



Published in final edited form as:

Am J Health Promot. 2014 ; 28(6): 397–402. doi:10.4278/ajhp.120816-ARB-396.

Mobile Technology, Cancer Prevention, and Health Status among Diverse, Low-Income Adults

Jason Q. Purnell, PhD, MPH⁺, Julia Griffith, MPH[^], Katherine S. Eddens, PhD, MPH[#], and Matthew W. Kreuter, PhD, MPH[^]

⁺George Warren Brown School of Social Work, Washington University in St. Louis, One Brookings Drive, Campus Box 1196, St. Louis, MO 63130

[^]Health Communication Research Laboratory, George Warren Brown School of Social Work, 700 Rosedale Avenue, St. Louis, MO 63112

[#]Department of Health Behavior, College of Public Health, University of Kentucky, 352 Bowman Hall, 151 Washington Avenue, Lexington, KY 40506

Abstract

Purpose—Characterize mobile technology ownership, use, and relationship to self-reported cancer prevention behaviors and health status in a diverse, low-income sample of callers to 2-1-1.

Design—Secondary analyses of cross-sectional survey data from a larger trial collected from June 2010 to December 2012.

Setting—United Way Missouri 2-1-1 serves 99 of 114 counties and received 166,000 calls in 2011.

Subjects—The respondents (baseline $n = 1,898$; 4-month $n = 1,242$) were predominantly female, non-Hispanic Black, under 50, with high school education and annual income $< \$20,000$.

Measures—Cell phone ownership and use and its relationship to cancer prevention services and health status were assessed via telephone-based survey using items adapted from previous research and the BRFSS. Smartphone ownership and use were also assessed.

Analysis—Descriptive statistics and bivariate and multivariate associations between cell phone ownership and prevention and health status are reported.

Results—Three-fourths (74%) of study participants owned a cell phone and 19% owned a smartphone. Text messaging was the most popular use. Ownership was significantly associated with good to excellent health status and presence of smoke-free home policies in multivariate models.

Conclusion—Cell phone ownership is growing and has potential to deliver health information to low-income populations. With 16 million calls annually, the national 2-1-1 system may be a promising model and platform.

Low-income, racial and ethnic minority populations have poorer health status, engage in more risky health behaviors, are less likely to engage in preventive health behaviors like cancer screening and smoking cessation, and are harder to reach with health interventions than populations with higher socioeconomic status.^{1,2} One promising way to effectively

reach these groups may be mobile technology. Cellular phones are an increasingly important tool, not just for communication, but for seeking up-to-date information on many topics, including health. Given their reach and popularity, they also could be a potentially powerful means of addressing health disparities.³ Relatively little is known about how mobile technology ownership and use are related to health status and preventive health behaviors in ethnically diverse, low-income populations in the U.S.

The “digital divide”—the gap in access to technology based on socio-demographic characteristics and originally used to describe access to personal computers and the Internet—has been reconceived in light of mobile technology.⁴ According to reports from the Pew Research Center’s Internet and American Life Project, 88% of American adults own a cell phone.⁴ While there are persistent socioeconomic disparities in access to the Internet,⁵ younger people, African Americans and Hispanics, and people with higher education are heavier users of cell phones than older, white, and less educated populations.⁴ This is an important development in light of the persistent cancer-related health disparities experienced by African Americans and Hispanics.⁶ By understanding how mobile technology is used, we may be able to deliver cancer prevention interventions to these vulnerable populations.

In this exploratory study we addressed the following research questions: 1) What are the levels of mobile technology ownership in a predominantly low-income, racial/ethnic minority population, and what demographic characteristics distinguish owners from non-owners? 2) What are the levels of usage of common cell phone and smartphone features? 3) Is mobile technology ownership associated with cancer prevention and control behaviors or self-reported health status?

METHOD

The Institutional Review Board at Washington University in St. Louis approved this study.

Study sample and recruitment

Participants were callers to United Way 2-1-1 Missouri, a three-digit-dial information and referral service that connects callers to social services in their community. Data are drawn from a larger randomized, controlled trial in which a sample of 2-1-1 callers was asked to complete a brief cancer risk assessment after receiving standard service.⁷ Those who provided verbal consent over the telephone, completed the assessment, and had at least one cancer control need (i.e., were eligible and off-schedule for one of several cancer screenings or HPV vaccination, were a current smoker, and/or lacked a smoke-free home policy) were invited to participate in a longitudinal study that included completing a baseline assessment while still on the phone and telephone follow-up interviews 1 and 4 months later. All participants were enrolled from June 2010 to June 2012. Only data from the baseline (n = 1,898) and 4-month follow-up (n = 1,242) were used in the current study. Full details of the original study’s design have been reported elsewhere.⁷

Measures

Mobile technology—Questions about cell phone ownership and use were included in the baseline survey. Participants were asked: *Do you have a working cell phone? Do you use*

your cell phone to: send and receive text messages; send and receive email; access the Internet? Smartphone ownership was assessed at 4 months: “Some cell phones are called smartphones and have features like email and Internet access. Common brand names include BlackBerry, iPhone, and Droid. Do you currently own a smartphone?” Smartphone owners also were asked about their use of text and instant messaging, email, Internet, and apps.

