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Multi-dimensional correlates of Internet addiction symptoms in adolescents with attention-deficit/hyperactivity disorder

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ABSTRACT

This study examined the associations of the severity of Internet addiction symptoms with reinforcement sensitivity, family factors, Internet activities, and attention-deficit/hyperactivity disorder (ADHD) symptoms among adolescents in Taiwan diagnosed with ADHD. A total of 287 adolescents diagnosed with ADHD and aged between 11 and 18 years participated in this study. Their levels of Internet addiction symptoms, ADHD symptoms, reinforcement sensitivity, family factors, and various Internet activities in which the participants engaged were assessed. The correlates of the severities of Internet addiction symptoms were determined using multiple regression analyses. The results indicated that low satisfaction with family relationships was the strongest factor predicting severe Internet addiction symptoms, followed by using instant messaging, watching movies, high Behavioral Approach System (BAS) fun seeking, and high Behavioral Inhibition System scores. Meanwhile, low paternal occupational SES, low BAS drive, and online gaming were also significantly associated with severe Internet addiction symptoms. Multiple factors are significantly associated with the severity of Internet addiction symptoms among adolescents with ADHD. Clinicians, educational professionals, and parents of adolescents with ADHD should monitor the Internet use of adolescents who exhibit the factors identified in this study.

1. Introduction

Internet addiction has substantial adverse effects on the lives of adolescents, such as declines in academic performance, physical and mental health, and interpersonal relationships (Shapira et al., 2000; Young, 1996). Hence, monitoring the Internet-use behaviors of adolescents is necessary to detect Internet addiction early. People diagnosed with attention-deficit/hyperactivity disorder (ADHD) are at a higher risk of Internet addiction than those without ADHD. Previous cross-sectional community studies have found significant associations between Internet addiction and ADHD symptoms in children (Yoo et al., 2004), adolescents (Cao et al., 2007; Yen et al., 2007), and young adults (Ko et al., 2008a, 2008b; Yen et al., 2009b). ADHD is the most common psychiatric disorder among adolescents with Internet addiction who have been referred for psychiatric treatment (Bozkurt et al., 2013). A 2-year prospective community study found that ADHD can predict the occurrence of Internet addiction in adolescents (Ko et al., 2009). Adolescent development is the result of multisystem interactions (Lerner and Castellino, 2002).

Ko et al. (2012) proposed a biopsychosocial mechanism to explain the coexistence between ADHD and Internet addiction. Firstly, the individuals with ADHD are usually easily bored and have an aversion for delayed reward (Castellanos and Tannock, 2002). The Internet provides rapid response and immediate reward to reduce the feeling of boredom. Secondly, striatal dopamine is released during video gaming, which may help the players keep focused on gaming and have better performance (Koepp et al., 1998). Thirdly, adolescents with ADHD have abnormal brain activities associated with impaired inhibition (Rubia et al., 2005), which may cause individuals with ADHD to become

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vulnerable to Internet addiction. Fourthly, motivation deficits, including rapid habituation to repeated positive reinforcement and less arousal to punishment, are one of endophenotypes of ADHD (Berger et al., 2007; Castellanos and Tannock, 2002). Internet activities such as online gaming usually provide immediate response and reward, and thus contribute to high vulnerability to Internet addiction. Therefore, investigating the individual and family correlates associated with Internet addiction among adolescents with ADHD is a fundamental step toward identifying risk groups, thereby enabling prevention and intervention. Based on our research, however, no study has examined the individual and family correlates of Internet addiction in adolescents clinically diagnosed with ADHD.

Research has found that both sex (Ko et al., 2008a, 2008b; Yen et al., 2009b; Yen et al., 2009a) and age (Yen et al., 2009c) are significant correlates of Internet addiction in adolescents. Reinforcement sensitivity, Internet activities engaged in, and ADHD symptoms are also individual factors that require examining for their association with Internet addiction in adolescents with ADHD. According to Gray's reinforcement sensitivity theory (Gray and McNaughton, 2003), the behavioral inhibition system (BIS) represents sensitivity to punishment, and the behavioral approach system (BAS) represents sensitivity to reward (Corr, 2004). Previous cross-sectional studies have found positive associations of Internet addiction with high BIS and high BAS fun seeking in young adults (Yen et al., 2009a) and with high BAS fun seeking in adolescents (Ko et al., 2008b). A prospective study found that high total BAS and BAS fun seeking predicted the occurrence of Internet addiction 1 year later. Concurrently, 1 year later, adolescents with Internet addiction decreased more on the BAS and BIS than the nonaddiction group did (Yen et al., 2012). The results indicated bidirectional interactions between Internet addiction and the BIS and BAS systems among adolescents. Furthermore, research has found that altered reinforcement mechanisms are a fundamental characteristic of ADHD. The review study of Tripp and Wickens (2012) found that ADHD has effects on reinforcement evaluated by cognitive task performance and psychophysiological responsiveness. Further research is necessary to determine whether sensitivity to reward and punishment are significant correlates of Internet addiction in adolescents with ADHD.

