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ABSTRACT

The World Wide Web (WWW) poses a distinct capability to offer interventions tailored to the individual's characteristics. To fine tune the tailoring process, studies are needed to explore how Internet accessibility and usage are related to demographic, psychosocial, behavioral, and other health related characteristics. This study was based on a cross-sectional survey conducted on 2373 7th grade students of various ethnic groups in Southern California. Measures of Internet use included Internet use at school or at home, Email use, chat-room use, and Internet favoring. Logistic regressions were conducted to assess the associations between Internet uses with selected demographic, psychosocial, behavioral variables and self-reported health statuses. The proportion of students who could access the Internet at school or home was 90% and 40%, separately. Nearly all (99%) of the respondents could access the Internet either at school or at home. Higher SES and Asian ethnicity were associated with higher internet use. Among those who could access the Internet and after adjusting for the selected demographic and psychosocial variables, depression was positively related with chat-room use and using the Internet longer than 1 hour per day at home, and hostility was positively related with Internet favoring (All ORs = 1.2 for +1 STD, $p < 0.05$). Less parental monitoring and more unsupervised time were positively related to email use, chat-room use, and at home Internet use (ORs for +1 STD ranged from 1.2 to 2.0, all $p < 0.05$), but not related to at school Internet use. Substance use was positively related to email use, chat-room use, and at home Internet use (OR for "used" vs. "not used" ranged from 1.2 to 4.0, $p < 0.05$). Self-reported health problems were associated with higher levels of Internet use at home but lower levels of Internet use at school. More physical activity was related to more email use (OR = 1.3 for +1 STD), chat room use (OR = 1.2 for +1 STD), and at school ever Internet use (OR = 1.2 for +1 STD, all $p < 0.05$). Body mass index was not related to any of the Internet use-related measures. In this ethnically diverse sample of Southern California 7th grade students, 99% could access the Internet at school and/or at home. This suggests that the Internet is already a potential venue for large scale health communication studies. Adolescents with more psychosocial risk factors or detrimental health behaviors were more likely to use the Internet. Therefore, if used properly, Internet interventions could effectively address the high risk populations. Additional research is needed to gain a more complete understanding of the positive and negative consequences of Internet use among adolescents.

INTRODUCTION

SINCE ITS INVENTION more than a decade ago, and especially since 1994, the Worldwide Web (WWW) has been rapidly adopted by the public. In 2002, 79% of people in the United States 16 years old or older could access the Internet, an increase of 3% since in 2001.¹ This technology has already produced profound changes in the United States, and will continue to bring to the world unprecedented transformations in all aspects of life. Public health professionals have been taking advantage of the WWW's capacity to serve as a virtual clearinghouse for health information.²⁻⁵ Health statistics and disease information are widely available to health professionals and the public through the Internet. Investigators have benefited from the channel's capacity to conduct large scale scientific surveys,⁶⁻¹⁰ to conduct paperless data collection,^{11,12} and to foster "virtual" communities by enabling persons with common health interests to maintain electronic contact.^{2,13} As technology innovations continue, WWW is no longer only a passive medium for information dissemination. It portends a much greater promise of being able to provide immediate, transactional feedback, and thus, create an unprecedented mass medium that possesses the capability to mimic the transactional and response-dependent qualities of interpersonal communication.¹⁴

Although there is still a dearth of evidence in the results of internet based health promotion interventions,¹⁵ the Internet is regarded as a potentially useful tool to conduct health research interventions.¹⁶ Researchers are starting to conduct web-based interventions for cigarette smoking prevention and cessation,¹⁷⁻²¹ depression and anxiety treatment,^{22-24,25} and other health related studies such as alcohol use,²⁶ drug abuse,²⁷ HIV,²⁸ nutrition and obesity,^{14,29,30} and physical activity.^{31,32} From completed or on-going web-based intervention programs, researchers have realized the difficulty of retaining participants in longitudinal web-based research,³³ as well as the challenges in both content development and program implementation.³⁴

To determine how this new technology can be better designed to facilitate tailored mass media health intervention for adolescents, two questions remain to be answered: (1) Can Internet-based communication effectively reach the target population, that is, the whole population for primary prevention studies or high risk populations for targeted secondary prevention studies? (2) When preparing tailored messages, to which subject characteristics should the messages be tailored? To help answer these two questions, this analysis reports

the prevalence of Internet accessibility and usage among adolescents, identifies the demographic and psychosocial predictors of Internet accessibility and usage, and examines the associations between Internet use and health status.

