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Access to and Use of Technology for Health: Comparisons Between Appalachian Kentuckians and the General U.S. Population

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Access to and Use of Technology for Health: Comparisons Between Appalachian Kentuckians and the General U.S. Population

Abstract

Introduction: Technology may increase the availability of health information and enable health promoting behaviors. However, lack of access to and use of technology may also exacerbate disparities, particularly in rural communities with limited Internet access.

Purpose: The purpose of this study was to compare Internet access, device ownership, and use of technology for health between Appalachian Kentuckians and the general U.S. population.

Methods: Findings from the 2017 Assessing the Health Status of Kentucky (ASK) survey were compared to national estimates from the Health Information National Trends Survey (HINTS) 5, Cycle 1 (2017), with a particular focus on degree of rurality. ASK and HINTS respondent sociodemographics, Internet access, and use of technology for health were assessed using weighted percentages; chi-square P-values were calculated based on weighted counts.

Results: Over 80% of both populations reported accessing the Internet. However, Appalachian Kentuckians across all geographic strata were significantly less likely to access the Internet through broadband, cellular networks, and Wi-Fi. The U.S. population reported greater electronic device ownership rates. Appalachian Kentuckians were significantly more likely to search for cancer information online compared to national estimates. The majority of both populations reported not having health apps on their smartphones or tablets. Appalachian Kentuckians reported significantly lower rates of using electronic media to exchange information with health professionals.

Implications: Ensuring high-speed Internet access among Appalachian Kentuckians could help this population leverage available technology to overcome barriers to care and reduce health disparities – for example, by enabling the use of health-related apps or electronic means to remotely communicate with providers. Such technologies have the potential to improve the health of medically underserved populations and deserve further attention.

Keywords

Appalachia, Kentucky, health information technologies, Internet, information seeking behaviors

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INTRODUCTION

Internet-enabled technologies have made it possible for users to more easily communicate with healthcare providers, obtain health information, and manage their health.^{1,2} However, access to these technologies is not universal. Although the Internet has become an important source of health information for most Americans,³ research has found that populations most impacted by health disparities also face inequities related to Internet access and use of technology to obtain health information.^{1,2} These health- and technology-related disparities may be particularly acute in rural U.S. communities.

Rural populations tend to be older, of lower socioeconomic status (SES), and have worse health outcomes than urban populations.^{2,4} This may be in part due to the fact that rural residents engage in health risk behaviors (e.g., smoking, physical inactivity) at higher rates than urban residents.⁴ Limited access to health care, lower rates of health insurance coverage, and the need to travel longer distances for care may also contribute to poor health outcomes in rural areas.^{4,5} Lower use of the Internet for health information among rural residents⁶ may also be a contributing factor, and may reflect lack of broadband access^{2,7} (in 2021, home broadband service remained lower in rural communities [72%] compared to urban [77%] and suburban [79%] communities⁷), but may also be driven by additional factors, such as social context, access to and affordability of technologic devices, and limited digital literacy.⁸

Internet access disparities also affect Appalachia, a geopolitical region with many rural communities.^{2,5,9} From 2015 to 2019, computer device ownership and broadband subscriptions were lower in Appalachia than the overall U.S., particularly in the most rural areas of the region.⁹ Despite known barriers to Internet access in rural Appalachia, there has been a lack of research regarding the impact on use of technology to support health.^{2,10} The need for such an assessment seems particularly critical for Appalachian states with the largest Internet access and device ownership disparities. From 2015 to 2019, households in Appalachian Kentucky had lower broadband Internet subscription rates (70.9%) in comparison to non-Appalachian Kentucky households (81.1%),⁹ and subscription rates in Appalachian Kentucky were also lower than in the Appalachian-designated regions in most other states.⁹ Similarly, during the same time period, Appalachian Kentucky had the highest percentage of households without a computer device (19.7%) compared to all other Appalachian-designated regions.⁹ Therefore, the purpose of this paper was to assess Internet access, device ownership, and use of technology for health among Appalachian Kentuckians compared to the general U.S. population.

