

Predictive Values of Psychiatric Symptoms for Internet Addiction in Adolescents

A 2-Year Prospective Study

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Objectives: To evaluate the predictive values of psychiatric symptoms for the occurrence of Internet addiction and to determine the sex differences in the predictive value of psychiatric symptoms for the occurrence of Internet addiction in adolescents.

Design: Internet addiction, depression, attention-deficit/hyperactivity disorder, social phobia, and hostility were assessed by self-reported questionnaires. Participants were then invited to be assessed for Internet addiction 6, 12, and 24 months later (the second, third, and fourth assessments, respectively).

Setting: Ten junior high schools in southern Taiwan.

Participants: A total of 2293 (1179 boys and 1114 girls) adolescents participated in the initial investigation.

Main Exposure: The course of time.

Main Outcome Measure: Internet addiction as assessed using the Chen Internet Addiction Scale.

Results: Depression, attention-deficit/hyperactivity disorder, social phobia, and hostility were found to predict the occurrence of Internet addiction in the 2-year follow-up, and hostility and attention-deficit/hyperactivity disorder were the most significant predictors of Internet addiction in male and female adolescents, respectively.

Conclusions: These results suggest that attention-deficit/hyperactivity disorder, hostility, depression, and social phobia should be detected early on and intervention carried out to prevent Internet addiction in adolescents. Also, sex differences in psychiatric comorbidity should be taken into consideration when developing prevention and intervention strategies for Internet addiction.

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THE INTERNET HAS BECOME one of the most important information resources for adolescents.¹ However, addiction to the Internet can also have a negative impact on academic performance, family relationships, and emotional state in adolescents.^{2,3} This phenomenon has been described as Internet addiction or problematic Internet use^{4,5} and classified as a possible behavior addiction.⁶ Previous reports found that 1.4% to 17.9% of adolescents have Internet addiction in both Western and Eastern societies,⁷⁻¹¹ and this high percentage led Block¹² to argue that Internet and gaming addictions should be added to the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders*. Identification of the risk factors for Internet addiction is therefore of clinical significance for the prevention of, and early intervention into, Internet addiction in adolescents.

There are currently no universally accepted diagnosis criteria for Internet addiction in adolescents. Several researchers have tried to construct definitions for

Internet addiction^{4,5,13,14}; however, these have not been developed for use in adolescents. Ko and colleagues¹⁵ proposed diagnostic criteria for adolescent Internet addiction based on empirical diagnostic interviews, in which preoccupation, uncontrolled impulses, usage more than intended, tolerance, withdrawal, impairment of control, excessive time and effort

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spent on the Internet, and impairment of decision-making ability were defined as core symptoms of Internet addiction. As these criteria proved to be of good diagnostic accuracy (95.4%),¹⁵ we use this diagnostic method to define Internet addiction in adolescents in the present study.

One of our research interests is the association between Internet addiction and psychiatric symptoms. Depression is the

most frequently reported psychiatric symptom associated with Internet addiction among adolescents^{9,11,16-18}; however, these investigations were cross-sectional. In a longitudinal study, Internet use was found to increase the risk of depression in adults,¹⁹ but a later longitudinal study revealed a positive effect of Internet use on well-being.²⁰ Recently, another longitudinal study found that compulsive Internet use increased the risk of depression in adolescents 6 months later.²¹ While these 3 studies focused on examining whether Internet use or compulsive Internet use results in depression, they did not examine whether depression is a risk factor for the development of Internet addiction.

Attention-deficit/hyperactivity disorder (ADHD) has been reported to be associated with Internet addiction in cross-sectional investigations among adolescents.^{11,16,22} Because ADHD is a persistent and pervasive mental disorder for which the age at onset is younger than 7 years,²³ it has been suggested to be an important associated factor for Internet addiction^{11,24}; however, to our knowledge, this hypothesis has not been proven by any prospective studies.

It has been reported that Internet use and Internet addiction are associated with social phobia,^{11,25,26} but a causal relationship has not been demonstrated. In addition, hostility has been reported to be associated with Internet addiction in adolescents,^{11,27} and further, a prospective study found that high levels of interpersonal sensitivity and hostility predicted the persistence of Internet addiction 1 year later.²⁸ However, no psychiatric symptoms were found to predict the occurrence of Internet addiction,²⁸ although the short follow-up might have contributed to this negative finding. Thus, a prospective study with a longer follow-up period might be necessary to examine the predictive values of psychiatric symptoms for the occurrence of Internet addiction.

