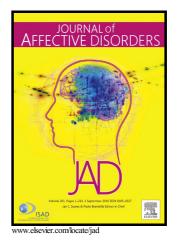# Author's Accepted Manuscript

Prevalence and correlates of comorbid depression in a nonclinical online sample with DSM-5 internet gaming disorder

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Prevalence and correlates of comorbid depression in a nonclinical online sample with DSM-5 internet gaming disorder

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ABSTRACT

Background

We investigated the prevalence and correlates of comorbid depression among patients with internet gaming disorder using the Internet Gaming Disorder scale (IGD-9) and the Patient Health Questionnaire-9 (PHQ-9) among nonclinical online survey respondents.

Methods

Korean adolescents and adults from 14-39 years of age were selected. We compared internet gaming use patterns and sociodemographic and clinical variables between patients with internet gaming disorder who had depression and those without depression.

Results

In 2016, 7,200 people participated in an online survey. Respondents with internet gaming disorder that was comorbid with depression were older, more often female, had greater Internet Addiction Test total scores, Alcohol Use Disorder Identification Test total scores, Generalized Anxiety Disorder Scale-7 total scores, Fagerstrom Test for Nicotine Dependence total scores, and higher Dickman Dysfunctional Impulsivity Instrument dysfunctional subscale scores than those without depression. The binary logistic regression analysis revealed that female gender, problematic alcohol use, anxiety, and a past history of psychiatric counseling or treatment due to internet gaming use were significant predictors for comorbid depression among participants

with internet gaming disorder.

Conclusion

Depression was a common comorbidity of internet gaming disorder. Internet gaming disorder with comorbid depression was related to more serious psychiatric phenomenology and a greater psychiatric burden.

Key Words: DSM-5; internet gaming disorder; depression; comorbidity; predictor

1. Introduction

Internet gaming is a popular activity among children, adolescents and young adults worldwide (Gentile, 2009), and a significant portion of these populations engage in uncontrollable and problematic gaming behaviors (Argyriou et al., 2017). Problematic internet gaming use has attracted much social concern, and many reports regarding problematic internet gaming have been published. However, so far, the prevalence of problematic internet gaming has varied considerably due to the heterogeneity of its definition and screening methods.

In response to rising concerns about and requests for a consensus in its diagnostic criteria, internet gaming disorder was first introduced as a condition for further study in Section III of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and was defined as the recurrent and persistent use of internet games leading to significant psychosocial functional impairment. Since this introduction, increasing numbers of studies investigating the prevalence of internet gaming disorder and its associated psychiatric symptoms have been conducted. The prevalence of internet gaming disorder based on DSM-5 criteria has varied from 1.16 to 5.9% depending upon the characteristics of the included population and also the study's methods of recruitment (Kaess et al., 2017). As a behavioral addiction, internet gaming disorder is known to be associated with various cognitive and psychiatric comorbidities, such as depression, anxiety and attention deficit hyperactivity disorder (ADHD) (Ha et al., 2006; Kim et al., 2016).

Depression is a chronic mental illness associated with significant morbidity and is a common comorbid condition in patients with other addictive disorders (Morozova et al., 2015; Neupane, 2016). Comorbid conditions that include depression and other addictive disorders lead to a greater disease burden and a poorer treatment outcome compared to either condition alone (Riper et al., 2014). In addition to other addictive disorders, depression is one common psychiatric comorbid condition among patients with internet gaming disorder (Kaess et al., 2017; Kim et al., 2016). However, little is known regarding the effects of comorbid depression on the disease characteristics and prognosis of internet gaming disorder. Therefore, we investigated the prevalence and correlates of comorbid depression among people with internet gaming disorder using a large-sample online survey of nonclinical adolescents and adults.

2. Methods

2.1 Participants and Study process

An internet-based observational study was conducted as an online survey in Korea. Participants with 14-39 years of age were recruited from a pool of panelists registered for online panels at Panel Marketing Interactive (PMI), a research company, that provides survey-related technology and data collection. The participants were given tokens that could be used in lieu of money online, as an incentive for their participation. The Institutional Review Board (IRB) of Seoul St. Mary's Hospital approved this study.

