Problematic Internet Use and Health in Adolescents: Data From a High School Survey in Connecticut

Timothy C. Liu, MD; Rani A. Desai, PhD; Suchitra Krishnan-Sarin, PhD; Dana A. Cavallo, PhD; and Marc N. Potenza, MD, PhD

Objective: This study aims to explore the prevalence and health correlates of problematic Internet use among high school students in the United States.

Method: A cross-sectional survey with a sample size of 3,560 students was conducted among high schools in Connecticut. Demographic data, characteristics of Internet use, health measures, and risk behaviors were assessed. Chi-square and logistic regression analyses were used to study the relationship between problematic Internet use and risk behaviors as well as related gender differences.

Results: When problematic Internet use was diagnosed with criteria modeled after the Minnesota Impulsive Disorder Inventory that address core features of impulse-control disorder (strong urge, growing tension, and attempts to cut back), the overall prevalence was about 4%, with no significant difference between genders. Problematic Internet use was more common among Asian (7.86%) and Hispanic (6.07%) students. Even though boys spent significantly more time on the Internet (16.52% of boys spent over 20 hours per week vs 12.62% of girls; $P = .0001$) and more frequently missed important school or social activities as a result (8.97% of boys vs 5.85% of girls; $P = .0004$), girls more frequently self-reported measures of excessive use of the Internet (11.81% of girls thought that they had a problem vs 8.90% of boys; $P = .0048$). After adjustment of sociodemographic factors, problematic Internet use was found to associate significantly with substance use ($P = .0014$), depression ($P < .0001$), and aggression ($P < .0001$), with largely similar patterns of associations between genders.

Conclusions: Problematic Internet use may be present in about 4% of high school students in the United States. It may be associated with depression, substance use, and aggressive behaviors. High school boys, though, may have heavier Internet use and may be less self-aware of the related problems.

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Corresponding author: *Timothy C. Liu, MD, Yale Child Study Center, Yale University School of Medicine, 230 South Frontage Rd, New Haven, CT 06520 (timothy.liu@yale.edu).*

Problematic Internet use can be broadly defined as uncontrolled use of the Internet that leads to significant psychosocial and functional impairments, and this pattern of use is not better accounted for by a primary psychiatric disorder such as mania or the physiologic effects of a substance.[1] It is a clinically recognizable behavioral syndrome albeit controversies exist about its validity as a discrete mental disorder.[1,2] Recently, it has been proposed that problematic Internet use, or alternatively termed *Internet addiction*, be included as a diagnosable condition in the forthcoming fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*).[3,4]

Among diagnostic categories in the current *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision (*DSM-IV-TR*),[5] problematic Internet use has been most frequently likened, based on phenomenological similarities, to substance dependence and pathological gambling.[1,6] However, direct evidence for the existence of physiologic changes associated with tolerance or withdrawal in individuals with problematic Internet use, which may qualify it as a condition of dependence, is currently lacking.[2] The proposal to conceptualize problematic Internet use as an impulse-control disorder similar to pathological gambling is largely based on the clinical observation that patients often report their Internet use as more impulsive and egosyntonic rather than compulsive and egodystonic. Small case series have noted high comorbidity rates (38% and 50%) with other impulse-control disorders,[7,8] and some empirical studies have found that adolescents with problematic Internet use might have higher impulsivity than controls on psychometric testing.[9,10] Despite the absence of specific criteria for problematic Internet use in *DSM-IV-TR*,[5] individuals with problematic Internet use have typically fulfilled criteria for a diagnosis of impulse-control disorder not otherwise specified.[8]

Given the popularity of the Internet[11] and emergence of patients reporting distress associated with preoccupation with Internet-related activities,[6] a better understanding of this clinical phenomenon is important. Much of the existing research on problematic Internet use has been conducted in Asian countries such as Korea and Taiwan.[3,12] There has been only one large-scale, offline epidemiologic study done in the United States that estimated the point prevalence of problematic Internet use to be ranging from 0.3% to 0.7% depending on diagnostic thresholds.[13] It employed a telephone survey methodology, and the sample consisted of adults ≥ 18 years of age.[13] To our knowledge, no large-scale epidemiologic study of problematic Internet use has been conducted in US high school students, individuals who are likely to have a high prevalence of Internet use[14] and may be at higher risk of problematic Internet use than the general population.[15] Epidemiologic studies of problematic Internet use in youths in other countries generally report higher prevalence rates than the above-mentioned survey of adults,[13] ranging from 1.4% to 2.0%.[16–18] Certain target populations such as high school and college students may have much higher prevalence rates,

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up to 10%–20%.[15,19] However, direct comparison of these studies is difficult due to differences in diagnostic criteria and methodologies.[12]

Reported comorbidities of problematic Internet use include mood disorders, obsessive-compulsive disorder, impulse-control disorders, attention-deficit/hyperactivity disorder, and substance abuse.[1] Among these, depression appears to be the most commonly reported comorbid condition, observed relatively consistently in case series and community surveys.[7,8,15,16,20,21] Excessive Internet use may lead to decreased communication with family members and depressed mood as shown in a longitudinal study.[22] However, the nature of the relationship between problematic Internet use and mood symptomatology, as well as other clinically relevant disorders and behaviors, remains poorly understood,[23] particularly among US adolescents.[1]

