Evaluation of the diagnostic criteria of Internet gaming disorder in the DSM-5 among young adults in Taiwan

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\textbf{A B S T R A C T}

The DSM-5 proposed the diagnostic criteria of Internet gaming disorder (IGD) and suggested that more evidence is necessary before it is included as a standard disorder in the DSM system. The aims of this study were to: 1) evaluate the diagnostic validity of individual criteria of IGD in the DSM-5 and the criteria of craving and irritability; 2) determine the optimal cut-off point for the IGD criteria in the DSM-5. We recruited 75 subjects with IGD, 75 without IGD, and 75 in remission from IGD based on the Diagnostic Criteria of Internet Addiction for College Students (DC-IA-C). All participants underwent a diagnostic interview based on the diagnostic criteria of IGD in the DSM-5 and completed the CIAS and Diagnostic Criteria of Internet Addiction for College Students (DC-IA-C). We found that the individual criteria of craving and irritability had diagnostic accuracy ranging from 77.3% to 94.7% to differentiate university students with IGD from remitted students. The criterion of craving had diagnostic accuracy of 88% and the criteria of irritability had an accuracy of 68.7%. Filling 5 or more criteria of IGD in the DSM-5 was the best cut-off point to differentiate young adults with IGD from healthy or remitted users.

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1. Introduction

Internet gaming is one Internet activity. Excessive and prolonged Internet gaming results in negative consequences, such as impaired real-life relationships or academic performance (Kuss et al., 2013). Loss control of Internet gaming presents a cluster of cognitive and behavioral symptoms analogous to the symptoms of substance use disorder. As it is of significance to determine the disorder classification of IGD, impulsivity, a central factor involved in the etiology of addictive behaviors, has been reported to be associated with and predict IGD (Gentile et al., 2011; Metcalf and Pammer, 2013). Impaired response inhibition, error processing, cognitive flexibility, and decision-making have been reported in IGD and might contribute to loss of control and continued online gaming despite negative consequences (Littell et al., 2012; Pawlikowski and Brand, 2011; Zhou et al., 2012; Ko et al., 2014). IGD also shows a cue-induced brain craving response and implicit reaction in cognitive tasks similar to substance craving (Ko et al., 2013a,b; Yen et al., 2011). Further, IGD shares similarities in comorbidities, such as social anxiety disorder, attention deficit and hyperactivity disorder and depression (Gentile et al., 2011; Ko et al., 2008; Kuss and Griffiths, 2011), and psychological factors, such as novelty seeking or low self-esteem (Ko et al., 2006, 2007; Kuss et al., 2013). These results indicate that IGD may share similarities in presentation or mechanism with substance use disorder. However, some essential factors, such as motivation or...
gaming characteristics, are specific to IGD (Kuss and Griffiths, 2011). Use of Internet gaming for immersion, achievement, escapism and socializing motives has been suggested to be associated with IGD (Billieux et al., 2011; Zanetta Dauriat et al., 2011). Thus, it is essential to develop a validated definition and evaluation tool to identify subjects with IGD for further detailed research of its nature and mechanisms.

However, most previously proposed diagnostic criteria were for a broad spectrum of addictive behaviors related to the Internet, but not specific for IGD. Loss of control of Internet use with impairment of psychosocial functions has been described as Compulsive Internet use (Sadock and Sadock, 2007), problematic Internet use (Shapira et al., 2000), internet addiction (Ko et al., 2009b), and Internet use disorder in the proposed DSM-5 (American Psychiatric Association, 2012). Anderson used seven true-false questions that closely paralleled the DSM-IV criteria of substance dependence to define Internet dependence (Anderson, 2001). Young modified the DSM-IV criteria of pathological gambling to define pathological Internet use (Young, 1998). Shapira and colleagues proposed diagnostic criteria for problematic Internet use according to the concepts of impulse control disorder in the DSM-IV-TR (Shapira et al., 2000). However, these diagnostic criteria were established based on the researchers’ reviews of the literature, and empirical evidence to support the contents and cut-off point is lacking. Tao and colleagues used “loss of interest in previous hobbies and entertainment as a result of Internet gaming” and “time consumption of at least 6 h per day on the Internet” as criteria for Internet addiction (Tao et al., 2010).

