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Internet use associated with HIV testing in adults in a national sample: Findings from the National Health Interview Survey, 2009

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ABSTRACT

Background. Routine Human Immunodeficiency Virus (HIV) testing is a CDC recommendation. Little is known about health information technology (HIT) use and HIV testing.

Purpose. To assess the relationship between HIT use and HIV screening and determine whether self-perceived HIV risk modifies this association.

Methods. Data from the National Health Interview Survey were analyzed. The survey response rate was 65.4%. The outcome was self-report of HIV testing (Y/N). Independent variables were HIT use, self-perceived HIV risk, and socio-demographics. HIT use is defined as internet or chat room use for health information. Logistic regression tested the association between HIV testing and HIT. Crude and adjusted models are reported.

Results. Of participants with data on HIV testing (n = 26,745), 40% reported being HIV tested, 52% used internet, and 4.2% used chat rooms. Internet and chat users had greater odds ratios for HIV testing (OR 1.8 95% CI (1.7, 1.9) and OR 1.7 95% CI (1.4, 2.0), respectively). Adjusting for covariates, internet use remained associated with HIV testing OR 1.4 95% CI (1.2, 1.7), but chat use did not. Self-perceived HIV risk did not modify this model.

Conclusion. Internet use was associated with higher odds of HIV testing in the general population. Promotion of HIV testing via online sources may benefit screening efforts.

Introduction

HIV infection remains a major public health problem, and early case detection is crucial for linkage to care, proper treatment and preventing spread of infection. Though the revised CDC guidelines published in 2006 recommend annual HIV testing for all patients aged 13–64 years, except in areas with documented extremely low prevalence, in an effort to capture the percentage of the US population who are unaware of their sero-positivity, this is not always practiced in clinical settings (Branson et al., 2006). Since these revised CDC guidelines were published, national testing rates have increased, from 40.4% in 2006 to 45.0% in 2010. However, there is a remaining estimated one-fifth of the HIV-infected American population that is unaware of their sero-positive status (, 2013Centers for Disease Control and Prevention). Furthermore, late diagnosis of HIV remains a problem — nearly one quarter of newly diagnosed cases in NYC in 2008 were late concurrent HIV/AIDS diagnoses (Mills et al., 2011). This is a problem not only for the treatment of the sero-positive individual, for whom early treatment improves long-term outcomes, but also for the possible unknowing spread of infection to others. Expanded screening engages those found to be positive in care early and is cost-effective (Long et al., 2010).

Numerous barriers to seeking HIV testing exist, including fear of a positive diagnosis and no or low self-perceived risk for infection. The notion of fear of a positive diagnosis, though less prevalent in the general population, has been shown to be a significant factor in late-diagnosed concurrent HIV/AIDS cases. Notably these late diagnosed cases had prior interactions with the health care system where screening tests could have been employed, but were not, partly through lack of identification of HIV risk factors (Centers for Disease Control and Prevention, 2013; Schwarcz et al., 2011). Data from national surveys sampling the general US population have confirmed that no or low self-perceived risk for contracting HIV is a major deterrent to testing among various groups including the elderly (Adekeye et al., 2012). These barriers contribute to stagnant rates of testing, despite nearly three decades of screening test availability.

Because of these barriers, and the estimated 20% of sero-positive persons who are unaware of their status, non-clinical settings for HIV-related information and links to testing and treatment are necessary. A ubiquitous medium such as the internet is a potentially powerful tool to educate the general population regarding risks, mitigating fear, all the while remaining anonymous. The Pew Charitable Trusts note

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that 93% of Americans are online, and more health related searches are the main motivation for seeking online information as patients age (Jones & Fox, 2009). Additionally, health information technology (HIT), which includes the use of the internet for health information, has been noted to have positive health impacts on certain groups. These include improving adolescent sexual health through online interventions (Guse et al., 2012), improved condom use among sexually active men and women (Noar et al., 2009), and improved ART adherence among people living with HIV/AIDS (Samal et al., 2011).

Given the large number of Americans seeking health information on-line, do online resources serve as a portal for entry into HIV screening among the general population? The objectives of this study were (Adekeye et al., 2012) to determine whether there is an association between HIT use and HIV testing, and (Bolding et al., 2004) whether this relationship is modified by self-perceived risk of HIV. We hypothesized that the use of HIT is associated with HIV testing, and that high self-perceived risk of HIV strengthens this association.

