CI 1.31-2.37), to feel frustration searching for information (OR 1.63, 95% CI 1.25-2.12), to be concerned about the quality of information (OR 1.60, 95% CI 1.20-2.13) and for the information found to be hard to understand (OR 1.56, 95% CI 1.13-2.15).

Some sociodemographic characteristics were also independently associated with satisfaction with information seeking. Respondents who identified as Non-Hispanic Asian had significantly higher odds of agreeing that it took a lot of effort to get the cancer information they needed (OR 1.77, 95% CI 1.03-3.07). Regarding frustration in searching for information, those who identified as Non-Hispanic Other felt more frustration during their search of cancer information they needed (OR 3.17, 95% CI 1.40-7.21).

For concerns on the quality of health information, respondents ages 18-34 had higher odds of reporting concern (OR 1.74, 95% CI 1.01-2.98) compared to respondents 75 and older. Also, Non-Hispanic Other respondents had higher odds of agreeing that they were concerned with the quality of cancer information compared to Non-Hispanic White respondents (OR 2.81, 95% CI 1.17-6.75).

Lastly, for hard-to-understand health information, respondents with some college had higher odds of agreeing that the information they found was hard to understand compared to those with post-baccalaureate degrees (OR 1.60, 95% CI 1.06-2.41). Further, Non-Hispanic Other respondents also agreed that the information they found was hard to understand, compared to Non-Hispanic White respondents (OR 2.52, 95% CI 1.07-5.93).

Table 2. Weighted multivariable logistic regression results regarding cancer information-seeking experiences

	Effort to get information		**Frustration searching for information**		**Concern about the quality of information**		**Hard to understand information**	
	Point Estimate (95% C.I.)	***P***	**Point Estimate (95% C.I.)**	***P***	**Point Estimate (95% C.I.)**	***P***	**Point Estimate (95% C.I.)**	***P***

Level of satisfaction with Internet at home								
Reference: High satisfaction with Internet	1.0	-	1.0	-	1.0	-	1.0	-
Low satisfaction with Internet	1.77 (1.31, 2.37)	<.001	1.63 (1.25, 2.12)	<.001	1.60 (1.20, 2.13)	.002	1.56 (1.13 2.15)	.01
Age								
Reference: 75+	1.0	-	1.0	-	1.0	-	1.0	-
18-34	0.83 (0.46, 1.50)	.53	0.81 (0.48, 1.36)	.41	1.74 (1.01, 2.98)	.05	1.67 (0.91, 3.07)	.10
35-49	0.79 (0.48, 1.31)	.35	0.82 (0.49, 1.38)	.45	1.38 (0.87, 2.18)	.17	1.17 (0.73, 1.89)	.50
50-64	1.21 (0.72, 2.03)	.46	0.87 (0.51, 1.50)	.61	1.53 (0.94, 2.49)	.09	1.27 (0.77, 2.09)	.34
65-74	0.91 (0.54, 1.53)	.71	0.63 (0.36, 1.12)	.11	1.01 (0.61, 1.67)	.99	1.36 (0.80, 2.31)	.25
Educational attainment								
Reference: Post-baccalaureate degree	1.0	-	1.0	-	1.0	-	1.0	-
Less than high school	0.78 (0.28, 2.21)	.63	0.56 (0.22, 1.46)	.23	0.62 (0.21, 1.79)	.36	1.0 (0.38, 2.63)	.99
High school graduate	0.95 (0.53, 1.73)	.87	1.08 (0.61, 1.90)	.80	0.74 (0.44, 1.25)	.26	1.57 (0.86, 2.88)	.14
Some college	1.06 (0.73, 1.54)	.75	1.07 (0.68, 1.69)	.76	0.87 (0.57, 1.33)	.51	1.60 (1.06, 2.41)	.03
Bachelor’s degree	0.97 (0.67, 1.42)	.87	0.93 (0.60, 1.43)	.72	0.82 (0.59, 1.14)	.24	1.24 (0.83, 1.84)	.29
Race/ethnicity								
Reference: Non-Hispanic White	1.0	-	1.0	-	1.0	-	1.0	-
Non-Hispanic Black	0.80 (0.48, 1.32)	.37	0.65 (0.34, 1.22)	.17	0.69 (0.41, 1.16)	.16	0.61 (0.33, 1.13)	.11
Hispanic	1.14 (0.66, 1.97)	.64	1.47 (0.85, 2.56)	.17	1.04 (0.65, 1.69)	.86	1.20 (0.69, 2.08)	.52
Non-Hispanic Asian	1.77 (1.03, 3.07)	.04	1.42 (0.77, 2.64)	.26	1.51 (0.76, 3.04)	.24	1.41 (0.70, 2.83)	.33
Non-Hispanic Other	1.99 (0.80, 4.95)	.13	3.17 (1.40, 7.21)	.007	2.81 (1.17, 6.75)	.02	2.52 (1.07, 5.93)	.04
Health insurance								
Reference: Health	1.0	-	1.0	-	1.0	-	1.0	-