However, Internet use includes a variety of activities, such as gaming, cybersex, downloading, social networking, and gambling. The high heterogeneity makes it difficult to define these behaviors by distinct criteria. As there are factors, such as motivation factors or structure characteristics of individual Internet activities (Billieux, 2012), associated with addiction to specific Internet activities, it has been suggested that Internet addiction should be replaced by addictions to specific Internet activities (Starcevic, 2013). On the other hand, the general characteristics of the Internet, such as anonymity, high availability, or information and efficiency, might also be associated with Internet addiction (Chiang and Su, 2012). Further, it is also impractical to define addiction to every Internet activity as a distinct disorder. How to define the highly heterogenous spectrum of addictive behavior related to Internet activities deserves further research.

Ko and colleagues proposed the Diagnostic Criteria of Internet Addiction (DC-IA) for adolescents (Ko et al., 2005) and for college students (Ko et al., 2009b) based on empirical data collected by systemic diagnostic interview. A total of 13 candidate criteria according to the DSM-IV-TR criteria for impulse control disorder and substance use disorder and clinical experience were selected for testing of their diagnostic accuracy for Internet addiction among adolescents in a randomly selected sample from junior and senior high schools (Ko et al., 2005). Internet addiction was defined based on the clinical diagnosis of a psychiatrist in a semi-structure interviewing. The results demonstrated that nine criteria, including preoccupation, uncontrolled impulse, usage more than intended, tolerance, withdrawal, impairment of control, excessive time and effort spent on the Internet, and continued excessive use despite psychosocial problems, have a 79.3-85.9% diagnostic accuracy. Further analysis revealed that 6 or more criteria was the best cut-off point. It also raised the necessity of taking functional impairment and exclusion criteria into consideration to make a diagnosis based on the DC-IA. This results in diagnostic accuracy of 95%. Then, the DC-IA was validated again among college students, with diagnostic accuracy of 95.9% (Ko et al., 2009b). The DC-IA has been used in several studies of adolescents (Ko et al., 2009c) and young adults (Ko et al., 2013a). Further, the same criteria have been used to evaluate online gaming behavior to identify cases of Internet gaming disorder (Yen et al., 2011; Ko et al., 2013a,b) to evaluate their neuropsychological characteristics. The revised diagnostic criteria of the DC-IA specific for online gaming behavior can be used as a reference to examine the validity of new criteria proposed for diagnosing Internet gaming disorder.

The criteria of IGD proposed in the DSM-5 include 9 items: preoccupation, withdrawal, tolerance, unsuccessful attempts to control, loss of interests, continued excessive use despite psycho-social problems, deceiving, escape, and functional impairment (American Psychiatric Association, 2013). The deceiving, escape, and preoccupation criteria are similar to the criteria of gambling disorder (American Psychiatric Association, 2013). The criterion of loss of interest was adopted from the criteria proposed by Tao et al. (2010). The other criteria are similar to those of substance use disorder in the DSM-IV. Five or more of the nine criteria should be fulfilled to diagnose IGD in the DSM-5. However, the DSM-5 suggests that optimal criteria and the threshold for the diagnosis of IGD should be determined empirically by further study (American Psychiatric Association, 2013). Thus, it is necessary to determine the diagnostic validity of individual criteria and determine the best cut-off point of the criteria for IGD based on empirical studies.

It is noteworthy that craving and irritability are not included in the diagnostic criteria of IGD in the DSM-5. The DSM-5 includes craving as one of the diagnostic criteria of substance use disorder (American Psychiatric Association, 2013). Research has found that craving forms a uni-dimensional latent trait for alcohol, cannabis, cocaine and heroin use (Hasin et al., 2012). Craving symptoms have also been reported in individuals with IGD (Ko et al., 2013a). The gaming cue-induced craving response drives the brain to activate the reward system (Ko et al., 2009a). A head-to-head comparison study of individuals with comorbid IGD and tobacco dependence also found that the gaming cue and tobacco cue induce similar brain activation over the hippocampus. This suggests that craving may play a similar psychopathological role in IGD and as in tobacco dependence (Ko et al., 2013b). However, no empirical study has examined the role of craving in diagnosing IGD. Further study is needed to examine this issue and provide information for the DSM system to consider whether to include craving as one of the diagnostic criteria of IGD, as in substance use disorder.