A disparity has been found in the prevalence of Internet addiction in males and females.^{29,30} Differences in the association of Internet addiction with psychiatric symptoms have also been found: for example, hostility is associated with Internet addiction in male adolescents but not in females.¹¹ The results of previous studies suggest that sex differences in the predictive power of psychiatric symptoms for the occurrence of Internet addiction should be addressed in further studies.

The aims of this 2-year prospective study were to (1) evaluate the predictive values of psychiatric symptoms for the occurrence of Internet addiction in adolescents and (2) determine the sex differences in the predictive value of psychiatric symptoms for the occurrence of Internet addiction in adolescents.

METHODS

SAMPLE

The subjects of this study were randomly selected from students in the seventh grade at 10 junior high schools (4 in urban areas, 4 in suburban areas, and 2 in rural areas) in southern Taiwan in September 2005. All students from 8 randomly selected classes in each school were invited to participate in the investigation. Research assistants explained the goals and procedure of the study to the students in their classrooms. A total of 2293 adolescents

(1179 boys and 1114 girls) agreed to participate in the prospective investigation and the other 77 refused the assessment. Informed consent was obtained from the adolescents before assessment. The mean (SD) age of the participants was 12.36 (0.55) years.

INSTRUMENTS

Chen Internet Addiction Scale

The Chen Internet Addiction Scale (CIAS) contains 26 items on a 4-point Likert scale with a scoring range of 26 to 104. The internal reliability of the scale and the subscales in the original study ranged from 0.79 to 0.93.³¹ According to the Ko diagnostic criteria of Internet addiction,¹⁵ a cutoff score of 64 has the highest diagnostic accuracy (87.6%).³² Accordingly, subjects with CIAS scores of 64 or more were classified as the Internet addiction group in this study.

Attention-Deficit/Hyperactivity Disorder Self-rated Scale

The Attention-Deficit/Hyperactivity Disorder Self-rated Scale (ADHDS) was designed for this research to measure ADHD symptoms. The 18 items in the ADHDS were modified from the Vanderbilt ADHD Diagnostic Parent Rating Scale³³ and represent the 18 diagnostic symptoms for ADHD in the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition, Text Revision),²³ taking the form of a 4-point Likert-type self-reported questionnaire, ranging from 1 (not at all) to 4 (almost always). The scores of items 1 to 9 and 10 to 18 were summed, giving the severity of symptoms for an attention-deficit score and a hyperactivity score, respectively; the attention-deficit score and hyperactivity score were then summed to give the ADHD score. Higher scores indicate more severe symptoms.¹¹ In this study, those whose total ADHDS score was 1 SD higher than the mean of the whole study population were classified as the group with significant ADHD symptoms.

Center for Epidemiological Studies Depression Scale

The 20-item Mandarin Chinese version of the Center for Epidemiological Studies Depression Scale (CES-D)³⁴ is a self-administered evaluation assessing participants' frequency of depressive symptoms over the previous week. The Cronbach α for the CES-D in the present study was 0.78. A previous study using the CES-D in a 2-phase survey for depressive disorders among nonreferred adolescents in Taiwan found that adolescents with total CES-D scores higher than 28 were more likely to have major depressive disorder with or without functional impairment.³⁵ In this study, we defined those adolescents whose CES-D score was higher than 28 as having significant depression.

Brief Version of the Fear of Negative Evaluation Scale

The original Fear of Negative Evaluation Scale (FNE) was developed to evaluate the cognitive symptoms of social phobia.³⁶ The Brief Version of the FNE (BV-FNE) is a brief, 5-point, Likert-type, 12-item version of the FNE that is highly correlated ($r=0.96$) with the original scale and has a high level of internal consistency ($\alpha=0.90$) and a 4-week test-retest reliability coefficient (0.75).³⁷ In this investigation, this scale was used to evaluate cognitive symptoms of

social phobia. Those participants whose total BV-FNE score was 1 SD higher than the mean of the whole study population were classified as the group with significant social phobia symptoms.

