

Health-information seeking on the internet and current smoking status: Evidence from the National Health Interview Survey

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Received 20 April 2012; revised 30 May 2012; accepted 13 June 2012

ABSTRACT

Two research questions were addressed. First, what are the differences between internet searchers and non-searchers for health-related information among current and former smokers? Second, does searching the internet for health-related information predict current smoking status in a multivariate model that controls for variations in sociodemographic and family characteristics? Data collected from 10,929 current and former smokers who participated in the 2009 National Health Interview Survey showed significant differences in sociodemographic and family characteristics between searchers and non-searchers. Importantly, searching the internet for health-related information made an independent contribution to the prediction of current smoking status in a multinomial logistic regression model. This study is significant in that it utilized a nationally representative sample to examine the correlation between internet use and smoking behavior and supports ongoing efforts of public health advocates to continue their efforts in developing and delivering online smoking cessation programs.

Keywords: Smoking Cessation; Internet; Smoking

1. INTRODUCTION

Smoking increases the risk of heart disease and lung cancer, adds a considerable burden to healthcare systems and costs, and is highly addictive [1]. In their efforts to reduce smoking, public health advocates are increasingly delivering smoking cessation programs over the internet as the medium provides a means of gaining significant efficiencies in program outreach and delivery. Also, Americans are increasingly using the internet for health-related information. Specifically, about 80% of Ameri-

can internet users have searched the internet on health related topics and 9% of those have searched the internet for information on smoking cessation [2].

Smoking cessation is a process described in terms of four stages: precontemplation, contemplation, action, and maintenance [3]. It may be that searching the internet for health-related information may indicate contemplation and readiness to adopt more healthy behaviors or to discontinue harmful behaviors [4-6]. Dutta-Bergman [7] found that internet-searchers for health information were likely to have advantages in terms of health consciousness, orientation, beliefs, and activities as compared to non-searchers.

In spite of the increase in the internet-delivered smoking cessation programs and the willingness of many smokers to engage those programs, evidence suggests a great deal of unevenness in the quality and the efficacy of those programs [8]. At the same time, the authors reported significant improvements in the quality of smoking-cessation websites compared to the study they conducted four years earlier [9]. Another study found that 47% of internet-based cessation programs reported positive outcomes [10]. Cumulatively, these findings suggest that quality internet-delivered programs are available, but that quality is inconsistent across programs.

Current smokers may have more tenuous social ties and less engagement in healthcare systems, as compared to people who have never smoked [11]. Interestingly, the same study suggested that current smokers had less trust in healthcare professionals than people who have never smoked, but more trust in internet sources of information. Based on these findings, the authors suggested that the internet may be a particularly important resource in efforts to reduce smoking.

Given that there has been a substantial increase in the number of internet-delivered smoking cessation programs and given inconsistencies in the quality of those programs, it is important to understand both the characteristics of smokers who search the internet for health-related information and to understand how searching the

internet may be related to smoking status. The first specific aim of this study was to examine the relationship between searching the internet for health information and sociodemographic and family characteristics of former and current smokers. Next, the correlation between searching the internet for health-related information and current smoking was examined. It was expected that searching the internet for health-related information is likely related to an increased willingness to engage in healthy behaviors, specifically smoking cessation, as compared to non-internet searchers [5,6]. Previous research on internet-delivered smoking cessation programs has largely focused on evaluations of specific programs [10] or on experts' reviews of the quality of smoking cessation websites [8]. This research, however, addresses a more general topic regarding the correlation of internet use for health information by current and former smokers and their smoking status using a nationally representative sample.

2. METHODS

2.1. Sample and Data

Data for this study comes from the 2009 nationally representative National Health Interview Survey (NHIS) [12]. A multi-stage stratified sampling design was used to achieve a sample that is representative of the civilian non-institutionalized population of the United States. Data were collected by trained US Census interviewers who used a Computer Assisted Personal Interview (CAPI) process. For each household included in the analyses, an adult was randomly selected and interviewed. Data from those interviews were provided in a person-level sample adult data file.