Individuals with IGD become irritable and angry if they are prevented from using a computer or returning to the game (American Psychiatric Association, 2013). Many online games, particularly massive multiplayer online role-playing games, provide a permanent virtual world that could satisfy a wide range of basic needs (Billieux et al., 2013). Game-related events will keep going if a player disconnects or is disturbed by events in the “real world”. This disconnection might result in loss of gains in the permanent gaming world and make a player irritable owing to disturbance from the “real world”. As the symptoms usually arise immediately when Internet use is interrupted, it should not be classified as a withdrawal symptom. As irritability is so prevalent in individuals with IGD, its diagnostic value for IGD should be examined to determine whether it is a candidate criterion for IGD.

The aims of this study were to: 1) evaluate the diagnostic validity of individual criteria of IGD in the DSM-5 and the criteria of craving and irritability by using the DC-IA as a reference; and 2) evaluate the best cut-off points of criteria of IGD in the DSM-5.

2. Methods

2.1. Participants

The participants were composed of three subgroups, including those who had current IGD (the IGD group), those who have had IGD but were in a remitted state (the remission group), and those
who had never had IGD (the control group). All participants in the three groups were recruited by advertisement from September 2011 to June 2012. The recruitment criteria of the participants in the IGD group included: 1) young adults with an age ranging from 20 to 30 years and an educational level greater than 9 years; 2) those who played Internet gaming for 4 or more hours per day on weekdays and 8 or more hours per day on weekends, or 40 or more hours per week; and 3) those who have maintained a pattern of Internet gaming for more than two years. Those participants who met all these three criteria underwent a further interview by a psychiatrist. The interview included three parts: 1) a diagnostic interview based on the MINI to determine the existence of psychotic disorders, bipolar I disorder, and substance use disorders; 2) a history-taking interview to determine psychotropic medication use, mental retardation, severe physical disorder, and brain injury; and 3) an interview based on the DC-IA-C to determine the diagnosis of IGD. As the criteria of DC-IA are for Internet addiction, the criteria were specific for online gaming behavior in this study, such as “Have you had a repeated experience in which you fail to resist the impulse to participate in online gaming”. Further, only functional impairment contributed by online gaming was recruited for diagnosis. Those who had current IGD based on the DC-IA-C had no psychotic disorders, bipolar I disorder, substance use disorders, psychotropic medication use, mental retardation, severe physical disorder, or brain injury were classified as the participants of the IGD group.

When we enrolled a participant in the IGD group, we also matched a participant of the control group and a participant of the remission group to the participant of the IGD group by gender, educational level, and age (within a range of 1 year). The recruitment criterion of participants in the control group was that their non-essential Internet use was less than 4 h per day in their daily life. Non-essential Internet use included online gaming, online gambling, leisure activities, or social interactions that were not related to their job, academic study, house, or other essential work. We limited the non-essential Internet use, but not the online gaming duration, in order to prevent recruitment of subjects addicted to other Internet activities. Subjects with an online gaming duration of less than 4 h were recruited in the control group in the initial steps. As frequent online gaming without functional impairment is not necessarily diagnosed as IGD, these participants could be classified into the control group after diagnostic interviewing by a psychiatrist. The recruitment criterion of participants in the remission group was that they had been involved in heavy Internet gaming use with functional impairment more than 2 years previously but have controlled Internet gaming use to less than 2 h per day or had no Internet gaming-related functional impairment in the most recent 3 months. Participants in both the control and remission groups underwent an interview by a psychiatrist based on the MINI, a history-taking interview, and the DC-IA-C. Those who had psychotic disorders, bipolar I disorder, substance use disorders, psychotropic medication use, mental retardation, severe physical disorder, or brain injury were excluded. The participants of the control group had no IGD in their lifetime, and the participants in the remission group had IGD based on the DC-IA-C for more than 2 years previously but had no current IGD. A total of 75 participants in the IGD group, 75 in the control group, and 75 in the remission group as defined by the criteria of IGD on the DC-IA-C were recruited into this study after informed consent was obtained. This study was approved by the Institutional Review Board (IRB) of Kaohsiung Medical University Hospital.

