Review

The association between Internet addiction and psychiatric disorder: A review of the literature

C.-H. Ko a,b,c, J.-Y. Yen b,c,d, C.-F. Yen b,c, C.-S. Chen b,c,d, C.-C. Chen b,c,e,*

a Department of Psychiatry, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan
b Department of Psychiatry, Faculty of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung City, Taiwan
c Department of Psychiatry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
d Graduate Institute of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan
e Department of Psychiatry, Kai-Suan Psychiatric Hospital, 130, Kai-Suan 2RD, Ling-Ya District, Kaohsiung 802, Taiwan, ROC

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A B S T R A C T

Internet addiction is a newly emergent disorder. It has been found to be associated with a variety of psychiatric disorders. Information about such coexisting psychiatric disorders is essential to understand the mechanism of Internet addiction. In this review, we have recruited articles mentioning coexisting psychiatric disorders of Internet addiction from the PubMed database as at November 3, 2009. We describe the updated results for such disorders of Internet addiction, which include substance use disorder, attention-deficit hyperactivity disorder, depression, hostility, and social anxiety disorder. We also provide discussion for possible mechanisms accounting for the coexistence of psychiatric disorders and Internet addiction. The review might suggest that combined psychiatric disorders mentioned above should be evaluated and treated to prevent their deteriorating effect on the prognosis of Internet addiction. On the other hand, Internet addiction should be paid more attention to when treating people with these coexisting psychiatric disorders of Internet addiction. Additionally, we also suggest future necessary research directions that could provide further important information for the understanding of this issue.

1. Introduction

In recent years, the Internet has become one of the most important academic and recreational tools for adolescents and adults. It provides an easy and immediate way for people to explore information and communicate with other people over the world. However, a loss of control over Internet use might lead to negative impacts on daily life function, family relationships, and emotional stability [1,3,8,47,65]. This phenomenon has been described as Internet addiction or problematic Internet use [23,50], and is suggested to be one type of behavioral addiction [18]. In recent years, Internet addiction has been reported in both Western and Eastern societies among adult and adolescent groups [5,39,53,61]. It has become an important global mental health problem and further attention should be paid to it.

1.1. The concept and definition of Internet addiction

The clinical features of behavioral problems related to Internet use have been described in various ways, including “Internet addiction disorder” [23], “pathological Internet use” [64], and “problematic Internet use” [50]. Several researchers have tried to construct diagnostic criteria for this clinical issue. Young modified the diagnostic criteria of pathological gambling in the Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV) [2] to construct diagnostic questionnaires for pathological Internet use. He has defined pathological Internet use as having five or more of eight characteristic symptoms including preoccupation, tolerance, withdrawal, failure to control, use longer than intended, functional impairment, lying, and escape [64]. Shapira et al. have also proposed diagnostic criteria for problematic Internet use according to the concepts of impulse-control disorder in DSM-IV-TR [3,50], and suggested that it is necessary to exclude behavioral changes secondary to mania [50]. Under the concept of these two definitions, Internet addiction was classified as impulse-control disorder.

Anderson used the seven true-false questions that most closely paralleled the diagnostic criteria of substance dependence in DSM-IV to define Internet dependence [1]. Ko and his colleagues had proposed two diagnostic criteria of Internet addiction in adolescents and college students based on data collected by systematic diagnostic interview [23,29]. These criteria (of Ko et al.) had provided data of sensitivity and specificity, and were composed of
criteria A, B, and C. Criterion A contains nine characteristic symptoms of Internet addiction, including preoccupation, uncontrolled impulse, usage more than intended, tolerance, withdrawal, impairment of control, excessive time and effort spent on the Internet, and impairment of decision-making ability. Six or more symptoms should be fulfilled in Criterion A. Criterion B describes functional impairment secondary to Internet use. Criterion C lists the exclusive criteria including psychotic disorder, bipolar I disorder, and other impulse-control disorder. People fulfilling criteria A, B, and C would be diagnosed as having Internet Addiction. Based on these criteria and termination, Internet addiction was defined as a behavior addiction and by the criteria similar to substance use disorder.