Additionally, stratified analyses by geography examined how degree of rurality might affect study variables across both populations, as variations in rurality are important to capture both within Appalachia and across the U.S.

METHODS

In 2016, the National Cancer Institute (NCI) provided funding to 15 cancer centers, including the University of Kentucky (UK) Markey Cancer Center (MCC), to help the centers better define the populations contained within their geographic catchment areas.¹¹ MCC used this funding to conduct the “ASK: Assessing the Health Status of Kentucky” survey in the 54-county region of Appalachian Kentucky in 2017. Results of the ASK survey were compared with data from HINTS 5, Cycle 1, a nationally-representative survey that was fielded by NCI in the same year.¹² The ASK and HINTS surveys used a comparable approach, with both surveys employing an address-based random sampling frame and similar mailed materials (i.e., postcards, cover letters, paper surveys, and \$2 cash incentives). Methodologies for both surveys, including full sampling and mailing protocols, are available elsewhere.^{12,13} For both surveys, questionnaire completion served as indication of consent to participate.

The current study compared sociodemographics, Internet access, device ownership, and use of technology for health among Appalachian Kentuckians (using ASK) and the general U.S. population (using HINTS). Sociodemographic variables included age, sex, race, annual household income, level of education, employment status, insurance coverage, marital status, and urban–rural status. To more granularly examine the association between level of rurality and study outcomes across both of these populations, geographic strata based on 2013 U.S. Department of Agriculture Rural–Urban Continuum Codes (RUCC) were created to categorize the survey samples by degree of rurality. Stratum I included metropolitan (urban) counties (RUCC 1–3), while Stratum II (RUCC 4–5), Stratum III (RUCC 6–7), and Stratum IV (RUCC 8–9) were composed of nonmetropolitan (rural) counties with different population sizes. Selected health-related variables such as current smoking status, having smoked at least 100 cigarettes, and body mass index ([BMI] calculated from self-reported weight and height measurements) were also included.

Additional variables assessed included Internet access, device ownership, and use of Internet-enabled technologies for health. Internet access was assessed by asking the two following items: (1) *Do you ever go online to access the Internet or World Wide Web, or to send and receive email?* (yes/no); and (2) *When you use the Internet, do you access it through...A regular dial-up telephone line; Broadband*

such as DSL, cable, or FiOS; A cellular network (i.e., phone, 3G/4G); A wireless network [Wi-Fi]). Device ownership was measured with one item: (1) *Please indicate if you have each of the following...Tablet computer like an iPad, Samsung Galaxy, or Kindle Fire; Smartphone, such as an iPhone, Android, Blackberry, or Windows phone; Basic cell phone only.* Use of Internet-enabled technologies for health was assessed using three items: (1) *In the past 12 months, have you used the Internet to look for information about cancer for yourself?* (yes/no); (2) *On your tablet or smartphone, do you have any "apps" related to health?* (yes/no); and (3) *In the past 12 months, have you used any electronic media (email, text messaging, smartphone app, or social media) to exchange (receive and/or send) information with a health care professional?* (yes/no).

To compare ASK and HINTS survey items, unweighted sample sizes and weighted percentages were calculated for all sociodemographic and health-related variables; chi-square P-values were calculated based on weighted counts. For variables related to Internet access, device ownership, and use of technology for health, the unweighted sample sizes and weighted percentages were based on “yes” responses; the P-values for these variables compared “yes” versus “no” responses. These variables were also examined across the four geographic strata. Data analyses were performed using SAS 9.4 (SAS Institute, Inc., Cary NC, USA). The study protocol was approved by the UK Institutional Review Board.