2.2. Measures

2.2.1. Diagnostic criteria of Internet addiction for college students (DC-IA-C)

The DC-IA-C was developed based on an empirical diagnostic interview study (Ko et al., 2009b). Criterion A of the DC-IA-C is met with six of nine characteristic symptoms of Internet addiction (as mentioned in the introduction section). Criterion B describes functional impairment secondary to Internet use. The healthy problem is included as one criterion of functional impairment in this evaluation for the DC-IA-C. Psychotic disorder, bipolar I disorder, paraphilia, and other impulse control disorders are listed in Criterion C as exclusion criteria. Research has demonstrated that the DC-IA-C has a good diagnostic accuracy (95.9%) and specificity (92.4%) for the diagnostic criteria (Ko et al., 2009b). In the present study, we used the DC-IA-C to determine the existence of IGD.

2.2.2. The diagnostic criteria of IGD in DSM-5

The diagnostic criteria of IGD in the DSM-5 are composed of 9 items, including preoccupation, withdrawal, tolerance, unsuccessful efforts to control, loss of other interests, continued excessive use despite psychosocial problems, deceiving regarding online gaming, escape, and functional impairment (American Psychiatric Association, 2013). We developed a semi-structured interview schedule to examine the DSM-5 criteria of IGD. Diagnostic criteria 1 to 4 and criterion 6 of IGD in the DSM-5 were similar to those in the DC-IA-C, and thus were evaluated in the same way. We evaluated participants’ social and recreational activities first and then inquired as to whether they had lost interests in previous hobbies and entertainment as a result of Internet gaming. If they responded positively to this question, and Internet gaming is really dominant in their daily life, criterion 5 was fulfilled. We inquired as to whether participants usually deceived their families or significant others regarding their Internet gaming to confirm criterion 7. To evaluate criterion 8, we inquired as to whether they usually escape to Internet gaming under stress or use Internet gaming to relieve a negative mood. For evaluation of criterion 9, we evaluated in detail the jeopardizing conflict or loss of intimacy, important social or family relationships, and severe impairment or failure in work, academic studies, or important examination performance that are attributed to Internet gaming. If the jeopardizing risk was significant, repeated, and persistent, criterion 9 was fulfilled.

2.2.3. Tested criterion of craving

We inquired of the participants whether they have ever had an extremely strong desire for Internet gaming. Under this intense urge, they must participate in Internet gaming immediately, or the urge is difficult to be controlled.

2.2.4. Tested criterion of irritability

Participants were asked whether they become irritable when their time on Internet gaming is interrupted.

2.2.5. The Chinese version of the mini international neuropsychiatric interview (MINI)

We conducted a diagnostic interview based on the modules of psychotic disorders, bipolar I disorder, and substance use disorders on the Chinese version of the MINI (Sheehan et al., 1998) to determine the existence of these psychiatric disorders.

2.2.6. Questionnaire on gaming urge-brief version (QGU-B)

The QGU-B (Ko et al., 2013a) is a modification of the Questionnaire on Smoking Urge-Brief Version (QSU-B) (Cox et al., 2001), which was developed to assess the nicotine craving response in smokers. The QSU-B repeatedly yielded two factors in previous studies; one is a strong desire and intention to smoke and another is anticipation of relief from negative effects and an urgent desire to smoke (Cox et al., 2001; Toll et al., 2006; Clausius et al., 2012; West and Ussher, 2010). However, the items of factor 1 or 2 are varied in these previous studies. Further, reduced reliability of the individual factor scores and the potential existence of additional latent
variables promote the use of the total score as a general craving measure in the clinical setting (Cox et al., 2001). Another report supported that the 10-item QSU-Brief is valid and reliable on total score and its two-factor structure (Cappelleri et al., 2007). The QGU-B contains 10 items measuring the craving for participating in Internet gaming; for example, “I have a desire for Internet gaming right now” and “Nothing would be better than Internet gaming right now”. Each item was rated on a score from 1 to 7. The total scores of the QGU-B were significantly correlated with the CIAS score, and the internal reliability and test—retest reliability of the scale were 0.99 and 0.96, respectively (Ko et al., 2013a). As exploring factor analysis of the QGU-B in this study yielded one factor that accounted for 81.67% of the item variance, we assessed the craving for playing Internet gaming with the total score of the QGU-B.

