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Rural–Urban Differences in General and Health-Related Internet Use

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Abstract

Literature has shown that people living in rural areas are less likely to have access to the Internet for demographic and technological reasons; however, less information is available regarding rural–urban differences in online health-information seeking. Data from the National Cancer Institute's nationally representative 2005 Health Information National Trends Survey ($N = 5,586$) are used to examine these relationships. Logistic regression results show that those in rural areas use the Internet less than those who live in urban areas. Among individuals who have used the Internet, those in rural areas are less likely to use the Internet for health purposes. The persistence of a digital divide between rural and urban residents in online health searching is attributable to factors such as educational level, income, and diffusion of broadband. The article discusses the impact of these differences.

Keywords

rural, rural–urban differences, broadband, computer use, Internet, online health-information seeking, digital divide

This article examines rural–urban differences in factors associated with using the Internet for general and health-related purposes. First, we examine factors associated with general Internet use. Second, we limit our analysis to Internet users to examine what factors are associated with types and number of health-related Internet uses during the past year. We pay particular attention to rural–urban differences, because

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geographic location is an aspect of digital inequality that has not been adequately studied in relation to online health-information seeking. Individuals in rural areas are less likely to have access to the Internet for demographic and technological reasons. Historically there has been a digital divide whereby Internet access increases with factors such as education and income. More recently, Internet use has also been tied to broadband access. Thus, those in rural areas have less Internet access given their lower levels of education and income and lower levels of access to broadband connections.

This article expands the digital inequality and health disparities literatures by focusing on the role of rural–urban differences in online health-information seeking. Many studies have shown that people living in rural areas travel farther to receive care, are less likely to have access to health care services and providers, visit health care providers less often, and have poorer health status than those in other areas (Chan, Hart, & Goodman, 2006; Bennett, Olatosi, & Probst, 2008; Hartley, 2004; Probst, Laditka, Wang, & Johnson, 2006; Weeks, Bott, Lamkin, & Wright, 2005; Weeks et al., 2004). During a time when increasing numbers of people are going online for health information (Fox, 2008; Harris Poll, 2008), little is known about the Internet behavior of those in rural areas.

Use of the Internet can solve some problems of access to health care and health information for those in rural communities, but only if the Internet is widely available. Rural areas are mostly medically underserved; there are fewer health care professionals, and rural patients must to travel farther to access health care (Jameson, 2006). Internet access is potentially useful to the general population and health care providers in rural areas—increasing access to health information and improving communication between patients and health care providers (Jameson, 2006). Internet use enhances social capital by facilitating communication with both strong and weak social ties, across geographic distances and time (Boase, Horrigan, Wellman, & Rainie, 2006). Internet use thus allows individuals to expand and strengthen their range of social ties, contact their social networks more frequently, and mobilize these ties more easily when needed (Quan-Haase, Wellman, Witte, & Hampton, 2002). Therefore, Internet use may help people to make key health care decisions by connecting them to local and extended social networks to access information and advice (Boase et al., 2006). We propose there are at least four interrelated ways through which individuals' use of the Internet may affect well-being: Individuals can (1) find health information to help them to make important health care decisions; (2) increase access to and acquisition of health care resources, including communication with health care providers and participation in support groups; (3) purchase medical and health products online, and (4) increase contact with their geographically close and distant social networks (Boase et al., 2006; Cotten, 2001).

Rural–Urban Differences in Internet Use

People living in rural areas have less access to computers and the Internet (Wilson, Wallin, & Reiser, 2003) and a smaller proportion use the Internet (Bell, Reddy, &

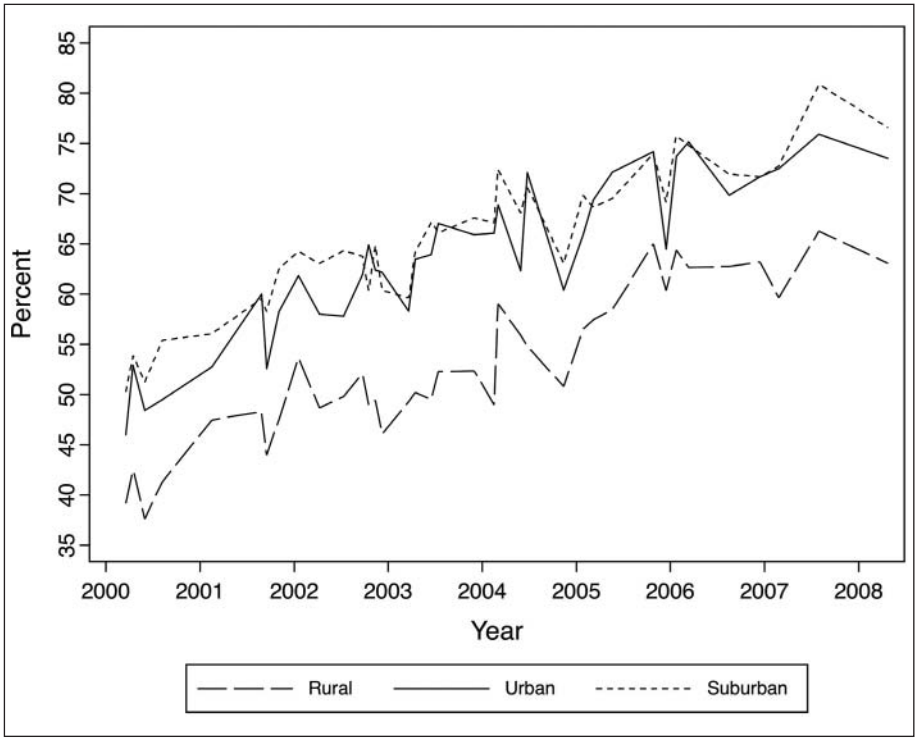

Figure 1. Percentage of individuals who use the Internet, by rural, urban, and suburban area: United States 2000-2008. Source: Pew Internet & American Life Project surveys.