Cancer prevention and control behavior—Need for cancer control services was used a proxy variable to measure cancer prevention and control behaviors. Items from the 2008 Behavioral Risk Factor Surveillance System (CDC, 2008) were used to assess eligible 2-1-1 callers’ needs for mammography, Pap testing, colonoscopy, HPV vaccination for self and female child living in the home, smoking cessation, and smoke-free home policies. Participants were considered in need of cancer control services if there were: women 40 years who had no mammogram in the last year; women 18 years who had no Pap test in the last two years; those 50 years who had no colonoscopy in the last 10 years; women ages 18–26 and those with a female child ages 9–17 living in their homes who had no received HPV vaccination; current smokers; and those without a total ban on smoking in their households.

Self-reported health status—Study participants were asked to rate their overall health on a 5-point Likert-type scale ranging from 1 = *poor* to 5 = *excellent*. For the purposes of analysis in this study, this variable was dichotomized as 0 = *fair to poor* vs. 1 = *good to excellent*.

Demographics—Age, gender, race/ethnicity, years of education, household income, employment status, and health insurance were assessed at baseline.

Data analysis

Descriptive statistics are provided for demographic variables in both the total baseline and 4-month follow-up samples and by cell phone and smartphone ownership respectively, with chi-squared tests for significant differences among groups. Frequencies of cell phone and smartphone feature usage are also reported. Bivariate associations between baseline cell phone ownership and the need for various cancer control referrals and health status were examined using chi-squared tests. As the study was exploratory, all associations with a *p*-value < .10 were followed up by logistic regression analysis that provided both crude and adjusted odds ratios with relevant covariates added to the multivariate models for each outcome. Covariates were factors identified in the literature as associated with mobile technology ownership (see Table 1), cancer prevention behaviors, and health status. Dependent variables in these logistic regression models were need for the various cancer control referrals and self-reported health status.

RESULTS

Sample description

Table 1 presents a sociodemographic description of the samples completing the baseline (*n* = 1,898) and 4-month follow-up (*n* = 1,242) assessments. Overall, the majority of study

participants was younger than 50 years old, female, non-Hispanic Black, with high school education or less and annual income less than \$20,000. Most were either unemployed or outside of the labor force, and a significant minority was uninsured.

Ownership and demographic characteristics of owners

Nearly three-fourths (74%) of baseline study participants owned a cell phone. Over one-fifth (23%) of participants completing the 4-month follow-up owned a smartphone. Only age, income and employment status significantly distinguished cell owners from non-owners. In addition to these factors, smartphone owners were also more likely to have education beyond high school.

Use of common features

Of those who owned cell phones, 78% used them to send and receive text messages, 41% to access the Internet, and 29% to send and receive email. Nearly all smartphone owners used their phones to send and receive text messages (95%), followed by 89% to access the Internet, 79% to send and receive email, 68% to download and use apps, and 53% to send and receive instant messages.

Ownership, cancer prevention and control, and health status

In all cases except mammography and HPV vaccination for a female child, cell phone owners were less likely to report need for cancer prevention and control services than non-owners. However, this difference was statistically significant only for Pap testing (25% in need of referral for owners vs. 31% for non-owners; $p = .02$), HPV vaccination for adult women (74% vs. 90%; $p = .03$) and smoke-free home policies (53% vs. 60%; $p = .01$). Cell phone owners were significantly *more* likely to need a mammography referral (72%) compared to non-owners (64%; $p = .01$). There were no significant differences between cell owners and non-owners on need for referrals for HPV for a female child or smoking cessation. In terms of self-reported health status, cell phone owners were more likely to report good-to-excellent health compared to non-owners (55% vs. 41%; $p < .001$).

Table 2 presents the models for self-reported health status and need for HPV vaccination for adult women, Pap testing, mammography, and smoke-free home policies. Only the association between cell phone ownership and self-reported health status and smoke-free home policies remained significant after adjusting for relevant covariates. Specifically, cell phone owners were more 50% more likely to report good-to-excellent health compared to non-owners, and owners were 25% less likely to need a referral for smoke-free home policies. Marginally significant results were observed for Pap testing ($p = .05$) and HPV vaccination for adult women ($p = .07$), with cell phone owners exhibiting less need for referrals.