2.2.7. Chen Internet Addiction Scale (CIAS)

The CIAS is a 4-point 26-item self-reported scale assessing five dimensions of Internet use problems, including symptoms of compulsive use, withdrawal, tolerance, problems with interpersonal relationships and problems with health/time management (Chen et al., 2003). The total score of the CIAS ranged from 26 to 104. Higher CIAS score indicates higher severity of IGD. The internal reliability of the scale and subscales in the original study ranged from 0.79 to 0.93 (Chen et al., 2003). The total score of the CIAS ranged from 26 to 104. Higher CIAS score indicates higher severity of IGD. The internal reliability of the scale and subscales in the original study ranged from 0.79 to 0.93 (Chen et al., 2003).

2.3. Procedures

A detailed explanation was given, and subsequently, informed consent was obtained from all participants. All the matched participants of the IGD, remission, and control groups underwent a diagnostic interview by a psychiatrist to determine the existence of each diagnostic criterion of IGD in DSM-5 and the criteria of craving and irritability. All participants of the three groups also completed the CIAS and QGU-B after the diagnostic interview.

2.4. Statistical analysis

The sensitivity, specificity, positive predictive rate, negative predictive rate, diagnostic accuracy, and Cohen’s kappa value of every criterion of IGD in the DSM-5, craving, and irritability were analyzed by comparison between the IGD and control groups and between the IGD and remission groups as defined by the criteria of IGD on the DC-IA-C. Then, we examined the best cut-off point of the diagnostic criteria of IGD in the DSM-5 to differentiate participants of the IGD group from those of the control and remission groups as defined by the criteria of IGD on the DC-IA-C. After the best cut-off point of the diagnostic criteria of IGD in the DSM-5 was determined, the participants of the IGD group, control group, and remission group were re-classified based on the cut-off point of diagnostic criteria of IGD in the DSM-5. Then, the best cut-off points for IGD in the DSM-5 and the receiver operating characteristic (ROC) curves of the CIAS were determined with reference to the diagnostic criteria of IGD in the DSM-5.

3. Results

Table 1 presents the results of comparisons of gender, age, educational level, varieties of and time spent on Internet gaming, and severities of Internet gaming on the CIAS and Internet gaming urge on the QGU-B of subjects of the IGD, remission, and control groups.

<table>
<thead>
<tr>
<th></th>
<th>IGD n (%)</th>
<th>Remission n (%)</th>
<th>Control n (%)</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>63 (84%)</td>
<td>63 (84%)</td>
<td>63 (84%)</td>
<td>0.00</td>
</tr>
<tr>
<td>Female</td>
<td>12 (16%)</td>
<td>12 (16%)</td>
<td>12 (16%)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>23.35 (2.57)</td>
<td>23.81 (2.86)</td>
<td>22.87 (2.54)</td>
<td>2.38</td>
</tr>
<tr>
<td>Educational level (years)</td>
<td>15.60 (1.46)</td>
<td>15.85 (1.46)</td>
<td>15.83 (1.07)</td>
<td>0.86</td>
</tr>
<tr>
<td>Time spent on Internet gaming on weekdays (hours)</td>
<td>5.87 (1.98)</td>
<td>1.20 (1.89)</td>
<td>0.3 (1.11)</td>
<td>228.18***</td>
</tr>
<tr>
<td>Time spent on Internet gaming on weekends (hours)</td>
<td>8.51 (2.74)</td>
<td>1.65 (2.63)</td>
<td>0.5 (1.77)</td>
<td>234.40***</td>
</tr>
<tr>
<td>Total score of the CIAS</td>
<td>81.53 (10.24)</td>
<td>61.07 (12.80)</td>
<td>48.73 (12.39)</td>
<td>145.59***</td>
</tr>
<tr>
<td>Total score of the QGU-B</td>
<td>44.71 (10.68)</td>
<td>20.47 (10.67)</td>
<td>16.81 (9.02)</td>
<td>145.19***</td>
</tr>
</tbody>
</table>

CIAS: Chen Internet Addiction Scale; IGD: Internet gaming disorder; QGU-B: Questionnaire on Gaming Urge, Brief Version.

*p < 0.05; **p < 0.001.

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Criterion 7 “deceiving” and criteria 8 “escape” were the two criteria with diagnostic accuracies less than 75%. The criteria of craving and irritability had diagnostic accuracies of 88.0% and 68.7%, respectively.