Rainie, 2004; U.S. Department of Agriculture, 2009). Estimates from 37 surveys conducted by the Pew Internet & American Life Project (PIP) show a steady increase in the percentage of people in the United States who use a computer and the Internet. During a span of 8 years, from March 2000 to May 2008, the percentage of people who reported computer use increased from 61.7% to 73.7% and Internet use from 46.1% to 73.1%. Despite these overall gains in use, there exists a persistent gap in the proportion of Internet users between rural and suburban/urban areas (see Figure 1) (supplemental analyses by authors; results available upon request). For example, in March 2000, 39.2% of individuals in rural areas used the Internet compared with 50.3% in suburban and 46% in urban areas—a difference between rural and suburban and urban areas of 11.1 and 6.8 percentage points, respectively. In May 2008, the proportion of Internet users had increased to 63.1% of individuals in rural areas, 76.6% in suburban, and 73.4% in urban. However, the proportion of individuals in rural areas who use the Internet remains lower than those living in suburban and urban areas—13.5 and 10.4 percentage points lower, respectively.

Although Internet use differences exist by location/place, we know that these differences are at least partially the result of larger social differences and inequalities that exist that are related to location/place in our society. Individuals living in rural areas tend to have lower levels of education and income than do those in urban and suburban areas. Key digital divide factors, like education and income, can explain at least part of this gap in technology use (Wilson et al., 2003). For example, data from the U.S. Census Bureau Current Population Survey, Computer and Internet Use Supplement (CIUS) 2007, show that among households with yearly incomes of less than $25,000 a year, 27.6% in rural areas have Internet access, compared with 32.9% in urban areas and 31.8% in central cities (U.S. Department of Commerce, 2008a). In terms of education, those who live in rural areas have fewer years of education, greater likelihood of dropping out of school, and lower math and reading achievement, compared with those who live in suburban areas (Roscigno, Tomaskovic-Devey, & Crowley, 2006). Education is associated with greater computer and Internet use (U.S. Department of Commerce, 2000) and Internet use for health purposes (Cotten & Gupta, 2004).

Another major reason that people living in rural areas use the Internet less is because of the exodus of the young, skilled, and educated from rural areas (Sullivan et al., 2002). Researchers have found that those who either have the skill and/or ability leave rural areas for better economic and educational opportunities in metropolitan areas. Thus, those most likely to use the Internet leave. This "brain drain" has led researchers to try interventions, such as creating community electronic networks in rural areas, to encourage more computer access (Sullivan et al., 2002). Researchers also examine under which conditions rural residents adopt new information technologies, such as being employed with a company that has information technologies (Hollifield & Donnermeyer, 2003).

Finally, the Internet gap in rural areas is also due to differing access to and use of broadband connections. Broadband refers to high-speed access to the Internet through technologies such as a digital subscriber line (DSL), satellite, or cable. Estimates using the CIUS show that from 2001 to 2007, overall home broadband access increased from 9.1% to 50.8% (U.S. Department of Commerce, 2008b). Between 2001 and 2007, home broadband access in rural areas increased by 23.2 percentage points (5.6% to 38.8%), whereas broadband access in urban areas increased by 43.5 percentage points (10.3% to 53.8%) (U.S. Department of Commerce, 2008a, 2008b, 2008c). The most recent PIP estimates using data collected in April 2009 found that 47% of rural and 67% of urban households had a broadband connection (Horrigan, 2009, p. 14). Although the proportion of people with access to broadband connections has steadily increased over time, people living in rural areas remain less likely to have home broadband access (Davison & Cotten, 2009; U.S. Department of Agriculture, 2009). In some cases broadband access is simply not available. Horrigan (2008, p. 12), for example, found that 28% of individuals in rural areas did not have access to broadband connections and that 24% of rural dial-up users would convert to broadband if it were available. "Indeed, differences in availability may account for much of the disparity in broadband use between rural and urban areas" (U.S. Department of Commerce, 2004,

p. 17). In other cases, there are few providers or potential subscribers, so broadband access is too expensive (Strover, 2003; U.S. Department of Commerce, 2004). Nearly one third (31.1%) of rural dial-up users cited expense as the reason why they do not have high-speed Internet access at home (U.S. Department of Commerce, 2004). Thus, the lack of broadband access in rural areas is linked to digital divide factors.