Methods

Sample and data

We performed a cross-sectional analysis using the 2009 National Health Interview Survey. The NHIS is a representative sample of the non-institutionalized civilian population of the United States. Data are anonymized and available publicly from the National Center for Health Statistics. To obtain representative respondents, the US is partitioned into regional primary sampling units, which are further stratified by regional/poverty factors. Trained US Census interviewers visited households and collected data for each household using a Computer Assisted Personal Interview (CAPI) process. Family level surveys included questions regarding education level and income. A random adult aged 18 or older was picked from each family and administered a separate survey which included detailed questions regarding medical information, internet use, and HIV knowledge and behaviors. For this analysis, data from the family and sample adult surveys were merged. The final response rate for adults was 65.4% (n = 27,731) (Centers for Disease Control and Prevention, 2010).

Measures

The primary outcome was reporting ever having been tested for HIV (yes/no). This question specifically excluded testing that was done as part of a blood donation. Independent variables included: having looked up health information on the internet, having looked up health information in a chat room, and self-perceived risk of acquiring HIV. For the internet and chat variables, adults who answered "refused" or "don't know" were excluded from the analysis and the variable was binary (yes/no). Self perceived risk of HIV was a categorical variable with responses high, medium, low, none, already have HIV/AIDS, refused, and don't know. This variable was recoded to 4 possible responses high/already have HIV, medium, low, or no risk. Covariates included age, sex, marital status, current pregnancy status (yes/no), ethnicity (Hispanic vs. other), race (coded as Black, White, American Indian/Alaskan native and Asian; excluded were a small number of people who identified as multiple race, which represented 423 people or 1.4% of the total population), annual income (<$35,000, 35,000–74,999, 75,000–99,999 and >100,000), and education level (high school no degree, high school degree/GED, some college, college degree or higher). Age was analyzed as a continuous variable and as a categorical variable in standard age groupings (18–24, 25–34 etc.) to determine if there was clustering of HIV testing, internet use or risk assessment around a particular age group.

Data analysis

Because of the complex sampling design, person weights provided by the NHIS were used to derive population variance estimates, and all analysis incorporated these weights. Analyses were performed using SAS v 9.3 statistical software. Frequencies were reported for characteristics of the entire population. Bivariate analysis using chi-square identified variables that were significantly different between those who were HIV tested and those who were not. Logistic regression was used in our unadjusted and adjusted models. In the internet analysis, model 1 tested the unadjusted association between internet use and the outcome of having been HIV tested. Model 2 tested the association between internet use, age (categorical), marital status, ethnicity, race, education, pregnancy status, income and self-perceived risk for HIV and the outcome of having been HIV tested. Model 3 included the same variables as model 2 except for education, which was not significant in model 2 and therefore removed. Model 4 included the same variables as model 3 with the addition of the interaction term between self-perceived risk for HIV and internet use. In the chat room analysis, model 1 tested the unadjusted association between chat room use and the outcome of having been HIV tested. Model 2 tested the association between chat room use, age (categorical), marital status, ethnicity, race, education, pregnancy status, income and self-perceived risk for HIV and the outcome of having been HIV tested. Model 3 included the same variables as model 2, with the addition of the interaction term between self-perceived risk for HIV and chat room use.

Results

There were 27,731 adults who completed the NHIS survey. Of these, 26,745 respondents had a recorded response to the question of whether they had been HIV tested and were included in the analysis. Table 1 shows sample characteristics, as well as the sample broken down by HIV testing status. Overall, slightly over half of the sample was female, with mean age of 45.9 years, with the highest representation among the 45–54 year old age group. The majority were married, identified as White, and had college degree or higher, with an income between $35,000 and $74,999 per year. Sixty percent of the sample had not been tested for HIV. Fifty-two percent used the internet for health queries, 4.2% used chat rooms for this purpose, and the majority (76%) did not consider themselves at risk for HIV. Those who had been HIV tested also were more often male, younger, Black, and Hispanic. Those who were tested were more often college graduates. In terms of self-perceived risk for HIV, there was a higher proportion of people who reported being at moderate or high level of risk (which included those already HIV positive) that had been HIV tested compared to those that had not been tested.