The results of evaluating the best cut-off point of the DSM-5 criteria of IGD are shown in Table 4. The results indicated that 4 or more criteria was the best cut-off point to discriminate the IGD group from the control group, with diagnostic accuracy of 98.7%. Further, 5 or more criteria was the best cut-off point to discriminate the IGD group from the remission group, with diagnostic accuracy of 96.0%. Lastly, 5 or more criteria was the best cut-off point to discriminate the IGD group from the remission and control groups, with diagnostic accuracy of 96.5% and positive prediction rate of 95.8%. Thus, 5 or more criteria was determined to be the best cut-off point for the DSM-5 criteria of IGD.

After the best cut-off point of the diagnostic criteria of IGD in the DSM-5 was determined to be 5 or more, the participants of the IGD group, control group, and remission group were re-classified based on the DSM-5 diagnostic criteria of IGD. The results indicated that 71 participants (95%) of the IGD group, 74 (98.7%) of the control group, and 73 (97.3%) of the remitted group were classified as participants with IGD, those without IGD, and those remitted from IGD based on the DSM-5 diagnostic criteria, respectively.

4. Discussion

4.1. Diagnostic validity of individual criteria of IGD in the DSM-5

This was the first study to test the diagnostic performance of IGD criteria in the DSM-5. The participants of the IGD group spent more time on Internet gaming on weekdays and weekends than those of the remission and control groups. Internet gaming may occupy daily time of individuals with IGD and prevent them from doing other things. This may result in impaired daily life function. In these evaluations, 64.8% of the participants with IGD based on the DSM-5 criteria had severe problems with academic performance. Further, 46.5%, 25.4%, 19.7%, and 4.2% had impaired social interaction, failure in a job, impaired family relationships, and failure in examination for a career opportunity. Our results indicated that functional impairment in different dimensions should be assessed for participants with IGD. Further, the results also supported that criterion 9 “has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in Internet gaming” had a good diagnostic accuracy to discriminate subjects with IGD from those without current IGD.

Criterion 6 “continued excessive use of Internet gaming despite knowledge of psychosocial problems” also had a good diagnostic accuracy to discriminate the participants with IGD from those without current IGD. Only participants who maintained excessive Internet gaming were recruited into the IGD group, and thus all participants of the IGD group fulfilled this criterion. Further, 85.3% of the participants of the IGD group had an attempt, not only an idea, to cut-down or control participation in Internet gaming; however, they engaged in Internet gaming again for reasons such as encountering stress or difficulty in finding other things to do. On the other hand, 14.7% of the participants of the IGD group had never attempted to control their Internet gaming. Thus, intervention, such as motivational interviewing to move individuals with IGD from the precontemplation or contemplation stage to the action stage, is necessary. However, the participants of the IGD group in

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this study were recruited by advertisement, not by random sampling of the general population. The high rate of having ever made an attempt to control participation in Internet gaming found in this study did not indicate that all individuals with IGD have the same level of insight or motivation to control Internet gaming. In fact, some subjects with IGD who are brought to the clinical setting or campus counselor centers deny psychosocial problems caused by Internet gaming and refuse to control their Internet gaming. Without a good rapport, true insight into the problems related to Internet gaming is difficult to obtain in the first encounter in the clinical setting or campus counselor centers.

Criterion 5 “loss of interest in previous hobbies and entertainment as a result of Internet games” was the only criterion that was not adopted from the criteria of substance use disorder or gambling disorder. 58.7% of the participants of the IGD group fulfilled this criterion. This criterion indicates that IGD is partially attributed to the rewarding salience. Research has found that individuals with substance addiction have decreased sensitivity of reward circuits and enhanced sensitivity of memory circuits to conditioned expectations to substances and substance cues (Volkow et al., 2010). A previous study on Internet addiction also found a decreased sensitivity to reward in real-world activities after developing an addiction to the Internet (Yen et al., 2012). Previous study has suggested that Internet gaming provides a permanent virtual world that could satisfy basic motives such as achievement, social affiliation, or power (Billieux et al., 2013). The satisfied motives in Internet gaming might attenuate these basic motives in the real world and make them of decreased interest in the real world. The results of the current study further supported that an impaired reward system is one of the core characteristics of IGD. Further, only 2.7% of the participants of the remission group fulfilled this criterion. This might suggest that restoration of interest in real life plays an essential role in the process of remission from IGD. It might also indicate that it is necessary for subjects with IGD to develop strategies of promoting real-life activities and to normalize reward the system naturally.