Until now, whether Internet addiction is classified as impulse-control disorder or a behavior addiction has not been confirmed. Furthermore, the operational definition of Internet addiction has not been conclusively developed and is not included in the DSM-IV-TR. However, the prevalence of Internet addiction has caught the attention of researchers and it has been suggested that Internet addiction should be included in DSM-V [8]. The DSM-V work group has proposed that pathological gambling would be reclassified from impulse-control disorders not elsewhere classified to substance-related disorders, which will be renamed addiction and related disorders. In addition, the report of the DSM-V Substance-Related Disorders Work Group has also suggested that Internet addiction might be one of the candidates for a possible “Non-substance addictions” category as is pathological gambling. However, the diagnostic criteria for Internet addiction was not provided by the DSM-V work group. More empirical data focusing on Internet addiction is necessary to support the definition and classification for Internet addiction.

2. The possible mechanism underlying the coexisting psychiatric disorders of Internet addiction

Shaffer et al. have criticized the fact that there is not yet adequate evidence demonstrating that Internet addiction is a primary disorder, and state that Internet addiction might be better explained by the results of other primary disorders [48]. This might suggest that understanding the association between Internet addiction and other psychiatric disorders might shed light on the mechanism of Internet addiction.

The comorbidity between addictive and other psychiatric disorders has been repeatedly reported and reviewed [21,44]. The comorbidity between two disorders indicates that the association between the two disorders is higher than expected by chance. Thus, it usually suggests a mechanism or mechanisms exist to contribute to the association, and it is therefore important to understand such mechanisms and develop effective treatment for both disorders. Four possible mechanisms have been described to explain the association between addictive behaviors and psychiatric disorders. Firstly, the psychiatric disorder results in, contributes to, or deteriorates the symptoms or course of the addictive disorder. Secondly, the addictive disorder leads to, contributes to, or further deteriorates the symptoms or course of other psychiatric disorders. Thirdly, there are underlying biological, psychological, or sociological mechanisms shared by addictive and psychiatric disorders. Lastly, other factors related to sampling, assessment, investigation, study design, or analysis result in inappropriate over-estimation of the comorbidity [41,44].

Thus, a very complex and comprehensive design is necessary to confirm or test the hypothesis for the above four mechanisms; however, it might be very difficult in situations with limited resources. On the other hand, much previous research has focused on the issue of coexisting psychiatric disorders of Internet addiction, and the results have shed light on understanding the possible mechanism(s) of Internet addiction. Accordingly, it is necessary to carry out further review of previous studies in order to provide updated information to clinicians and provide a direction of future study for researchers.

In this review, we have recruited articles mentioning coexisting psychiatric disorders of Internet addiction from the PubMed database as at November 3, 2009. All articles that could be recruited from PubMed with the key words of Internet addiction and that were associated with coexisting psychiatric disorders of Internet addiction.

3. The epidemiology of Internet addiction

The epidemiological findings of Internet addiction is summarized in Table 1. Based on the Internet addiction test [IAT], Lam et al. found 10.8% of 13- to 18-year-olds were moderately to severely addicted to the Internet in China [35]. Cao and Su had reported 18.2% of junior high school students in China were classified as Internet addicts based on the same test [10]. Further, IAT had also revealed that 6.44% of first-year university students were addicted to the Internet [42]. Kim et al. found that 38% of adolescents were classified as possible Internet addicts and 1.6% of adolescents were diagnosed as Internet addicts in Korea [22]. Furthermore, Park et al. found that 10.7% of adolescents in Korea had Internet addiction according to the Internet addiction scale [45]. Moreover, Jang et al. found that 4.3% of adolescents showed Internet addiction in Korea respectively [20]. In Italy, Milani et al. found that 36.7% of adolescents aged 14–19 years had signs of problematic Internet use, which was defined as scoring more than 50 in IAT [39]. Canan et al. had reported that 11.6% of adolescents aged 14–19 years were classified as Internet addicts based on the cut-off point of the Turkish version of the Internet addiction scale [9]. Three different cut-off points, 50, 70, and 81, of IAT might be one of the possible factors for the inconsistent results (Table 2).

By using Young’s Diagnostic Questionnaire [YDQ], Siosmos et al. found that 11% of 12- to 18-year-old adolescents had fulfilled the criteria of Internet addiction in Greece [51]. Bakken et al. found 4.1% of females and 19% of males among a group aged 16 to 29 were classified as having Internet addiction or at-risk addiction in Norway [5]. Cao and Su found 2.4% of adolescents were classified as having Internet addiction in China [10]. In China, Huang and Leung also found 9.8% of teenagers had Instant Messaging addiction (which is a subtype of Internet addiction) [19]. Shek et al. reported that 19.1% of Hong Kong Chinese adolescents were found to have Internet addiction [51].