Rural–Urban Differences in Online Health Activities

It is well-established from nationally representative surveys that about 60% of U.S. adults, or about 80% of Internet users, have looked online for health information (Fox & Jones, 2009, p. 6). However, few researchers have examined rural–urban differences in online health activities. Of those who do, many simply include rural–urban measures as control variables in their multivariate models (see, e.g., Baker, Wagner, Singer, & Bundorf, 2003; Flynn, Smith, & Freese, 2006). People living in rural areas are less likely to search the Internet for health information (Flynn et al., 2006; Licciardone, 2001). However, as we noted above, geographical location does not exist in isolation. There are larger scale social differences and inequalities that affect the type of resources available in different types of locations. The type of Internet connection affects the frequency and type of online activities. Those with broadband access engage in more online activities and are more likely to search for specific information on health services or practices and general health information (Fox & Jones, 2009; Rains, 2008; U.S. Department of Commerce, 2004). Davison and Cotten (2009) found that lack of access to broadband was a better predictor of frequency of online activities than traditional digital divide factors like income (with the exception of age).

In sum, we expect that those in rural areas will be less likely to use the Internet, in part because of lower income, education, and broadband access. In addition, although we know little about rural use of the Internet for health purposes, we expect use levels to be lower among those in rural areas.

Methods

We use existing data from the National Cancer Institute's (NCI) nationally representative 2005 Health Information National Trends Survey (HINTS) ($N = 5{,}586$), which was designed to capture data on whether people in the United States seek and use cancer-related information. Individuals were not required to have cancer or have a family member with cancer to participate in the study. The HINTS study also included questions assessing several methods of health information retrieval, including the Internet. Random digit dialing was used in combination with a purchased prefix list to develop the sample of households, with random selection of one adult participant. The response rate for the initial screener interview was 34.0%, and of those recruited, 61.2% completed the extended interview (Cantor, Covell, Davis, Park, & Rizzo, 2005).

We use two samples to conduct our statistical analyses: the full sample and Internet users. The full sample is reduced by 6.9% after we delete cases with missing values on

having ever used the Internet, demographics, socioeconomic status, and health, resulting in an analytic sample of 5,215. To examine health-related Internet use, we restrict our later analyses to a subsample of respondents who report having ever used the Internet. Among the 3,089 respondents who report having ever used the Internet, 17.1% are missing values on 1 or more of 10 types of health-related Internet use, hours of Internet use, and type of Internet connection, reducing the sample size to 2,560.

Because we are interested in the relationship of health-related use of the Internet during the past 12 months and our subsample was selected based on respondents who report having "ever" gone online, we examined the number of respondents who reported recent Internet use and access. We found that among the subsample of 2,560 Internet users, only 366 respondents reported no health-related use of the Internet during the past 12 months, 31 respondents reported no hours of Internet use during the week or on weekends, and all respondents in the subsample reported having some type of Internet connection at home. This suggests that an overwhelming majority use the Internet on a regular basis and have access to the Internet at home.

All analyses were conducted using the sample and replicate weights to adjust for the complex sampling design of the HINTS dataset. Use of these weights is necessary to compute nationally representative point estimates, standard errors, and p values.

Measures

Rural–urban place of residence. We use the 2003 Office of Management and Budget (OMB) county-based definitions of metropolitan and nonmetropolitan areas to distinguish between people living in rural and urban areas. Although a dichotomous measure obscures the heterogeneity found in rural and urban areas (Hall, Kaufman, & Ricketts, 2006), the OMB classification is a useful general definition of *rural* and is the most frequently used classification scheme in the development of federal and state policies (Hart, Larson, & Lishner, 2005; U.S. Department of Agriculture, 2007). The OMB defines metropolitan and nonmetropolitan areas using two criteria: (1) population size and density and (2) percentage of workers who commute between counties (U.S. Department of Agriculture, 2007). Counties are classified as metropolitan if they consist of one or more urbanized areas with 50,000 or more people and a core population density of 1,000 persons per square mile or if 25% or more of workers commute between a metropolitan and outlying county. Nonmetropolitan counties are outside the boundaries of metropolitan counties and consist of urban clusters of less than 50,000 persons. The U.S. Department of Agriculture's Economic Research Service used data from the 2000 census to classify counties as metropolitan or nonmetropolitan. Based on this classification, there are 1,090 urban (metropolitan) and 2,052 rural (nonmetropolitan) counties, with rural counties accounting for 17.4% of the total U.S. population in 2000 (U.S. Department of Agriculture, 2007).

General Internet use. General Internet use is measured by four separate variables: (1) ever used the Internet, (2) type of home Internet connection, (3) hours of personal Internet use each weekday, and (4) hours of personal Internet use on weekends. Internet

users are coded as those respondents who answered yes (1 = *yes*) to the question, "Do you ever go online to use the Internet, World Wide Web, or send/receive e-mail?" Type of home Internet connection is coded as broadband (1 = *yes*) if a participant uses a DSL, cable, or satellite modem versus telephone modem (dial-up), wireless such as a PDA, or some other connection. Hours of personal Internet use are assessed by asking participants, "About how many hours do you use the Internet for personal reasons during a typical (a) weekday and (b) on the weekend?" Hours are coded to represent daily hours of Internet use.

Health-related Internet use. Health-related Internet use is measured by a series of 10 items that assess whether a respondent used the Internet for various health-related purposes during the past 12 months (1 = *yes* for each item). These items include (1) looked for health or medical information for oneself, (2) looked for health or medical information for someone else, (3) bought medicine or vitamins online, (4) participated in an online support group for people with a similar health or medical issue, (5) used e-mail or the Internet to communicate with a doctor or a doctor's office, (6) looked for information about physical activity or exercise, (7) looked for information about diet or nutrition, (8) looked for information about protecting oneself from the sun, (9) looked for information about quitting smoking, and (10) did anything else health-related on the Internet.