MATERIALS AND METHODS

Study design

The data described in this article are from a longitudinal study of health behaviors among adolescents living in an ethnically diverse, urban social context. Respondents were 6th grade students attending 24 middle schools in Southern California. Details of the inclusion criteria and participation rates among school districts and schools are described elsewhere.³⁵ Respondents completed surveys in 6th grade in 2001 and again in 7th grade in 2002. The survey questions about Internet usage reported in this article first appeared on the 7th grade survey (wave 2).

Student recruitment

All 6th-grade students in the participating schools were invited to participate in the study. Consent forms were sent home to the parents/guardians of all 6th-grade students in the school. If a parent provided active written consent, the child was invited to participate in the study. Of the 4,427 students invited to participate in the 6th-grade survey, 3,319 (75%) provided active parental consent. Some limited anonymous demographic information was obtained from the students whose parents did not respond to the request for consent, as allowed by an IRB-approved implied-consent protocol. Compared with the students whose parents did not respond to the request for consent, the students who provided active written parental consent were more likely to be female (chi-square = 49.08, $p < 0.001$), to be non-African-American (chi-square = 17.78, $p < 0.005$), and had higher grades in school (chi-square = 43.87, $p < 0.005$).

Subjects

Among the 3190 adolescents who completed the 6th grade survey, 2701 (85%) also completed the 7th grade survey. Compared with the respondents who were lost to attrition between 6th and 7th grades, those with successful follow-up at 7th grade were older, had more rooms per person in the home, and had more Asians and less Hispanics (all $p < 0.05$).

Of the 2701 respondents with 6th and 7th grade data, 2373 (88%) provided complete data on the key variables used in this analysis (Internet related and demographic information). Compared with the subjects who did not supply complete data, those who offered complete data were more likely from higher SES families (assessed as parents' education and rooms per person in the home), more likely to be Asian and less likely to be Hispanic, and had higher GPA at school.

The analysis sample of 2373 students ranged from 11 to 16 years of age (mean age = 12.8 years, SD = 0.4 year). The sample was 47% boys and 53% girls; 16% attended parochial school; 11% were white, 54% Latino, 26% Asian, and 9% other. A within ethnic group summary of the demographics for the participating subjects are summarized in Table 1. As shown in this table, on average, Asian and non-Hispanic White students had a higher GPA, their parents had higher education levels, and had more rooms per person in the home (an estimate of SES) than students of Hispanic or other ethnic groups. Asian and Hispanic students were more likely to be 1st or 2nd generation immigrants, and less likely to speak mostly English at home or in general.

Measures

The measures involved in this analysis can be categorized into four general groups: Internet,

demographic, psychosocial, and behavioral factors and substance use status.

The internet related measures include Internet favoring (viewing the Internet as one of the favorite ways to spend time), email use, chat-room use, and Internet use profiles at home or at school (accessibility, ever use, and heavy use). Internet favoring was a dichotomous variable assessing whether Internet use was one of the favorite ways to spend time. Email and chat-room use were assessed by asking the frequency of the uses, with 6 levels of answers ranging from "never used" to "used them many times a day." Internet accessibility and usage at school was assessed by asking how much time the students spent on the Internet at school. Response options were (1) can't use the internet at school, (2) I could use the Internet at school, but I don't, (3) occasionally, but not everyday, (4) 10-30 min a day, (5) half an hour to 1 h a day, and (6) more than 1 h a day. Likewise, Internet accessibility and usage at home was assessed by asking how much time the students spent on the Internet each day at home. Response options were (1) can't use the internet at home, (2) I could use the Internet at home, but I don't, (3) less than 1 h, (4) 1-2 h, (5) 3-4 h, and (6) more than 4 h.