There were 27,731 persons included in the entire sample adult data file. However, this study only examined smoking among persons who reported that they were currently or had been a smoker. The focus of this research was on smokers' or former smokers' internet searches for health information, never smokers were excluded from the analyses. Although 11,647 persons met the criterion for inclusion in the study, 718 persons (about 6%) were excluded because of missing data on key variables. In the end, the analyses are based on data from 10,929 adults.

2.2. Measures

Current smoking status was operationalized using two items from NHIS. First, participants were categorized into three smoking statuses: *former smoker*, *current some-day smoker*, and *current everyday smoker*. Second, the category *former smoker* was further differentiated into those who had quit more than a year prior to the interview and

less than a year prior to the interview, resulting in four categories of smoking status.

Sociodemographic, family characteristics, and internet search behavior were also examined in this study. Sociodemographic variables included sex, age, race, Hispanic ethnicity, annual income, and educational achievement. Family characteristics included marital status, the number of children living in the household, and whether or not any family member was in poor health. Finally, participants' responses to whether or not they had searched the internet for health information were included in the study.

2.3. Data Analyses

Because of the complex sample design, person weights were computed and provided by NHIS in the data set to enable researchers to make population estimates in their analyses. In this study, all analyses incorporated those weights using the *surveyfreq* and *surveylogistic* procedures in SAS v. 9.2 statistical analysis software.

Data analyses included both descriptive and multivariate analyses. First, cross-tabs and chi-square tests were used to compare internet searchers and non-searchers on smoking status, sociodemographic, and family characteristics. Next, multinomial logistic regression models were used to predict membership in one of three current smoking categories (*i.e.*, *former smoker for more than one year*, *former smoker for less than one year*, and *current some-day smoker*) using the fourth status (*i.e.*, *current everyday smoker*) as the comparison category.

3. RESULTS

3.1. Internet Searchers vs. Non-Searchers

About 4% of participants were *former smokers (less than 1 year)* and 47% were *former smokers (more than 1 year)*. *Current some-day smokers* were nearly 11% of the sample and the remainder of participants—slightly more than 38%—consisted of *current everyday smokers*. As seen in **Table 1**, there were significant differences, in terms of smoking status between participants who had searched the internet for health information and others. Internet searchers were less likely to be *current everyday smokers* than non-searchers ($p < 0.0001$) and more likely to be *former smokers for longer than one year* ($p < 0.0001$) and *for less than one year* ($p < 0.01$). Only in terms of being *current some-day smokers* was there no significant difference between searchers and non-searchers.

Women were more likely to search the internet for health related information than men ($p < 0.0001$). Specifically, nearly 54% of female participants in the study had searched the internet for health-related information

Table 1. Participant characteristics by internet use for health information (N = 10,929).