To demonstrate more clearly the relationship between level of Internet use and our independent variables, we use a 10-item summary measure based on research by Drentea, Goldner, Cotten, and Hale (2008). This creates an ordinal measure indicating four levels of Internet use: no health-related use of Internet, one or two health-related uses, three or four health-related uses, and five or more health-related uses.

Physical health and psychological distress. Given that we are examining online health-information seeking, assessing health status is important. Physical health is measured by a single question asking respondents to rate their health on a scale from 1 = *poor* to 5 = *excellent*. Psychological distress, a measure of mental health, is assessed using the six-item K6 scale, which measures the frequency respondents experienced symptoms of nonspecific psychological distress during the past 30 days (Kessler et al., 2002). Scores range from 0 to 24, with higher levels representing a greater frequency of symptoms and greater psychological distress (Cronbach's alpha = .813).

Socioeconomic status. Education is measured as the highest level of completed education and coded as one of 11 categories (1 = *never attended school or only attended nursery school/kindergarten* to 11 = *professional school or doctorate degree*). Missing values (n = 211, 3.8%) are recoded to the unweighted mean (7 = *some college, but no degree*). Household income is measured in dollars with missing values (n = 1,813, 32.5%) imputed using a regression-based method and the variables of gender, age, race, education, marital status, and employment status as predictors.

Control variables. Work status, health care coverage, and demographics are included as control variables. Work status is coded as "employed" if a respondent is employed for wages or self-employed (1 = *employed*) versus "out of work or unable to work, retired, a student, or a homemaker." Health care coverage is coded as "uninsured" if

respondents report they do not have any kind of private or public health care insurance or coverage (1 = *uninsured*). Standard demographic variables include age (coded in years), gender (1 = *female*), race (1 = *non-White*), and marital status (1 = *married*).

Data Analysis

Our strategy is to explore differences in Internet use and health-related Internet use by rural or urban location. We first focus on a dichotomous variable indicating if a respondent has ever used the Internet among the full analytic sample. We then focus our attention on health-related Internet use among the subsample of Internet users. Table 1 presents the results of the descriptive analysis of variables in the full analytical sample (N = 5,215) and statistical tests of differences by rural–urban residence. In Table 2 we present the results of logistic regression models with Internet use (yes/no) as the dependent variable. Model 1 tests the relationship between rural residence and Internet use while controlling for sociodemographics. Successive models add variables to assess the effects associated with socioeconomic status (Model 2) and health (Model 3).

The remaining analyses focus on rural–urban differences in health-related Internet use among respondents who report being Internet users (n = 2,560). Table 3 presents the results of the descriptive analysis and statistical tests of significant differences in variables by rural–urban residence. Types of health-related Internet use that differ significantly by rural-urban residence at the bivariate level in Table 3 are further explored using logistic regression in Table 4. Variables are added to successive models to assess the effects of socioeconomic status (Model 2), hours using the Internet and broadband access (Model 3), and health variables (Model 4) to explain the relationship between rural residence and each type of health-related Internet use. Finally, in Table 5, multinomial logistic regression is used to examine differences in levels of health-related Internet use during the past 12 months. This compares the relative odds associated with each level of use in reference to those who use the Internet but report no health-related Internet use during the past 12 months. We use successive models test the effects of rural residence, controlling for sociodemographics (Model 1), socioeconomic status (Model 2), hours using the Internet and broadband access (Model 3), and health variables (Model 4) to explain differences in level of health-related Internet use.

Results

Table 1 shows the weighted means and standard deviations or percentages for variables in the full sample (N = 5,215) and by subsamples of place of residence, urban (n = 4,060) and rural (n = 1,154). Compared with participants who report living in urban counties, rural participants are, on average, slightly older (mean age 46.8 vs. 44.8 years), married (62.9% vs. 57.1%), and less likely to be non-White (19.4% vs. 32.6%). Rural participants report lower mean levels of education (6.20 vs. 6.59) and a total household income about $10,000 less than urban participants ($50,892 vs. $60,789).

Table 1. Descriptives, Health Information National Trends Survey 2005

	Full Sample (N = 5,215)		Urban (n = 4,060)		Rural (n = 1,154)	
	M^a	*SD*	M^a	*SD*	$M^{a,b}$	*SD*
Age, years	45.18	17.47	44.77	17.24	46.83*	18.17
Female, %	52.33		51.91		54.01	
Race, minority, %	29.93		32.59		19.36***	
Married, %	58.27		57.11		62.89*	
Uninsured, %	16.40		16.21		17.16	
Employed, %	58.70		58.66		58.89	
Education (11 categories)	6.51	2.10	6.59	2.10	6.20***	2.06
Household income (continuous), $	58,804.91	50,442.79	60,789.50	52,156.77	50,892.11***	39,708.83
Health measures						
Self-rated health (5 categories)	3.24	1.04	3.25	1.04	3.22	1.04
Psychological distress (0-24)	4.70	4.20	4.70	4.12	4.68	4.49
Use Internet, %	62.54		63.88		57.23**	
Rural residence, %	20.05					

