The Comorbid Psychiatric Symptoms of Internet Addiction: Attention Deficit and Hyperactivity Disorder (ADHD), Depression, Social Phobia, and Hostility

Ju-Yu Yen, M.D. a,b,c, Chih-Hung Ko, M.D. b,c, Cheng-Fang Yen, M.D., Ph.D. c,d, Hsiu-Yueh Wu, M.S. a,c,e, and Ming-Jen Yang, M.D., Sc.D. c,f,g,*

aDepartment of Psychiatry, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan
bGraduate Institute of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan
cDepartment of Psychiatry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
dDepartment of Psychiatric, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
eDepartment of Nursing, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan
fGraduate Institute of Behavioral Science, Kaohsiung Medical University, Kaohsiung, Taiwan
gYuh-Ing Junior College of Health Care and Management, Kaohsiung, Taiwan

Manuscript received November 15, 2006; manuscript accepted February 16, 2007

Abstract

Purpose: To: (1) determine the association between Internet addiction and depression, self-reported symptoms of attention deficit and hyperactivity disorder (ADHD), social phobia, and hostility for adolescents; and (2) evaluate the sex differences of association between Internet addiction and the above-mentioned psychiatric symptoms among adolescents.

Methods: A total of 2114 students (1204 male and 910 female) were recruited for the study. Internet addiction, symptoms of ADHD, depression, social phobia, and hostility were evaluated by the self-report questionnaire.

Results: The results demonstrated that adolescents with Internet addiction had higher ADHD symptoms, depression, social phobia, and hostility. Higher ADHD symptoms, depression, and hostility are associated with Internet addiction in male adolescents, and only higher ADHD symptoms and depression are associated with Internet addiction in female students.

Conclusion: These results suggest that Internet addiction is associated with symptoms of ADHD and depressive disorders. However, hostility was associated with Internet addiction only in males. Effective evaluation of, and treatment for ADHD and depressive disorders are required for adolescents with Internet addiction. More attention should be paid to male adolescents with high hostility in intervention of Internet addiction. © 2007 Society for Adolescent Medicine. All rights reserved.

Keywords: Internet addiction; Adolescent; ADHD; Depression; Hostility

The Internet is one of the most widely accessible media in the world. Adolescents are required to learn about it for academic and recreational reasons, however, addiction to the Internet has resulted in negative impact on academic performance, family relationships, and emotions for adolescents [1,2]. This phenomenon has been defined as Internet addiction [3] and reported to be associated with depression and attention deficit hyperactivity disorder (ADHD) [4]. However, Shaffer et al have countered that there is not yet sufficient construct validity to establish it as a primary disorder and it is better explained by other primary disorders [5]. Because comorbidity of two disorders may indicate the causal relationship or common etiology shared by them [6], the evaluation for comorbid psychiatric symptoms of Internet addiction could reveal which psychiatric symptoms are associated with the development or maintenance of the Internet addiction, and shed light on the mechanism of Internet addiction.

*Address correspondence to: Dr. Ming-Jen Yang, Department of Psychiatry, Kaohsiung Medical University, 100 Tzyou 1st Rd., Kaohsiung City 807, Taiwan.
E-mail address: m750141@ksts.seed.net.tw


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Until now, there is no conclusive diagnostic definition for Internet addiction. Diagnostic tools of Internet addiction have been developed by Young [3]. However, there is no empirical evidence such as sensitivity or specificity that provides support for the contents or cut-off points for this tool. Ko et al [7] have proposed diagnostic criteria for adolescent Internet addiction (DC-IA-A) based on empirical diagnostic interview study. Criterion A is met with six of nine characteristic symptoms of Internet addiction: preoccupation, uncontrolled impulse, use more than intended, tolerance, withdrawal, impairment of control, excessive time and effort devoted to the Internet, and impaired decision-making. Criterion B describes functional impairment secondary to Internet use. Criterion C lists the exclusion criteria. These diagnostic criteria had the good accuracy (95.4%), high specificity (97.1%), and accepted sensitivity (87.5%) and could discriminate among those individuals with different severities of Internet use [7]. Based on the diagnostic criteria, the diagnostic cut-off point of a self-reported questionnaire, Chen Internet Addiction Scale (CIAS), had been developed to be used in massive epidemiological investigations [8]. Thus, Internet addiction of adolescents was defined according to the cut-off point of CIAS in this presenting study.