insurance								
No health insurance	0.74 (0.41, 1.34)	.31	0.63 (0.32, 1.24)	.17	1.02 (0.55, 1.90)	.94	0.75 (0.37, 1.53)	.43
Annual household income								
Reference: $75,000+	1.0	-	1.0	-	1.0	-	1.0	-
<$20,000	1.33 (0.76, 2.34)	.31	1.02 (0.64, 1.64)	.93	0.98 (0.49, 1.96)	.95	1.35 (0.72, 2.53)	.34
$20,000 to <$35,000	0.99 (0.58, 1.67)	.95	0.88 (0.53, 1.49)	.64	1.22 (0.72, 2.05)	.46	0.83 (0.52, 1.35)	.45
$35,000 to <$50,000	1.02 (0.58, 1.80)	.94	0.83 (0.48, 1.41)	.48	0.79 (0.46, 1.35)	.38	1.30 (0.87, 1.95)	.19
$50,000 to <$75,000	1.13 (0.77, 1.67)	.53	0.76 (0.49, 1.18)	.22	0.92 (0.67, 1.25)	.59	1.15 (0.77, 1.71)	.50
Geographic region of residence								
Reference: Urban/metro	1.0	-	1.0	-	1.0	-	1.0	-
Rural/non-metro	0.74 (0.48, 1.15)	.17	1.11 (0.73, 1.67)	.63	0.91 (0.60, 1.39)	.66	0.82 (0.49, 1.36)	.43

Use of health technology

Table 3 includes findings on health information technology use and satisfaction with at-home Internet connection among HINTS 6 respondents. Participants who reported lower satisfaction with their home Internet had lower odds of reporting accessing their online medical portal at least once over the past 12 months (OR 0.69, 95% CI 0.50-0.95). The same outcome was seen with education and income, where compared to those with a post-baccalaureate degree, individuals with a high school diploma, (OR 0.49, 95% CI 0.31-0.79). and those reporting a yearly household income of $20,000 or less had significantly lower odds of reporting access to their online medical records at least once over the past 12 months (OR 0.39, 95% CI 0.23-0.68) than those with a household income of $75,000 or more.

For the outcome of receiving care through telehealth, those who reported low satisfaction

with their home Internet connection had significantly lower odds of receiving care from a healthcare provider using telehealth over the past 12 months (OR 0.73, 95% CI 0.58-0.92). Younger adults (18-34 years) had significantly lower odds of receiving care through telehealth compared to respondents 75 years and older (OR 0.67, 95% CI 0.45-1.01). Finally, respondents without health insurance also had lower odds of receiving care from a healthcare provider using telehealth over the past 12 months, compared to respondents with insurance (OR 0.41, 0.23- 0.74).