2.2 Assessment

Respondents were questioned on sociodemographic and clinical variables, pattern of internet gaming use and several self-report scales. The variables included gender, age, socioeconomic status (SES), marital status, and any prior history of psychiatric counseling or treatment due to problematic internet gaming use.

To obtain information regarding anxiety symptoms, alcohol consumption problems and the severity of nicotine dependence, we administered the Generalized Anxiety Disorder Scale-7 (GAD-7) (Spitzer et al., 2006), the Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993) and the Fagerstrom Test for Nicotine Dependence (FTND) (Heatherton et al., 1991). The GAD-7 is composed of seven items and is a screening instrument for generalized anxiety disorder. A previous validation study demonstrated its good reliability and validity and suggested a score of 10 as an optimal cutoff value. (Spitzer et al., 2006) The AUDIT is a screening scale for alcohol use problems that is composed of 10 items. (Saunders et al., 1993) Kim et al.'s study demonstrated the validity of the Korean version of the AUDIT and suggested a score of 12 as the optimal cutoff value. (Kim et al., 2008) The FTND contains 6 items, with higher scores indicating a more intense dependence on nicotine. (Heatherton et al., 1991) The validity and accuracy of the FTND were demonstrated in a previous review. (Meneses-Gaya et al., 2009) We selected a cutoff value of 4 to screen for clinically significant nicotine dependence as suggested by Ahn et al. (2002)

To evaluate information regarding self-control, we administered the Brief Self-Control Scale (BSCS) (Hong et al., 2012). The BSCS was originally developed by Tangney et al.(Tangney et al., 2004) and is composed of 13 items using a 5-point Likert-scale from 1 to 5, with higher scores indicating poorer self-control. Its acceptable performance has been shown to predict undesirable behaviors in previous studies. (de Ridder et al.,2012, Wolff et al., 2016) To investigate impulsivity, the Dickman Dysfunctional Impulsivity Instrument (DFDII) was administered (Dickman, 1990). The DFDII includes 23 items that measure functional and dysfunctional impulsivity. Functional impulsivity indicates a "quick and inaccurate response" leading to a beneficial outcome, whereas dysfunctional impulsivity suggests a "quick and inaccurate response" that produces

a negative outcome. Functional impulsivity was measured with 11 items, and dysfunctional impulsivity was assessed using 12 items. Higher scores on the 12 items of dysfunctional impulsivity indicate a higher level of impulsivity resulting in a negative outcome. It has shown good reliability and validity in previous studies. (Chico et al., 2003, Dickman, 1990) To obtain information regarding internet gaming use patterns and the severity of internet use problems, we gathered information regarding the number of days per week spent playing internet games and administered the Internet Addiction Test (IAT). (Young, 1998) The IAT is a popular screening tool for internet addiction that is composed of 20 questions using a 5-point Likert scale from 1 to 5 (Ghassemzadeh et al., 2008; Villella et al., 2011). Its validity and reliability were proven in a previous study. (Widyanto et al., 2004)

To screen for internet gaming disorder, we developed a self-report scale composed of 9 items suggested by the DSM-5 internet gaming disorder criteria (the IGD-9 scale). The respondents were asked to answer each item with either "yes" or "no", and the total number of 'affirmative answers' was defined as the total score of the IGD-9 scale. To define the IGD-9 positivity, we adopted a cutoff value of 5 ("yes" to 5 or more items), suggested by the DSM-5. To screen for depression, the Patient Health Questionnaire-9 (PHQ-9) was administered. The PHQ-9 is composed of 9 items that measure the symptoms of major depression based on the criteria of the DSM-IV(Spitzer et al., 1999). To define PHQ positivity, we adopted a cutoff value of 10 as suggested by Koenke et al. (2001).

2.3 Statistical analyses

We selected participants who met the criteria for internet gaming disorder (as defined by IGD-9 positivity) from the entire sample that participated in this online survey. Then, the participants with internet gaming disorder were categorized into two groups according to whether they were PHQ-9 positive. The "pure IGD group" was composed of those who were PHQ-9 negative, while the "comorbid depression group" included people who were PHQ-9 positive. Factors related to sociodemographic and clinical variables were also compared between the two groups. For continuous variables, an analysis of variance (ANOVA) was conducted, and Pearson's Chi-square test was performed for categorical variables. To identify predictors for comorbid depression of internet gaming disorder, a binary logistic regression analysis was conducted. The Statistical Package for the Social Sciences, Version 18(SPSS Inc., Chicago, IL, USA) was used for the statistical analyses. A p-value <0.05 was defined as statistical significance.