To address this gap in knowledge, we conducted in 10 Connecticut high schools a large cross-sectional survey of risk behaviors, including problematic Internet use. Data from this survey were used in the present analysis to investigate the extent of problematic Internet use and its relationships with other health measures among a US sample of high school students. Previous research suggests important gender differences with regard to the prevalence of problematic Internet use,[19] favorite Internet activities,[22] and motivations to use.[6] On the basis of these findings, the current analysis was conducted in a gender-specific manner, and we hypothesized that (1) problematic Internet use would be more prevalent in male than in female participants; (2) male participants would spend more hours online than female participants; (3) problematic Internet use would be more significantly associated with other risk behaviors, including substance use and aggressive behaviors in male participants; and, (4) problematic Internet use would be more significantly associated with depression in female participants.

METHOD

Study Procedures and Sampling

Methodology for the high school survey has been described previously.[24] Briefly, the study team sent invitation letters by mail to all public 4-year high schools in the state of Connecticut, excluding vocational and special education high schools. These letters were followed by phone calls to all school principals. Schools that expressed an interest were contacted to begin the process of obtaining permission from School Boards and/or school system superintendents, if this was needed. In many cases, the process of obtaining permission required the presentation of a specific proposal to the School Board at a regularly scheduled meeting of the board.[24]

After the initial round of letters was mailed, the response from schools was not yet sufficient to ensure that all regions of the state were sufficiently represented. Therefore, targeted contacts were made to schools that were in geographically underrepresented areas to ensure that the sample was representative of the state. The final survey contained schools from each geographical region of the state of Connecticut, and it contained schools from each of the 3 tiers of the state's district reference groups. District reference groups are groupings of schools based on the socioeconomic status of the families in the school district. Sampling from each of the 3 tiers of the district reference groups was intended to create a more socioeconomically representative sample. Although this was not a random sample of public high school students in Connecticut, the sample obtained in this study is similar in demographics to the sample of Connecticut residents enumerated in the 2000 Census ages 14–18 years.[24]

Once permission was obtained from the necessary parties in each school, a passive consent procedure was followed. Letters were sent through the school to parents informing them about the study. Parents were instructed to call the main office of their child's high school to deny permission for their child's participation if they wanted their child to be excluded from the survey. If no message was received from a parent, parental permission was assumed. The passive consent procedure was approved by all participating schools and by the Institutional Review Board of the Yale University School of Medicine.[24]

In most cases, the entire student body was targeted for administration of the survey. Some schools conducted an assembly at which surveys were administered, while others had students complete the survey in every health or English class throughout the day. The school was visited on a single day by a number of research staff who explained the study, distributed the surveys, answered questions, and collected the surveys. Students were told that participation was voluntary and that they could refuse to complete the survey if they wished. The refusal rate was less than 1%.[25] Students were reminded to keep surveys anonymous by not writing their name or other identifying information anywhere on the survey. Data were double-entered from the paper surveys into an electronic database. Data cleaning and random spot checks of the completed surveys were performed to ensure the accuracy of data entry.[24]

Measures

The survey consisted of 153 questions concerning demographic characteristics, a wide range of risk behaviors (eg, gambling, substance use, aggression, and stealing), health and functioning, and an impulsive sensation–seeking scale. For the current analyses, questions assessing Internet use, functioning (grade average, extracurricular activities), depression, substance use (cigarette, marijuana, alcohol, caffeine, and other drugs), and aggression were used to address the abovementioned hypotheses.

There were 7 questions concerning Internet use. Students were first asked to report how many hours they spend using the Internet in a typical week (question 1). If students acknowledged using the Internet, 6 additional questions were asked: (2) Do you think you have a problem with excessive Internet use? (3) Have you ever experienced an irresistible urge or uncontrollable need to use the Internet? (4) Have you ever experienced a growing tension or anxiety that can

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be relieved only by using the Internet? (5) Have you ever missed school, work, or an important social activity because you were using the Internet? (6) Have you ever tried to cut back on your Internet use? and (7) Has a family member ever expressed concern about the amount of time you use the Internet? *Problematic Internet use* was defined as simultaneously endorsing questions 3, 4, and 6. These questions were modeled after those used to assess other impulse-control disorders in the Minnesota Impulsive Disorder Inventory, a semistructured clinical interview with excellent classification accuracy in adults and adolescents with impulse-control disorders.[26,27] The remaining questions serve to provide additional measures related to features of impulse-control disorders.