Logistic regression showed that internet and chat users were more likely to have been HIV tested (Tables 2 and 3). For internet use (Table 2), in the unadjusted model 1, internet users were more likely to have been tested compared to non-users (OR 1.8, 95% CI (1.7, 1.9)). When all covariates were included in the model, internet users were still more likely to seek HIV testing compared to non-users (OR 1.4, 95% CI (1.2, 1.7)). In this model, the 25–34 year old age group, Hispanic ethnicity, Black race (as compared to White), current pregnancy, and lowest income (compared to the highest income quartile) were the most associated with having been HIV tested. Education level was not significant and removed from the third model. Controlling for the remaining variables in the third model, the relationship between internet use and HIV testing remained (OR 1.5, 95% CI (1.3, 1.7), data not shown). When the interaction of self-perceived risk for HIV and internet use was added to the fourth model, there was no evidence of interaction and the other model estimates did not change appreciably (data not shown).

Chat users (Table 3) were more likely to be HIV tested compared to non-users in our unadjusted model 1 (OR 1.7, 95% CI (1.4, 2.0)). In model 2, when all covariates were included, the main effect was no

Table 1
National Health Institute Survey, 2009, sample characteristics: total and by HIV testing. Raw numbers (weighted %) unless noted otherwise.

	Total sample n = 26745	HIV tested n = 11291 (39.9)	Not HIV tested n = 15454 (60.1)	p-value[a]
Female	14952 (51.9)	4477 (43.8)	7316 (51.0)	<0.0001
Male	11793 (48.1)	6814 (56.2)	8138 (49.0)	
Age, mean (SEM)	45.9 (0.1)	40.8 (0.2)	49.3 (0.2)	<0.001[aa]
Age groups				<0.0001
18–24	2741 (12.9)	1079 (11.2)	1662 (14.0)	
25–34	4875 (18.0)	2977 (26.2)	1898 (12.6)	
35–44	4815 (18.0)	2824 (25.2)	1991 (13.3)	
45–54	5007 (19.6)	2312 (20.5)	2695 (19.0)	
55–64	4137 (15.2)	1328 (11.4)	2809 (17.7)	
65+	5170 (16.2)	771 (5.5)	4399 (23.4)	
Marital Status				<0.0001
Married	13566 (61.4)	5619 (62.0)	7947 (61.1)	
Widowed	2368 (5.8)	413 (2.3)	1955 (8.1)	
Divorced/separated	4456 (11.2)	2283 (14.0)	2173 (9.4)	
Never married	6304 (21.6)	2949 (21.7)	3355 (21.5)	
Current pregnancy[b]				<0.0001
Yes	293 (3.6)	244 (4.9)	49 (1.9)	
No	7932 (96.4)	4926 (95.1)	3006 (98.1)	
Hispanic	5024 (13.9)	2389 (15.8)	2635 (12.6)	<0.0001
Race				<0.0001
White	20037 (82.1)	7717 (76.3)	12320 (85.9)	
Black	4416 (12.3)	2662 (18.6)	1754 (8.1)	
Asian	1580 (4.8)	119 (0.9)	119 (0.8)	
American Indian/ Alaskan Native	238 (0.8)	544 (4.1)	1036 (5.2)	
Education				<0.0001
High school, no degree	4566 (14.8)	1657 (12.3)	2909 (16.5)	
High school, degree/GED	7205 (27.8)	2692 (24.8)	4513 (29.9)	
Some college	5214 (20.2)	2383 (21.5)	2831 (19.3)	
College degree+	9639 (37.1)	4524 (41.4)	5115 (34.3)	
Income				0.0187
<35,000	10739 (33.2)	4628 (33.8)	6111 (32.8)	
35,000–74,999	7968 (33.4)	3301 (32.2)	4667 (34.2)	
75,000–99,999	2527 (12.4)	1066 (12.1)	1461 (12.6)	
>100,000	4006 (21.0)	1813 (21.9)	2193 (20.3)	
Internet and Chat Room Use				<0.0001
Internet users	12937 (52.0)	6446 (60.8)	6491 (46.1)	<0.0001
Internet non-users	13790 (48.0)	4833 (39.2)	8957 (53.9)	
Chat room users	1151 (4.2)	637 (5.5)	514 (3.4)	
Chat room non-users	25573 (95.8)	10640 (94.5)	14933 (96.6)	
Self-perceived risk for HIV				<0.0001
High	165 (0.6)	119 (1.0)	46 (0.3)	
Moderate	450 (1.7)	287 (2.5)	163 (1.1)	
Low	5839 (21.4)	3019 (25.8)	2820 (18.5)	
None	20063 (76.3)	7786 (70.7)	12277 (80.1)	

[a] Chi square p value for difference in HIV tested vs not tested samples unless noted otherwise.
[b] 18,503 missing given age, gender limitations of this variable.
[aa] *t*-Test for sample means.