3. Results

In total, 9,474 people were contacted, and among them, 7,200 people (76% of those contacted) participated in our online survey. Of these 7,200, 3,200 (44.4%) were male and 4,000 (55.6%) were female; 774 (10.8%) met the criteria for internet gaming disorder defined by IGD-9 positivity. The participants with internet gaming disorder (n=774) were older (p=0.001), were more likely to be male (p<0.001), had higher IAT total scores (p<0.001), a higher number of days spent using internet games per week (p<0.001), greater AUDIT total scores (p<0.001), and higher FTND total scores (p<0.001) than the remaining respondents without internet gaming disorder (n=6,426) (Table 1).

Among the 774 people who met the criteria for internet gaming disorder, 482 (62.3%) also satisfied the criteria for depression as defined by PHQ-9 positivity (comorbid depression group); the remaining 292 (37.7%) did not meet the criteria for depression (pure IGD group). The mean age of the 774 participants was 24.97 (SD 6.97) years. The comorbid depression group showed a significantly higher mean age than the pure IGD group (25.70±6.78 vs. 23.76±7.12 years, p<0.001). The comorbid depression group were more likely to be female than the pure IGD group (44.8% vs. 34.2%, respectively, p=0.004). The comorbid depression group were more likely to be married than the pure IGD group (21.6% vs. 11.6%, respectively), whereas the pure IGD group had a higher prevalence of being single than the comorbid depression group (86.6% vs. 72.8%, respectively, p<0.001) (Table 2).

There was no significant difference in the number of days spent using internet games per week between the two groups (5.21±1.73 days in the pure IGD group vs. 5.04±1.70 days in the comorbid depression group, p=0.177). The comorbid depression group showed higher IAT total scores than the pure IGD group (58.41±26.79 vs. 51.00±24.22, p<0.001). There was no significant difference in total DFDII functional subscales scores between the two groups (5.08±2.18 in the comorbid depression group vs. 5.28±2.45 in the pure IGD group, p=0.239). The comorbid depression group showed higher total scores on the DFDII dysfunctional subscales (6.12±2.20 vs. 5.68±2.81, p=0.022), GAD-7 scores (11.18±4.11 vs. 4.04±3.05, p<0.001), BSCS scores (42.46±5.74 vs. 39.51±6.31, p<0.001), AUDIT scores (11.13±11.01 vs. 6.33±8.08, p<0.001) and FTND scores (1.28±2.45 vs. 0.63±1.75, p<0.001) compared to the pure IGD group. The comorbid depression group demonstrated a higher incidence of past psychiatric counseling or treatment due to problematic internet gaming use compared to the pure IGD group (18.7% vs. 4.8%, respectively, p<0.001). The comorbid depression group also showed a higher prevalence of AUDIT positivity (defined by AUDIT total scores ≥ 12, p<0.001), GAD-7 positivity (defined by GAD-7 total scores ≥ 10, p<0.001) and FTND positivity (defined by FTND total scores ≥

4, p<0.001) than the pure IGD group. (Table 3)

A binary logistic regression analysis revealed that female gender (odds ratio (OR)= 1.889, 95% confidence interval (CI) 1.178-3.028, p=0.008), a past history of psychiatric counseling or treatment due to problematic internet gaming use (OR=3.036, 95% CI 1.312-7.021, p=0.009), AUDIT positivity (OR=1.855, 95% CI 1.081-3.183, p=0.025), and GAD-7 positivity (OR=35.084, 95% CI 18.408-66.869, p<0.001) were all significant predictors for comorbid depression and internet gaming disorder (Table 4).

The internal consistencies of the instruments used in this study were relatively good. The Cronbach's alpha of the IAT, AUDIT, GAD-7, BSCS, and PHQ-9 was 0.983, 0.983, 0.892, 0.828, and 0.864, respectively.