Table 3. Weighted multivariable logistic regression of satisfaction with Internet on telehealth and patient portal use

	Accessing medical record/patient portal		**Receive health care using telehealth**	
	Point Estimate (95% C.I)	***P***	**Point Estimate (95% C.I)**	***P***
Level of satisfaction with Internet at home				
Reference: High satisfaction with Internet	1.0	-	1.0	-
Low satisfaction with Internet	0.69 (0.50, 0.95)	.02	0.73 (0.58, 0.92)	.01
Age				
Reference: 75+	1.0	-	1.0	-
18-34	1.08 (0.56, 2.08)	.83	0.67 (0.45, 1.01)	.05
35-49	1.26 (0.64, 2.46)	.50	1.07 (0.75, 1.52)	.71
50-64	1.51 (0.88, 2.60)	.14	0.83 (0.59, 1.16)	.26
65-74	0.96 (0.53, 1.75)	.89	0.72 (0.49, 1.06)	.10
Educational attainment				
Reference: Post-baccalaureate degree	1.0	-	1.0	-
Less than high school	0.37 (0.13, 1.10)	.07	0.61 (0.27, 1.38)	.23
High school graduate	0.49	.004	0.73	.08

	(0.31, 0.79)		(0.51, 1.04)	
Some college	0.56 (0.37, 0.86)	.01	0.80 (0.56, 1.13)	.20
Bachelor's degree	0.87 (0.58, 1.30)	.48	0.91 (0.64, 1.30)	.59
Race/ethnicity				
Reference: Non-Hispanic White	1.0	-	1.0	-
Non-Hispanic Black	1.02 (0.62, 1.68)	.95	0.72 (0.52, 1.01)	.06
Hispanic	0.83 (0.54, 1.25)	.36	1.22 (0.87, 1.67)	.22
Non-Hispanic Asian	1.26 (0.45, 3.56)	.65	1.02 (0.59, 1.76)	.94
Non-Hispanic Other	1.07 (0.50, 2.27)	.86	1.11 (0.70, 1.77)	.65
Health insurance				
Reference: Health insurance	1.0	-	1.0	-
No health insurance	0.71 (0.41, 1.23)	.22	0.41 (0.23, 0.74)	.004
Annual household income				
Reference: $75,000+	1.0	-	1.0	-
<$20,000	0.39 (0.23, 0.68)	.001	1.23 (0.82, 1.86)	.32
$20,000 to <$35,000	0.61 (0.34, 1.07)	.09	1.04 (0.67, 1.59)	.87
$35,000 to <$50,000	0.80 (0.51, 1.28)	.35	1.10 (0.72, 1.66)	.66
$50,000 to <$75,000	0.70 (0.42, 1.18)	.18	0.80 (0.57, 1.13)	.20
Geographic region of residence				
Reference: Urban/metro	1.0	-	1.0	-
Rural/non-metro	0.69 (0.47, 1.01)	.06	0.88 (0.67, 1.15)	.33

Discussion

Principal Findings

The purpose of this study was to assess how satisfaction with at-home Internet connectivity was associated with cancer health information-seeking perceptions, digital health technology use, and respondent characteristics in a nationally representative sample of US adults. Our findings pinpoint disparities in how satisfied Americans are with their Internet connection by age, level of education, income, and geography. Our assessment of perceived satisfaction with at-home Internet connection to meet health-related needs is a novel contribution to the literature, and the results are consistent with previous studies that examined predictors of Internet access and use. A previous study using data from eight HINTS iterations (2003-2017) found age to be significantly associated with overall Internet use, broadband Internet access, and Internet use through a cellular network, with younger respondents (18-34) reporting greater access than older age groups [27]. Previous studies have also found that use of broadband Internet is associated with higher levels of educational attainment and higher income households, which parallel our current findings with at home Internet satisfaction [28-31]. Furthermore, our findings underscore the pervasive disparity in access to broadband Internet in rural communities, which has been widely documented throughout the digital health literature [32-34].