All estimates are weighted and adjusted for complex sample design.
[a]Means for dichotomous variables presented as percentage.
[b]Results of *t* test, significant difference in means between rural and urban subsample.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2. Odds Ratios for Logistic Regression Models Predicting Whether Individuals Use the Internet by Place of Residence, Sociodemographics, Socioeconomic Status, and Health, Health Information National Trends Survey 2005 (N = 5,215)

	(1)	(2)	(3)
Rural residence	0.660*** (0.069)	0.843 (0.088)	0.835 (0.088)
Age	0.944*** (0.003)	0.942*** (0.003)	0.941*** (0.004)
Female	1.139 (0.090)	1.136 (0.106)	1.138 (0.103)
Race, minority	0.291*** (0.034)	0.399*** (0.054)	0.410*** (0.057)
Married	1.562*** (0.141)	1.093 (0.120)	1.108 (0.123)
Uninsured	0.320*** (0.058)	0.520** (0.099)	0.520** (0.098)
Employed	1.577*** (0.161)	1.011 (0.121)	0.962 (0.114)
Education (11 categories)		1.541*** (0.035)	1.532*** (0.035)
Household income (in $10,000)		1.131*** (0.029)	1.114*** (0.028)
Self-rated health (5 categories)			1.212** (0.077)
Psychological distress (0-24)			0.992 (0.012)
Pseudo R^2	.187	.307	.312

All estimates are weighted and adjusted for complex sample design. Robust standard errors in parentheses.
*$p < .05$. **$p < .01$. ***$p < .001$

Table 3. Descriptives, Among Internet Users, Health Information National Trends Survey 2005

	All Internet Users (n = 2,560)		Urban (n = 2,087)		Rural (n = 473)	
	M^a	*SD*	M^a	*SD*	$M^{a,b}$	*SD*
Age	41.05	14.94	40.86	15.30	41.95	15.41
Female, %	51.73		51.25		54.00	
Race, minority, %	20.96		22.92		11.88***	
Married, %	62.87		61.78		67.96	
Uninsured, %	11.37		10.96		13.25	
Employed, %	66.36		65.76		69.12	
Education (11 categories)	7.30	1.86	7.40	1.89	6.81***	1.93
Household income (continuous), $	72,950.36	54,703.79	74,857.61	58,093.39	64,082.28**	44,216.93
Health measures						
Self-rated health (5 categories)	3.45	.94	3.46	.97	3.42	
Psychological distress (0-24)	4.21	3.68	4.22	3.79	4.17	3.73
Internet use						
Broadband access, %	56.20		58.99		43.25***	
Internet weekday hours	1.80	1.76	1.84	1.87	1.63	1.44
Internet weekend hours	1.25	1.25	1.26	1.31	1.17	1.12
1. Information for yourself, %	59.36		60.54		53.86	
2. Information for someone else, %	61.52		62.67		56.16	
3. Bought medications, %	13.14		13.66		10.71	
4. Used support groups, %	3.80		3.83		3.69	
5. Sent e-mail to doctor, %	10.29		10.84		7.42	
6. Information on exercise, %	47.66		49.56		38.83***	
7. Information on diet, %	55.01		56.51		48.02*	
8. Information on sun protection, %	13.57		14.28		10.25	
9. Information on quitting smoking , %	9.76		9.90		9.14	
10. Done anything else health-related, %	23.75		24.97		18.06**	
Internet use score (sum of items, excluding support; range 0-10)	2.98	1.98	3.07	2.03	2.56**	1.98

(continued)

Table 3. (continued)

	All Internet Users (n = 2,560)		Urban (n = 2,087)		Rural (n = 473)	
	M^a	SD	M^a	SD	$M^{a,b}$	SD
Uses Internet, but zero health-related Internet uses, %	15.35		14.25		20.46	
1 or 2 health-related Internet uses, %	26.38		25.80		29.07	
3 or 4 health-related Internet uses, %	33.49		33.37		34.07	
≥5 health-related Internet uses, %	24.78		26.58		16.41***	
Rural residence, %	17.70					

All estimates are weighted and adjusted for complex sample design.
[a]Means for dichotomous variables presented as percentage.
[b]Results of t test, significant difference in means between rural and urban subsample.
*$p < .05$. **$p < .01$. ***$p < .001$.

A smaller proportion of rural participants report having ever used the Internet: 57.2% compared with 63.9% of urban participants. Rural and urban groups do not differ in mean levels of self-rated health or psychological distress.

Table 2 shows the odds ratios for logistic regression models predicting whether individuals have ever used the Internet (1 = *yes*) by rural–urban residence, sociodemographics, socioeconomic status, and health. In Model 1, rural residence is associated with a 34% reduction in the odds of having ever used the Internet, controlling for sociodemographic variables. Level of education and total household income mediate the relationship between rural residence and Internet use in Model 2. Higher levels of education and income are associated with an increase in the odds of Internet use—an increase of 54% and 13%, respectively, holding other variables constant. Variables assessing physical and mental health are added in Model 3; however, physical health is the only one significantly related to Internet use. Minority status and lacking medical insurance are associated with lower odds of having ever used the Internet, 59% and 49% lower, respectively. The increase in odds associated with being married or employed is mediated by differences in level of education and household income (see Models 1 and 2). When controlling for other variables, we found that education is a strong predictor of whether one has ever used the Internet. In Model 3, a 1 *SD* increase in level of education (2.1 categories, see Table 1) is associated with an average increase of 146% in the odds of having ever used the Internet. For comparison, a 1 *SD* increase in income is associated with an increase of 69% in the odds of having ever used the Internet, self-rated health a 22% increase, and age a 66% decrease.