In Taiwan, the most popular assessment tool for Internet addiction is the Chen Internet Addiction Scale (CIAS) [12]. The CIAS provides a clear cut-off point with good specificity and adequate sensitivity to determine Internet addiction in adolescents [24] and college students [29], based on the developed diagnostic criteria of Internet addiction [23,29]. By using the questionnaire, 18.8% of high school students [30], 17.9% of senior high school students [59], 10.8% of grade 7 students [31] and 12.9% of college students [61] were classified as Internet addiction. Until now, no study has evaluated the prevalence based on psychiatric-interview diagnosis.

In these studies, we found that Internet addiction was prevalent across Eastern and Western societies. This might indicate the disorder is a globalizing disorder worthy of more attention. Furthermore, Internet addiction has been reported in adolescents [30], college students [61], and adults [7]. However, most reports focused on adolescents and young adult groups – those who had grown up in an environmental with a well-developed Internet. Moreover, many reports were investigated in Asia countries in which the Internet had been rapidly developed in recent years. It might suggest that early exposure to the Internet and
environmental factors were important associated factors for Internet addiction.

4. The association between Internet addiction and psychiatric disorders

4.1. The association between Internet addiction and mental health

Based on the Symptom Checklist-90-Revision, obsessive-compulsive and depressive symptoms were found to be associated with intermittent and unabated addiction to the Internet respectively, in a Korean study [20]. Yang and colleagues also noted that excessive Internet use on IAT was associated with higher psychiatric symptoms on the Symptom Checklist-90-Revision in Korea [58]. However, Niemz and colleagues did not find a significant association between pathological Internet use and the level of mental health on the General Health Questionnaire [43]. Yen and colleagues evaluated psychiatric symptoms by using the Brief Symptoms Inventory, and found that adolescents with Internet addiction had higher psychiatric symptoms than those without Internet addiction [60]. In that study, hostility and depression were noted to be the most associated symptoms with Internet addiction. It also suggested the possible bi-directional interaction between Internet addiction and psychiatric symptoms. On the one hand, heavy Internet use might be utilized to cope with or relieve psychiatric symptoms. On the other hand, maladaptive Internet use might also result in or further amplify psychiatric symptoms. However, these mechanisms could not be proven by the above cross-sectional studies.

4.2. The association between Internet addiction and substance use disorders

Volkow and Li have suggested that addiction-prone phenotypes for substance use disorders would also reflect sensitivity to other alternative reinforcers in the individual’s environment [56]. Thus, if the Internet had the potential to be addictive, adolescents or college students with vulnerability to substance use disorders would be vulnerable to Internet addiction. Bai and colleagues first noted the high prevalence of substance use disorders among cases of Internet addiction in a virtual clinic [4]. Lam and colleagues stated that adolescents with alcohol drinking behavior are more likely to have Internet addiction [OR = 1.7, 95% CI = 1.1–2.8] [35]. Ko and colleagues declared that adolescents with substance use experience are more likely to have Internet addiction [25]. Furthermore, this article also noted that adolescents with Internet addiction or substance use experience shared the same personality characteristics, including high novelty-seeking and low reward dependence. However, adolescents with Internet addiction had high harm avoidance, which was low among adolescents with substance exposure [25]. Ko and colleagues also determined that adolescents with problematic alcohol use were more likely to have Internet addiction [27]. This study also ascertained that psychosocial proneness, including high behavior activation, low self-esteem, low family function, and low life satisfaction, were all associated with both Internet addiction and problematic alcohol use. Based on the results, the authors suggest that Internet addiction could be included in the organization of a problematic behavior model. Yen and colleagues further demonstrated that
college students with harmful alcohol use were more likely to have Internet addiction [62]. Besides, both harmful alcohol use and Internet addiction were associated with high behavior activation. These results might suggest the shared personality characteristics play a role in the coexistence between Internet addiction and substance use disorders. Furthermore, Ko and colleagues demonstrated that cue-induced gaming urges activates similar brain areas corresponding to substance craving in a functional magnetic resonance study [32]. However, more neurobiological studies are necessary to test the hypothesis that Internet addiction has similar neurocognitive mechanism[s] to substance use disorders.