Table 2
The association between internet use with HIV testing in the National Health Institute Survey, 2009, unadjusted and adjusted models.

HIV tested	Model 1	Model 2
	OR (95% CI)	OR 95% CI
Internet use	1.8 (1.7, 1.9)	1.4 (1.2, 1.7)
Age		
18–24		1.1 (0.9, 1.4)
25–34		2.6 (2.2, 3.2)
35–44		1.9 (1.6, 2.3)
45–54		Ref
Marital Status		
Married		Ref
Widowed		1.2 (0.6, 2.2)
Divorced/separated		1.2 (1.0, 1.5)
Never married		0.6 (0.5, 0.7)
Ethnicity		
Hispanic v other		1.4 (1.2, 1.7)
Race		
White		Ref
Black		3.2 (2.6, 4.0)
Asian		0.7 (0.5, 0.9)
AIAN		1.3 (0.7, 2.6)
Education[a]		
High School, no degree		Ref
High School, degree		1.3 (1.0, 1.6)
Some college		1.2 (0.9, 1.5)
College degree+		1.3 (1.0, 1.7)
Currently pregnant		2.6 (1.7, 3.9)
Income		
<35,000		1.4 (1.1, 1.7)
35,000–74,999		1.0 (0.8, 1.2)
75,000–99,999		0.9 (0.7, 1.2)
>100,000		Ref
Self perceived HIV risk		
High		2.5 (1.1, 5.7)
Moderate		1.5 (0.9, 2.5)
Low		1.2 (1.1, 1.5)
None		Ref

Model 1 tests the unadjusted association between internet use and HIV testing.
Model 2 tests all the listed variables and their association with HIV testing.
[a] Education variable borderline significant in model 2.

longer statistically significant. When testing our hypothesis regarding the possible interaction between self-perceived risk for HIV and chat room use, there was significant effect measure modification present at the highest level of self-perceived HIV risk, however these data were hard to interpret given small samples sizes within each highest levels of self perceived risk and the large sampling weights (data not shown).

Discussion

This cross-sectional analysis of a nationally representative sample of 26,745 adults shows that use of internet and chat rooms were positively associated with having obtained an HIV test. This association, while slightly attenuated, remained statistically significant in the adjusted internet use model. It was not significant after adjustment in the chat use model. We also hypothesized that self-perceived risk for HIV would modify the association; we did not find any significant effect modification in either analysis.

Results of other analyses of national surveys have looked at characteristics of health information seekers, and found that females, younger age and higher education are associated with the use of HIT (Powell et al., 2011; Choi, 2011). Our study is unique in using data from a representative sample of US adults. In an age where internet-based interventions are increasingly used to promote behavioral interventions (Webb et al., 2010), further attempts at understanding the role of internet and chat room based HIV prevention efforts are warranted.

Our findings that internet use was associated with HIV testing complement trends in motivations for HIT use. Previous studies have described high rates of HIT use in the general population (Jones & Fox, 2009; Powell et al., 2011; Choi, 2011) motivated by perceived external barriers to accessing information through traditional sources, desire for supplemental information regarding their health conditions, and desire for second opinion (Powell et al., 2011). In one study, particularly high use of internet was noted for chronic conditions, notably depression. These researchers suggested that the higher rates in depressed patients were potentially an indication that people with stigmatized conditions may use online resources more often (Wagner et al., 2004). While HIV does not carry the same notion of a "death sentence" in the US as it once did, HIV still carries stigma. Although the NHIS questionnaire did not capture the nature of the information that respondents

Table 3
The association between chat room use and HIV testing in the National Health Institute Survey, 2009, unadjusted and adjusted models.