Table 1. Characteristics of Internet Use Among Those Who Have Used the Internet (N = 3,560)

	Total Sample		Boys		Girls			
Item	n	%	n	%	n	%	χ^2	*P* Value
Frequency of Internet use in a typical week, h							20.69	.0001
<7	1,551	43.57	641	39.81	910	46.67		
7–14	994	27.92	466	28.94	528	27.08		
15–20	503	14.13	237	14.72	266	13.64		
20+	512	14.38	266	16.52	246	12.62		
Ever tried to cut back?	960	26.97	321	19.94	639	32.77	73.7242	<.0001
Family expressed concern?	1,204	33.90	450	28.05	754	38.71	44.5414	<.0001
Missed activities to use?	258	7.26	144	8.97	114	5.85	12.7186	.0004
Do you think you have a problem?	373	10.50	143	8.90	230	11.81	7.9606	.0048
Experienced irresistible urge to use?	737	20.70	264	16.40	473	24.26	33.1784	<.0001
Experienced growing tension only relieved by using?	442	12.42	196	12.17	246	12.62	0.1581	.691
Total no. of items endorsed							78.42	<.0001
0	1,720	48.31	903	56.09	817	41.90		
1	767	21.54	309	19.19	458	23.49		
2	483	13.57	176	10.93	307	15.74		
3	287	8.06	106	6.58	181	9.28		
4	175	4.92	63	3.91	112	5.74		
5	88	2.47	31	1.93	57	2.92		
6	40	1.12	22	1.37	18	0.92		

Measures for the use of cigarettes, marijuana, alcohol, and other drugs assessed lifetime use. Respondents were asked, "Have you ever smoked a cigarette?" "Have you ever smoked marijuana?" "Have you ever had a sip of alcohol?" and "Have you ever used designer or other drugs, such as Ecstasy, GHB, Special K, or cocaine?" Before the question about lifetime use of other drugs, it was explained in the questionnaire that they could include a wide variety of drugs such as Ecstasy, methamphetamine, and heroin. For the assessment of alcohol use, participants who endorsed having had a sip of alcohol were further asked if they had ever had a "full" drink of alcohol. For those who responded "yes," frequency of current alcohol use (during the past 30 days) was also assessed. Since the prevalence of lifetime caffeine use (including soda) was presumed to be high, the measure for caffeine use assessed amount of daily use rather than lifetime use. Depression was defined as endorsement of the question "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?" This screening question was designed to capture the majority of respondents with a history of major depression while minimizing respondent burden.

Data Analysis

The associations between problematic Internet use and demographic factors were evaluated in several steps. First, by using χ^2 analyses, the sociodemographic characteristics of the total sample and girls and boys separately were investigated with respect to problematic Internet use status. χ^2 Analyses were also performed to investigate the relationships between problematic Internet use and health and other risk behaviors. Second, logistic regression models were fit to assess the association between each health correlate and problematic Internet use status overall and for girls and boys, adjusting for demographic differences. Interaction terms between gender and health correlates determined whether the associations were significantly different in girls and boys.

RESULTS

Characteristics of Internet Use

Overall, about one-third of respondents (28.51%) reported spending 15 or more hours per week on the Internet. A gender-related difference was observed in frequency of use ($P = .0001$), with boys typically reporting spending more time using the Internet than did girls. For example, 16.52% of boys as compared with 12.62% of girls reported spending more than 20 hours using the Internet in a typical week (Table 1).

Individual measures of excessive engagement in the Internet were endorsed frequently among respondents (Table 1). The least frequently endorsed item was missing activities due to Internet use (7.26%), and the most frequently endorsed item was a family member expressing concern about their Internet use (33.90%). Gender-related differences in the frequencies of reported items were observed for 5 of the 6 measures, with similar percentages of boys and girls acknowledging a growing tension that is relieved by Internet use. Although 1 measure was more frequently acknowledged by boys (missing important school or social activities because of Internet use), the majority (feeling an irresistible urge to use, family member expressing concern regarding extent of Internet use, thinking that they had a problem and having tried to cut back) were more frequently acknowledged by girls.

Problematic Internet use, as defined by simultaneous acknowledgment of having an irresistible urge to use the Internet, a growing tension that is relieved by Internet use, and trying to cut back on Internet use, was acknowledged by

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Table 2. Demographic Characteristics of Those Who Report Problematic Internet Use (N = 3,560)

	Total Sample					Girls					Boys				
Variable	n	%	With 3 Symptoms, %	χ^2	*P* Value	n	%	With 3 Symptoms, %	χ^2	*P* Value	n	%	With 3 Symptoms, %	χ^2	*P* Value
African American															
Yes	305	8.57	3.61	0.1652	.6844	168	8.62	2.98	0.9515	.3293	137	8.51	4.38	0.3088	.5784
No	3,255	91.43	4.09			1,782	91.38	4.60			1,473	91.49	3.46		
White															
Yes	2,824	79.33	3.79	2.3063	.1289	1,566	80.31	4.60	0.3459	.5564	1,258	78.14	2.78	9.6853	.0019
No	736	20.67	5.03			384	19.69	3.91			352	21.86	6.25		
Asian															
Yes	140	3.93	7.86	5.4566	.0195	62	3.18	8.06	1.9502	.1626	78	4.84	7.69	4.1378	.0419
No	3,420	96.07	3.89			1,888	96.82	4.34			1,532	95.16	3.33		
Hispanic															
Yes	412	11.99	6.07	4.5903	.0322	222	11.77	5.86	0.9710	.3244	190	12.26	6.32	4.8456	.0277
No	3,024	88.01	3.84			1,664	88.23	4.39			1,360	87.74	3.16		
Other races															
Yes	447	12.56	5.15	1.5950	.2066	244	12.51	5.33	0.4911	.4834	203	12.61	4.93	1.3062	.2531
No	3,113	87.44	3.89			1,706	87.49	4.34			1,407	87.39	3.34		
Grade															
Ninth	1,079	30.35	4.82	2.5382	.4684	609	31.29	4.93	0.8044	.8484	470	29.21	4.68	2.7162	.4375
10th	988	27.79	3.85			540	27.75	4.26			448	27.84	3.35		
11th	943	26.53	3.50			509	26.16	3.93			434	26.97	3.00		
12th	545	15.33	3.85			288	14.80	4.86			257	15.97	2.72		
Family structure															
1 Parent	788	22.42	3.81	0.8323	.6596	461	24.02	3.90	1.3107	.5193	327	20.49	3.67	0.1050	.9488
2 Parents	2,578	73.34	4.11			1,377	71.76	4.72			1,201	75.25	3.41		
Other	149	4.24	2.68			81	4.22	2.47			68	4.26	2.94		