The Buss-Durkee Hostility Inventory–Chinese Version–Short Form

The Buss-Durkee Hostility Inventory–Chinese Version–Short Form (BDHIC-SF) 20-item, 5-point Likert-type scale was used to assess 4 dimensions of the hostility construct: hostility cognition, hostility affection, expressive hostility behavior, and suppressive hostility behavior. The coefficient of internal consistency (Cronbach α) was 0.93 and the 4-week test-retest reliability was 0.80. Higher scores indicate higher hostility.³⁸ Those participants whose total BDHIC-SF score was 1 SD higher than the mean of the whole study population were classified as the group with significant hostility.

STUDY PROCEDURE AND STATISTICAL ANALYSIS

The study was approved by the institutional review board of Kaohsiung Medical University Hospital. The participants completed the assessments for demographic data and Internet behavior, CIAS, ADHD, CES-D, BV-FNE, and BDHIC-SF in the initial assessment. They were then invited to complete the CIAS 6, 12, and 24 months later (the second, third, and fourth assessments, respectively). To determine the risk factors for Internet addiction, data from participants who were classified as non-Internet-addicted in the initial assessment and who had completed at least 1 follow-up CIAS assessment were selected for statistical analysis. Among the 10 schools initially evaluated, 8, 10, and 9 schools participated in the second, third, and fourth assessments, respectively.

All statistical analyses were performed using the software package SPSS (SPSS Inc, Chicago, Illinois). Univariate Cox proportional hazard regression analysis with time-dependent variables was used to examine the predictive values of baseline psychiatric symptoms (depression, ADHD, social phobia, and hostility), Internet use behaviors (time spent on the Internet and the kinds of online activities participated in), and demographic characteristics (sex and age) for the occurrence of Internet addiction during the 2-year period of follow-up. The outcome variable (survival time) in Cox proportional hazard regression was defined as the period between the initial assessment and the detection of occurrence of Internet addiction during follow-up. If a participant was found to meet the criteria for Internet addiction in a follow-up assessment, an event was recorded and that case's data were not censored. On the other hand, if Internet addiction was not detected in any follow-up assessment, no event was recorded and the participant's data were censored. Thus, censored individuals were those who either had no Internet addiction by the end of the study or were lost to follow-up during the course of the study before Internet addiction had been identified.

We first examined the predictive values of categorical variables (sex and Internet use behaviors) for the occurrence of Internet addiction using univariate Cox proportional hazard regression. Then, the predictive values of age and the psychiatric symptoms group were also examined using the same statistical method for all, male, and female participants. All significant psychiatric predictors found in the univariate analysis were then further used in forward stepwise multivariate Cox proportional hazard regression to determine which psychiatric symptom was the most significant predictor of Internet addiction among all, male, and female participants. Because the aim of this study was to ex-

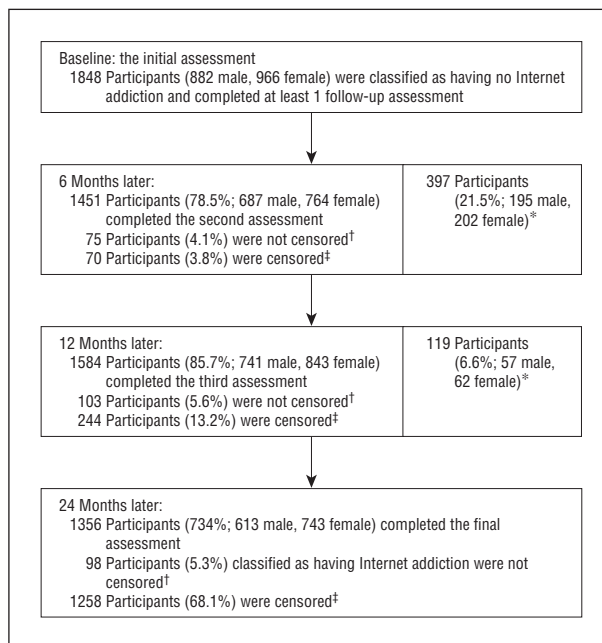


Figure. Flowchart of the recruitment, assessment, and survival analysis processes. *Participants who did not participate in this investigation but were assessed in subsequent investigations. †Participants who were diagnosed with Internet addiction. ‡Participants who were lost to follow-up assessment.

amine the psychiatric predictors of Internet addiction, the variables pertaining to Internet use behaviors were not selected into the multivariate analysis to prevent limiting the possible predictive value of psychiatric symptoms. A *P* value lower than .05 was considered significant.