Characteristics	Internet Searchers (n = 5173)		Internet Non-Searchers (n = 5756)		p
	Unweighted N	Weighted %	Unweighted N	Weighted %	
Smoking Status					
Former Smoker (Less than 1 Year)	236	2.32	183	1.61	<i>p</i> < 0.01
Former Smoker (More than 1 Year)	2595	25.35	2603	21.67	<i>p</i> < 0.0001
Current Some Day Smoker	594	5.55	637	5.07	<i>p</i> = 0.2686
Current Everyday Smoker	1748	17.12	2333	21.32	<i>p</i> < 0.0001
Sex					
Female	2878	26.17	2375	18.36	<i>p</i> < 0.0001
Male	2295	24.17	3381	31.31	<i>p</i> < 0.0001
Age					
34 Years or Younger	1457	14.81	1059	10.34	<i>p</i> < 0.0001
35 to 44	956	9.43	792	7.11	<i>p</i> < 0.0001
45 to 54	1115	11.19	1104	10.17	<i>p</i> = 0.0955
55 to 64	1035	9.60	1025	8.79	<i>p</i> = 0.1340
65 Years or Older	610	5.30	1776	13.25	<i>p</i> < 0.0001
Hispanic					
Yes	463	3.10	1041	6.93	<i>p</i> < 0.0001
No	4710	47.24	4715	42.73	<i>p</i> < 0.0001
Race					
Black	493	3.15	1138	6.85	<i>p</i> < 0.0001
Non-Minority	4377	44.76	4227	40.02	<i>p</i> < 0.0001
Other Minority	303	2.42	391	2.80	<i>p</i> = 0.0983
Income					
Less than 35 k	1642	12.61	3288	23.49	<i>p</i> < 0.0001
35 k to 75 k	1835	18.04	1689	16.69	<i>p</i> = 0.0567
75 k to 100 k	644	7.08	374	4.47	<i>p</i> < 0.0001
100 k or More	1052	12.59	405	5.01	<i>p</i> < 0.0001
Education					
Less than High School	181	1.37	1196	7.84	<i>p</i> < 0.0001
High School	2221	21.09	3143	27.68	<i>p</i> < 0.0001
College	2010	20.35	1160	11.56	<i>p</i> < 0.0001
Graduate School	761	7.52	257	2.60	<i>p</i> < 0.0001
Marital Status					
Married	2384	28.28	2244	24.55	<i>p</i> < 0.0001
Separated or Divorced	1055	6.82	1286	7.98	<i>p</i> < 0.001
Widowed	240	1.52	742	4.34	<i>p</i> < 0.0001
Not Married	1494	13.72	1484	12.80	<i>p</i> = 0.1810
Number of Children					
No Children	3490	32.58	4293	35.35	<i>p</i> < 0.0001
1 or 2 Children	1360	14.14	1109	11.04	<i>p</i> < 0.0001
3 or More Children	323	3.61	354	3.27	<i>p</i> = 0.3696
Family Member in Poor Health					
Yes	258	2.85	538	4.68	<i>p</i> < 0.0001
No	4915	47.48	5218	44.98	<i>p</i> < 0.0001

whereas, only about 40% of the male participants had. Not surprisingly, there were age differences by internet use for health information. Nearly 58% of participants younger than 35 years old and about 55% of those between 35 and 44 years old had searched the internet for health-related information. About half of participants between 45 and 64 had used the internet to search for health-related information. Only about 1 in 4 of those 65 years old and older had used the internet to search for health-related information.

Higher income and educational achievement were related to a greater likelihood of searching the internet for health-related information. There were also significant differences in searching the internet for health-related information by ethnicity and race. Specifically, 31% of Hispanic participants had searched the internet for health-related information and 30% of African-American participants were internet searchers. About 51% of non-minority participants and nearly 44% of non-Black minorities were internet searchers.

Only about 24% of widowed participants reported searching the internet for health information. Forty-five percent of separated or divorced participants reported searching the internet for health-related information. About half of both single and married participants reported searching the internet. Slightly more than 55% of participants with one or two children had searched for health information and less than half of those with three or more were internet searchers. Only slightly more than 32% of participants who had a family member in poor health reported being an internet searcher.

3.2. Predicting Current Smoking Status

A multinomial logistic regression model was used to predict the participants' current smoking status and is provided in **Table 2**. The omitted comparison category in the model was *current every day smoker* ($n = 4081$) and the model predicted the likelihood that participants would be a *former (less than one year) smoker* ($n = 419$), *former (more than one year) smoker* ($n = 5198$), and *current some-day smoker* ($n = 1231$). Logistic regressions were weighted using the person-level weights provided in the NHIS. Predictor variables in the model included sociodemographic, family, and internet-use variables.