4.04% of the sample (144 of 3,560) and 3.54% (57 of 1,610) of boys and 4.46% (87 of 1,950) of girls. Overall, less than half (48.31%) of the respondents did not endorse any of the 6 Internet use measures. Significantly more girls endorsed a higher number of Internet use measures than boys P < .0001); for example, 9.28% of girls endorsed any 3 items, while 6.58% of boys did (Table 1).

Demographic Characteristics

The majority of students, about 80%, was white. Over 70% of all the students lived with 2 parents. Ninth graders was the largest group and 12th graders was the smallest group, constituting 30.35% and 15.33% of the total sample, respectively (Table 2).

In the total sample, prevalence of problematic Internet use was higher among Asian students (7.86%) than non-Asian students (3.89%) and among Hispanic students as compared with non-Hispanic students (6.07% vs 3.84%). These two associations were significant at $P < .05$ in boys but not in girls, among whom no relationship between race and problematic Internet use status was found (Table 2). In the total sample and in gender-specific analyses, no significant association was found between problematic Internet use status and grade level or family structure (Table 2).

Health and Functioning Measures

Among the total sample, problematic Internet use was associated at $P < .05$ with multiple health and functioning measures, including lifetime smoking, lifetime marijuana use, lifetime other drug use, depression, serious fights, and carrying a weapon (Table 3). All of these associations were significant at $P < .05$ among boys. Among girls, only depression and serious fights were associated at $P < .05$ with problematic Internet use (Table 3).

Among the entire sample, logistic regression analyses that were corrected for between-group sociodemographic differences identified elevated odds between problematic Internet use and multiple measures, including alcohol use, tobacco smoking, marijuana use, other drug use, depression, getting into serious fights, and carrying a weapon (Table 4). Largely similar patterns of associations were observed across gender groups. For example, both depression and getting into serious fights were strongly associated with problematic Internet use in girls and boys, with odds ratios ranging from 3 to 7 (Table 4).

Models testing for differentially robust associations across gender groups identified 2 variables that were significant at $P < .05$. Interaction analysis showed that the relationships between health measures and problematic Internet use in boys and in girls were statistically different with regard to occasional smoking and other drug use. Both measures were associated with problematic Internet use in boys but not in girls (Table 4).

DISCUSSION

To our knowledge, this study represents the first large-scale, offline survey of problematic Internet use in high school students in the United States. The analyses confirmed some of our a priori hypotheses. We estimated the prevalence of problematic Internet use among high school students in the United States and demonstrated gender differences in the pattern of Internet use. Our results also showed that problematic Internet use is associated with other risk behaviors,

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Table 3. Health and Functioning Measures' Associations With Problematic Internet Use (N = 3,560)