RESULTS

A total of 2162 students completed all questionnaires at the first investigation. Of them, 233 participants (10.8%) were classified as having Internet addiction, and 1929 participants (89.2%) were classified as having no Internet addiction in the initial assessment. Among the 1929 participants (921 male, 1008 female) without Internet addiction, 1848 (95.8%) (882 male, 966 female) completed at least 1 follow-up assessment and their data were included in the statistical analysis. No sex difference ($\chi^2=0.006$; *P* = .94) was found between the enrolled participants and those for whom data were missing. The numbers of censored and noncensored cases in the 3 follow-up assessments are shown in **Figure**.

The results of univariate Cox proportional hazard regression analysis are shown in **Table 1** and **Table 2** and indicate that being male, playing online games, and using the Internet every day and/or for more than 20 hours/wk were risk factors for Internet addiction (Table 1). Depression, ADHD, social phobia, and hostility were also found to predict the occurrence of Internet addiction among all participants and female participants (Table 2); among male participants, only ADHD and hostility were identified as risk factors for Internet addiction.

The significant psychiatric predictors were further selected into the forward stepwise multivariate Cox proportional hazard regression (**Table 3**). The results in-

Table 1. Predictive Value of Sex and Internet-Using Behaviors for Internet Addiction in the Univariate Cox Proportional Hazard Regression

Variable (No. Missing Data)	Internet Addiction, No. (%)		Wald χ^2	Hazard Ratio (95% Confidence Interval)
	Event	Censored		
Sex				
M	176 (20.0)	706	31.73 ^a	2.03 (1.58-2.59)
F	100 (10.4)	866		1 [Reference]
Using Internet more than 4 y (10)				
Yes	148 (15.3)	817	0.17	1.05 (0.83-1.33)
No	126 (14.4)	747		1 [Reference]
Using Internet every day (14)				
Yes	55 (19.8)	223	6.59 ^b	1.47 (1.10-1.98)
No	221 (14.2)	1335		1 [Reference]
Using Internet >20 h/wk (49)				
Yes	30 (25.2)	89	10.93 ^c	1.90 (1.30-2.78)
No	237 (14.1)	1443		1 [Reference]
Internet activity (221)				
Online gaming	134 (18.5)	589	13.70 ^a	1.79 (1.31-2.46)
Interactive chatting	55 (13.8)	344		1.35 (0.93-1.97)
Others	54 (10.7)	451		1 [Reference]

^a $P < .001$.

^b $P < .05$.

^c $P < .01$.

indicated that ADHD was the most significant predictor of the occurrence of Internet addiction among all participants after controlling for sex and age, followed by hostility. Further, hostility and ADHD significantly predicted the occurrence of Internet addiction among male and female participants, respectively.

COMMENT

The results of this 2-year prospective study revealed that ADHD and hostility were the leading risk factors for the occurrence of Internet addiction, and depression and social phobia predicted Internet addiction among female, but not male, adolescents. In addition, further analysis revealed that hostility and ADHD were the most significant risk factors for Internet addiction among male and female adolescents, respectively.

In line with previous cross-sectional studies,^{11,16} we found that adolescents with significant ADHD symptoms were more likely to become addicted to the Internet. The biopsychosocial characteristics of adolescents with ADHD might explain this association. First, being easily bored and having an aversion to delayed reward have been identified as the 2 core symptoms of ADHD.^{39,40} Internet behavior is characterized by rapid response, immediate reward, and multiple windows with different activities, which may reduce feelings of boredom or delayed aversion in adolescents with ADHD. Second, Koepp and colleagues⁴¹ reported that striatal dopamine is released during video gaming, which may compensate for the dopamine deficit of adolescents with ADHD; thus, they may perform well in games and this may compensate for real-life frustration. Third, adolescents with ADHD have abnormal brain activities associated with impaired inhibition.⁴² A lack of self-control may cause them to experience difficulty

in controlling Internet use, and hence, they become vulnerable to Internet addiction.