DISCUSSION

Ownership of cell phones is substantial in a predominantly low-income and racial/ethnic minority sample, though less so for smartphones. Cell phone owners were more likely to be younger, higher income, and employed, and smartphone owners were also more likely to

have higher levels of education. These findings are consistent with general population data and supportive of recent observations regarding a persistent socioeconomic “digital divide.”^{4,5,8} Text messaging, the most popular non-voice feature, may be a promising mode of intervention for this population. Cell phone owners were more likely to report good-to-excellent health and were more likely to have smoke-free policies in their homes.

It is not clear why cell phone owners report better self-rated health and are more likely to have smoke-free policies. Cell phone owners may have better access to social networks or enjoy more social support because they are able to maintain regular communication.⁹ Cell phones also may increase access to health information. The younger age of cell phone owners could also account for the differences noted, though age was controlled in multivariate models. Additional research is needed to replicate these findings and search for potential mechanisms that explain these associations.

2-1-1 could be a potentially powerful platform for preventive health interventions using mobile technologies. 2-1-1 already collects much of the information that would be used for tailoring text messages, and previous studies have demonstrated both the need for preventive health services and the feasibility of integrating health assessment and referral into a system that fields 16 million calls yearly.^{7,10} Low-income callers might need some subsidy for data usage on cell phone plans, and the implications of “pay-as-you-go” plans should be considered. Leveraging the resources of systems like 2-1-1 alongside a popular technology in a vulnerable population is a potentially promising strategy for public health intervention.

There are some limitations that should be noted. The geographic and programmatic specificity of this study and the inclusion of those with at least one cancer control need may make it inappropriate to generalize findings beyond this population. The larger trial also was not designed to answer research questions specific to mobile technology, prevention, and health. Ideally, cell phone and smartphone use would be more thoroughly assessed, including the frequency of use.

Despite these limitations, this study used a large, diverse sample of low-income individuals and provides important information for understanding their access to and use of mobile technology and how this is related to preventive health behavior and health status.

REFERENCES

1. Siegel R, Ward E, Brawley O, Jemal A. Cancer statistics, 2011: The impact of eliminating socioeconomic and racial disparities on premature cancer deaths. *CA Cancer J Clin*. 2011; 61:212–236. [PubMed: 21685461]
2. Stringhini S, Sabia S, Shipley M, et al. Association of socioeconomic position with health behaviors and mortality. *JAMA*. 2010; 303:1159–1166. [PubMed: 20332401]
3. Krishna S, Boren SA, Balas EA. Healthcare via cell phones: a systematic review. *Telemed J E Health*. 2009; 15:231–240. [PubMed: 19382860]
4. Zickuhr, K.; Smith, EA. Digital Differences. Washington, DC: Pew Internet & American Life Project; 2012. Available at: <http://pewinternet.org/Reports/2012/Digital-differences.aspx>. [Accessed August 22, 2012]
5. Talukdar D, Gauri DK. Home internet access and usage in the USA: Trends in the socio-economic digital divide. *Commun Assoc Inform Syst*. 2011; 28:86–98.

6. Siegel R, Naishadham D, Jemal A. Cancer statistics, 2012. *CA Cancer J Clin*. 2012; 62:10–29. [PubMed: 22237781]
7. Kreuter MW, Eddens KS, Alcaraz KI, et al. Use of cancer control referrals by 2-1-1 callers: a randomized trial. *Am J Prev Med*. 2012; 43:S425–S434. [PubMed: 23157761]
8. Smith, EA. Americans and Their Cell Phones. Washington, DC: Pew Internet & American Life Project; 2011. Available at: <http://www.pewinternet.org/Reports/2011/Cell-Phones.aspx?src=prc-headline>. [Accessed August 15, 2011]
9. Campbell SW, Kelley M. Mobile phone use in AA networks: an exploratory study. *J Appl Commun Res*. 2006; 34:191–208.
10. Purnell JQ, Kreuter MW, Eddens KS, et al. Cancer control needs of 2-1-1 callers in Missouri, North Carolina, Texas, and Washington. *J Health Care Poor Underserved*. 2012; 23:752–767. [PubMed: 22643622]

SO WHAT?

Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Access to mobile technology continues to grow in the general population, and early studies using these technologies show some efficacy in changing health behaviors. Little is known about the feasibility of using mobile technology to deliver health information and interventions to diverse, low-income populations.

What does this article add?