There were 419 participants who reported that they were former smokers and that they had stopped smoking less than a year prior to participating in the survey. Participants between 35 and 44 ($OR = 0.61, p < 0.01$) and those between 45 and 55 years old ($OR = 0.41, p < 0.0001$) had lower odds of being former, less than one year smoker as compared to those 34 years old and younger. Hispanic participants had higher odds ($OR =$

$2.15, p < 0.0001$) than other participants, and Black participants had higher odds ($OR = 1.71, p < 0.01$) than non-minority participants. Higher odds for this category were also observed for those with annual incomes of \$100,000 or more ($OR = 1.76, p < 0.05$), compared to those with incomes under \$35,000. Similarly, those with graduate school degrees had higher odds ($OR = 2.58, p < 0.01$), as compared to those with less than a high school education. Coefficients associated with family variables were not significantly related to odds in this category. Participants who had searched the internet for health-related information had significantly higher odds of being former smokers for less than a year ($OR = 1.74, p < 0.0001$), as compared to non-searchers.

There were 5198 participants who reported that they were former smokers for greater than one year. Women had significantly lower odds of being in this category than men ($OR = 0.85, p < 0.05$). Age was positively related to the odds for those who were between 45 and 54 ($OR = 1.57, p < 0.0001$), between 55 and 64 ($OR = 12.06, p < 0.0001$), and for those 65 and older ($OR = 2.43, p < 0.0001$), as compared to those 34 years or younger. Hispanic participants had higher odds ($OR = 2.43, p < 0.0001$), as compared to others. All levels of income were positively related to being in this category, as compared to the lowest income group. Having a high school education was not related to the odds of being in this category, but all other higher levels of educational achievement were positively related to the odds of being in this category.

The comparison category for marital status was married. The coefficients for all other categories of marital status (*i.e.*, separated/divorced ($OR = 0.61, p < 0.0001$), widowed ($OR = 0.72, p < 0.01$), and not married ($OR = 0.47, p < 0.0001$) were significantly less than one, indicating a lower odds of being in this category as compared to married participants. A family member in poor health living in the household was significantly related to lower odds ($OR = 0.64, p < 0.0001$), as compared to those without family members in poor health. Internet-searchers had higher odds of being former smokers for greater than a one year ($OR = 1.84, p < 0.0001$), as compared to non-searchers. Current some-day smokers characterized 1231 participants in the study. Odds ratios associated with age were below one for participants between 35 and 64 years old, as compared to younger participants (see **Table 2**). Hispanic participants had higher odds ($OR = 2.92, p < 0.0001$) than non-Hispanic participants and Black participants had higher odds ($OR = 1.82, p < 0.0001$) than non-minority participants. Higher odds were also observed for participants with annual incomes of \$100,000 or more ($OR = 1.58, p < 0.01$), as well as those with college ($OR = 1.41, p < 0.05$) or graduate school educations ($OR = 1.98, p < 0.01$). None of the

Table 2. Multinomial logistic regression on current smoking status (current every day smoker): Odds ratios and 95% confidence intervals (N = 10,929).