Having significant symptoms of ADHD was the most important predictive factor of Internet addiction among girls. One possible explanation for this is that peer tolerance to ADHD symptoms is lower in girls than in boys,⁴³ which may lead girls with ADHD to experience more severe difficulties in peer relationships. Engaging in anonymous Internet-based activities might decrease discrimination and reduce some of the difficulties in social interaction caused by ADHD, an effect that might make female adolescents with ADHD more likely to use the Internet heavily and develop an addiction to the Internet if the primary problem is not resolved. Thus, ADHD should be effectively screened for and treated to prevent the emergence of Internet addiction, especially in girls.

As in previous cross-sectional studies,^{11,27} the results of this study indicated that male adolescents with significant hostility were more likely to develop Internet addiction than those without. Hostility was also reported to predict the persistence of Internet addiction in a previous prospective study.²⁸ Many Internet activities, especially online gaming, provide a world in which hostility can be expressed and violence perpetrated without restriction, providing a space in which adolescents with significant hostility can express their aggression in ways that might be prohibited in the real world. Accordingly, more attention to and intervention into hostility should be provided through a preventive and treatment schedule for Internet addiction. In addition, previous reports have found that violence in games increases physical violence,⁴⁴ and Internet addiction is associated with violent behavior⁴⁵ among adolescents. Whether addiction to the Internet results in a vicious cycle of violence should therefore be addressed in a longitudinal study in the future.

Table 2. Predictive Value of Age and Psychiatric Symptoms for Internet Addiction: Univariate Cox Proportional Hazard Regression

Variable (No. Missing Data)	No. (%)		Wald χ^2	Hazard Ratio (95% Confidence Interval)
	Event	Censored		
All Participants				
Age			0	1.00 (0.78-1.28)
Depression ^a (85)				
Yes	36 (20.5)	140	6.10 ^b	1.56 (1.10-2.22)
No	217 (13.7)	1370		1 [Reference]
ADHD ^c (96)				
Yes	50 (24.9)	151	19.97 ^d	2.02 (1.49-2.76)
No	206 (13.3)	1345		1 [Reference]
Social phobia ^e (66)				
Yes	54 (18.5)	238	3.93 ^b	1.35 (1.004-1.82)
No	212 (14.2)	1278		1 [Reference]
Hostility ^f (109)				
Yes	51 (23.4)	167	14.86 ^d	1.83 (1.34-2.48)
No	206 (13.5)	1315		1 [Reference]
Boys				
Age			0.16	0.95 (0.70-1.30)
Depression ^a (49)				
Yes	15 (27.8)	39	3.55	1.67 (0.98-2.84)
No	145 (18.6)	634		1 [Reference]
ADHD ^c (59)				
Yes	31 (27.4)	82	5.77 ^b	1.62 (1.09-2.39)
No	130 (18.3)	580		1 [Reference]
Social phobia ^e (39)				
Yes	25 (27.2)	67	3.74	1.52 (0.99-2.33)
No	142 (18.9)	609		1 [Reference]
Hostility ^f (58)				
Yes	28 (32.6)	58	10.06 ^g	1.93 (1.29-2.91)
No	133 (18.0)	605		1 [Reference]
Girls				
Age			0.12	1.07 (0.72-1.61)
Depression ^a (36)				
Yes	21 (17.2)	101	7.58 ^g	1.98 (1.22-3.22)
No	72 (8.9)	736		1 [Reference]
ADHD ^c (37)				
Yes	19 (21.6)	69	13.47 ^d	2.56 (1.55-4.24)
No	76 (9.0)	765		1 [Reference]
Social phobia ^e (27)				
Yes	29 (14.5)	171	4.62 ^b	1.61 (1.04-2.48)
No	70 (9.5)	669		1 [Reference]
Hostility ^f (51)				
Yes	23 (17.4)	109	8.14 ^g	1.98 (1.24-3.16)
No	73 (9.3)	710		1 [Reference]

Abbreviation: ADHD, attention-deficit/hyperactivity disorder.

^aDepression was assessed by the Center for Epidemiological Studies Depression Scale.³⁴

^b $P < .05$.

^cAttention-deficit/hyperactivity disorder was assessed by the Attention-Deficit/Hyperactivity Disorder Self-rated Scale.¹¹

^d $P < .001$.

^eSocial phobia was assessed by the Brief Version of the Fear of Negative Evaluation Scale.³⁷

^fHostility was assessed by the Buss-Durkee Hostility Inventory—Chinese Version—Short Form.³⁹

^g $P < .01$.