Conducted within the context of an information and referral service (2-1-1) largely used by members of low-income and racial ethnic minority populations, this study shows that prevalence of cell phone ownership is substantial and text messaging is particularly popular. Ownership is also associated with good-to-excellent self-reported health status and cancer prevention and control behaviors, like smoke-free home policies.

What are the implications for health promotion practice or research?

It appears feasible to use mobile technology for health information and interventions in diverse low-income populations, and the 2-1-1 system may be a promising partner in national efforts to address health disparities. This system answers over 16 million calls per year and reaches populations most in need of preventive health services.

Table 1
Sample descriptives by cell phone (baseline) and smartphone (4-month follow-up) ownership.

	Baseline sample				4-month follow-up sample			
	Total (%)	Cell owners (%)	Non-cell owners (%)	p-value	Total (%)	Smartphone owners (%)	Non-smartphone owners (%)	p-value
Age				< .001				< .001
< 30	382 (20.1)	317 (83.0)	65 (17.0)		209 (16.8)	84 (40.2)	125 (59.8)	
30 to 39	415 (21.9)	325 (78.3)	90 (21.7)		243 (19.6)	79 (32.5)	164 (67.5)	
40 to 49	485 (25.6)	370 (76.3)	115 (23.7)		330 (26.6)	74 (22.4)	256 (77.6)	
50+	616 (32.5)	402 (65.3)	214 (34.7)		460 (37.0)	44 (9.6)	416 (90.4)	
Gender				.67				.52
Male	279 (14.7)	205 (73.5)	74 (26.5)		171 (13.8)	42 (24.6)	129 (75.4)	
Female	1619 (85.3)	1209 (74.7)	410 (25.3)		1071 (86.2)	239 (22.3)	832 (77.7)	
Race *				.74				.35
White	560 (29.8)	423 (75.5)	137 (24.5)		362 (29.5)	85 (23.5)	277 (76.5)	
Black	1108 (58.9)	822 (74.2)	286 (25.8)		741 (60.4)	155 (20.9)	586 (79.1)	
Other	75 (4.0)	58 (77.3)	17 (22.7)		51 (4.2)	13 (25.5)	38 (74.5)	
More than one	134 (7.1)	96 (71.6)	38 (28.4)		73 (5.9)	23 (31.5)	50 (68.5)	
Education *				.12				< .001
12 years	1144 (60.3)	838 (73.3)	306 (26.7)		743 (59.9)	139 (18.7)	604 (81.3)	
> 12 years	752 (39.9)	575 (76.5)	177 (23.5)		497 (40.1)	142 (28.6)	355 (71.4)	
Income *				.03				< .001
\$0 to \$9,999	828 (43.6)	592 (75.3)	236 (28.5)		555 (46.3)	96 (17.3)	459 (82.7)	
\$10,000 to \$19,999	665 (36.0)	501 (75.3)	164 (24.7)		446 (37.2)	108 (24.2)	338 (75.8)	
\$20,000 to \$34,999	255 (13.4)	204 (80.0)	51 (20.0)		157 (13.1)	57 (36.3)	100 (63.7)	
\$35,000+	74 (3.9)	58 (78.4)	16 (21.6)		41 (3.4)	13 (31.7)	28 (68.3)	
Employment				< .001				< .001
Employed	413 (21.8)	336 (81.4)	77 (18.6)		242 (19.5)	83 (34.3)	159 (65.7)	
Other	1485 (78.2)	1078 (72.6)	407 (27.4)		1000 (80.5)	198 (19.8)	802 (80.2)	

	Baseline sample				4-month follow-up sample			
	Total (%)	Cell owners (%)	Non-cell owners (%)	p-value	Total (%)	Smartphone owners (%)	Non-smartphone owners (%)	p-value
Health Insurance*				.21				.63
Insured	1139 (60.2)	840 (73.7)	299 (26.3)		760 (61.4)	169 (22.2)	591 (77.8)	
Uninsured	754 (39.8)	572 (75.9)	182 (24.1)		478 (38.6)	112 (23.4)	366 (76.6)	

Note:

* Variables missing data due to refusal and “don’t know” responses and computerized data collection errors.

Table 2

Crude and adjusted odds ratios for the association between cell phone ownership and prevention and self-reported health status.