(text continues on p. 1319)

Table 4. Odds Ratios for Logistic Regression Models Predicting Health-Related Internet Use by Place of Residence, Sociodemographics, Socioeconomic Status, and Health Among Internet Users, Health Information National Trends Survey 2005 (n = 2,560)

	Exercise				Diet				Anything Else			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Rural residence	0.651**	0.702**	0.748*	0.749*	0.711*	0.772	0.806	0.800	0.686*	0.747	0.774	0.774
	(0.085)	(0.090)	(0.095)	(0.097)	(0.109)	(0.116)	(0.119)	(0.120)	(0.109)	(0.122)	(0.129)	(0.131)
Age	0.976***	0.974***	0.977***	0.978***	0.984***	0.982***	0.985***	0.985***	1.001	1.000	1.002	1.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Female	1.431**	1.429**	1.534***	1.510***	1.957***	1.965***	2.083***	2.090***	1.029	1.022	1.075	1.050
	(0.163)	(0.165)	(0.182)	(0.177)	(0.226)	(0.229)	(0.252)	(0.252)	(0.172)	(0.176)	(0.186)	(0.183)
Race, minority	0.947	0.959	0.936	0.931	1.138	1.162	1.164	1.143	1.405	1.435	1.417	1.399
	(0.167)	(0.172)	(0.178)	(0.175)	(0.190)	(0.192)	(0.218)	(0.220)	(0.263)	(0.273)	(0.294)	(0.280)
Married	0.725*	0.687**	0.751*	0.770*	0.943	0.889	0.970	0.988	1.060	0.998	1.099	1.157
	(0.092)	(0.088)	(0.096)	(0.099)	(0.123)	(0.122)	(0.127)	(0.130)	(0.148)	(0.152)	(0.166)	(0.180)
Uninsured	0.968	1.058	1.090	1.064	1.032	1.142	1.187	1.195	0.990	1.097	1.115	1.081
	(0.244)	(0.279)	(0.287)	(0.286)	(0.221)	(0.252)	(0.276)	(0.292)	(0.213)	(0.249)	(0.258)	(0.254)
Employed	0.979	0.905	0.951	0.960	1.007	0.923	0.947	0.968	0.957	0.870	0.895	0.918
	(0.117)	(0.111)	(0.123)	(0.123)	(0.132)	(0.127)	(0.137)	(0.142)	(0.162)	(0.147)	(0.155)	(0.156)
Education (11 categories)		1.151***	1.150***	1.158***		1.144***	1.144***	1.155***		1.159***	1.166***	1.186***
		(0.037)	(0.035)	(0.035)		(0.041)	(0.041)	(0.041)		(0.046)	(0.043)	(0.045)
Household income (in $10,000)		0.993	0.989	0.991		1.000	0.998	1.002		0.996	0.996	1.001
		(0.011)	(0.010)	(0.010)		(0.011)	(0.010)	(0.011)		(0.012)	(0.012)	(0.011)
Internet weekday hours			1.056	1.047			1.003	0.992			1.002	0.984
			(0.066)	(0.069)			(0.080)	(0.085)			(0.050)	(0.052)
Internet weekend hours			1.187*	1.180*			1.235*	1.229*			1.236*	1.226*
			(0.081)	(0.085)			(0.115)	(0.119)			(0.102)	(0.104)

(continued)

Table 4. (continued)

	Exercise				Diet				Anything Else			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Broadband access			1.537*** (0.181)	1.558*** (0.182)			1.350* (0.185)	1.347* (0.186)			1.226 (0.171)	1.249 (0.173)
Self-rated health (5 categories)				0.962 (0.071)				0.832* (0.065)				0.854* (0.054)
Psychological distress (0-24)				1.032 (0.021)				1.007 (0.019)				1.049* (0.019)
Pseudo R^2	.046	.056	.076	.079	.037	.047	.062	.068	.007	.018	.034	.045

All estimates are weighted and adjusted for complex sample design.
Robust standard errors in parentheses
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 5. Relative Risk Ratios for Multinomial Logistic Regression Models Predicting Levels of Internet Use by Place of Residence, Sociodemographics, Socioeconomic Status and Health Among Internet Users, Health Information National Trends Survey 2005 (n = 2,560)