The demographic variables were age, gender, ethnicity (Asian, Non-Hispanic white, Hispanic, and other), highest parents' education (less than high school, high school, and college or higher), rooms per

TABLE 1. SUMMARY OF DEMOGRAPHIC INFORMATION

Variables	Ethnicity				p ^c
	Asian, n = 619 (26%)	Latino, n = 1269 (54%)	White, n = 261 (11%)	Other, n = 221 (9%)	
Age, years (mean, STD)	12.76, 0.36	12.77, 0.38	12.80, 0.34	12.80, 0.44	ns
Boy (%)	48%	43%	56%	52%	***
Parents' highest education (%) ^a					
High school only	23%	37%	19%	29%	***
College or above	72%	33%	73%	57%	***
No. of room per person (mean, STD)	1.03, 0.44	0.68, 0.36	1.10, 0.51	0.78, 0.46	***
Parochial School (%)	18%	14%	26%	10%	***
GPA (mean, STD)	3.46, 0.72	2.71, 0.99	3.05, 0.97	2.79, 1.03	***
Generation of immigration					
1 st generation (%)	23%	15%	6%	22%	***
2 nd generation (%)	63%	51%	17%	41%	***
Speak mostly English (%) ^b	37%	34%	77%	46%	***

^aHighest education of either father or mother.

^bSpeak mostly English at home or in general.

^cF test for significance of difference across the four ethnic groups: ns, nonsignificant; +, < 0.1; *, < 0.05; **, < 0.01; ***, < 0.001.

person at home, school type (parochial vs. public), self-reported GPA, immigration status (1st, 2nd, or 3rd and higher generation), and level of acculturation. Ethnicity was assessed with a series of dichotomous questions (e.g., "Are you White, Chinese/Chinese-American, Pacific Islander, Filipino, Korean/Korean-American, Vietnamese/Vietnamese-American, Latino/Hispanic, or Black/African-American.").

The psychosocial variables used in this analysis included three categories: psychopathology related (depression, hostility, perceived discrimination),³⁶ social and family interaction related (school bonding, neighborhood bonding, parental monitoring, communication with parents, latchkey, unsupervised time, bullying perpetration or victimization, and pro- or anti-smoking media exposure),³⁷ and Asian or Hispanic traditional cultural values (filial piety, sympathy, respect, familism, and machismo).³⁸ The psychopathological variables were selected because previous studies have suggested that they were related to Internet use^{39,40}; the social and family interaction variables were selected to explore the possible association between virtual interaction over the Internet and interaction with society and family in the real world.⁴¹ The list of variables was also designed to represent a wide range of positive constructs (e.g., bonding to school and neighborhood, parental monitoring and communication) as well as negative constructs (e.g., depression, hostility, perceived discrimination, unsupervised time, bullying). Certain Asian and Hispanic cultural values were studied in this analysis because including the cultural values might help explore whether these cultural values partially explain the ethnic variation in Internet use.

The behavioral and health related variables include cigarette smoking (lifetime ever use, susceptibility of future smoking, and passive smoking), lifetime use of certain drugs (alcohol, marijuana, inhalants, other hard drugs), physical activity, body mass index, and self-reported health status. The variables were selected because they have been, or could be, targeted by web-based interventions. A variety of health-risk variables (e.g., substance use, obesity) and health-promotive variables (e.g., physical activity, good self-reported health) were included to assess a wide array of health behaviors and conditions associated with Internet use. To understand how the Internet use might correlate with these behavioral variables will facilitate the design and implementation of better web-based studies of health promotion and disease prevention.