4.3. The association between Internet addiction and attention-deficit hyperactivity disorder (ADHD)

ADHD as defined by DSM-IV-TR manifests distractibility, difficulty focusing, excessive talking and restlessness, and affects 5–10% of children and 4% of adults [11]. Yoo and colleagues first reported the association between Internet addiction and ADHD in

<table>
<thead>
<tr>
<th>Author/Year/country</th>
<th>Sample (n)</th>
<th>Design</th>
<th>Coexisting psychiatric disorder</th>
<th>Assessment tool</th>
<th>Statistically analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jang et al./2008/Korea</td>
<td>Junior and senior high school (914)</td>
<td>Cross-section</td>
<td>Obsessive-compulsive and depressive symptoms</td>
<td>Symptom Checklist-90-Revised</td>
<td>Logistic regression</td>
</tr>
<tr>
<td>Yang et al./2005/Korea</td>
<td>Senior high school (328)</td>
<td>Cross-section</td>
<td>Psychiatric symptoms</td>
<td>Symptom Checklist-90-Revised</td>
<td>ANOVA</td>
</tr>
<tr>
<td>Niemz et al./2005/British</td>
<td>University students (371)</td>
<td>Cross-section</td>
<td>Mental health</td>
<td>General Health Questionnaire</td>
<td>ANOVA</td>
</tr>
<tr>
<td>Yen et al./2008/Taiwan</td>
<td>Junior and senior high school (3662)</td>
<td>Cross-section</td>
<td>Psychiatric symptoms</td>
<td>Brief Symptoms Inventory</td>
<td>t test Logistic regression</td>
</tr>
<tr>
<td>Bai et al./2001/Taiwan</td>
<td>Visitors to the virtual clinic (251)</td>
<td>Cross-section</td>
<td>Substance use disorder</td>
<td>Unknown</td>
<td>Chi-square</td>
</tr>
<tr>
<td>Lam et al./2009/China</td>
<td>Junior and senior high school (1639)</td>
<td>Cross-section</td>
<td>Drinking more than 2 times a week</td>
<td>Questionnaire</td>
<td>Logistic regression</td>
</tr>
<tr>
<td>Yen et al./2007/Taiwan</td>
<td>Senior high school (2114)</td>
<td>Cross-section</td>
<td>ADHD* Depression Social anxiety Hostility</td>
<td>ADHD* Self-rated scale The Center for Epidemiological Studies’ Depression Scale Social Phobia Inventory The Buss-Durkee Hostility Inventory-Chinese Version-Short Form</td>
<td>t test Logistic regression</td>
</tr>
<tr>
<td>Ko et al./2005/Taiwan</td>
<td>Junior and senior high school (3662)</td>
<td>Cross-section</td>
<td>Substance use experience</td>
<td>Questionnaire</td>
<td>Chi-square</td>
</tr>
<tr>
<td>Ko et al./2008/Taiwan</td>
<td>Senior high school (2114)</td>
<td>Cross-section</td>
<td>Problematic alcohol use</td>
<td>CRAFFT</td>
<td>Chi-square</td>
</tr>
<tr>
<td>Yen et al./2009/Taiwan</td>
<td>College students (2453)</td>
<td>Cross-section</td>
<td>Harmful alcohol use</td>
<td>Alcohol Use Disorders Identification Test</td>
<td>Chi-square</td>
</tr>
<tr>
<td>Yoo et al./2004/Korea</td>
<td>Element school (535)</td>
<td>Cross-section</td>
<td>ADHD*</td>
<td>DuPaul’s ADHD* rating scale</td>
<td>Correlation t test</td>
</tr>
<tr>
<td>Bernardi and Pallanti/2009/</td>
<td>Adult (50)</td>
<td>Cross-section</td>
<td>ADHD* Dysthymic disorders Social anxiety disorder Hostility</td>
<td>Diagnostic interviewing</td>
<td>Just reporting percentage</td>
</tr>
<tr>
<td>American</td>
<td>Ha et al./2006/Korea</td>
<td>Children (455) and adolescents (836)</td>
<td>Cross-section</td>
<td>ADHD* Depression</td>
<td>Psychiatric interviewing for 12 children and adolescents</td>
</tr>
<tr>
<td>Yen et al./2007/Taiwan</td>
<td>College students (2793)</td>
<td>Cross-section</td>
<td>ADHD*</td>
<td>Adult ADHD Self-Report Scale</td>
<td>t test Logistic regression</td>
</tr>
<tr>
<td>Ko et al./2008/Taiwan</td>
<td>College students (216)</td>
<td>Cross-section</td>
<td>Adult ADHD Depressive disorder Social anxiety disorder</td>
<td>Psychiatric interviewing</td>
<td>Chi-square</td>
</tr>
<tr>
<td>Ko et al./2009/Taiwan</td>
<td>Junior High School (2293)</td>
<td>Prospective</td>
<td>ADHD* Depression Social anxiety Hostility</td>
<td>ADHD* Self-rated scale The Center for Epidemiological Studies’ Depression Scale Negative self evaluation scale The Buss-Durkee Hostility Inventory-Chinese Version-Short Form</td>
<td>Survival analysis</td>
</tr>
<tr>
<td>Kim et al./2006/Korea</td>
<td>High school students (1573)</td>
<td>Cross-section</td>
<td>Depression</td>
<td>Korean version of the Diagnostic Interview Schedule for Children-Major Depression Disorder-Simple Questionnaire</td>
<td>ANOVA</td>
</tr>
<tr>
<td>Ko et al./2007/Taiwan</td>
<td>Junior High School (517)</td>
<td>Prospective</td>
<td>Hostility Interpersonal sensitivity</td>
<td>Brief Symptoms Inventory</td>
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*Attention-deficit and hyperactivity disorder.
elementary schoolchildren in Korea [63]. Bernardi and Pallanti found that 14% of adults with Internet addiction were diagnosed with ADHD [7]. Ha and colleagues had also reported that seven out of 12 children with Internet addiction were diagnosed with ADHD [16]. Yen and colleagues found that adolescents with Internet addiction had significantly higher ADHD symptoms than those without Internet addiction and ADHD symptoms were the most significantly associated symptoms of Internet addiction [61]. In a study among adults, Yen and colleagues also demonstrated the association between Internet addiction and higher symptoms of adult ADHD among college students. Among the manifesting ADHD symptoms, attention deficit was the most associated one with Internet addiction, and the association was more prominent among females [61]. Ko and colleagues conducted a diagnostic psychiatric-interview study that found an association between adult ADHD and Internet addiction [28]. This study also found that adult ADHD was the most significantly associated psychiatric disorder of Internet addiction among college students. Although the fact that ADHD had developed before 7 years of age provides temporal information, the causal relationship between Internet addiction and adult ADHD could not be confirmed in the cross-sectional designed study. A recent two-year prospective study found that adolescents with ADHD were more likely to become Internet-addicted in the two-year follow-up [31].