	1 or 2 Health-Related Uses of the Internet vs. No Health-Related Use				3 or 4 Health-Related Uses of the Internet vs. No Health-Related Use				5 or More Health-Related Uses of the Internet vs. No Health-Related Use			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Rural residence	0.797 (0.215)	0.908 (0.246)	0.904 (0.252)	0.899 (0.256)	0.691 (0.159)	0.802 (0.189)	0.843 (0.208)	0.838 (0.210)	0.428** (0.119)	0.524* (0.147)	0.566 (0.167)	0.561 (0.171)
Age	0.989 (0.007)	0.986 (0.007)	0.988 (0.007)	0.987 (0.007)	0.978*** (0.006)	0.975*** (0.006)	0.979** (0.006)	0.979*** (0.006)	0.984* (0.006)	0.981** (0.006)	0.987 (0.006)	0.989 (0.006)
Female	1.783** (0.358)	1.827** (0.378)	1.920** (0.432)	1.946** (0.420)	2.402*** (0.548)	2.471*** (0.589)	2.742*** (0.718)	2.766*** (0.698)	2.789*** (0.618)	2.881*** (0.667)	3.380*** (0.917)	3.333*** (0.885)
Race, minority	1.342 (0.314)	1.391 (0.314)	1.288 (0.329)	1.280 (0.334)	0.993 (0.235)	1.028 (0.238)	0.956 (0.255)	0.941 (0.251)	1.272 (0.341)	1.349 (0.356)	1.271 (0.382)	1.248 (0.365)
Married	1.219 (0.277)	1.130 (0.248)	1.263 (0.265)	1.244 (0.264)	1.205 (0.273)	1.113 (0.257)	1.314 (0.298)	1.307 (0.302)	0.980 (0.249)	0.854 (0.224)	1.058 (0.282)	1.125 (0.314)
Uninsured	0.691 (0.246)	0.830 (0.294)	0.823 (0.305)	0.838 (0.318)	0.899 (0.301)	1.102 (0.376)	1.142 (0.387)	1.160 (0.404)	0.868 (0.313)	1.140 (0.422)	1.217 (0.466)	1.179 (0.478)
Employed	0.784 (0.171)	0.671 (0.163)	0.697 (0.170)	0.715 (0.178)	0.805 (0.126)	0.676* (0.124)	0.722 (0.141)	0.743 (0.148)	0.906 (0.178)	0.712 (0.156)	0.770 (0.188)	0.815 (0.200)
Education (11 categories)		1.221** (0.085)	1.227** (0.087)	1.230** (0.086)		1.297*** (0.078)	1.299*** (0.079)	1.307*** (0.078)		1.387*** (0.097)	1.396*** (0.095)	1.438*** (0.098)
Household income (in $10,000)		1.013 (0.025)	1.014 (0.025)	1.016 (0.027)		.999 (0.025)	.996 (0.024)	.999 (0.027)		1.013 (0.026)	1.009 (0.025)	1.018 (0.028)
Internet weekday hours			1.083 (0.101)	1.079 (0.098)			1.121 (0.113)	1.112 (0.118)			1.096 (0.096)	1.058 (0.099)
Internet weekend hours			1.257 (0.275)	1.261 (0.269)			1.370 (0.293)	1.371 (0.288)			1.594 (0.378)	1.584 (0.377)

(continued)

Table 5. (continued)

	1 or 2 Health-Related Uses of the Internet vs. No Health-Related Use				3 or 4 Health-Related Uses of the Internet vs. No Health-Related Use				5 or More Health-Related Uses of the Internet vs. No Health-Related Use			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Broadband access			0.996 (0.188)	0.980 (0.186)			1.517* (0.298)	1.503 (0.305)			1.907** (0.368)	1.972** (0.392)
Self-rated health (5 categories)				0.873 (0.087)				0.835 (0.088)				0.726** (0.076)
Psychological distress (0-24)				0.978 (0.042)				0.989 (0.039)				1.061 (0.042)
Pseudo R^2									.021	.031	.053	.062

All estimates are weighted and adjusted for complex sample design. Robust standard errors in parentheses
*$p < .05$. **$p < .01$. ***$p < .001$.

In Table 3 we examine the relationship between rural residence and specific types of health-related use of the Internet among the subsample of Internet users. We find the same pattern of statistically significant differences in the means and proportions of sociodemographic and socioeconomic status variables as in Table 1. Variables assessing Internet use show that a smaller proportion of rural residents have broadband access compared with urban residents (43.3% vs. 59.0%). However, there are no statistically significant differences in the number of hours of Internet use during days of the week or weekend. Of the 10 types of health-related Internet use, rural residents report significantly less use of three types: (1) looking for information about physical activity or exercise, (2) looking for information about diet or nutrition, and (3) doing anything else health-related online. The mean number of types of health-related Internet use during the past year is significantly lower among rural residents compared with urban residents (2.56 vs. 3.07). A significantly smaller proportion of rural residents report five or more health-related uses of the Internet in the past 12 months than urban residents (16.4% vs. 26.6%).

To better understand what explains the association between rural residence and the three types of health-related Internet uses identified in Table 3, we conducted logistic regression analyses using each of the three types of health-related use variables as the outcomes (see Table 4). For all three types of health-related use, rural residence is associated with a significant decrease in the odds of each type of use. Compared with those living in an urban residence, a rural residence is associated with a decrease in the odds of having looked for information about exercise (35%) or diet (29%) or doing anything else health-related online (32%), holding other variables constant. Of the two variables assessing socioeconomic status added in Model 2, only education is a significant predictor of health-related use. Across types of use and models, for each unit increase in level of education there is an average increase of between 14% and 19% in the odds of health-related Internet use, holding other variables constant. Socioeconomic status completely mediates the relationship between rural residence and looking for information on diet or doing anything else health-related online in Model 2 and attenuates the relationship to looking for information on exercise. In Model 3, variables assessing hours of Internet use and broadband access are added. Hours of weekend Internet use are associated with a greater odds of all three types of health-related uses, whereas broadband access is associated with a greater odds of looking for information on exercise and diet. In Model 4, better self-rated health is associated with a decrease in the odds of looking for information on diet or doing anything else health-related online. Higher psychological distress is associated with a small increase in the odds of doing anything else online. Female gender is associated with increased odds of looking for information on exercise and diet, 51% and 109% respectively, controlling for other variables.