RESULTS

Sociodemographics and Health Risk Factors

The overall response rate for ASK was 25%,¹³ and the HINTS response rate was 32%.¹² As detailed in Table 1, there were significant differences in sociodemographics and health risk factors between Appalachian Kentuckians (ASK) and the general U.S. population (HINTS). For example, 98% of Appalachian Kentuckians were non-Hispanic white in comparison to 66% of the general U.S. population ($p < 0.0001$). Additionally, compared to Appalachian Kentuckians, members of the general U.S. population were more likely to have higher annual household incomes ($p = 0.0004$), be currently employed ($p = 0.0134$), and have private insurance ($p < 0.0001$). The majority of the U.S. population resided in metropolitan (Stratum I) counties (86%) while only 10% of Appalachian Kentuckians lived in urban areas ($p < 0.0001$), with the remaining 90% living in rural, or nonmetropolitan, communities. Differences between the two populations in age, sex, and education level were nonsignificant. Significant differences in health measures were identified, with Appalachian Kentuckians being more likely to report smoking every day ($p = 0.0025$) and smoking at least 100 cigarettes in their lifetime ($p = 0.004$) and being less likely to have a healthy

BMI compared to the general U.S. population (p=0.0014). These observed differences largely align with prior comparisons between Appalachia and the U.S. based on other data sources, such as the American Community Survey and County Health Rankings, used by the Appalachian Regional Commission.^{9,14}

Table 1. Sociodemographics and Health Risk Factors, ASK vs HINTS

	Appalachian Kentuckians: ASK (2017)		U.S. General Population: HINTS 5, Cycle 1 (2017)		P-value ^c
	N ^a	% ^b	N ^a	% ^b	
Total	798		3285		
Age					0.8885
18–49	211	50.4	1022	50.6	
50–64	269	29.4	1063	30.1	
65+	297	20.3	1061	19.3	
Gender					0.9845
Male	272	48.8	1303	48.9	
Female	516	51.2	1914	51.1	
Race					<0.0001
Non-Hispanic white	757	97.7	1868	65.7	
Other/multiple race	19	2.3	1085	34.3	
Annual Household income					0.0004
\$0–\$19,999	204	23.8	559	17.4	
\$20,000–\$49,000	228	32.9	809	27.1	
\$50,000–\$99,999	178	27.9	899	31.4	
\$100,000+	90	15.4	695	24.1	
Highest level of education					0.1047
Below high school	93	12.2	217	8.7	
High school and/or some college	457	56.6	1558	55.8	
College or graduate school	230	31.2	1406	35.6	
Employment status					0.0134
Employed	278	50.7	1614	58.0	
Unemployed	496	49.3	1574	42.0	
Insurance coverage					<0.0001
Uninsured	26	5.3	196	9.4	
Medicare	232	20.4	535	10.5	
Medicaid	89	16.5	263	11.6	
Private	315	51.4	2165	64.9	
Other	53	6.4	126	3.6	
					<0.0001

Marital status					
Married/living together	468	69.5	1751	55.2	
Not married	310	30.5	1415	44.8	
Urban–rural status					<0.0001
Urban (Metropolitan)	134	9.8	2848	85.8	
Rural (Non-metropolitan)	664	90.2	437	14.2	
Current smoking status					0.0025
Every day	113	40.7	303	28.5	
Some days	13	3.9	111	10.6	
Not at all	247	55.4	856	60.9	
Smoked at least 100 cigarettes					0.0004
Yes	366	48.4	1279	38.1	
No	421	51.6	1985	61.9	
Body mass index					0.0014
Underweight	55	5.8	147	3.8	
Healthy	183	21.7	991	31.5	
Overweight	278	36.3	1078	32.2	
Obese	282	36.2	1069	32.5	
Geographic Strata					<0.0001
Stratum I (RUCC 1–3; metro counties)	134	9.8	2848	85.8	
Stratum II (RUCC 4–5; rural counties with populations of 20,000 or more)	164	16.2	161	5.5	
Stratum III (RUCC 6–7; rural counties with populations between 2,500 and 19,999)	253	50.1	226	6.7	
Stratum IV (RUCC 8–9; rural counties with populations under 2,500)	247	23.9	50	1.9	

^aUnweighted sample size

^bWeighted percentage

^cWeighted chi-square P-value

Internet Access and Device Ownership

The majority of both populations reported going online (ASK: 84%; HINTS: 81%), and there were no statistically significant differences between the two groups (Table 2). However, across all geographic strata, members of the general U.S. population were more likely to report using broadband ($p < 0.0001$), cellular ($p < 0.0001$), and wireless networks ($p < 0.0001$) than Appalachian Kentuckians. Additionally, although rates of smartphone ownership were high (ASK: 74%,

HINTS: 79%) and basic cell phone ownership was low (ASK: 14%, HINTS: 22%) across both groups, members of the general U.S. population were more likely to report having a smartphone (p=0.0107) and basic cell phone only (p=0.0002) compared to Appalachian Kentuckians.