Biopsychosocial mechanisms have been utilized to explain the coexistence between Internet addiction and ADHD. Firstly, two core symptoms reported in ADHD are “being easily bored” and “having an aversion for delayed reward” [11,15], which usually resulted in impaired academic function and difficulties in interpersonal relationships. Internet behavior is characterized by rapid response, immediate reward, and multiple windows with different activities, which may reduce the feeling of boredom or provide immediate stimulation and reward for subjects with ADHD.

Secondly, Koepp and colleagues have reported that striatal dopamine is released during video gaming [33], which may help the game players keep focused on gaming and have better performance. Thus, adolescents with ADHD may utilize the Internet to compensate for the frustration they feel in real-life situations. Thirdly, research has found that adolescents with ADHD have abnormal brain activities associated with impaired inhibition [46]. This lack of self-control may cause individuals with ADHD to have difficulty in controlling Internet use and hence become vulnerable to Internet addiction. Fourthly, motivation deficit, an anomalous reaction to reward and punishment, has been reported to be an endophenotype of ADHD [11]. The deficit includes rapid habituation to repeated positive reinforcement and less arousal or behavioral response to punishment [6]. Internet activities, especially for online gaming, usually provide immediate response and reward. Higher reward sensitivity might contribute to higher vulnerability to Internet addiction. Lastly, impulsivity, hyperactivity, and inattention usually negatively influence individuals’ interpersonal relationships. However, these deficits could be masked well online. Thus, for people with ADHD, establishing interpersonal relationships online is easier than in the real world. Although these factors possibly explain why people with ADHD are more likely to be addicted to the Internet, further research focusing on these mechanisms is necessary to prove/disprove these hypotheses.

In any case, the association between ADHD and Internet addiction might suggest that people with ADHD should be an important target group of preventive scheduling for Internet addiction. Furthermore, ADHD should be well-evaluated and treated among cases of Internet addiction. Han and colleagues have found that methylphenidate could decrease online gaming use among adolescents with ADHD and online gaming behaviors [17]. These results suggest that treating the coexisting psychiatric disorders could also benefit Internet addiction. On the other hand, whether Internet addiction would deteriorate or benefit the course of ADHD should also be researched by prospective studies.

