



## Risk factors associated with online game addiction: A hierarchical model



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### ABSTRACT

Online gaming addiction has been increasingly recognized as a mental disorder. However, the predictive factors that lead to online gaming addiction are not well established. The aim of this study was to identify factors that may influence the development of online gaming addiction. A total of 263 patients with problematic online gaming addiction (255 males (97%) and 8 females (3%), age: mean = 20.4 ± 5.8 years) and 153 healthy comparison subjects (118 males (77%) and 35 females (23%), age: 21.2 ± 5.5 years, range) were recruited for participation in the current study. Hierarchical logistic regression analyses among each set of variables were conducted. Individual factors (sex and age), cognitive factors (IQ and perseverative errors), psychopathological conditions (ADHD, depression, anxiety, and impulsivity), and social interaction factors (family environment, social anxiety, and self-esteem) were evaluated in a stepwise fashion. All four factors were associated with online gaming addiction, with psychopathological conditions being the strongest risk factors for the addiction. Individual factors, psychological factors, and social interactions were associated with the development of pure online gaming addiction. As before, psychological factors (attention, mood, anxiety and impulsivity) were the strongest risk factors for online gaming addiction in patients with pure online gaming addiction. Psychopathologies, including ADHD and depression, were the strongest factors associated with the development of online gaming addiction in individuals.

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## 1. Introduction

Recently, it has been suggested that internet addiction is a mental health problem (Lam, Peng, Mai, & Jing, 2009). Internet addiction may impair daily life, academic performance, family relationships, and emotional development, particularly among adolescents. Since 1996, when the concept of “internet addiction” was introduced as a new clinical disorder, internet addiction has been studied in terms of the physical and psychological consequences, particularly in China, Korea, and Taiwan. However, the causes or aggravating factors that lead to internet addiction remain unknown, although many studies have attempted to explore its causes in terms of demographic factors, psychopathological conditions, psychosocial and family environment, and cognitive functions (Aboujaoude, Koran, Gamel, Large, & Serpe, 2006; Ha et al., 2006; Park et al., 2011; Tsai et al., 2009; Wang & Wang, 2013).

In general, individual factors related to online gaming addiction such as sex and age have been considered in previous studies. Most studies report that the male sex conveys a 2–3 times higher risk for internet addiction than the female sex (Lee, Han, Kim, & Renshaw, 2013; Sasmaz et al., 2014). In addition, older age has been reported to be a risk factor for internet addiction among adolescents (Ahmadi & Saghafi, 2013).

In terms of causal cognitive factors for online gaming addiction, IQ and cognitive flexibility have been considered. A study by Park et al. (2011) noted that adolescents with internet addiction have lower comprehensive sub-item scores on the Wechsler Adult Intelligence Scale (WAIS-R) in comparison to healthy control subjects. A study by Zhou, Yuan, and Yao (2012) indicated that patients with online gaming addiction demonstrate low mental flexibility and response inhibition in modified versions of go/no-go tests. In our previous study, patients with online gaming addiction showed increased numbers of perseverative responses and perseverative errors on the Wisconsin Card Sorting Test (Han, Lyoo, & Renshaw, 2012).

Psychopathological conditions that are often co-morbid with online gaming addiction, attention deficit and hyperactivity

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disorder (ADHD), major depressive disorder (MDD), anxiety, and impulsivity have been considered. Several previous studies of internet addiction have noted that some symptoms in patients with problematic internet use are the same as those observed in other psychopathologies (Aboujaoude et al., 2006). For example, ADHD and MDD are the most frequent comorbid disorders in a South Korean sample population, and the clinical characteristics of internet addiction are similar to clinical symptoms in patients with ADHD or MDD (Ha et al., 2006; Park, Lee, Kim, Jeong, & Han, 2013; Yoo et al., 2004). In a survey of 987 Indian adolescents (Goel, Subramanyam, & Kamath, 2013), adolescents with higher internet addiction score also show higher scores on anxiety and depression scales. The association between violent games and aggressive behavior is controversial. The association between violent games and aggressive behavior is controversial. Past study suggested the correlation between violent video game and aggressive behavior in healthy subjects (Anderson & Dill, 2000). However, a recent time series analysis and meta-analysis have shown that violent films are negatively correlated with aggressive behaviors (Markey, French, & Markey, in press), and there is no evidence that violent video games increase aggression in children (Ferguson, in press).

In terms of social interaction factors that have been related to online gaming addiction, family environment, social anxiety, and self-esteem have been considered. Based on an online survey of 1642 people (19–60 years of age), Wang and Wang (2013) reported that excessive internet use is motivated by cyberspace social encounters in individuals with poor offline social support, including support from family members. However, based on a survey of 2348 college students, Yen et al. (2012) suggested that the internet is a good alternative outlet for individuals with social anxiety. In contrast, Lee and Stapinski (2012) reported that online communication exacerbates face-to-face avoidance in individuals with higher levels of perceived social anxiety.