	Model 1		Model 2	
Good to excellent health status				
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Cell ownership (ref = no)	1.83 (1.48–2.28)	<.001	1.52 (1.21–1.92)	<.001
Age (ref = <30)			-	-
30 to 39			.43 (.31–.60)	<.001
40 to 49			.25 (.18–.34)	<.001
50+			.22 (.16–.30)	<.001
Gender (ref = male)			.80 (.60–1.06)	.13
Race (ref = White)			-	-
Black/African American			1.37 (1.09–1.72)	.01
More than one race			1.01 (.67–1.53)	.97
Other			1.31 (.76–2.28)	.34
Education (ref = >12 years)			.73 (.59–.90)	.003
Income (ref = \$35,000+)			-	-
\$0 to \$9,999			.59 (.34–1.02)	.06
\$10,000 to \$19,999			.44 (.25–.75)	.003
\$20,000 to \$34,999			.59 (.33–1.06)	.08
Employment status (ref = employed)			.41 (.31–.53)	<.001
Health insurance status (ref = insured)			1.38 (1.12–1.70)	.003
Smoking status (ref = non-smoker)			.65 (.52–.81)	<.001
Need for mammography referral				
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Cell ownership (ref = no)	1.52 (1.03–1.95)	.01	1.28 (.92–1.78)	.15
Age (ref = 40 to 49)			.47 (.34–.65)	<.001
Race (ref = White)			-	-
Black/African American			.43 (.30–.63)	<.001
More than one race			.82 (.41–1.67)	.59
Other			.45 (.20–1.01)	.05
Education (ref = >12 years)			.75 (.54–1.04)	.09
Income (ref = \$35,000+)			-	-
\$0 to \$9,999			.16 (.04–.69)	.01
\$10,000 to \$19,999			.15 (.03–.64)	.01
\$20,000 to \$34,999			.18 (.04–.81)	.03
Employment status (ref = employed)			1.03 (.67–1.57)	.91
Health insurance status (ref = insured)			2.13 (1.53–2.97)	<.001
Need for HPV vaccine referral (self)				

	Model 1		Model 2	
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Cell ownership (ref = no)	.37 (.12–1.10)	.07	.35 (.11–1.09)	.07
Race (ref = White)			-	-
Black/African American			.50 (.22–1.14)	.10
More than one race			.51 (.14–1.85)	.30
Other			.43(.10–1.78)	.24
Education (ref = >12 years)			1.13 (.58–2.19)	.73
Income (ref = \$35,000+)			-	-
\$0 to \$9,999			.93 (.08–11.02)	.96
\$10,000 to \$19,999			.83 (.07–9.68)	.88
\$20,000 to \$34,999			.44 (.04–5.44)	.52
Employment status (ref = employed)			1.27 (.59–2.76)	.54
Health insurance status (ref = insured)			.96 (.47–1.95)	.90
<i>Need for Pap test referral</i>				
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Cell ownership (ref = no)	.73 (.57–.93)	.01	.77 (.58–1.00)	.05
Age (ref = <30)			-	-
30 to 39			1.24 (.83–1.85)	.29
40 to 49			1.52 (1.05–2.21)	.03
50+			2.73 (1.91–3.90)	<.001
Race (ref = White)			-	-
Black/African American			.42 (.32–.54)	<.001
More than one race			.60 (.36–.98)	.04
Other			.66 (.36–1.20)	.17
Education (ref = >12 years)			.99 (.78–1.27)	.95
Income (ref = \$35,000+)			-	-
\$0 to \$9,999			.89 (.48–1.65)	.71
\$10,000 to \$19,999			1.09 (.59–2.03)	.78
\$20,000 to \$34,999			1.26 (.65–2.43)	.49
Employment status (ref = employed)			1.07 (.79–1.44)	.68
Health insurance status (ref = insured)			1.59 (1.25–2.03)	<.001
<i>Need for smoke-free home referral</i>				
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Cell ownership (ref = no)	.74 (.59–.91)	.005	.75 (.59–.96)	.02
Age (ref = <30)			-	-
30 to 39			1.04 (.76–1.43)	.81
40 to 49			1.36 (1.00–1.85)	.05
50+			1.71 (1.27–2.32)	<.001
Gender (ref = male)			.89 (.66–1.20)	.43

	Model 1		Model 2	
Race (ref = White)			-	-
Black/African American			1.47 (1.16–1.86)	.001
More than one race			.95 (.62–1.45)	.81
Other			1.12 (.64–1.95)	.70
Education (ref = >12 years)			1.07 (.86–1.32)	.56
Income (ref = \$35,000+)			-	-
\$0 to \$9,999			2.01 (1.17–3.47)	.01
\$10,000 to \$19,999			2.02 (1.17–3.49)	.01
\$20,000 to \$34,999			1.40 (.79–2.51)	.25
Employment status (ref = employed)			.81 (.62–1.06)	.12
Health insurance status (ref = insured)			.87 (.70–1.08)	.20
Smoking status (ref = non-smoker)			6.44 (5.14–8.08)	<.001