4. Discussion

We found that the prevalence of internet gaming disorder as defined by IGD-9 positivity among nonclinical online survey respondents was 10.8% (77.4/7200). We also concluded that depression is a common comorbidity of internet gaming disorder. In this study, the prevalence of comorbid depression among participants with internet gaming disorder was 2.59 times as high as that of people without internet gaming disorder. The prevalence of internet gaming disorder (10.8%) in our study was a little higher than has been previously reported. This prevalence was determined using self-report scales based on DSM-5 criteria that varied according to the characteristics of the included population and also the type of self-report scales that were used. Kiraly et al.(2017) used the Ten-item Internet Gaming Disorder Test composed of ten items based on operationalized DSM-5 criteria requiring yes or no answers and found that 2.9% of 4887 online gamers met the criteria for internet gaming disorder. Pontes et al. (2016) employed a self-report scale called the Nine-item Internet Gaming Disorder Scale-Short-Form consisting of nine items derived from DSM-5 answerable on a 5-point Likert scale and found that 2.5% of the 1,071 respondents met the criteria for internet gaming disorder among nationally representative adolescent samples. Yu et al. (2016) used a self-report scale called the Internet Gaming Disorder Scale composed of nine items based on the "Internet Use Disorder" criteria suggested by the DSM-5 Task Force and Work Groups and reported that 5.9% of the included national sample (n=2,024) met the criteria for internet gaming disorder. The finding that the prevalence of internet gaming disorder in our study (10.8%) was higher than that reported in Kiraly's(2017) study (2.9%) and Pontes'(2016) study (2.5%) is in line with prior evidence showing a higher prevalence of internet gaming disorder in Asian countries compared with Western countries (Kaess et al., 2017). Yu's study (2016) was conducted among Korean middle school students

randomly selected through a cluster sampling design instead of using an online environment (Yu and Cho, 2016). Thus, differences in the measurements used and the methods of recruitment and the characteristics of the included populations (i.e., nationally representative adolescent samples vs. online survey respondent samples) may have led to the differences in the prevalence of internet gaming disorder between Yu's study and our own.

In this study, female gender, problematic alcohol use, anxiety symptoms, and a history of previous psychiatric counseling or treatment due to problematic internet gaming use were shown to be significant predictors for comorbid depression and internet gaming disorder. In terms of gender, prior evidence indicated that male gender was a predictor for internet gaming disorder, which suggests that males have a higher likelihood of engaging in internet games (Chen et al., 2015; Finkenauer et al., 2012; Tsai et al., 2009). In contrast, it is well-known that female gender is associated with a higher vulnerability to depression (Bekhbat and Neigh, 2017). Females report twofold higher rates of major depression compared to males (Derry et al., 2015). In our original sample (n=7,200), the prevalence of internet gaming disorder was 14.3% (458/3200) among males and 7.9% (316/4000) in females; the higher prevalence for males was consistent with previous findings. However, among patients with internet gaming disorder, female prevalence was higher in the comorbid depression group than in the pure IGD group. This finding suggests that even though internet gaming disorder is more prevalent among males, being female could be a risk factor for a poorer prognosis of internet gaming disorder (i.e., comorbid depression).

Depression is often comorbid with alcohol use disorder and is related to younger age of onset, higher impulsivity, a greater rate of dependence on other substances or a past abuse history, and more suicide risk (Sher et al., 2008). Internet gaming disorder is also related to alcohol use disorder (Jorgenson et al., 2016). However, so far, little prior evidence exists regarding whether internet gaming disorder comorbid with problematic alcohol use is associated with a poorer clinical outcome than internet gaming disorder alone. Thus, our study findings are meaningful in that we showed the addition of problematic alcohol use to internet gaming disorder contributes to a more severe psychiatric phenomenology. In addition to alcohol use disorder, anxiety symptoms were also found to predict comorbid depression and internet gaming disorder in this study. Previous studies have revealed that patients with internet gaming disorder present with greater anxiety symptoms compared to those without internet gaming disorder (Kaess et al., 2017; Pearcy et al., 2017). Anxiety symptoms are associated with a poorer prognosis, such as higher suicidality and greater treatment resistance (Dold et al., 2017; Nishiyama and Matsumoto, 2013). In line with previous studies, our investigation also provided additional evidence that anxiety symptoms in patient with internet gaming disorder were related to comorbid depression, and therefore a