Depression has been repeatedly reported to be associated with Internet addiction for adolescents [4,9]. However, the validity for the cut-off point of the screening tool, Young’s Internet Addiction Scale, was not provided in these researches [10]. A diagnostic tool for Internet addiction with validity for a cut-off point will clearly reflect what level of Internet use is pathological and correlated with depression.

Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders, diagnosed in 3% to 5% of children [11]. ADHD has been reported to be associated with Internet addiction for children [4,12]. Besides, adolescents who play more console or internet video gaming had been reported to have higher ADHD symptoms [13]. However, the relationship between Internet addiction and ADHD in adolescents had not been directly evaluated. Social phobia has been reported to be positively associated with Internet use in adolescents [14], yet the association between social phobia and Internet addiction has not been addressed by empirical community evaluation for adolescents. Furthermore, hostility has been noted to be associated with substance addiction in adolescents [15]. Until now, its association with Internet addiction had not been evaluated.

Internet addiction and ADHD were reported to be more prevalent in males and social phobia and depression were more prevalent in females [16,17]. However, whether there is a sex difference in the association between Internet addiction and psychiatric symptoms are unknown. It is essential to evaluate the sex difference of this association because it would be important in developing preventive strategies for Internet addiction specified for males and females.

Thus, to explore the comorbid psychiatric symptoms of Internet addiction, which could be provided to develop preventive and therapeutic strategies specified for males and females, the aim of this study is to: (1) determine the association between Internet addiction and depression, symptoms of ADHD, social phobia, and hostility for adolescents; and (2) evaluate the sex differences of the association between Internet addiction and the above psychiatric symptoms among adolescents.

Methods

Three of 33 senior high schools, and 7 of 20 vocational high schools in Kaohsiung City and County in Taiwan were selected for evaluation. The selected schools included five, three, and two schools from urban, suburban, and rural areas, respectively. Two classes were randomly selected from each grade in the 10 schools. A total of 2114 students (1204 male and 910 female) were recruited. The mean of their age was 16.26 years (SD = 9.9, range 15 to 23 years). All students in the selected classes were invited to complete the measurement anonymously after informed consent was obtained. A total of 224 participants (140 male, 84 female) were omitted because they failed to complete all rating scale. There was no significant difference on sex ($\chi^2 = 3.14, p = .08$), age ($t_{2112} = -9.8, p = .33$) and school type ($\chi^2 = .008, p = .93$) between enrolled and excluded participants. One hundred sixty-seven excluded participants responded to CIAS and demonstrated no significant difference from participants entered in the final analysis ($t_{2055} = 1.35, p = .18$). A total of 1890 participants (1064 male, 826 female) who completed all scales entered the final analysis. The mean of their age was 16.26 ± 1.00 years old. The study was approved by the Institutional Review Board (IRB) of Kaohsiung Medical University Hospital.

Measures

**Chen Internet Addiction Scale (CIAS).** The CIAS contains 26 items on a four-point Likert scale that assesses five dimensions of Internet-related problems with scaled score ranging 26 to 104. The internal reliability of the scale and the subscales in the original study ranged from $.79$ to $.93$ [18]. In this study, the internal reliability of the subscales of compulsive, withdrawal, tolerance, interpersonal and health problems, and time management problems and the total scale were $.80$, $.82$, $.75$, $.82$, $.79$, and $.94$, respectively. According to the DC-IA-A [7], the 63/64 cut-off point of CIAS has the highest diagnostic accuracy (87.6%) and accepted sensitivity (67.8%) and specificity (92.6%) [8]. Accordingly, those with CIAS scores of 64 or more were classified as the Internet Addiction group.