	Total Sample					Girls					Boys				
Variable	n	%	With 3 Symptoms, %	χ^2	*P* Value	n	%	With 3 Symptoms, %	χ^2	*P* Value	n	%	With 3 Symptoms, %	χ^2	*P* Value
Grade average															
As and Bs	2,136	61.38	3.56	3.5113	.1728	1,276	67.16	3.76	4.3269	.1149	860	54.43	3.26	0.6993	.7049
Cs	988	28.39	4.55			482	25.37	5.19			506	32.03	3.95		
Ds and Fs	356	10.23	5.34			142	7.47	7.04			214	13.54	4.21		
Extracurricular activities															
Yes	2,726	76.57	4.26	1.3268	.2494	1,517	77.79	4.88	2.7805	.0954	1,209	75.09	3.47	0.0627	.8022
No	834	23.43	3.36			433	22.21	3.00			401	24.91	3.74		
Smoking, lifetime															
Never	2,185	63.02	3.16	15.7111	.0004	1,171	61.31	4.01	5.4349	.0660	1,014	65.13	2.17	14.9086	.0006
Occasionally	854	24.63	4.92			497	26.02	4.43			357	22.93	5.6		
Regularly	428	12.34	7.01			242	12.67	7.44			186	11.95	6.45		
Marijuana, lifetime															
Yes	1,293	38.61	5.41	10.4089	.0013	695	37.55	5.61	3.6690	.0554	598	39.92	5.18	7.9005	.0049
No	2,056	61.39	3.16			1,156	62.45	3.72			900	60.08	2.44		
Sip of alcohol, lifetime															
Yes	2,974	87.91	4.27	2.2965	.1297	1,689	90.08	4.74	2.6183	.1056	1,285	85.21	3.66	0.1480	.7005
No	409	12.09	2.69			186	9.92	2.15			223	14.79	3.14		
Current alcohol frequency															
Never regular	686	30.98	3.50	6.1413	.1049	378	29.91	3.70	5.2974	.1513	308	32.42	3.25	3.1772	.3651
Light	651	29.40	5.99			378	29.91	6.35			273	28.74	5.49		
Moderate	624	28.18	4.97			372	29.43	6.45			252	26.53	2.78		
Heavy	253	11.43	3.16			136	10.76	2.94			117	12.32	3.42		
Other drug use, lifetime															
Yes	258	8.77	7.75	9.4965	.0021	132	8.18	5.30	0.2375	.6260	126	9.48	10.32	17.2331	<.0001
No	2,684	91.23	3.76			1,481	91.82	4.39			1,203	90.52	2.99		
Caffeine use															
None	652	18.69	4.29	5.5907	.0611	324	16.88	4.63	2.2362	.3269	328	20.91	3.96	4.0525	.1318
1–2 drinks/d	1,948	55.83	3.34			1,122	58.44	3.83			826	52.64	2.66		
3+ drinks/d	889	25.48	5.17			474	24.69	5.49			415	26.45	4.82		
Sad or hopeless 2+ weeks															
Yes	731	21.34	8.76	57.9759	<.0001	505	26.68	8.32	24.4440	<.0001	226	14.75	9.73	35.1593	<.0001
No	2,694	78.66	2.60			1,388	73.32	3.03			1,306	85.25	2.14		
Serious fights															
Yes	209	5.98	16.27	87.9318	<.0001	82	4.26	17.07	32.5122	<.0001	127	8.09	15.75	63.0313	<.0001
No	3,286	94.02	3.20			1,843	95.74	3.85			1,443	91.91	2.36		
Carry a weapon															
Yes	629	17.95	5.88	7.3936	.0065	153	7.94	5.23	0.2286	.6325	476	30.16	6.09	15.6935	<.0001
No	2,876	82.05	3.55			1,774	92.06	4.40			1,102	69.84	2.18		

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Table 4. Adjusted Odds Ratios of Problematic Internet Use (N = 3,560)

Variable	Total Sample		Girls		Boys		Girls vs Boys Interaction
	Odds Ratio	*P* Value	Odds Ratio	*P* Value	Odds Ratio	*P* Value	*P* Value
Grade average (reference: As and Bs)							
Cs	1.26	.2414	1.47	.1424	1.028	.8246	.2925
Ds and Fs	1.51	.1267	2.02	.0580	0.946	.7413	.3480
Extracurricular activities							
Yes	1.24	.3283	1.66	.1015	0.808	.4974	.1377
Smoking, lifetime (reference: never)							
Occasionally	1.70	.0095	1.17	.5583	2.891	.0012	.0462
Regularly	2.65	<.0001	2.12	.0122	3.541	.0008	.4314
Marijuana, lifetime							
Yes	2.04	.0001	1.69	.0268	2.702	.0010	.3236
Sip of alcohol, lifetime							
Yes	1.70	.1002	2.24	.1242	1.327	.5040	.2808
Current alcohol frequency (reference: never regular)							
Light	1.98	.0127	1.88	.0698	2.132	.0933	.8655
Moderate	1.74	.0552	1.95	.0570	1.230	.6977	.3938
Heavy	1.12	.7905	0.86	.7916	1.613	.4481	.5110
Other drug use, lifetime							
Yes	2.30	.0014	1.20	.6551	4.140	<.0001	.0382
Caffeine use (reference: none)							
1–2 drinks/d	0.75	.2302	0.76	.3760	0.717	.3721	.7789
3+ drinks/d	1.20	.4785	1.12	.7451	1.361	.4142	.7560
Sad or hopeless 2+ weeks							
Yes	3.75	<.0001	3.08	<.0001	5.081	<.0001	.1479
Serious fights							
Yes	5.50	<.0001	5.04	<.0001	6.857	<.0001	.3936
Carry a weapon							
Yes	1.65	.0131	1.22	.6037	2.920	.0002	.0665

including substance use (smoking, marijuana, and other drugs) and aggressive behaviors (serious fights and carrying a weapon), as well as with depression. The data also showed important racial differences in Internet use behaviors.