greater psychiatric burden and more severe psychiatric symptomatology. In this study, a previous history of psychiatric counseling or treatment due to problematic internet gaming use also significantly predicted comorbid depression, which was in agreement with previous findings that indicated psychiatric comorbidities were significantly associated with increased psychiatric service utilization (Birgenheir et al., 2014; Bowe and Rosenheck, 2015). This trend could be explained by the fact that people who are depressed or who experience greater distress feel a need for psychiatric treatment or evaluation due to their uncontrolled internet gaming use, but this topic requires further study. Nevertheless, we could conclude that comorbidity between internet gaming disorder and depression is related to a more serious psychiatric burden and severe psychiatric phenomenology.

Regardless of whether addiction is substance-related or behavioral, it is still known to be associated with an increased risk for depression (de Graaf et al., 2004; Gilman and Abraham, 2001; Lalanne et al., 2014; Spak et al., 2000). The comorbidity between addiction and depression is also correlated with longer illness duration, greater functional impairment and less social competence (de Graaf et al., 2004; Lalanne et al., 2014). As a result, our study also has important clinical implications for confirming that internet gaming disorder (as a behavioral addiction) comorbid with depression is also related to more severe psychiatric symptomatology and poorer clinical outcomes (Lalanne et al., 2014). Previous electroencephalogram studies have reported that patients with internet gaming disorder comorbid with depression showed different neurophysiological features compared with those with internet gaming disorder without depression(Lee et al., 2014; Son et al., 2015). These previous findings as well as ours suggest that comorbid depression could negatively influence the brain function of patients with internet gaming disorder. Considering the greater psychiatric burden that accompanies comorbid conditions, our study findings provide evidence for the necessity of early screening for comorbid depression among internet gaming disorder risk groups.

This study has several limitations. First, we used the IGD-9 scale that included 9 items from the DSM-5 criteria requiring answers of either yes or no. The survey was administered online, so face-to-face diagnoses by psychiatrists were not possible. Since the introduction of internet gaming disorder in Section III of the DSM-5, many studies have been published regarding the prevalence of this disorder. However, most of these studies have used various self-report scales to apply DSM-5 criteria rather than a psychiatrist's face-to-face diagnosis (Kiraly et al., 2017; Monacis et al., 2016) because many studies regarding the prevalence of internet gaming disorder often require large-scale samples or online mass-screening due to the disease characteristics of internet gaming disorder itself. Considering this, future studies that investigate the usefulness of various self-report scales based on DSM-5 criteria that can be efficiently administered online are needed. Second, this study

was conducted with a sample of online survey respondents, and thus cannot be declared a representative sample. It is possible that people who worry more excessively about their uncontrolled internet gaming use were more likely to participate in this online survey. In addition to this possibility, people who engaged in internet use more, due to their familiarity with internet surfing, were more likely to participate in this survey. All these characteristics of our sample might have produced an overestimated prevalence of internet gaming disorder relative to the general population. Third, this was a cross-sectional observational study, so we could not identify a causal relationship between various characteristics and comorbid depression. Future studies with a prospective design among representative samples should be conducted to complement the results of this investigation.

In conclusion, this study found that depression is a common comorbid condition among patients with internet gaming disorder. In addition, the comorbidity of internet gaming disorder and depression was significantly related to female gender, more serious psychiatric phenomenology (i.e., anxiety or alcohol use disorder) and increased psychiatric service utilization. Although the PHQ-9 and IGD-9 scales are not standardized diagnostic tools for case findings, their co-administration was effective in screening a high-risk population that requires early and intensive psychiatric evaluation in an online environment.

Author Disclosure

* The contributor – nothing to declare

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Conflict of interest statement

No conflicts declared.

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Table 1 Sociodemographic characteristics of the original study sample.