Statistical analysis

Multivariate logistic regressions were applied to determine the independent associations between the study variables and the Internet related variables. The study variables were the selected measures related to demographic, psychosocial, behavioral assessments and health outcomes. The effects of demographic and psychosocial variables on the Internet variables were estimated in the first two groups of regressions. In the first group of regressions, all demographic variables were used to predict the Internet related variables in a multivariate logistic regression, so that the independent associations between each of the demographic variables and each of the internet related variables were assessed. In the second group of regressions, all psychosocial variables and demographic variables were treated as independent variables, so that the independent effect of each psychosocial variable on the Internet variables could be computed. The third group of regressions was conducted to estimate the independent relationship between behavioral and health outcomes on internet accessibility and usage. Demographic variables were adjusted in this third group of regressions.

RESULTS

Internet accessibility and usage

Among all subjects, 37% reported that they prefer Internet (surfing the Internet, using chat rooms, emailing or instant-messaging) as a favorite way to spend their time. Internet use was the 6th favorite thing to do in a multiple choice enabled question listing 12 common activities for adolescents, following that of watching TV/Videos, listening to music/radio, hanging out with friends, video or computer games, and team sports. Over half of the respondents (57%) reported that they had used email before, and 17% used email daily. Nearly half (46%) reported that they had used internet chat-rooms before, and 13% used internet chat-rooms daily. At school, 90% of the subjects could access the Internet, 40% used it at least occasionally, and 13% used daily. At home, 79% could access the Internet, 62% used it at least once in their lifetime, and 37% used it at least 1 h per day. Nearly all (99%) of the respondents reported that they could access the Internet from either school or home. Table 2 shows the Internet related variables by gender and ethnicity. It is worthwhile to note that although at-home Internet accessibility and usage

TABLE 2. PREVALENCE OF INTERNET ACCESSIBILITY AND USAGE

Internet access and usage (%)	Girls					Boys					p for difference ^d		
	Asian	Latino	White	Other	Asian	Latino	White	Other	Across gender	Across ethnicity			
N	321	721	116	106	298	548	145	115					
Internet as a favorite way to spend time	67%	27%	42%	27%	55%	26%	34%	25%	*	***			ns
Email usage													
Ever use	84%	47%	71%	51%	71%	45%	68%	48%	*	***			+
Daily use	29%	13%	23%	17%	21%	13%	20%	16%	ns	***			ns
Chat-room usage													
Ever use	61%	40%	46%	37%	57%	42%	47%	42%	ns	***			ns
Daily use	19%	8%	9%	11%	18%	13%	15%	14%	*	***			Ns
At school													
Internet accessibility													
Internet usage ^a	89%	89%	91%	94%	87%	93%	85%	90%	ns	ns			ns
Ever use	44%	39%	49%	35%	57%	40%	59%	44%	*	ns			+
Daily use	8%	14%	10%	11%	15%	19%	19%	18%	*	ns			ns
At home													
Internet accessibility													
Internet usage ^b	96%	68%	85%	76%	94%	73%	86%	74%	ns	***			ns
Ever use	89%	71%	85%	67%	90%	73%	80%	81%	ns	***			ns
Daily use >1 h	63%	37%	42%	41%	64%	40%	47%	49%	ns	***			ns
At school													
or home													
Internet accessibility	100%	97%	98%	98%	99%	98%	99%	100%	ns	+			ns
Internet usage ^c													
Ever use	81%	59%	75%	59%	80%	62%	71%	62%	ns	***			ns
Daily use	64%	34%	39%	37%	65%	39%	49%	46%	*	***			ns

^aCalculated as a percentage among those who can access Internet at school.

^bCalculated as a percentage among those who can access Internet at home.

^cCalculated as a percentage among those who can access Internet at school or home.

^dF test for significance of difference across ethnicity, gender, and ethnicity * gender: ns, nonsignificant; +, <0.10; *, <0.05; **, <0.01; ***, <0.001.

was lower in Hispanic students, at-school Internet accessibility and usage was equivalent across ethnic groups.