Prevalence

When defining problematic Internet use as reporting (1) Internet use interfering with relationships, (2) feeling preoccupied with Internet use when offline, (3) having tried unsuccessfully to either cut down or quit, and (4) staying online longer than intended, Aboujaoude et al[13] found a prevalence of 0.7% in adults. In a more recent study, Bakken et al[28] found in the adult Norway population a 1% prevalence of Internet addiction, as defined by endorsing 5 or more of the 8 questions on the Young Diagnostic Questionnaire,[6] which resembles the *DSM-IV* criteria for pathological gambling.[29] Our definition of problematic Internet use shares with Aboujaoude and colleagues'[13] definition only the criterion of "attempt to cut down." This criterion, but not the other 2 of our criteria ("an irresistible urge to use" and "a growing tension only relieved by Internet use"), is also included in the Young Diagnostic Questionnaire.[6] Comparing our results with those of Aboujaoude et al[13] and Bakken et al,[28] it appears that high school students may have a higher prevalence of problematic Internet use than adults, but differences in diagnostic criteria hinder accurate comparison. Our prevalence estimate of 4% is comparable to those reported in studies done in Asia in similar age groups, which ranged from 4.3% to 10.7%.[30–32] Therefore, despite being less recognized in the United States as compared to some Asian countries, problematic Internet use may be as commonly present among adolescents in the United States. The apparent higher prevalence of problematic Internet use in US adolescents as compared to adults cannot be explained by changes in Internet usage with age. Recent data showed that, while 68% of 11- to 14-year-olds and 77% of 15- to 17-year-olds use the Internet,[14] Internet usage among 18- to 42-year-olds is above 90%, and usage rate does not drop sharply until the age of 62 years.[33] Therefore, the role of other adolescence-specific propensities needs to be explored in future studies, including sensation-seeking and impulsivity, which may increase with pubertal maturation and decrease with age thereafter.[34] The question that follows, then, would be, do those who develop problematic Internet use in adolescence grow out of the problem as they mature? The answer needs to be clarified with longitudinal studies in the future.

The Young Diagnostic Questionnaire is one of the most commonly used sets of criteria in problematic Internet use research,[6] though empirical data supporting its validity are limited. As mentioned, the criteria used in the current study were adopted from the Minnesota Impulsive Disorder Inventory, which addresses core features of impulse-control disorders and showed excellent classification accuracy in adults and adolescents with impulse-control disorders[26,27] but has not been previously used to assess problematic Internet use, and, currently, we do not have data on its internal consistency, reliability, and validity. Given that most problematic Internet use patients fulfill current diagnostic criteria for impulse-control disorder not otherwise specified,[8] the properties of these 3 criteria in identifying problematic Internet use warrant further study.

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Characteristics of Internet Use and Gender Differences

Our results showed that heavy Internet use in this sample of high school students is common, with about 30% of students spending an average of 2 hours a day or more on the Internet. According to reports from the Kaiser Family Foundation, young people have increased the amount of time they spend consuming media by an hour and 17 minutes daily, from 6 hours 21 minutes in 2004 to 7 hours 38 minutes in 2009—almost the amount of time most adults spend at work each day.[35] The increased engagement in newer media such as the Internet has increased the total media use significantly and has displaced other activities such as reading.[35] In addition to exposure to potentially harmful media contents, increased screen time in adolescents has been associated with obesity and metabolic syndrome.[36,37] In the current study, the high endorsement rates of individual measures of excessive Internet use (averaged over 10%) may signify that a high percentage of students have had negative consequences from their use, much higher than the percentage fulfilling our criteria for problematic Internet use (4%). Moreover, "family expressing concern" was the most commonly endorsed measure (over 30%), which is consistent with previous findings that problematic Internet use is significantly associated with higher rates of family conflicts and poorer family functioning.[38,39] It is important for families and clinicians to recognize that problematic Internet use is a significant source of parent-adolescent conflicts. Further research is needed to investigate how to effectively intervene problematic Internet use in a family-based manner.[38]

Studies of college students and adults typically found that problematic Internet use is more common among males.[19,30,40] We did not find a significant difference between the prevalences of the 2 sexes, which is consistent with epidemiologic studies in other countries of a similar age range.[17,18] However, boys and girls showed significant differences in their self-reported Internet use behaviors. More girls than boys endorsed the subjective measures of problematic Internet use, including thinking that they have a problem and acknowledging an irresistible urge to use the Internet. Also, more girls noted that their families have expressed concern about their use and that they have tried to cut back, despite the finding that boys spent more hours on the Internet and might have more functional impairments as reflected by higher endorsement rates of missing other important school and social activities in boys. This pattern may reflect different rates of development between sexes, with high school girls being more mature than boys and thus having more insights into their own behaviors and the consequences. Other variables should also be explored in future studies, such as preferred Internet activities and motivations to stay online for male and female subjects. It has been suggested that women typically prefer to use the Internet for communication and social reasons, whereas men are more likely to obtain information or play games.[41,42] An understanding of the different reasons to use may also help us explain why in our sample substance use is associated with problematic Internet use in boys but not in girls. For example, problematic Internet use in girls may predominantly be a way of coping for depression, while it represents excessive fun and sensation seeking in boys.