Previous reports have suggested that women with alcohol use disorder are more likely to have a mood disorder, and depression was identified as the antecedent diagnosis for alcoholism among most women.⁴⁶ In line with findings on alcohol use disorder, female adolescents with depression were identified as having a higher risk of Internet addiction in this study. As the Internet provides adolescents with social support,^{16,47} achievement,⁴⁸ the pleasure of control,⁴⁹ and a virtual world in which to escape from emotional difficulties in the real world, it appears reasonable that female adolescents with

depression would be more likely to use the Internet to alleviate that depression. Kraut and colleagues²⁰ proposed a “rich get richer” model in which the Internet provides more benefits to those who are already well-adjusted, and in contrast, poorly adjusted adolescents with depression may experience more deleterious effects with heavy Internet use and may be vulnerable to becoming addicted to the Internet.

Whether Internet communication benefits adolescents with social phobia is still under debate.^{50,51} However, the results of this study demonstrate that female

Table 3. Predictive Value of Age and Psychiatric Symptoms for Internet Addiction: Multivariate Cox Proportional Hazard Regression^a

Variable (No. Missing Data)	Wald χ^2	Hazard Ratio (95% Confidence Interval)
All participants (287)		
Age	0.03	0.98 (0.74-1.29)
Male	23.68 ^b	1.97 (1.50-2.59)
ADHD	9.34 ^c	1.72 (1.21-2.43)
Hostility	7.97 ^c	1.67 (1.17-2.38)
Male (158)		
Age	0.03	1.03 (0.73-1.46)
Hostility	6.35 ^d	1.82 (1.14-2.89)
Female (129)		
Age	0.10	0.93 (0.59-1.47)
ADHD	16.00 ^b	2.83 (1.70-4.72)

Abbreviation: See Table 2.

^aForward regression.

^b $P < .001$.

^c $P < .01$.

^d $P < .05$.

adolescents with higher social phobia were more likely to develop Internet addiction. Because Internet use can provide social support,⁵² female adolescents with social phobia might benefit from avoiding the stress caused by face-to-face interaction; however, if their social difficulties in the real world do not improve, female adolescents with social phobia might receive social support predominantly from the Internet, and hence, the risk of becoming addicted to the Internet may increase.

Thus, screening and treatment for depression and social phobia are essential for the prevention of and intervention into Internet addiction among adolescents, especially girls. Only female adolescents were found to be vulnerable to the effects of depression and social phobia on Internet addiction, which may indicate that alleviating emotional difficulty is a more important mechanism underlying Internet addiction among female adolescents than among boys. However, this hypothesis should be investigated in further research into sex differences in the mechanism of Internet addiction.

The results of this study raise several important suggestions and implications for clinical practice. First, because ADHD, hostility, depression, and social phobia are predictors of the emergence of Internet addiction, albeit to different degrees in different sexes, effective screening and intervention for these psychiatric symptoms are necessary to prevent Internet addiction among adolescents. Second, because a strategy of integrated therapy for both disorders in dual diagnosis could provide more consistent treatment effects,⁵³ it is important to evaluate and treat these psychiatric symptoms in adolescents with Internet addiction. Third, sex differences in psychiatric comorbidity should be taken into consideration when developing prevention and intervention strategies for Internet addiction.

This study had the following limitations. First, the classification of Internet addiction was based only on the results of a self-reported questionnaire. Second,

ADHD symptoms were determined solely on self-reported data, which might make the results less objective. Some previous studies have suggested that parents may be more reliable than adolescents at detecting ADHD symptoms⁵⁴; however, other research has reported that both parents and adolescents themselves are able to report ADHD symptoms distinctly.⁵⁵ Third, 2 schools and 1 school did not participate in the second and fourth investigations, respectively, because their administrative departments were unable to provide adequate time and space for the assessment at the time of the investigation.

This 2-year prospective study revealed that ADHD and hostility are leading risk factors for Internet addiction among young adolescents, followed by depression and social phobia. In addition, hostility was identified as the most significant predictor of Internet addiction in male adolescents and ADHD was the most significant predictor for the same condition in female adolescents. These results suggest that ADHD, hostility, depression, and social phobia should be detected early and intervention carried out to prevent the occurrence of Internet addiction in adolescents.

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All television is educational television. The question is: what is it teaching?
—Nicholas Johnson