4.4. The association between Internet addiction and major depressive disorder

Bernardi and Pallanti have reported that 7% of adult cases of Internet addiction had comorbid dysthymic disorder [7]. Ha and colleagues discovered an association between Internet addiction and depression among adolescents in a Korean sample [16]. Kim and colleagues noted that Internet addiction was associated with depression and suicide ideation [22]. Yen and colleagues demonstrated the association between Internet addiction and depressive symptoms under control of other psychiatric symptoms among adolescents in Taiwan [59]. Another psychiatric diagnostic interview study demonstrated the association between Internet addiction and depressive disorders [major depressive disorder and dysthymic disorder] in college students [28]. These cross-sectional studies demonstrate the association between Internet addiction and depression. However, the causal relationship between Internet addiction and depression could not be proven. Ko and colleagues conducted a prospective questionnaire study to demonstrate that adolescents with depression are more likely to become Internet-addicted in the two-year follow-up period. Since the Internet provides adolescents with social support [55], the pleasure of control [37], and a virtual world in which they can escape from emotional difficulty in the real world, it appears reasonable that adolescents with depression would be more likely to use the Internet to alleviate depression, and would be more prone to subsequent Internet addiction than are their unaffected peers. Kraut and colleagues [34] proposed a “rich get richer” model where the Internet provides more benefits to those who are already well-adjusted, and by contrast, poorly adjusted adolescents with depression may suffer more deleterious effects from heavy Internet use, creating a vicious circle.

Additionally, previous research has found that the ‘short’ alleles of the 5HTTLPR polymorphism, which is associated with depression [57], is also associated with Internet addiction [36]. The 5HTTLPR gene is implicated in serotonin function; therefore, the biological vulnerability to both depression and Internet addiction might be linked to serotonin dysfunction, which in turn might explain the relationship found in this study. Thus, depressive disorders should be a target of preventive scheduling of Internet addiction and should be assessed and treated among cases of Internet addiction. On the other hand, the effect of Internet addiction on the course or prognosis of depression has not been thoroughly investigated. Further prospective studies to address this important issue are necessary.

4.5. The association between Internet addiction and social anxiety

The Internet could provide non-face-to-face interaction with anonymity and might attenuate anxiety when interacting. However, whether Internet communication benefits adolescents with social phobia is still inconclusive [40,52]. Bernardi and Pallanti found that 15% of adult cases of Internet addiction were classified to have social anxiety disorder [7]. Milani and colleagues reported that adolescents with symptoms of problematic Internet use had worse interpersonal relationships [39]. In China, shyness and alienation from family, peers, and school have been noted to be associated with Instant Messaging addiction among teenagers [19]. The association between Internet addiction and social anxiety has also been found among adolescents in Taiwan [59]. Furthermore, this association was found in a psychiatric diagnostic
interviewing study among college students [28]. Moreover, social anxiety symptoms could predict the emergence of Internet addiction in a two-year follow-up study [31]. Since Internet use could provide social support [52], adolescents with social phobia might benefit from avoiding the stress caused by face-to-face interaction with others. However, if their social difficulties in the real world did not improve, adolescents with social phobia might receive social support predominantly from the Internet, and this could decrease their motivation to meet others in the real world. Then, the risk of becoming addicted to Internet use would increase. However, we found that the predictive effect of social phobia was insignificant after control of depression and ADHD [31]. This might indicate that other psychiatric symptoms are more important predictors of Internet addiction than social phobia. In any case, social anxiety is an important psychiatric problem deserving more attention when treating Internet addiction.

4.6. The association between Internet addiction and hostility, and aggressive behavior

Yen and colleagues have noted that hostility was associated with Internet addiction in adolescents [59,60]. Then, after one year of follow-up, hostility could predict the persistence of Internet addiction [26]. Moreover, Ko and colleagues determined that adolescents with Internet addiction are more likely to manifest aggressive behaviors [30]. All these studies demonstrate the strong association between Internet addiction and hostility.