Table 2. Internet Access by Geographic Strata, ASK vs. HINTS

		Appalachian Kentuckians: ASK (2017)		U.S. General Population: HINTS 5, Cycle 1 (2017)		P-value^c
	Total	798		3285		
	Geographic Strata	N (Yes) ^a	% (Yes) ^b	N (Yes) ^a	% (Yes) ^b	
Do you ever go online to access the Internet or World Wide Web, or to send and receive email?	Total	596	83.8	2533	81.2	0.1550
	1. Stratum I (RUCC 1–3)	104	88.8	2221	81.8	
	2. Stratum II (RUCC 4–5)	133	89.7	114	75.5	
	3. Stratum III (RUCC 6–7)	188	84.2	163	77.8	
	4. Stratum IV (RUCC 8–9)	171	77.0	35	80.7	
When you use the Internet, do you access it through...						
A regular dial-up telephone line	Total	23	2.1	67	2.7	0.4560
	1. Stratum I (RUCC 1–3)	2	3.3	54	2.3	
	2. Stratum II (RUCC 4–5)	2	0.6	2	1.6	
	3. Stratum III (RUCC 6–7)	9	1.7	10	8.6	
	4. Stratum IV (RUCC 8–9)	10	3.5	1	1.9	
Broadband such as DSL, cable, or FiOS	Total	256	36.8	1364	55.9	<0.0001
	1. Stratum I (RUCC 1–3)	43	35.4	1226	58.0	
	2. Stratum II (RUCC 4–5)	54	39.4	52	44.3	
	3. Stratum III (RUCC 6–7)	76	37.0	72	41.6	
	4. Stratum IV (RUCC 8–9)	83	35.2	14	41.9	
A cellular network (i.e., phone, 3G/4G)	Total	258	42.3	1436	65.4	<0.0001
	1. Stratum I (RUCC 1–3)	41	36.8	1286	66.4	
	2. Stratum II (RUCC 4–5)	69	51.9	61	61.6	

	3. Stratum III (RUCC 6-7)	71	41.9	76	58.7	
	4. Stratum IV (RUCC 8-9)	77	39.0	13	52.9	
A wireless network (Wi-Fi)	Total	420	64.0	1983	82.0	<0.0001
	1. Stratum I (RUCC 1-3)	78	68.0	1754	82.5	
	2. Stratum II (RUCC 4-5)	94	67.1	93	85.9	
	3. Stratum III (RUCC 6-7)	129	66.4	111	73.2	
	4. Stratum IV (RUCC 8-9)	119	55.3	25	77.8	
Please indicate if you have each of the following...						
Tablet computer like an iPad, Samsung Galaxy, or Kindle Fire	Total	389	56.9	1916	61.6	0.0975
	1. Stratum I (RUCC 1-3)	71	61.2	1677	61.4	
	2. Stratum II (RUCC 4-5)	95	61.7	92	66.7	
	3. Stratum III (RUCC 6-7)	119	58.8	121	59.3	
	4. Stratum IV (RUCC 8-9)	104	47.9	26	60.6	
Smartphone, such as an iPhone, Android, Blackberry, or Windows phone	Total	487	73.5	2386	78.9	0.0107
	1. Stratum I (RUCC 1-3)	89	81.8	2117	80.6	
	2. Stratum II (RUCC 4-5)	124	86.0	97	64.0	
	3. Stratum III (RUCC 6-7)	146	72.5	143	70.6	
	4. Stratum IV (RUCC 8-9)	128	63.6	29	74.5	
Basic Cell Phone Only	Total	140	13.6	849	21.6	0.0002
	1. Stratum I (RUCC 1-3)	22	9.2	700	20.3	
	2. Stratum II (RUCC 4-5)	27	11.0	58	30.3	
	3. Stratum III (RUCC 6-7)	47	15.4	75	29.7	
	4. Stratum IV (RUCC 8-9)	44	13.4	16	24.9	