In Table 5 we examine the relative risk ratios associated with the frequency of health-related use of the Internet during the past year using multinomial logistic regression. The results from this table are interpreted as the relative risk ratio associated with each level of health-related use in reference to a group who uses the Internet but reports no health-related Internet use during the past year. The results show that rural residence

is a significant predictor of differences in the frequency of health-related Internet use only for the group of five or more uses. In Models 1 and 2 in this group, living in a rural area compared with an urban area is associated with a decrease of between 48% and 57% in the odds of using five or more health-related Internet uses compared with no health-related uses. Broadband access is associated with a 91% increase in the odds of using five or more health-related Internet uses and completely mediates the effect of rural residence. In Model 4, better self-rated health is associated with a 27% decrease in the odds of using five or more health-related uses. Psychological distress is not a significant predictor of level of health-related use.

Looking across all levels of health-related Internet use shows that on average, women are much more likely to make health-related use of the Internet and have more frequent use compared with men. For example, being female is associated with increased odds of reporting more frequent use, ranging from 78% to 95% in the odds of one or two health-related uses, 140% to 177% in the odds of three or four health-related uses, and 179% to 233% in the odds of five or more health-related Internet uses, holding other variables constant. Next most important appears to be type of Internet connection. Broadband access is associated with an increase of about 52% in the odds of three or four health-related uses in Model 3 and a 91% to 97% increase in the odds of five or more uses. Education is also important, but not to the level of these other factors. The odds associated with higher levels of education increase across levels of use, about 23% for one or two uses, 30% for three or four uses, and 40% for five or more uses, holding other variables constant.

Discussion and Conclusions

Our study provides a current and extensive look at rural–urban differences in factors associated with using the Internet for general and health-related purposes. First, we examined general Internet use. After controlling for age, gender, race, marital, employment, and insurance status, we found that rural residents were 34% less likely to report Internet use than urban residents. The lower odds of Internet use associated with rural residence were explained by differences in education and household income. Second, among Internet users we examined rural–urban differences in factors associated with types and number of health-related Internet use. Rural residents were less likely to report health-related Internet use. Again, education was an important factor, explaining some or all of difference in type of health-related Internet use associated with rural residence. We found that rural residents were about half as likely to report five or more types of health-related uses than urban residents and that education and broadband access explain most or all of this relationship.

In summary, rural residents were less likely than urban residents to use the Internet and engage in online health activities. Education was a consistently strong and robust predictor of Internet use and specific types of online health activities. Other factors such as household income and age were salient in terms of explaining Internet access

whereas gender and broadband access were important for explaining the frequency of online health searching. Thus, geographical location reflects multiple inequalities.

There are several limitations to our research. First, more detailed information regarding why respondents do not have computer and Internet access, or do not conduct online health searches, would be helpful. Second, we do not know how respondents used the online health information or whether they found it useful. This is important because studies have shown that many Web sites contain outdated, incomplete, or inaccurate information (Berland et al., 2001). Third, our sample lacks a sufficient number of participants to examine differences between metropolitan, suburban, and rural counties using the Rural–Urban Continuum Codes available in the data. Finally, the response rate to the survey is relatively low. This raises the possibility of nonresponse bias in our estimates to the extent that key variables of interest are strongly correlated with the likelihood of persons responding to the survey (Groves, 2006). Although higher response rates reduce the risk of nonresponse bias, studies have not found a simple empirical relationship between response rates and nonresponse bias (Groves, 2006). Unfortunately, we are not able to conduct an analysis to determine the level of nonresponse bias present in our estimates.

Using the Internet can improve health care access for those in rural communities. Although there have been improvements in access to health care, a shortage of rural physicians persists (Rosenblatt, 2000). Using the Internet can lessen the problem by allowing isolated individuals to find health information, communicate with health care professionals, and receive support from others in a similar health situation (Cotten, 2001; Drentea & Moren-Cross, 2005). As a result, much has been written about enhancing digital development in rural areas to benefit that population (Davison & Cotten, 2009; Malecki, 2003), and a number of initiatives are being debated and implemented specifically to increase broadband Internet access in rural communities (Kruger & Gilroy, 2008). There is some evidence of success. For example, between 2006 and 2009 the percentage of adults with home broadband access increased by 84%, from 25% to 46% (Horrigan, 2009, p. 14).

Yet, "while broadband use has grown significantly in all areas…the rural–urban differential continues" (U.S. Department of Commerce, 2004, p. 15). As our study shows, broadband diffusion must go hand in hand with other changes such as increased education and training and a reversal of the youth brain drain (Malecki, 2003) in order to increase Internet access and use in rural communities. This multifaceted approach is vital to assist the "information disadvantaged" (U.S. Department of Commerce, 1995).

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