Racial Differences

Our data showed important racial differences, and Asian and Hispanic students were found to have higher prevalence rates of problematic Internet use than Caucasian students. As compared to the United States, the diagnosis of problematic Internet use or Internet addiction is more recognized in Asian countries, such as Taiwan and Korea, and these governments have also spent more resources in its research and treatment.[3] This could represent cultural differences in the perception and definition of disordered or deviant behaviors. On the other hand, there could be real racial differences in the prevalence of problematic Internet use as suggested by the present data, which were solely collected in the United States. A study comparing college students in the United States and in China found that Chinese students had a higher prevalence of problematic Internet use and rated significantly higher on all 5 dimensions of Internet addiction, namely negative outcome, social escape, secretive behavior, virtual intimacy, and obsessive-compulsive behavior.[43] Moreover, Asian-Americans have long been stereotyped as having superior quantitative and technical skills, and are overrepresented in fields such as computer science and engineering.[44] Future research may consider differences among parents of different ethnic groups with regard to parenting attitudes, communication within the family, and perception of Internet use, all of which likely play an important role in adolescents' Internet use behaviors.[31] Internet use among Hispanic high school students has not been studied specifically, and our finding that they have a comparatively higher prevalence of problematic Internet use is novel. It is unclear why these racial differences were seen only in male but not in female students, which represents another important research question.

Health and Functioning Measures

Largely consistent with studies conducted in Asian countries, problematic Internet use is strongly associated with measures that assessed depression, aggressive behaviors, and substance use in adolescents.[15,21,30] The association between depression and problematic Internet use has been shown in adults,[22,45] college students,[46] and adolescents.[21,30] Excessive use of the Internet may lead to decreased communication with family and friends, social withdrawal, loneliness, and depressed mood, as shown in a longitudinal study.[22] Activities on the Internet may also be a way of coping for certain depressed individuals, and problematic Internet use may represent a coping strategy going awry.[40] While both theories may be true and the relationship between problematic Internet use and depression may be bidirectional, recent studies have started to explore possible associations via common personality traits[20] and genetic polymorphisms.[47] As

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compared to normal controls, excessive Internet users were shown to have higher frequencies of the homozygous short allelic variant of the serotonin transporter gene–linked polymorphic region (SS 5-HTTLPR), as well as higher levels of harm avoidance and depression.[47] Within-group comparison also found that excessive users who expressed SS 5-HTTLPR had higher levels of harm avoidance and problematic use of the Internet than those who expressed the long allelic variant.[47] These findings give support to the hypothesis that the anonymity and secretiveness of the Internet make it a preferred way of coping for those depressed and fearful.

Among all health measures in the present study, depression and aggressive behaviors are most strongly associated with problematic Internet use across genders. These results are consistent with a survey of adolescents in Taiwan that investigated a wide range of psychiatric symptoms in problematic Internet users and substance users and found prominent depression and aggression in both groups.[15] As compared to controls, both problematic Internet users and substance users had higher rates of psychiatric symptoms ranging from depression and anxiety to paranoia and psychoticism. Only depression and hostility were found to be significantly associated with both problematic Internet use and substance use in logistic regression analysis after gender, age, and school were controlled.[15] Using the same data, it was demonstrated that problematic Internet use and substance use experience in adolescents also shared common family characteristics, including higher parent-adolescent conflicts, habitual alcohol use among siblings, perceived parents' positive attitude to adolescent substance use, and lower family function, as well as common personality traits of high novelty seeking and low reward dependence.[48] These similarities between problematic Internet use and substance use provide preliminary support to conceptualizing problematic Internet use within the spectrum of addiction disorders. The same personality traits may explain increased rates of other risk-taking behaviors, such as participating in serious fights and carrying a weapon, as seen associated with problematic Internet use in the current data. Such associations also have important clinical significance. Most psychiatric disorders are not considered to be independent risk factors for violent behaviors, except substance abuse and antisocial personality.[49,50] Future studies should examine whether problematic Internet use may be a risk factor for violent behaviors in adolescents.

The association between problematic Internet use and substance use (smoking, marijuana, and other drugs) is consistent with findings from previous studies. It has been shown in an online survey[51] and a clinical case series[8] that substance use disorders may be comorbid in up to 60% of adult subjects with problematic Internet use. We report a strong association between problematic Internet use and substance use in high school students, which is seen in male students only in our study population. Different from findings in a sample of college students,[52] measures of alcohol use were not associated with problematic Internet use in our study. This may represent difference in developmental stages, since certain risk behaviors, particularly alcohol use, have been reported to increase significantly during the transition from high school to college.[53]

Similar to a study of Korean adolescents,[30] we did not find any relationship between problematic Internet use and grade average and participation in extracurricular activities, which may be a result of (1) our thresholds for diagnosing problematic Internet use being too low, (2) our problematic Internet use category capturing students who in fact spent long hours on the Internet doing academic work, and (3) grade average and participation in extracurricular activities being inadequate measures for functioning and academic performance. Given that the Internet has become an integral part of the lives of many high school students who utilize it for both work and leisure, certain measures such as "time spent online" may not reflect a problematic pattern of use.[54] For example, a student spending 20 hours a week doing academic research on the Internet is likely to have a different pattern of use and grade average than one who spends the same amount of time on multiplayer online games. As such, the particular online activities and other behavioral features of use, eg, feeling preoccupied and having difficulties discontinuing use, may have more relevance in measuring problematic patterns of use. In addition, data from collateral sources such as ratings by teachers and parents can be considered in future studies to increase accuracy in identifying problematic users.