^aUnweighted sample size

^bWeighted percentage

^cWeighted chi-square P-value (comparing yes vs. no)

Use of Technology for Health

As shown in Table 3, Appalachian Kentuckians across all geographic strata were more likely to report using the Internet to look for information about cancer in the past 12 months compared to the general U.S. population (p=0.0003). Less than 50% of either population indicated having health-related apps on their tablet or smartphone (ASK: 41%, HINTS: 46%) and the difference was nonsignificant. Approximately one-quarter of Appalachian Kentuckians (28%) reported using electronic media to communicate with health providers compared to over half of the general U.S. population (52%); the difference was statistically significant.

Table 3. Use of Technology by Geographic Strata, ASK vs. HINTS

		Appalachian Kentuckians: ASK (2017)		U.S. General Population: HINTS 5, Cycle 1 (2017)		P-value ^c
		N (Yes) ^a	% (Yes) ^{^b}	N (Yes) ^a	% (Yes) ^{^b}	
Total		798		3285		
	Geographic Strata	N (Yes) ^a	% (Yes) ^{^b}	N (Yes) ^a	% (Yes) ^{^b}	
In the past 12 months, have you used the Internet to look for information about cancer for yourself?	Total	157	25.3	564	16.9	0.0003
	1. Stratum I (RUCC 1–3)	26	22.0	493	16.6	
	2. Stratum II (RUCC 4–5)	36	23.9	22	18.2	
	3. Stratum III (RUCC 6–7)	52	27.1	43	20.5	
	4. Stratum IV (RUCC 8–9)	43	24.0	6	11.7	
On your tablet or smartphone, do you have any "apps" related to health?	Total	182	40.5	1173	46.4	0.0915
	1. Stratum I (RUCC 1–3)	31	40.2	1063	48.0	
	2. Stratum II (RUCC 4–5)	47	42.4	44	40.0	
	3. Stratum III (RUCC 6–7)	57	40.8	54	32.9	
	4. Stratum IV (RUCC 8–9)	47	38.6	12	38.3	
In the past 12 months, have you used any electronic media (email, text messaging, smartphone app, or social media) to exchange (receive and/or send)	Total	210	27.5	1723	51.7	<0.0001
	1. Stratum I (RUCC 1–3)	44	34.2	1547	53.3	
	2. Stratum II (RUCC 4–5)	62	37.9	67	44.3	
	3. Stratum III (RUCC 6–7)	56	26.0	90	40.5	

information with a health care professional? *	4. Stratum IV (RUCC 8–9)	48	20.6	19	36.3		
[^] Denominator only includes Yes, No							

*As stated on the ASK survey, item B6. This question was originally modeled after item B7 on the HINTS 4, Cycle 4 survey. Due to changes in HINTS questions between HINTS 4 and HINTS 5 and to calculate a comparable HINTS result for the current analysis, we combined data from any of the “Yes” responses to the following three HINTS 5, Cycle 1 items: B4e (Used email or the Internet to communicate with a doctor in the last 12 months), B9 (Shared health information from an electronic monitoring device or smartphone with a health professional in the last 12 months), and B11 (Sent or received a text message from doctor or other health care professional within the last 12 months). Respondents who selected “Don’t know” or had missing responses for all three items were treated as unknown.