HIV tested	Model 1	Model 2
	OR (95% CI)	OR 95% CI
Chat room use	1.7 (1.4, 2.0)	1.2 (0.9, 1.6)
Age		
18–24		1.1 (0.9, 1.4)
25–34		2.7 (2.2, 3.3)
35–44		1.9 (1.6, 2.3)
45–54		Ref
Marital Status		
Married		Ref
Widowed		1.2 (0.6, 2.2)
Divorced/separated		1.2 (1.0, 1.5)
Never married		0.6 (0.5, 0.7)
Ethnicity		
Hispanic v other		1.3 (1.1, 1.5)
Race		
White		Ref
Black		3.1 (2.5, 3.8)
Asian		0.7 (0.5, 0.8)
AIAN		1.3 (0.6, 2.6)
Education		
High School, no degree		Ref
High School, degree		1.3 (1.0, 1.7)
Some college		1.3 (1.0, 1.7)
College degree +		1.5 (1.2, 1.9)
Pregnant		2.6 (1.7, 3.9)
Income		
<35,000		1.3 (1.1, 1.7)
35,000–74,999		1.0 (0.8, 1.2)
75,000–99,999		0.9 (0.7, 1.1)
>100,000		Ref
Self-perceived HIV risk		
High		2.5 (1.1, 5.7)
Moderate		1.6 (1.0, 2.5)
Low		1.3 (1.1, 1.5)
None		Ref

Model 1 tests the unadjusted association between chat room use and HIV testing.
Model 2 tests all the listed variables and their association with HIV testing.

sought online, our results alongside these studies suggest that HIT use can be used to avoid the stigma that can arise in face-to-face interactions. We cannot say for certain whether respondents were looking up general testing information or behavioral risk factors, but perhaps they felt more comfortable seeking these online.

Perceived risk is a well-established reason for seeking HIV-related information. This has been noted in many populations, including Hispanics participating in the NHIS (Lopez-Quintero et al., 2000), high-risk minority adolescents (Lopez-Quintero et al., 2000) and the elderly (Adekeye et al., 2012). Specific high-risk subgroups have been the focus of research regarding HIT and HIV. Studies have looked at the internet as an environment where risky sexual behaviors can put individuals at risk for HIV (Rietmeijer & McFarlane, 2013; Bolding et al., 2004) but studies focused on high-risk sexually active groups have found the use of internet for healthy behavior change. These studies have shown a desire to use the internet for HIV-related information to overcome barriers of anonymity and fear, as well as for education regarding risk (Mustanski et al., 2011; Young et al., 2011). Results of small pilot studies have shown promise in using chat room and internet-based interventions to reach high-risk groups such as men who have sex with men (MSM) (Young et al., 2011; Rhodes et al., 2010). An expert panel held by the Centers for Disease Control and Prevention (CDC) viewed the internet and new media in general as having potential to reach high risk groups, specifically MSM, given the flexibility, potential for extensive reach, interactivity and engagement of this media (Lewis et al., 2011). While our bivariate analysis showed that higher levels of self-perceived risk were associated with HIV testing, this association was not significant in our final model of internet use which incorporated the interaction between internet use and self-perceived risk. In our chat room analyses however, there may be a role for self-perceived risk where those who perceive higher levels of risk seek advice and information via chat rooms. Our main effect was no longer significant but this may have been the effect of small sample sizes. Though chat room may be in decline since the 2009 NHIS survey, tools such as smartphone applications with similar chat functionality, have been evaluated in specific risk groups and warrant further examination for their potential use as a venue for information seeking in the general population (Holloway et al., 2014).

Limitations

The NHIS survey was cross-sectional, and determining temporality was not possible. The NHIS survey was not specifically designed to answer our research hypothesis. A questionnaire tailored to answer this question, with survey items querying which health topics HIT users are searching for, would allow for more specific inferences to be made. Although we found an interaction between chat room use and perceived risk, this association was limited to a small group that included both high-risk and HIV-positive persons, this stratum was very small (0.1% of total population).

Conclusion

In conclusion, the use of the internet and chat rooms was associated with HIV testing in a representative sample of the adult US population. This may reflect a desire for more information in a stigma-free setting. The role of self-perceived risk may not be as great a factor in motivating HIV testing in the general population as compared to sub-groups.

Implications

Interventions using internet resources to provide information and possibly motivation regarding HIV to help expand testing in the general US population should be explored as an approach to increasing current screening rates.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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