Demographic and psychosocial predictors of internet accessibility and usage

The first group of logistic regressions assessed the association between the demographic variables and Internet accessibility and usage. As listed in Table 3, older age was a significant predictor of chat-room use, and boys were more likely than girls to use the Internet at school. Asian students were in general more likely to use the Internet, were more likely to view the use of the Internet as one of the favorite ways to spend time, used emails and chat-rooms more, were more likely to have Internet accessibility, and were more likely to spend more than one hour per day on the Internet at home. In multivariate models, Hispanic was no longer an independent predictor of Internet accessibility or usage. After adjusting for other demographic variables, Hispanics had the same level of Internet accessibility and usage as that of Non-Hispanic whites. SES (parents' education and rooms per person) were positively related with Internet use. Students at parochial schools were more likely to have used email and to use the Internet at school, relative to students in public schools. Being first generation immigrants predicted more ever-use of the Internet at school, but language usage was not associated with any of the Internet related variables.

The second group of logistic regressions on Internet accessibility and usage was with the psychosocial variables while adjusting for the demographic and other psychosocial variables. Some psychopathological, social and family interaction, and cultural variables were found to be related to Internet use. Table 4 lists the odds ratios for those with significant relationships ($p < 0.05$). Depression was positively related to Internet favoring, daily chat-room use, and using the Internet at home for longer than 1 h. Hostility was positively associated with Internet favoring. School bonding was negatively associated with ever using the Internet at school. Parental monitoring reduced, but more unsupervised time increased, the use of email, chat-room, and long-time Internet use at home, but did not influence the students' Internet use at school. Students who had been victimized by bullies were more likely to have ever used the Internet at school. Students who had bullied other students were more likely to use chat-rooms daily, and less likely to have ever used the Internet at home. There was more email use but less chat-room use among sub-

jects with a higher filial piety cultural value. Those with more pro-smoking media exposure were more likely to use chat-rooms daily, to use the Internet daily at school, and to use the Internet longer than 1 hour at home. Those who had received more anti-smoking media exposure were more likely to have used chat-rooms before, and have ever used the Internet at school.

Internet accessibility and usage with behavioral variables and health outcomes

The third group of logistic regressions was with each of the behavioral and health related variables. As shown in Table 5, even after adjusting for age, gender, ethnicity, SES, and other demographic variables, lifetime cigarette smoking, smoking susceptibility, lifetime alcohol drinking, marijuana use, and inhalant use were all positively related to email use, chat-room use, and heavy Internet use at home. The use of other illegal drugs (cocaine, LSD, methamphetamine, or Ecstasy) was positively related to chat-room use. Self-reported health status was positively related to more ever use of the Internet at school and less heavy use of the Internet at home. Those who had more self-reported diseases were more likely to view Internet use as a favorite way to spend time, to have more email and chat-room uses, and to spend longer than 1 hour per day on the Internet at home. Physical activity was positively related to daily use of email and chat-rooms, and ever use of the Internet at school. Body Mass Index (BMI) was not related to any of the Internet use related variables. As an example of the findings, the relationship between drug abuse and daily chat-room use or heavy Internet use at home are depicted in Figure 1.

DISCUSSION

The Internet represents a potentially useful new venue for delivering health promotion messages and disease prevention messages. Of course, the effectiveness of Internet-based health promotion messages will be limited by their ability to reach their target audiences. In the early days of the Internet, Internet access and use was limited primarily to highly educated adults. The results of this study suggest that the reach of the Internet has extended to include a large number of adolescents in the United States. Among a diverse sample of 7th grade students in urban Southern California, varying in SES and ethnic background, 99% reported that they had access to the Internet at school and/or at home.

TABLE 3. ODDS RATIO^a OF INTERNET ACCESSIBILITY AND USAGE FOR DESIGNATED COMPARISONS IN SELECTED DEMOGRAPHIC VARIABLES^b

	Internet favoring			Email use			Chat-room use			At school			At home			At school or at home		
	Internet favoring	Ever		Daily		Access	Ever	Daily		Access	Ever	>1 h per day		Ever	Heavy			
		2.6	1.7	2.2	2.0			1.6	1.4			1.6	3.7			2.6	0.6	0.6
Age (1 year older)			1.6	1.5														
Gender (boy vs. girl)						1.4	1.6											
Ethnicity																		
Asian vs. white									3.7						2.4			
Latino vs. white																		
Other vs. white																		
Parents education																		
High school vs. high school		1.4																
College vs. high school		1.8	1.4	1.8					1.8	1.8								
Rooms per person	1.5	2.0			1.6				2.6									
(1 more room/person)																		
School Type																		
(parochial vs. public)		1.4							1.7									
GPA (each +1 point)		1.1								1.2					1.2			
Immigration status																		
1 st vs. 3 rd or more																		
2 nd vs. 3 rd or more																		
Speak mostly English																		
Yes vs. no																		