However, these previous studies could not confirm the causal relationship suggested by the above hypothesis. On the other hand, a prospective study demonstrates that adolescents with higher hostility have higher risk of developing Internet addiction [31]. For adolescents, high hostility might result in interpersonal conflict or rejection. The Internet could provide a cheap, free, and virtual world to escape from the interpersonal difficulties of the real world, as previously mentioned. In addition, many Internet activities, especially online gaming, provide a world in which to express hostility and perpetrate violence without restriction, but that does not mean such violence is harmless according to the effect mentioned above. However, whether online behavior or Internet addiction would result in hostility or aggressive behaviors has not been validated. It is necessary to evaluate whether people with Internet addiction are more aggressive online than in the real world, and whether this tendency would result in progression of hostility and aggressive behavior in the real world.

4.7. The association between Internet addiction and other psychiatric disorders

Internet addiction has also been reported to be associated with many psychiatric disorders that have not been well or repeatedly evaluated. Bernardi and Pallanti found that 7% of adult cases of Internet addiction had hypomania [7]. Shapiro et al. noted that a significant percentage of cases with Internet addiction in a clinical setting were the cases of bipolar I disorder [49]. However, these results could not demonstrate that Internet addiction was more prevalent in those with bipolar I disorder than those without. Bernardi and Pallanti found that 15% of adults with Internet addiction had general anxiety disorder, 7% had obsessive-compulsive personality, 14% had borderline personality disorder, and 7% had avoidant personality disorder [7]. Furthermore, the association between Internet addiction and dissociative symptoms was noted in the clinical [7] and nonclinical groups [14]. Choi and colleagues found a significant association between Internet addiction and excessive daytime sleepiness among adolescents [13]. Ha and colleagues also found an association between Internet addiction and obsessive-compulsive symptoms [16]. Since heavy Internet use has been labeled as compulsive Internet use, whether Internet addiction is associated with obsessive-compulsive spectrum disorders is important but not demonstrated. These associations between Internet addiction and bipolar I disorder, dissociative disorder, general anxiety disorder, and obsessive-compulsive disorder should be evaluated by further studies.

5. The clinical implication of comorbidity

The associations between Internet addiction and psychiatric disorders provide important information for treatment and prevention for Internet addiction. These psychiatric disorders, including ADHD, depression, social anxiety disorder, substance use disorder, and aggressive behaviors, should be thoroughly assessed for cases of Internet addiction. To treat these disorders concurrently might provide benefit to intervention for Internet addiction. Furthermore, since these disorders might predispose Internet addiction, appropriate screening and treatment for these disorders might prevent emergence of Internet addiction. Moreover, since the Internet is one of the common leisure activities, it might become a coping strategy for emotional or social difficulties. However, persistent coping use of the Internet without effective intervention in the real world of some maladaptive people might result in Internet addiction, which leads to a vicious cycle. In such a condition, treatment focusing on Internet addiction without paying attention to psychiatric disorders might result in failure of treatment. Lastly, the effect of suggested preventing schedule and treating coexisting psychiatric disorder for Internet addiction should be further evaluated in future.

On the other hand, it is also necessary to evaluate the existence of Internet addiction when treating people with ADHD, depression, social anxiety disorder, substance use disorder, and aggressive behaviors, especially among adolescents. Lastly, the association between Internet addiction and well-known psychiatric disorders might increase understanding toward Internet addiction. For example, Ko and colleagues found that brain activation of a cue-induced gaming urge was similar to that in substance craving [32].

6. The questions deserve future study

Firstly, temporal relationships have not been properly investigated in most studies. Whether psychiatric disorder predicts Internet addiction or Internet addiction predicts psychiatric disorders is necessary to be evaluated. Secondly, how comorbidity contributes to the prognosis of Internet addiction and psychiatric disorders should be examined by follow-up studies. Thirdly, the underlying mechanism of the comorbidity has not been studied well. Underlying biological, psychological, and social mechanisms that could explain the comorbidity should be further studied. Lastly, whether the treatment for comorbidity can benefit the case of Internet addiction has not been systematically evaluated.

7. Conclusion

Based on this review, Internet addiction is associated with substance use disorder, ADHD, depressive disorder, social phobia, and hostility. Furthermore, ADHD, depressive disorder, social phobia, and hostility would predict the emergence of Internet addiction. When treating subjects with Internet addiction, these disorders should be properly assessed and treated at the same time. Additionally, the comorbidity should be screened and interventions developed to prevent the emergence of Internet addiction.
addiction. Lastly, it is also important to pay attention to Internet addiction when treating people with these comorbid disorders. Further research focusing on the mechanisms of the comorbidity of Internet addiction is necessary.

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References