This study found that only 44% of the participants of the IGD group deceived family members or others regarding their amount of Internet gaming. The low rate of criterion 7 “deceiving” might be partially accounted for by the characteristics of this study sample, in that they were young adults and not children or adolescents. Besides, as the participants of the IGD group in this study had maintained excessive Internet gaming for more than two years, many participants responded “they know how I play Internet games for a long time.” Criterion 7 had the lowest diagnostic accuracy in the current study. Thus, our results did not support its validity in diagnosing DSM-5 IGD among young adults.

Further, the “escape” criterion had a 78.7% diagnostic accuracy to discriminate participants with IGD from controls. However, it had only a 72% diagnostic accuracy to differentiate those from remitted participants. As coping with daily stressors and escapism is one of the leading gaming motivations associated with IGD (Kuss et al., 2012), 69% of participants with IGD reported engaging in online gaming to relieve distress. However, some participants with IGD dislike playing online games under a dysphoric mood because it will impair their performance in gaming, particularly in competitive games requiring high skills and attention, such as League of Legends. On the other hand, 25.3% of the remitted participants usually escape to gaming under stress. Although the high percentage in the remitted participants indicated a poor diagnostic performance of the criterion, it also indicated a higher vulnerability to relapse of remitted subjects with higher stress. Thus, counseling for stress could be provided to vulnerable remitted subjects to prevent relapse of IGD.

### 4.2. Diagnostic validity of the testing criteria of craving and irritability

Craving manifests as an intense desire or urge for substances with addictive potential (American Psychiatric Association, 2013). It contributes to the risk of relapse and is a key marker for treatment response in substance use disorders (Tiffany and Wray, 2011). The DSM-5 includes craving as a criterion of substance use disorders (American Psychiatric Association, 2013). A previous study showed that craving is the fifth most prevalent criterion and had the third highest discriminating value for alcohol use disorder (Mewton et al., 2011). Another study demonstrated that inclusion of the craving criterion improves the application of the diagnostic criteria of alcohol use disorder in a general population (Casey et al., 2012).

In this study, craving demonstrated a good diagnostic accuracy of 88%. It was the criterion examined in this study with the third highest diagnostic accuracy to discriminate participants with IGD from remitted participants. This result suggested that craving could be a candidate criterion of IGD, as per its role in substance use disorder. Accordingly, this result supported that craving symptoms provide adequate information to diagnose IGD.

This study did not support, however, that irritability had a good diagnostic accuracy (68.7%). This study found that irritability was also prevalent (34%) in the participants of the remission group. In line with the results of a previous study (Co et al., 2005), the results of this study did not support that irritability when Internet gaming is interrupted contributes to differentiating subjects with IGD from those in remission.

### 4.3. The cut-off point of the DSM-5 criteria of IGD

This was the first study to examine the cut-off point of IGD criteria in the DSM-5. The results of this study supported the proposed cut-off point of IGD criteria in the DSM-5 that fulfilling 5 or more criteria is the best cut-off point for diagnosis of IGD. Although 4 or more was the best cut-off point for discriminating participants with IGD from the controls, only 5 participants in the control group were regular Internet gaming users, and their Internet use was limited (less than 1 h/day); thus, a lower cut-off point is adequate to discriminate participants with IGD from controls. However, some of the participants of the remission group maintained Internet gaming without significant functional impairment. They seemed to have some of the IGD criteria, such as preoccupation symptoms, but still maintained adequate function in daily life. Thus, 5 or more

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**Table 4**

Evaluation of the best cut-off point of the DSM-5 criteria of Internet gaming disorder (IGD).