The question of whether problematic Internet use should be listed as a distinct disorder in the upcoming *DSM-5* is complex and under considerable discussion.[1–3] The controversies and questions that make a conclusive decision difficult include (1) Are subjects preoccupied with the contents (eg, gambling, gaming) delivered by the Internet or the process of being online itself? (2) Is problematic Internet use a coping strategy to unpleasant emotions (eg, depression, social anxiety) gone awry; or is it a primary disorder? (3) How might listing problematic Internet use as a diagnosis impact our conceptualizations of other behavioral "addictions" such as problematic video game playing and cell phone use? and (4) What are the social implications of labeling certain Internet use behaviors as a psychiatric disorder? Considering the results of the current study, and the apparent consistency of case descriptions across cultures,[3] data suggest that problematic Internet use warrants inclusion in Appendix B of the *DSM*—Criteria Sets and Axes Provided for Further Study, while clinicians can continue to use the diagnosis of impulse-control disorder not otherwise specified until more data are available.

Limitations

There are a number of limitations in the current study. First, since it is a local sample in the state of Connecticut with about 80% of subjects being white, results may not be generalizable to the whole of United States. The cross-sectional design does not allow the demonstration of causal

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relationships. The inherent self-report bias might have led to underreporting of behaviors, including aggressive behaviors and substance use due to recall difficulties and social desirability concerns, as suggested by previous studies.[55] To encourage accurate reporting, we emphasized anonymity and reminded the students not to put their names on the survey. In spite of possible underestimation of the rates of aggressive and substance use behaviors, their association with problematic Internet use remained significant in our analysis, an outcome that suggests these correlations may even be stronger than the current results indicate. Given these preliminary findings, it would be important for future research to study subjects with problematic Internet use utilizing direct clinical assessment and standardized diagnostic scales to characterize the phenomenology of problematic Internet use and calculate actual rates of comorbid *DSM*-defined psychiatric disorders, paying particular attention to depressive, substance use, and impulse-control disorders.

With regard to the design of the survey, the original objective was to study a wide range of risk behaviors in high school students in Connecticut. Thus, the questionnaire was relatively long to include questions for multiple behaviors of interest. To balance respondent burden and comprehensiveness of the survey, only 7 questions pertaining to Internet use were included, and these represented a small proportion of all the questions. Internet use in high school students warrants more focused study in the future, and additional studies should include questions addressing the extent, phenomenology, clinical characteristics (including associated comorbidities), and other aspects of problematic Internet use.

Even though the criteria for problematic Internet use used in the present study address the core features of impulse-control disorders, they have not been validated and data on their internal consistency or reliability are lacking. The Young Diagnostic Questionnaire is one of the most commonly used sets of criteria in problematic Internet use research.[6] Although direct comparison of our results with prior studies that used the Young Diagnostic Questionnaire is difficult, our main findings appear to be consistent with previous studies (for example, Yen et al[21]; Ko et al[46]; Yen et al[15]; and Fu et al[56]). The extent to which Minnesota Impulsive Disorder Inventory–type questions have clinical utility in problematic Internet use research requires further evaluation.

Given considerations of time constraints and subjects' burden for a large-scale study conducted in the classroom setting, a single question rather than full *DSM-IV-TR* criteria was used to define depression. Thus, the variable *depression* should be regarded as suggestive, and not diagnostic of *DSM-IV-TR*–defined depressive disorders. Moreover, more detail measures will allow us to better delineate functional and academic impairments in problematic Internet users.

CONCLUSION

This study represents an effort to begin understanding the phenomenon of problematic Internet use among high school students in the United States, and we have raised questions that warrant further research. Despite controversies about the validity of problematic Internet use as a separate disorder, we showed that it is a recognizable behavioral syndrome among US high school students, with prevalence comparable to those reported in other countries. Consistent with findings in other parts of the world, problematic Internet use is strongly associated with depression, substance use, and aggressive behaviors among high school students in the United States. Important racial and gender differences exist, and problematic Internet use may be more common among Asian and Hispanic students. Boys and girls, although they have comparable prevalence rates, showed different Internet use behaviors. Such differences suggested that they may well have different motivations to use the Internet and thus develop problematic Internet use via different mechanisms, though the current study did not capture such data. We are still in need of valid and reliable research diagnostic criteria for problematic Internet use, as well as appropriate screening instruments to be used in epidemiologic studies. The Minnesota Impulsive Disorder Inventory, which has excellent diagnostic accuracy in adults and adolescents with impulse-control disorders, may be a suitable model. Future research needs to take into consideration the roles of cultural background and gender so that data generated would provide meaningful guides to parents, educators, and clinicians.

Author affiliations: Department of Psychiatry (all authors) and Yale Child Study Center (Drs Liu and Potenza), Yale University School of Medicine, New Haven, Connecticut.

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