**Attention-Deficit/Hyperactivity Disorder Self-Rated Scale (ADHDS).** The ADHDS was designed for this research to measure self-reported ADHD symptoms. The 18 items in the ADHDS were modified from Vanderbilt ADHD diag-
nostic parent rating scale [19] and reflected the 18 diagnostic symptoms for ADHD in the DSM-IV TR [20]. It is a four-point Likert-type self reported questionnaire, ranging from one (“Not at all”) to four (“almost always”). The scores of questions 1 to 18 were summed to be ADHDS scores and ranged from 18 to 72. The internal consistency of ADHDS was .88 in this study. Higher scores indicated more severe symptoms. Preliminary evaluation for psychometric characteristics of ADHDS was performed on 54 adolescents (41 males and 13 females). Their mean age was 14.9 ± 2.46 years (range 10–19 years). The internal Cronbach alpha value of ADHDS scores was .90. There is a high intra-class correlation coefficient (ICC) between self-reports and parents’ reports (ICC = .78, p < .001). The difference between self-reports and parents’ reports on ADHDS scores was also significantly (negatively) correlated with function scores rated by parents (R = −.49, p < .001; R = −.47; p = .001; R = −.51, p < .001). The preliminary evaluation demonstrated that ADHDS had accepted reliability and validity to represent the severity of ADHD symptoms among adolescents.

The Center for Epidemiological Studies’ Depression Scale (CES-D). The 20-item Mandarin-Chinese version [21] of CES-D [22] is a self-administered evaluation assessing depressive symptoms with a scaled score ranging from 0 to 60. The Cronbach alpha of CES-D in the present study was .94. Higher CES-D scores indicated more severe depression.

Social Phobia Inventory (SPIN). The SPIN, developed by Connor et al, is a 17-item self-reported rating scale. Each item ranges from zero to four with score ranging from 0 to 68. Higher total scores of SPIN indicate higher severity of social phobia. The scale has good test-retest reliability (.89 and .78), internal consistency (.87–.94 and .82–.90), and construct validity [23]. The internal consistency of SPIN in this study was .94.

The Chinese Hostility Inventory-Short Form (CHI-SF). The CHI-SF consisting of 20 Likert-type items was used to assess four dimensions of hostility construct: hostility cognition, hostility affection, and expressive hostility behavior, and suppressive hostility behavior. It was modified from 44 items of the Chinese Hostility Inventory [24]. The preliminary evaluation revealed that it had good psychometric properties: the coefficient of internal consistency (Cronbach alpha) was .93 for the whole inventory; 4-week test-retest reliability was .80. In this study, the internal consistency of CHI-SF was .93. The score ranges from 20 to 100 and higher score indicated higher hostility.

Besides this, the demographic data, the time consumed online, and the main Internet activity were also queried.

**Study process and statistical analysis**

All participants were arranged to complete the questionnaires detailing their Internet use and CIAS, ADHDS, CES-D, SPIN, and CHI-SF. The associations between Internet addiction and category variables, including demographic character and Internet behavior character, were evaluated by chi-square analysis. T-tests were used to evaluate the association between Internet addiction and scores of ADHDS, CES-D, SPIN, and CHI-SF. Then, the associations between Internet addiction and psychiatric symptoms were further examined by the stepwise logistic regression model under control of sex, age, and school. Then, the t-test and logistic regression were conducted for male and female students, respectively. All statistical analyses were performed using the computer software program SPSS 10.0 (SPSS Inc., Chicago, IL). A p-value < .05 was considered significant.