Satisfaction with Internet and cancer information-seeking

In our analysis, negative experiences with health information-seeking (more effort, frustration with search, concern over information quality, and difficulty understanding the information found) were all significantly associated with lower at-home Internet satisfaction. These findings provide evidence for the relationship between Internet quality and health-information seeking. Previous work on health-information seeking perceptions has assessed effort, frustration, quality of the resources and challenges to understand health information within the context of different types of literacy, including health and e-Health literacy [35, 36]. Furthermore, greater frustration in information-

seeking efforts can hinder utilization of informational resources provided through trusted sources, such as healthcare providers [37]. Such results suggest that the intersection between limited or unsatisfactory access to quality Internet and low literacy should be assessed together, to determine their potential as a deterrent to health information-seeking.

Satisfaction with Internet and health technology use

Our findings suggest that individuals who report lower satisfaction with their home Internet connection have significantly lower odds of utilizing certain Internet-driven health technologies, such as electronic health records or telehealth appointments. Such results align with previous assessments of digital health technology utilization. A study of fee-for-service beneficiaries that examined healthcare utilization and broadband access found counties at the highest median household income quintile reported 35% higher telehealth utilization compared to those at the lowest median income quintile [13]. Another study assessing disparities between telehealth users and nonusers found users were significantly more likely to have post-high school education, compared to nonusers [38]. A recent assessment of financially distressed cancer patients also found that patients with an annual household income of $23,999 or less were more likely to have never received a telemedicine appointment, similar to the results presented in our study [39]. While use of electronic health records is widely promoted as a complementary resource to in-person care, our findings suggest that lack of health insurance is a persistent barrier for their uptake. A study using previous cycles of HINTS data (2017-2018) found an association between having health insurance and use of patient portals; this suggests that while the COVID pandemic might have amplified the use of some Internet health tools, access to health care persists as a barrier towards uptake of digital health technology [40].

The COVID-19 pandemic underscored the value of digital health technologies in providing and sustaining care when in-person healthcare was not feasible, and the potential towards expedient adoption of these tools under these types of crises [41, 42]. However, it also underscored the

pervasiveness of “intervention-generated inequalities” in digital health, where patients who have the advantages of infrastructural and financial access to technology benefit, but those without do not [30]. The importance of access is illustrated through the Federal government’s Healthy People initiative, which outlines major national objectives and goals towards improving health promotion and the prevention of disease and includes an objective to “increase the proportion of adults with broadband Internet.” [43]. While the Federal Communications Commission (FCC) received funding to increase broadband coverage during the COVID pandemic, sustainability of quality Internet in the long-term will play a pivotal role for the dissemination of digital health resources, particularly among poor, underserved and/or rural communities [44-46].

Strengths and limitations

Our study has notable strengths and some limitations. HINTS 6 data includes a relatively large, representative sample of US adults and is one of the first federal, public-use surveys to include an item about satisfaction with at-home Internet. Furthermore, the inclusion of the final sample weight and replicate weights as part of the analysis allowed us to calculate population-level estimates and accurate standard errors of estimates. One limitation is with the telehealth outcome in that those who responded “No” may have not needed an appointment with a provider as opposed not having satisfactory access to the Internet. Also, HINTS is a cross-sectional survey, so temporality among associations cannot be established.

Conclusions

This study suggests that lower self-reported satisfaction with home Internet connection can have negative impacts on perceived health information-seeking experiences and utilization of digital health resources. As digital health tools become more ubiquitous in health care, efforts to enhance access of high speed, quality Internet, particularly among underserved, hard-to-reach rural communities will be needed to lessen the digital gap. Future research should also continue to assess satisfaction with at-home Internet connection, along with broadband access metrics, to better

examine the relationship between user perceptions about Internet access and resultant outcomes.

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Conflicts of Interest

None declared.

Abbreviations

HINTS: Health Information National Trends Survey
CMS: Centers for Medicare & Medicaid Services
EHR: Electronic health records
MU: Meaningful use
OR: Odds ratio

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Supplementary Files

CONSORT (or other) checklists

HINTS 6 sample description using the Preferred Reporting Items for Complex Sample Survey Analysis (PRICSSA).
URL: http://asset.jmir.pub/assets/32d5267950254dded4675bf18c8a8988.pdf