Predictor Variables	Former Smoker < 1 Year (n = 419)		Former Smoker > 1 Year (n = 5198)		Current Some Day Smoker (n = 1231)	
	OR	95% CI	OR	95% CI	OR	95% CI
Sex (Reference = Male)						
Female	0.81	0.62 - 1.07	0.85*	0.76 - 0.97	0.84	0.70 - 1.01
Age (Reference = 34 Years or Younger)						
35 to 44	0.61**	0.42 - 0.88	1.09	0.090 - 1.32	0.62***	0.49 - 0.80
45 to 54	0.41****	0.27 - 0.62	1.57****	1.29 - 1.91	0.52****	0.40 - 0.67
55 to 64	0.71	0.45 - 1.11	3.54****	2.86 - 4.40	0.56****	0.41 - 0.75
65 Years or Older	1.16	0.66 - 2.05	12.06****	9.45 - 15.39	0.79	0.53 - 1.17
Hispanic	2.15****	1.48 - 3.12	2.43****	2.00 - 2.96	2.92****	2.31 - 3.71
Race (Reference = Non-Minority)						
Black	1.71**	1.19 - 2.47	1.00	0.83 - 1.21	1.82****	1.43 - 2.31
Other Minority	1.20	0.73 - 1.92	0.92	0.72 - 1.18	1.15	0.83 - 1.59
Income (Reference = Less than 35 k)						
35 k to 75 k	1.21	0.90 - 1.64	1.24**	1.07 - 1.43	1.05	0.85 - 1.29
75 k to 100 k	1.01	0.59 - 1.74	1.58****	1.26 - 1.98	1.34	0.95 - 1.89
100 k or more	1.76*	1.06 - 2.94	1.59****	1.27 - 1.99	1.58**	1.13 - 2.21
Education (Reference = Less than High School)						
High School	0.79	0.49 - 1.28	0.97	0.80 - 1.18	0.86	0.66 - 1.11
College	1.13	0.68 - 1.89	1.71****	1.37 - 2.13	1.41*	1.04 - 1.91
Graduate School	2.58**	1.35 - 4.91	3.35****	2.45 - 4.58	1.98**	1.27 - 3.10
Marital Status (Reference = Married)						
Separated or Divorced	0.97	0.65 - 1.45	0.61****	0.52 - 0.72	1.19	0.93 - 1.52
Widowed	0.78	0.31 - 1.96	0.72**	0.56 - 0.91	1.03	0.66 - 1.61
Not Married	0.77	0.55 - 1.08	0.47****	0.40 - 0.56	1.22	0.97 - 1.54
Number of Children (Reference = No Kids)						
1 or 2 children	0.87	0.62 - 1.21	0.98	0.84 - 1.15	0.87	0.70 - 1.08
3 or more children	0.97	0.58 - 1.63	0.95	0.72 - 1.27	0.82	0.58 - 1.17
Family Members in Poor Health? (Reference = No)						
Yes	0.85	0.50 - 1.46	0.64****	0.51 - 0.79	0.79	0.53 - 1.18
Internet Use for Health Information? (Reference = No)						
Yes	1.74***	1.30 - 2.34	1.84****	1.61 - 2.11	1.32**	1.08 - 1.60

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$.

family variables had statistically significant coefficients for current some-day smokers. Internet searchers for health information had higher odds ($OR = 1.98$, $p < 0.01$) than non-searchers.

Current some-day smokers characterized 1231 participants in the study. Odds ratios associated with age were below one for participants between 35 and 64 years

old, as compared to younger participants (see **Table 2**). Hispanic participants had higher odds ($OR = 2.92$, $p < 0.0001$) than non-Hispanic participants and Black participants had higher odds ($OR = 1.82$, $p < 0.0001$) than non-minority participants. Higher odds were also observed for participants with annual incomes of \$100,000 or more ($OR = 1.58$, $p < 0.01$), as well as those with col-

lege ($OR = 1.41, p < 0.05$) or graduate school educations ($OR = 1.98, p < 0.01$). None of the family variables had statistically significant coefficients for current some-day smokers. Internet searchers for health information had higher odds ($OR = 1.98, p < 0.01$) than non-searchers.

4. DISCUSSION

It was not surprising that there was an advantage in smoking status by whether or not participants had used the internet to search for health-related information. The only exception was for the status *current some-day smoker* for which there was no significant difference by internet search status, although the multivariate model showed a positive relation between searching the internet and being a *current some-day smoker*, as compared to a *current every day smoker*. In fact, the multivariate model suggested that searching the internet for health-related information predicted a widespread advantage in current smoking status. Given the limitations of these data it is difficult to know how to specifically interpret these findings, although previous work suggests some possible interpretations for which more research is needed.

One interpretation is that internet-searchers may have been able to find information that helped them to stop or to reduce smoking. Not only are internet-based smoking cessation programs growing in number, there is evidence that some provide accurate and useful information. Although Bock, Graham, Whiteley, and Stoddard [8] expressed significant concerns about the quality of the smoking cessation websites they reviewed, they also found that many provided accurate and evidence-based information on smoking cessation, and a significant increase in the quality of information as compared to a similar evaluation completed four years earlier [9].