**Result**

Based on the scores of CIAS, 338 participants (17.9%) were classified into the Internet addiction group. Table 1 indicates that the adolescents with Internet addiction are more likely to be male, have higher educational grades, use the Internet more than 20 hours/week, and have online gaming habits in the main. Playing online games (42%) is the most frequent Internet activity of Internet addicts, followed by online chatting (30.3%), downloading (5.3%), e-mail (2.1%), and adult sex webs (9%).

Tables 2 and 3 illustrate that adolescents with Internet addiction had higher scores on CES-D, SPIN, ADHDS, and CHI-SF for male, female, and all students. Then, scores on CES-D, SPIN, ADHDS, and CHI-SF were used to enter the

**Table 1**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Internet addiction</th>
<th>( \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n = 338)</td>
<td>No (n = 1552)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>242 (71.6)</td>
<td>822 (53.0)</td>
</tr>
<tr>
<td>Female</td>
<td>96 (28.4)</td>
<td>730 (47.0)</td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior high school</td>
<td>122 (36.1)</td>
<td>618 (39.8)</td>
</tr>
<tr>
<td>Vocational school</td>
<td>216 (63.9)</td>
<td>934 (60.2)</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>117 (34.6)</td>
<td>631 (40.7)</td>
</tr>
<tr>
<td>11</td>
<td>106 (31.4)</td>
<td>491 (31.6)</td>
</tr>
<tr>
<td>12</td>
<td>115 (34.0)</td>
<td>430 (27.7)</td>
</tr>
<tr>
<td>Internet use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥20 hours/week</td>
<td>131 (39.8)</td>
<td>237 (15.5)</td>
</tr>
<tr>
<td>&lt;20 hours/week</td>
<td>198 (60.2)</td>
<td>1294 (84.6)</td>
</tr>
<tr>
<td>Internet activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaming</td>
<td>142 (42.0)</td>
<td>399 (25.7)</td>
</tr>
<tr>
<td>Chatting</td>
<td>102 (30.2)</td>
<td>602 (38.8)</td>
</tr>
<tr>
<td>Others</td>
<td>94 (27.8)</td>
<td>551 (35.5)</td>
</tr>
</tbody>
</table>

*Mission value: 30.
*p < .05; ***p < .001.
The results of stepwise regression for internet addiction under control of gender, age, and school

Table 4
<table>
<thead>
<tr>
<th>Variables</th>
<th>Internet addiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Wald $\chi^2$</td>
</tr>
<tr>
<td>School</td>
<td>4.33*</td>
</tr>
<tr>
<td>Gender (male)</td>
<td>33.89***</td>
</tr>
<tr>
<td>ADHDS</td>
<td>65.38***</td>
</tr>
<tr>
<td>CES-D</td>
<td>20.84***</td>
</tr>
<tr>
<td>CHI-SF</td>
<td>8.56***</td>
</tr>
</tbody>
</table>

ADHDS = Attention-Deficit/hyperactivity disorder self-rated scale; CES-D = The Center for Epidemiological Studies’ Depression Scale; CHI-SF = The Chinese Hostility Inventory-Short Form.

*p < .05; ***p < .001.

Discussion

The results of the study revealed that adolescents with Internet addiction had higher self-reported ADHD symptoms, which correlate with Internet addiction mostly in the regression model for both male and female students. This is the first report to demonstrate an association between ADHD symptoms and Internet addiction for adolescents. Because ADHD is a persistent and pervasive mental disorder with onset before age 7 years [20], the preexisting neuropsychological characteristics of ADHD could be used to explain the association.

Patients with ADHD had been reported to have an increased sensitivity to reward [25]. The feeling of being in control, synchronous interactive quality, and the freedom of self-representation of Internet activity may provide high incentive motivation and highly reward adolescents with ADHD. Furthermore, aversion for delayed reward and preference for immediate reward has been reported to be an endophenotype of ADHD [26]. The Internet activity, like gaming, which provides intermediate responses and rewards, may satisfy adolescents with ADHD more than other adolescents. Moreover, adolescents with ADHD have abnormal brain activity associated with impairment of inhibitions in performance [27]. The shortage of self-control may cause adolescents with higher ADHD symptoms difficulty in controlling Internet use after being engaged in Internet activity. As a result, under the design of the Internet, the endless activity usually consumes a great deal of time and deprives them of creative activities, thus making them progress to addiction.