^aOnly significant ($p < 0.05$) Odds ratios were reported in the cells; $p > 0.05$ for all blank cells.

^bFor Internet favoring, email use, and chat-room use, regression were run within those subjects who can access Internet; for at school Internet use, regressions were run within those who can access internet at school, for at home Internet use, regressions were run within those who can access Internet at home. Eleven multivariate logistic regressions were run with each of the internet related variables as the dependent variable, and all demographic variables as the independent variables. Only significant Odds Ratios were depicted.

TABLE 4. ODDS RATIO^a OF INTERNET USAGE FOR THE INCREASE OF ONE STANDARD DEVIATION IN EACH OF THE PSYCHOSOCIAL VARIABLES^b

	Internet favoring		Email use		Chat-room use		At school		At home		At school or at home	
	Yes	Daily	Yes	Daily	Yes	Daily	Ever	Daily	Ever	>1 h per day	Ever	Heavy
Perceived discrimination												
Depression												
Hostility	1.2			1.2						1.2	1.2	1.2
School bonding						0.8						
Neighborhood bonding												
Parental monitoring	0.8	0.7	0.6	0.5						0.6		0.7
Communication with parents	1.2							0.7				
Latchkey									1.5			
Un-supervised time									1.4	1.3	1.2	1.3
Sufferer of bully												
Offender of bully									0.8			
Filial piety		1.2		1.3								
Sympathy				0.8								
Familism												
Machismo	1.3										1.3	
Respect												
Pro-smoking media exposure												
Anti-smoking media exposure					1.2					1.2		1.2

^aSignificant Odds ratios ($p < 0.05$) were reported in this table; non-significant results were not listed in the cells.

^bEach OR showing in this table was the result from logistic regression conducted within those subjects who could access Internet. A total of 11 regressions were run, each with one of the Internet use variables as the dependent variable. Other covariates are the demographic variables that include age, gender, ethnicity (Hispanic, Asian, Non-Hispanic White, and Other), parents' highest education (less than high school, high school, college or higher), number of rooms per person at home, school type (public vs. parochial), GPA, and immigration status (1st, 2nd, or 3rd and higher generation).

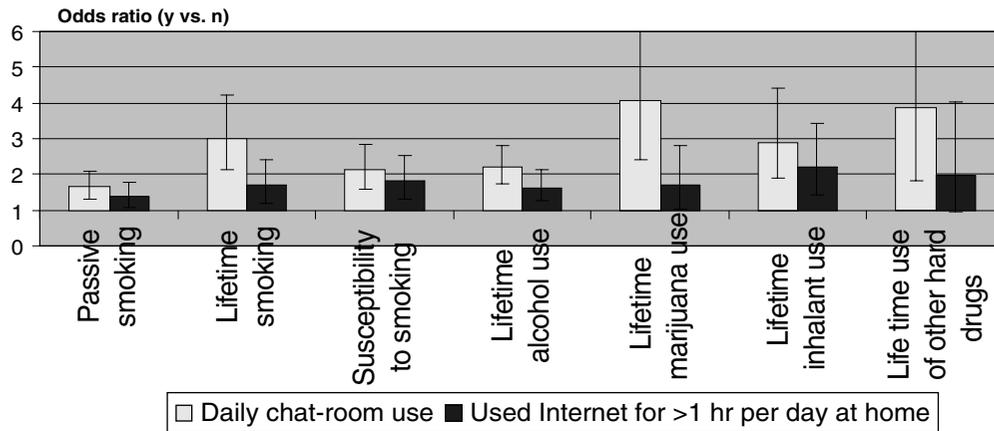


FIG. 1. Internet use with substance use. "Other hard drugs" include cocaine, LSD, methamphetamine, and ecstasy. Error bars = 95% CI.