In addition, research has found that online gaming was the most frequent Internet activity in which adolescents with Internet addiction have participated (Ko et al., 2005a). However, adolescents may use the Internet to participate in many entertainment activities, because developing interpersonal relationships is a major developmental task (Gemelli, 1996). Further research is necessary to determine whether Internet interaction, such as instant messaging, is significantly associated with Internet addiction in adolescents with ADHD.

Previous studies have determined that the severity of Internet addiction was positively associated with self-reported inattention (Yen et al., 2009b) and hyperactivity/impulsivity symptoms in college students (Dalbudak and Evren, 2014; Yen et al., 2009b) and with parents' and teachers' reported inattention and hyperactivity/impulsivity symptoms in elementary school students (Yoo et al., 2004). However, no study has examined the relationship between the severity of Internet addiction and ADHD symptoms in adolescents clinically diagnosed with ADHD. The presentation of ADHD symptoms can change from childhood to adolescence with less overt hyperactivity but ongoing attentional problems (Hart et al., 1995). Further study is necessary to determine whether the association of parent-rated ADHD symptoms with the severity of Internet addiction among adolescents is distinct from those among elementary and college students found in previous studies.

Social contexts in which adolescents are placed are critical forces that influence adolescent health (Rutter, 1993). Family constitutes an essential social environment for adolescents, and the influence of family factors on Internet addiction has drawn considerable attention. Previous studies have found that higher family conflict (Yen et al., 2009c), lower family monitoring (Yen et al., 2009c), lower parental educational levels (Ahmadi and Saghafi, 2013), parental unemployment (Durkee et al., 2012), and parents' favorable attitudes toward adolescents' Internet use (Jeong and Kim, 2011) were associated with Internet addiction of adolescents. Youths with ADHD and their families have encountered various difficulties in supporting, interacting, and communicating with each other (Gau, 2007). Further research is necessary to determine the family correlates of Internet addiction in adolescents with ADHD.

The aim of this study was to examine the associations of demographic characteristics, reinforcement sensitivity, family factors, Internet activities engaged in, and parent-rated ADHD symptoms with the severity of Internet addiction in a clinical sample of adolescents in Taiwan diagnosed with ADHD.

2. Methods

2.1. Participants

The participants were recruited from the child and adolescent psychiatric outpatient clinics of two medical centers in Kaohsiung, Taiwan. Adolescents aged between 11 and 18 years diagnosed with ADHD according to the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders-IV Text Revision (DSM-IV-TR; American Psychiatric Association, 2000) were consecutively invited to participate in this study between November 2012 and November 2013. The diagnosis of ADHD was ascertained by applying multiple information recorded in the chart for the first visit to the psychiatric outpatient service, including (a) the results of the diagnostic interview with a child psychiatrist; (b) the results of clinical observation of the subject's behavior; and (c) the results of the short version of the parent-reported Swanson, Nolan, and Pelham Version IV Scale-Chinese version (SNAP-IV; Gau et al., 2008; Swanson et al., 2001). According to the norm developed based on the results of the SNAP-IV in a population of adolescents in Taiwan (Liu et al., 2006), those with a percentage score of 85 or higher had a high risk to have ADHD. Based on the results of chart recordings, clinical observation, and information provided by parents, adolescents who exhibited intellectual disability, schizophrenia, bipolar disorder, autistic disorder and difficulty communicating, or any cognitive deficits that prevented the children and adolescents from understanding the study purpose or completing the questionnaires were excluded. A total of 316 adolescents diagnosed with ADHD were invited to participate in this study. Among them, 287 (90.8%) agreed to participate and were interviewed by the research assistants based on the research questionnaire. Of the 29 adolescents who refused to join this study, 16 and 13 refused based on their parents' opinion and their personal opinion, respectively. The Institutional Review Boards of Kaohsiung Medical University and Chang Gung Memorial Hospital, Kaohsiung Medical Center approved the study.

2.2. Measures

2.2.1. Internet addiction and activities

We used the Chen Internet Addiction Scale (CIAS) to assess participants' severity of Internet addiction in the month preceding the study. The CIAS contains 26 items on a 4-point Likert scale with the scaled score ranging from 26 to 104 (Chen et al., 2003). A higher total score indicates a more severe level of Internet addiction. The internal reliability (Cronbach's α) of the CIAS in the present study was 0.94. We also requested participants to indicate the types of Internet activity in which they had participated in the preceding one month, including online gaming, online chatting, instant messaging, e-mail writing, bulletin board systems, watching movies, watching news, downloading, searching information, online shopping, online study, online gambling, and visiting adult sex Web sites (Lin et al., 2014). The Internet activities in which more than 5% of the participants reported to have participated were analyzed.

2.2.2. ADHD symptoms

The short version of the SNAP-IV-Chinese version was used to assess the severity of ADHD symptoms in the month preceding the study. The short version of the SNAP-IV-Chinese version is a 26-item rating instrument comprising the core DSM-IV-derived ADHD subscales of inattention, hyperactivity, impulsivity, and