Depressive disorder had been reportedly associated with Internet addiction [4,9]. Our results demonstrated that adolescents with Internet addiction had higher depressive levels. Two models may account for the association. First, Kraut has reported that Internet use results in negative effect on psychological well-being [28], which may indicate that Internet addiction would lead to depression. However, the negative

Table 3
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<tr>
<th>The gender differences of the association between age and scores of CES-D, SPIN, ADHDS, and CHI-SF and internet addiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male internet addiction</td>
</tr>
<tr>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>CES-D</td>
</tr>
<tr>
<td>ADHDS</td>
</tr>
<tr>
<td>CHI-SF</td>
</tr>
</tbody>
</table>

CES-D = The Center for Epidemiological Studies’ Depression Scale; SPIN = Social phobia Inventory; ADHDS = Attention-Deficit/hyperactivity disorder self-rated scale; CHI-SF = The Chinese Hostility Inventory-Short Form.

***p < .001.
Early aggressive behavior was found to be predictable for later heavy substance use for males, but not for females [37]. Sex difference was also found in the association between hostility and Internet addiction in the present study. Because increased hostility among adolescents with Internet addiction may manifest as anger and resistance to limitations of Internet use, to establish therapeutic relationship with them was difficult. Accordingly, male adolescents with high hostility require more attention and patience in preventive strategies and therapeutic interventions for Internet addiction.

The study revealed that adolescents with Internet addiction had higher social phobia, however, it didn’t predict Internet addiction after ADHD symptoms, depression, and hostility were entered into the regression model. These results may indicate that ADHD symptoms, depression, and hostility are more proximal predictors than social phobia.

The results of this study revealed that males are more likely to have Internet addiction than females, even when comorbid psychiatric symptoms were controlled. This result of sex difference was corresponded to previous reports on Internet addiction [7]. It had been reported that more males than females engaged in substance use for social bonding and self-image [38]. Males may have the tendency to be attracted by the social interaction and achievement provided by Internet activities. In addition, female Taiwanese adolescents often receive more family supervision than males, which may prevent females from becoming addicted to Internet. However, other biological and psychological factors should be further evaluated to account for the sex difference of Internet addiction.

This study had the following limitations: first, because the cross-section investigation design could not provide any temporal relationship, the causal relationship between ADHD symptoms, depression, hostility, and Internet addiction could not be made clear in this study. Secondly, more students of vocational high schools were selected in the study population, although the type of school was controlled in regression analysis. Thirdly, the ADHD symptoms relied solely on self-report data. Previous research suggests that parents may be more reliable indicators than adolescents for their ADHD symptoms [39]. On the contrary, Cantwell et al reported that adolescents report insignificantly more symptoms than parents and the ICC between adolescent and parental reports is .58 [40]. The results corresponded to our preliminary data, which revealed that ADHD scores could represent the severity of ADHD as parental observations do. However, more than one information source to investigate ADHD should be considered in further studies to provide clearer evidence.

**Conclusion**

The present research made clear that self-reported ADHD symptoms, depression, and hostility are associative factors of Internet addiction among adolescents. However, hostility was associated with Internet addiction for male but
not for female students. Although the mechanism of the association was beyond the scope of this study, it appears reasonable to suggest that effective evaluation of, and treatment for ADHD and depressive disorder are required for adolescents with Internet addiction. Besides, male adolescents with high hostility require more attention in preventive strategies and therapeutic interventions for Internet addiction.

Acknowledgments

This study was supported by a grant from Department of Health, Executive Yuan, ROC (DOH95-TD-M-113-039).

References