Although more information is needed about the Internet access of adolescents in other areas of the United States, the results of this study suggest that the Internet potentially could be an effective medium for communicating with the general population of adolescents in the United States.

Within this ethnically diverse sample of urban adolescents, disparities in Internet access and usage remained evident. Students with lower socioeconomic status reported lower rates of Internet access and usage, and Asian students reported especially high rates of Internet access and usage. The bivariate association between Hispanic ethnicity and lower Internet usage appears to have been confounded by SES. On the other hand, in both univariate and multivariate models, Asian subjects showed higher Internet uses than others. Further studies are needed to explore the demographic, environmental, psychosocial, and cultural mediators of higher Internet use among Asian adolescents.

The associations between psychosocial variables and Internet usage corroborated previous research. In a longitudinal setting, Kraut et al.⁴⁰ found by following 169 people in 73 households during their first 1 to 2 years on-line that Internet use increased depression, loneliness, and stress, decreased family's members' communications within the family, and reduced the size of the family's social circle. Klemm et al.⁴² also found that more depressed patients with cancer use Internet support groups instead of face-to-face support. In the present study, adolescents with high levels of depression showed more Internet use. It is not clear from this study whether excessive Internet use made the adolescents more depressed, or whether adolescents who were already depressed sought out the Internet as a form of escapism to avoid or distract themselves

from distressing interpersonal interactions.⁴³ Other studies, however, have found positive effects of Internet use. For example, Shaw et al.³⁹ and White⁴⁴ found that Internet use decreased loneliness and depression significantly and increased perceived social support and self-esteem significantly. Another study by Epstein et al.⁴⁵ showed, when used properly, the Internet can help people facing infertility by educating, empowering, and diminishing their feelings of depression. If adolescents indeed are more likely to turn to the Internet if they are psychologically distressed, and web-based interventions are able to render positive effects on reducing depression,²⁵ the Internet might be an ideal venue for providing social support, teaching coping skills and interpersonal communication skills, and directing adolescents to available mental health resources. It is not clear whether the Internet can empower adolescents and therefore improve their real-world interactions, or whether it is just a channel for them to spend their time and withdraw from real-world interactions. Another topic that is not clear and may also be interesting is for how long the Internet use can help lower depression level. There is a possibility that excessively heavy Internet use could be pathological.⁴⁶⁻⁴⁸ Similar to the addiction to cigarette smoking, alcohol use and other drug abuse,⁴⁹ it might be able to exert a short term effect in reducing depression or loneliness. However, sole reliance on the Internet as a social resource might prevent adolescents from developing the interpersonal skills to form stronger in-person social support networks.

Less parental monitoring or more unsupervised time were related with more email use, chat-room use, and at home Internet use, but was not related to the Internet use at school. At school, less school

TABLE 5. ODDS RATIO^a OF INTERNET USAGE FOR DESIGNATED COMPARISONS IN SUBSTANCE USE AND HEALTH STATUS-RELATED VARIABLES^b

	Internet favoring		Email use		Chat-room use		At school		At home		At home or school		
	Ever	Daily	Ever	Daily	Ever	Daily	Ever	Daily	Ever	>1 h per day	Ever	Heavy use	
Environmental cigarette smoking (yes vs. no)					1.7	1.4						1.4	
Lifetime cigarette smoking (yes vs. no)			2.1	1.8	3.0	2.6						1.7	1.6
Susceptibility to cigarette smoking (yes vs. no)													
Lifetime alcohol drinking (yes vs. no)	1.3		1.4	1.6	2.2	2.6						1.8	1.6
Lifetime marijuana use (yes vs. no)			1.3		2.2	2.8						1.6	1.6
Lifetime inhalant use (yes vs. no)			1.8		4.0	2.9						1.7	
Lifetime use of other hard drugs (cocaine, LSD, methamphetamine, ecstasy) (yes vs. no)	1.6		2.0	1.6	2.9	2.7						2.2	1.6
Self-perceived health status (excellent vs good, or good vs. fair, or fair vs. poor)					3.9	5.0							2.0
Self-reported total number of health problems in the past month (+1 more)	1.2		1.1	1.1	1.1	1.1						0.8	
Physical activity (+1 STD)													1.1
Body Mass Index (BMI)				1.3		1.2							1.1