Another reasonable interpretation of the findings is that participants who look for health-related information on the internet are more motivated and oriented toward behavioral change than non-searchers. This is consistent with the previous results suggesting that internet-searchers had advantages over non-searchers in health attitudes and behaviors across a wide-range of health-behaviors [6]. These findings regarding the relationship between using the internet for health-related information, in general, are consistent with findings that have specifically examined smoking cessation. Cobb and Graham [7] found that individuals who search the internet for smoking cessation programs were actively pursuing behavior change. Cobb and Graham suggested that searching the internet for health-related information is an indicator that persons are in the appropriate stages wherein intervention is likely to be effective. Although more research is needed to specify the interpretation and meaning of the observed advantage that internet searchers have over

non-searchers in regard to smoking status, the correlation between internet searching and advantages in smoking status is consistent with previous literature.

Because the criteria of inclusion for this study was that participants were either current or former smokers, it was not surprising that there were more men than women participants, as men comprise a larger percentage of smokers [13]. At the same time, it is long established that women have more difficulty quitting smoking than men [14]. In fact, Preston and Wang [15] presented evidence suggesting that the female mortality advantage is declining partially as a result of a declining sex differential in smoking. Women in the present study were significantly more likely to search the internet for health-related information, presumably reflecting men's avoidance of pursuing health behaviors because of socially constructed beliefs about masculinities [16,17]. However, the multivariate model in this research was similar to previous findings suggesting that women had a small, but significant disadvantage in smoking cessation. Specifically, women were less likely than men to be classified as former smokers for more than one year. In other words, in spite of the fact that women were significantly more likely than men to search for health-related information on the internet, they remained less likely than men to be former smokers for more than one year.

Findings from this study were also consistent with previous findings regarding differences in smoking behavior by age, race, and class [18], as well as a digital divide by age, race, and class [19-21]. In the present study, younger persons were more likely than older persons to search the internet for health-related information; non-Hispanic participants were more likely to use the internet than Hispanic participants; non-minority persons were more likely to use the internet than minority persons, and both income and educational achievement were positively related to the likelihood that a participant would search the internet for health-related information.

Age was positively related to being classified as former smokers (in either category), as well as a current some-day smoker. Income was positively related to smoking cessation and reduction, as was educational achievement. More research is needed to better understand the relationship between these sociodemographic factors and smoking cessation and reduction. However, it is known that family stress is related to smoking initiation by adolescents [22] and that family and financial stress is related to decreased cessation [23]. Although these findings are generally positive about the role that the internet may play in smoking cessation and reduction, they raise some concerns about outreach to poor, minority, and elderly persons. This is particularly a concern given that, with only a few exceptions, variations in smoking by sociodemographic characteristics mirror variations in the

digital divide.

As compared to married persons, participants who reported any other marital status were less likely to have been a former smoker for greater than one year. There was no other observed effect for marital status. The number of children was not related to smoking status; but, participants who reported that they had a family member in poor health living in the household were less likely to have been a former smoker for greater than one year.

It is important to note some important limitations to the study. Importantly, the question of using the internet to search for health-related information is a vague question in this data set and it is not known whether or not participants were specifically looking for information regarding smoking cessation. It is also not known whether or not participants' internet searches contributed to the adoption of healthier behaviors. Indeed, it may be that searching the internet for health-related information may only be indicative of higher levels of health consciousness and activities, in general [9]. In spite of the limitations, this study is relevant in that it provides population-based estimates of the characteristics of former and current smokers who search the internet for health-related information and the correlation of those internet searches with decreased smoking in a multivariate model that controls for sociodemographic and family characteristics.

Results from this study were generally positive about the potential role of the internet for delivering efficacious smoking cessation and reduction programs. At the same time, the study raised some concerns about outreach to poor, minority, and older persons. Findings presented here are supportive of increased efforts for the development and delivery of internet-based smoking-cessation programs and, at the same time, suggest increased awareness of and reductions to the sociodemographic digital divide that may decrease the ability of some persons to take advantage of internet-based programs.

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