Self-esteem is thought to mediate social interactions and preference for online social interactions (Caplan, 2005; Fioravanti, Dettore, & Casale, 2012; Stinson et al., 2008). Bozoglan, Demirel, and Sahin (2013) found that low self-esteem was associated with internet addiction in a sample of Turkish university students 18–24 years of age. A study by Lemenger et al. (2013) reported self-confidence deficits in individuals characterized as major users of multiplayer online role-playing games.

Each of these studies, however, focused on only one or two independent factors, without considering the hierarchical importance among variable risk factors. As observed in other addiction disorders as well as in child and adolescent disorders (Lee et al., 2013), identifying the hierarchical importance of risk factors for online gaming addiction may influence policy and treatment. Based on patients with online gaming addiction consecutively referred to the Online Game Clinic Center at OO University Hospital, we aimed to assess the hierarchical importance among individual factors, cognitive functions, psychopathological conditions, and levels of psychosocial and family support in patients with online gaming addiction.

## 2. Method

### 2.1. Participants

The current study screened 308 patients with problematic online gaming habits (296 males (96%) and 12 females (4%)), age: mean = 21.0 ± 5.9 years, range: 12–45 years) who visited the Online Game Clinic Center at OO University Hospital from June 2011 to March 2013. Through advertisements posted at OO University and OO University Medical Center, 153 healthy comparison subjects (118 males (77%) and 35 females (23%)), age:

21.2 ± 5.5 years, range: 13–40 years) were recruited to voluntarily participate in the study. Both the patients and the control subjects were screened with the Structured Clinical Interview for DSM-IV (Ha et al., 2006; Kusumakar, MacMaster, Gates, Sparkes, & Khan, 2001), and patients were secondarily diagnosed with comorbidities by two child and adolescent psychiatrists. All subjects were asked to complete questionnaires regarding the severity of internet addiction, individual factors, family environment, social interactions, and comorbidities.

The criteria for online game addiction in the current study were similar to those employed in other previous studies (Han, Hwang, & Renshaw, 2010; Ko et al., 2009). Factors associated with addiction included: (1) online game playing through the internet, more than 4 h per day or 30 h per week, (2) Internet Addiction Scale score >50 (Young, 1996), (3) irritable, anxious, and aggressive behaviors when compelled to stop online game playing, (4) impaired behaviors or distress, economic problems, or maladaptive patterns of regular life due to excessive online game play, and (5) irregular life patterns due to disrupted diurnal rhythms (e.g., sleeping during the day and gaming at night, irregular meals, and failure to maintain personal hygiene), school truancy, or loss of job.

Exclusion criteria included: (1) a history or current episode of other Axis I psychiatric diseases, with the exception of MDD and ADHD, (2) IQ < 80, (3) substance abuse history, with the exception of alcohol or tobacco abuse, and (4) neurological or medical disorder. Ultimately, 263 patients with online gaming addiction (255 males (97%) and 8 females (3%)), age: mean = 20.4 ± 5.8 years, range: 12–45 years), consisting of 109 with only online gaming addiction (referred to herein as pure online gaming addiction), 92 with online gaming addiction and ADHD, and 62 with online gaming addiction and MDD, were included in the study. The patients excluded were 14 patients with multiple diagnoses of online gaming addiction plus ADHD and major depression, 11 patients with schizophrenia, 5 patients with obsessive–compulsive disorder, 4 patients with alcohol dependence, 7 patients with autism spectrum disorders, and 4 patients with mental retardation. The research protocol for the current study was approved by the OO University Hospital Institutional Review Board. Written informed consent was provided by patients older than 18 years. In adolescents younger than 18 years, written informed consent was provided by parents and adolescents.

### 2.2. Independent factors

#### 2.2.1. Individual factors

For sex, 'male' was coded as '1' and female was coded as '0.' For age, the chronological age of each patients was recorded.

#### 2.2.2. Cognitive functions

2.2.2.1. *Korean-Wechsler Adult Intelligent Scale (K-WAIS)*. The K-WAIS was used to assess the IQ of each subject (Kim, Yum, Oh, Park, & Lee, 1992). The standardized WAIS is the most widely used intelligence test. The K-WAIS-IV is designed for persons 16–69 years of age and is the latest revision, comprising 10 subtests and a composite score. The internal consistency of the K-WAIS has been reported to range from 0.78 to 0.94 (Kim et al., 1992).

2.2.2.2. *Wisconsin card sorting test*. A computerized version of the Wisconsin Card Sorting Test was used to assess executive function, including set shifting, working memory, and inhibitory control processes in all subjects (CNT4.0, Maxmedica Inc.) (Lee, Shin, Lee, & Lee, 2002). The reliability of the test has been reported to have a Cronbach's  $\alpha$  of 0.783 (Lee et al., 2002). The WCST sub-item to evaluate perseverative errors, represented by set shifting, is thought to be associated with prefrontal cortex function (Pedersen et al., 2012). Perseverative errors occur when subjects

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