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPR (%)</th>
<th>NPR (%)</th>
<th>DA (%)</th>
<th>Cohen’s kappa</th>
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<tbody>
<tr>
<td><strong>Between IGD and controls</strong></td>
<td></td>
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<tr>
<td>IGD 3/4</td>
<td>100</td>
<td>97.3</td>
<td>97.4</td>
<td>100</td>
<td>98.7</td>
<td>0.97</td>
</tr>
<tr>
<td>IGD 4/5</td>
<td>94.7</td>
<td>98.7</td>
<td>98.6</td>
<td>94.9</td>
<td>96.6</td>
<td>0.93</td>
</tr>
<tr>
<td>IGD 5/6</td>
<td>86.7</td>
<td>100</td>
<td>100</td>
<td>88.2</td>
<td>93.3</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Between IGD and remission subjects</strong></td>
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<tr>
<td>IGD 3/4</td>
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<td>90.7</td>
<td>91.5</td>
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<tr>
<td>IGD 4/5</td>
<td>94.7</td>
<td>97.3</td>
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<td>94.8</td>
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<td>88.2</td>
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<td>0.87</td>
</tr>
<tr>
<td><strong>Among IGD, control, and remission subjects</strong></td>
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<tr>
<td>IGD 3/4</td>
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<td>94.0</td>
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<tr>
<td>IGD 4/5</td>
<td>94.7</td>
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<tr>
<td>IGD 5/6</td>
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<td>100</td>
<td>100</td>
<td>93.8</td>
<td>95.6</td>
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</tr>
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</table>

DA: diagnostic accuracy; NPR: negative predictive rate; PPR: positive predictive rate.
criteria are required to discriminate subjects with IGD from those with remission from IGD. In the DSM-5, only 2 criteria are required to fulfill the diagnosis of substance use disorder. Many addictive substances such as cocaine and heroin are illegal, and most people will not try to use them. Further, legal substances such as alcohol and tobacco are not essential for daily life for most people. Thus, a low cut-off point of 2 is adequate to discriminate individuals with from those without substance use disorders. However, the Internet is an essential tool for daily life. Internet gaming is also a popular recreational activity in young people. A higher cut-off point is necessary to discriminate those with from those without IGD.

Our result supported the validity of the diagnostic criteria of IGD in DSM-5 to identify subjects with IGD to provide intervention for them. However, the IGD could include highly different/heterogeneous presentations and its detailed mechanisms are not comprehensively understood. Presentation of addictive symptoms is not necessary to conclude an addiction theory under such behaviors. Gentile et al. (2011) provided evidence that IGD influences other mental health issues and expected a reciprocal interaction between psychiatric disorders and IGD. This might suggest that IGD could be a maladaptive coping to another psychiatric disorder (Kuss, 2013), such as depression or ADHD, in some cases of IGD. Thus, the criteria “the disturbance is not better explained by the symptoms of another mental disorder, including ...” could be considered in the next version of the IGD criteria based on more evidence from detailed IGD comorbidity studies. Before that, other primary disorders should be evaluated before the diagnosis of IGD is made. Further, intervention for IGD should pay attention not only to the addiction mechanism to online gaming, but also to its precipitating factors, such as depression, ADHD, and low social competence (Gentile et al., 2011).

4.4. Limitations

There are several limitations that should be considered when generating the results of this study. First, the diagnosis of IGD was made relying solely on the participants’ responses to the structured psychiatric interview. More information gathered from other sources such as parents or partners may contribute further to confirm the diagnosis of IGD. Second, the diagnosis of IGD in the participants of the remission group was made based on retrospective history-taking. Recall bias could not be excluded without additional information from family or friends.

4.5. Conclusion

This study first demonstrated that except for deceiving, all DSM-5 criteria of IGD had an adequate diagnostic accuracy to discriminate subjects with IGD from remitted subjects. Meanwhile, this study provided empirical evidence to support the cut-off point, 5 or more, of diagnostic criteria with a good diagnostic accuracy for IGD in the DSM-5. Our results also suggested that Internet gaming craving is a candidate criteria with an adequate diagnostic accuracy to identify subjects with IGD. The addition of craving into the criteria of IGD in the future should be considered, as per its role in substance use disorder in the DSM-5.

Contributors

Ju-Yu Yen designed the study and wrote the protocol. Cheng-Fang Yen and Sue-Huei Chen managed the literature searches and analyses. Peng-Wei Wang and Cheng-Sheng Chen undertook the statistical analysis, and Chih-Hung Ko wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Role of the funding source

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Conflict of interest

All authors declare that they have no conflicts of interest.

Acknowledgments

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