^aUnweighted sample size

^bWeighted percentage

^cWeighted chi-square P-value (comparing yes vs. no)

IMPLICATIONS

To our knowledge, this is the first population-based study to compare Internet access, device ownership, and use of technology for health among Appalachian Kentuckians to the general U.S. population. Consistent with other estimates,^{4,9} Appalachian Kentuckians were of lower SES and reported higher rates of health risk behaviors than the U.S. population. However, although rural populations in the U.S. tend to be older and have lower education levels,^{4,9} the population of Appalachian Kentucky, which was overwhelmingly rural, was not found to be significantly different in age and education compared to the general U.S. population.

Appalachian Kentuckians also had similar rates of Internet use as the general U.S. population. However, members of the general U.S. population had higher rates of broadband, cellular, and wireless Internet access, which parallels recent data showing that lower broadband usage persists in rural areas, including rural counties in the broader Appalachian region.^{2,9} Notably, Appalachian Kentuckians were more likely to report using the Internet to look for cancer information than the general U.S. population. This finding may reflect the unique context of the region, including the high cancer burden experienced by Appalachian populations and the increased need for such health information; limited access to and shortages of other important sources of cancer information, including healthcare providers; and the extensive cancer education efforts of

state and local public health and clinical organizations focused on cancer prevention and control in Appalachian Kentucky.^{2,10,15,16}

Across both surveys, less than half of both populations reported having health-related apps on their smartphone or tablets. Although only half of the U.S. population reported using electronic media to exchange information with health professionals, this rate was almost double the usage reported by Appalachian Kentuckians. These findings suggest individuals across the U.S. may not be fully utilizing technology to support their health. Although health technology has the potential to benefit many people, it may be especially useful in a rural context where additional barriers to in-person health care and participation in traditional health promotion programs exist.^{2,6,15}

Although the current study has several limitations, including the cross-sectional nature of the surveys (which does not allow for inference of causality) and the fact that study findings may not be generalizable to the entire 13-state Appalachian region, it nonetheless provides insights about the use of technology for health in an underserved rural area that faces both structural and socioeconomic challenges. Although Appalachian Kentuckians did not report significantly lower rates of Internet use, they did indicate lower access to high-speed Internet. This is consequential, as Benda et al. have argued that broadband Internet access deserves further consideration as a social determinant of health.⁶ The poor health outcomes observed in many rural populations, including among Appalachian Kentuckians, make it vital to ensure high quality Internet access in these areas, as the Structural Influence Model of Health Communication suggests that health disparities may be, at least partially, explained by differential access to and use of information channels and engagement with health-related content.¹⁷ Lack of access to high-speed Internet could be preventing rural populations from leveraging available technology to seek cancer information, use health-related apps, exchange information with providers, and engage in telehealth. These technologies have the potential to reduce access barriers and improve the health of Appalachians; therefore, multilevel strategies to enable and encourage the use of these tools in rural populations deserve further attention.

Summary Box

What is already known on this topic?

Residents of rural areas, such as Appalachian Kentucky, experience disparities in health as well as inequities in Internet access and use of technology for health.

What is added by this report?

Compared to the general U.S. population, Appalachian Kentuckians did not report lower use of the Internet but did report lower access to high-speed Internet (including broadband). They also reported higher use of the Internet for cancer information seeking, which may indicate both a greater need for information as well as lack of access to other sources of information such as healthcare providers. Similar to the general U.S. population, less than half of Appalachian Kentuckians did not have health apps on their smartphone or tablets. Approximately one-quarter of Appalachian Kentuckians reported using electronic media to communicate with health providers compared to over half of the general U.S. population.

What are the implications for future research?

Technology can support the health of medically underserved rural populations and improve access to care; however, Appalachian Kentuckians may not be fully benefiting from these health-related technologies. Future research should examine barriers to the use of these technologies in this population as well as multilevel interventions that may facilitate the use of these tools.

Authors' Note: The HINTS 5, Cycle 1 (2017) instrument is available at <https://hints.cancer.gov/data/survey-instruments.aspx#H5C1>. The ASK survey is available upon request from the Patient-Oriented and Population Sciences Shared Resource Facility at the University of Kentucky Markey Cancer Center (<https://ukhealthcare.uky.edu/markey-cancer-center/research/bcbr>).

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