^aOdds ratios were reported in the cells; $p < 0.05$ for all cells with numeric numbers, $p > 0.05$ for all blank cells.

^bEach OR showing in this table was the result from one logistic regression conducted within those subjects who could access Internet. The regression was with each of the internet related variable (column header) as the dependent variable, the row variable as one of the independent variable, other independent variables include the demographic variables: age, gender, ethnicity (Hispanic, Asian, Non-Hispanic White, and Other), parents' highest education (less than high school, high school, college or higher), number of rooms per person at home, school type (public vs. parochial), GPA, and immigration status (1st, 2nd, or 3rd and higher generation).

bonding was associated with more ever Internet use. The findings suggested that Internet use and virtual social interactions and bonding in cyberspace might be a supplement to social support for those who were less supported by, or bonded to, home or school. The findings may also indicate that parents who closely monitor their children's activities tend to limit their children's internet use because they have negative attitudes towards the Internet's potential effects on their children's well-being. For web-based intervention programs that will involve Internet use at home, these findings indicate that parents should be involved in the intervention process. It may be necessary to convince parents of the potential benefits of health promotion websites to gain their full cooperation in a community-wide intervention.

Another important finding in this study is that students who used the Internet heavily are more likely to be involved in substance use. This indicates that the Internet could be an effective channel for communicating with adolescents who are at high risk for substance use. Therefore, Internet-based substance use prevention programs are likely to be successful in reaching their target audience—a target audience that is notoriously difficult to reach and follow through school-based or community-based prevention programs. More detailed studies are needed to explore why Internet use and drug abuse are related. One hypothesis is that both internet use and drug use are predisposed by the same psychosocial risk factor profiles (e.g., depression, hostility, less parental monitoring, sensation seeking).^{50,51} Another possibility was that students who spend more time online are more likely to receive pro-drug use messages and to form allegiances with other rebellious adolescents worldwide. In this way, they might form a virtual community that is less regulated by the rules of school, family, and society. Limited by the cross-sectional nature of this analysis, further tests of the hypotheses would be beyond the scope of this paper. Another limitation was that the data was collected in wave 2 of a longitudinal study; subject selection was biased due to parent and self consenting process in subject recruitment, attrition from baseline to wave 2, and exclusion of subjects for missing data. It is also not clear if similar relationships would still hold in populations of different geographic region, age group, or culture.

Although a wide array of health-risk and health-promoting behaviors were included as predictors in this analysis, there are many more psychosocial and behavioral factors that affect the health and well-being of adolescents. Therefore, the results of

this analyses are limited by the variables that were selected for inclusion in this survey. Future studies are likely to discover other important correlates of Internet use among adolescents.

Internet use, as some of the other innovations in technology, is a double-edged sword that could be both detrimental and beneficial to health promotion and disease prevention. Health professionals are still at the beginning stage of trying to harness the full capability of the Internet for disease prevention. The findings from our study and further studies will help health researchers to design better internet-based health promotion and disease prevention studies. It is an encouraging finding to the health professionals that Internet-based assessments and interventions may have the potential to research nearly all adolescents, and especially high risk groups. At the same time, this study indicated that the actual use of web-based interventions may be related with subject level demographic, psychosocial, and behavioral characteristics; therefore, when assessing the outcome of web-based interventions, it is essential to conduct both intention-to-treat and exposure-outcome analyses. Finally, more studies would be needed to fully clarify this relationship so that future Internet-based health experiments can be better designed and implemented with more attention to study design, population group, and subjects' characteristics for message tailoring.

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