	IGD-9 negative	IGD-9 positive	t or Chi square	P value
N	6426	774		
Age	24.05±6.70	24.97±6.97	-3.484	0.001
Gender (male %)	42.7	59.2	76.193	<0.001
IAT total	33.92±20.22	55.61±26.09	-22.346	<0.001
Days spent internet gaming per week	4.21±1.94	5.10±1.71	-13.087	<0.001
IGD-9 total score	0.86±1.19	6.24±1.21	-116.763	<0.001
AUDIT total score	4.90±6.99	9.32±10.27	-11.674	<0.001
FTND total score	0.29±1.10	1.04±2.24	-9.182	<0.001

AUDIT, the Alcohol Use Disorder Identification Test; FTND, the Fagerstrom Test for Nicotinic Dependence; IAT, the Internet Addiction Test; IGD-9, the Internet Gaming Disorder scale.

Table 2 Sociodemographic characteristics of study participants with internet gaming disorder.

	Pure IGD group	Comorbid depression group	t or Chi square	P value
N	292	482		
Age	23.76±7.12	25.70±6.78	-3.777	<0.001
Male (%)	65.8	55.2	8.404	0.004
Marrital status (%)			21.987	<0.001
Single	86.6	72.8		
Cohabitating	1.0	2.9		
Married	11.6	21.6		
Divorced	0.7	1.5		
Separated	0.0	1.2		
SES			3.917	0.417
Low	7.9	8.9		
Middle-low	28.1	23.9		
Middle	46.9	45.2		
High-middle	15.4	19.3		
High-middle	1.7	2.7		

Table 3 Internet use pattern and clinical variables of study participants with internet gaming disorder.

	Pure IGD group	Comorbid depression group	t or Chi square	p
N	292	482		
Days spent internet gaming per week	5.21±1.73	5.04±1.70	1.350	0.177
IAT total score	51.00±24.22	58.41±26.79	-3.864	<0.001
DFDII functional total score	5.28±2.45	5.08±2.18	1.178	0.239
DFDII dysfunctional total score	5.68±2.81	6.12±2.20	-2.306	0.022
GAD total	4.04±3.05	11.18±4.11	-27.606	<0.001
BSCS total	39.51±6.31	42.46±5.74	-6.658	<0.001
AUDIT total	6.33±8.08	11.13±11.01	-6.965	<0.001
FTND_total	0.63±1.75	1.28±2.45	-4.315	<0.001
History of psychiatric counseling or treatment d/t an internet gaming use problem (%)	4.8	18.7	30.109	<0.001
AUDIT positivity (%)	25.3	48.8	41.559	<0.001
GAD-7 positivity (%)	5.0	69.0	241.007	<0.001
FTND positivity (%)	8.2	19.9	18.994	<0.001

AUDIT, the Alcohol Use Disorder Identification Test; BSCS, the Brief Self-Control Scale; DFDII, the Dickman Dysfunctional Impulsivity Instrument; FTND, the Fagerstrom Test for Nicotinic Dependence; GAD-7, the Generalized Anxiety Disorder Scale 7; IAT, the Internet Addiction Test.

Table 4 Logistic regression results for predicting comorbid depression among participants with internet gaming disorder

	Odds Ratio (95% CI)	*p* value
Age	1.017 (0.985-1.050)	0.301
Female gender	**1.889 (1.178-3.028)**	**0.008**
IAT total score	1.004 (0.995-1.014)	0.354
DFDII dysfunctional total scores	1.051 (0.959-1.153)	0.288
BSCS total scores	1.019 (0.977-1.062)	0.383
Past history of psychiatric counseling or treatment d/t problematic internet gaming use	**3.036 (1.312-7.021)**	**0.009**
AUDIT positivity	**1.855 (1.081-3.183)**	**0.025**
GAD-7 positivity	**35.084 (18.408-66.869)**	**<0.001**
FTND positivity	1.117 (0.502-2.488)	0.787

AUDIT, the Alcohol Use Disorder Identification Test; BSCS, the Brief Self-Control Scale; DFDII, the Dickman Dysfunctional Impulsivity Instrument; FTND, the Fagerstrom Test for Nicotinic Dependence; GAD-7, the Generalized Anxiety Disorder Scale 7; IAT, the Internet Addiction Test.

Highlights

▶ Depression is a common comorbid condition among patients with IGD.

▶ The comorbid condition is associated with serious clinical phenomenology.

▶ Co-administration of IGD-9 and PHQ-9 is useful in screening comorbid condition.