ORIGINAL RESEARCH

# What Types of Internet Services Make Adolescents Addicted? Correlates of Problematic Internet Use

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**Purpose:** This study investigated the prevalence and correlates of problematic internet use (PIU) in a large sample of adolescents based on the type of internet service used.

**Materials and Methods:** The study was conducted from 2008 to 2010, and 223,542 adolescents aged 12 to 18 years participated in the study. The participants responded to a self-report questionnaire including items for demographic factors, internet usage time, most used internet service and mental health. The PIU was assessed with the Internet Addiction Proneness Scale for Youth-Short Form.

**Results:** The overall prevalence rate of PIU was 5.2%, and the prevalence rates stratified by sex were 7.7% in boys and 3.8% in girls. The distribution of most used internet services was significantly different across sexes. The most commonly used internet services were gaming (58.1%) in boys and blogging (22.1%) and messenger/chatting (20.3%) in girls. The odds ratio for PIU was significantly different according to the most used internet service; using the internet mostly for pornography compared to information searching had the highest odds ratio (4.526-fold higher). Depressive episodes, suicidal ideation, and suicidal attempts were significantly associated with higher odds ratios for PIU (1.725-, 1.747- and 1.361-fold, respectively).

**Conclusion:** The present study identified clinically important information about PIU in adolescents. The distribution of PIU has different patterns based on sex and specific internet services. Studies of PIU with well-defined methodology and assessment tools for PIU of each specific internet service are needed.

**Keywords:** addiction, adolescence, sex differences, internet usage

## Introduction

In the last two decades, the internet has penetrated into the people's life in a very rapid and wide way and has become an important means of daily living, such as shopping, getting news and contact with friends. US survey data reported that approximately 90% of adults had access to the internet in 2019, and the proportion of people who did not use the internet decreased from 48% in 2000 to only 10% in 2019.[1] In particular, adolescents use the internet more in their daily lives than other populations. In 2018, 95% of US adolescents were reported to have access to smartphones, and 45% of teens are online on a near-constant basis.[2]

Although the internet provides various benefits, such as education, entertainment, social communication, convenience, and psychological well-being,[3] many studies have reported negative associations of the internet with youth's mental health, including depression, social anxiety, suicide, and cyberbullying.[4–7] Notably, problematic internet use (PIU) characterized by excessive use and addictive features is one of the biggest

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problems with internet use in adolescent populations, of which prevalence has been reported as high up to 26.7% by previous studies.[8,9]

Adolescents are known to be vulnerable to PIU due to heightened impulsivity accompanied by the relative immaturity of the prefrontal cortex (PFC), especially in the early and mid-adolescent period.[10–12] In addition, the emotional dysregulation in the early infant period (2 years old) has been reported to have a substantial impact on PIU in the adolescents, indicating that the inborn temperament is one of the major risk factors for PIU.[13] Sex is known to be another differentiating moderator for the pattern of PIU. Boys are more likely to use internet gaming, whereas girls use more social network services than boys.[14,15] In addition, environmental factors, including attachments with parents and peers are also reported as one of the predictors for PIU in adolescents. For instance, Badenes-Ribera et al[16] reported that relationships with their parents influenced the level of PIU the most in early adolescents, whereas peer relationships were the most relevant factor in the older adolescent period.

Likewise, multiple studies have investigated the prevalent concerns for PIU and related risk factors in adolescents, Nevertheless, a clear definition of PIU has not been made. Researchers have investigated PIU with different terms and concepts, such as "internet addiction",[17] "compulsive internet use",[18] "problematic internet use"[19] and "pathological internet use".[20] Other studies focusing on internet gaming have used the terms "problematic online game use",[21] "internet gaming addiction"[22] and "internet gaming disorder".[23]

Although these different terms and their definitions include a psychological construct implying a pattern of uncontrolled internet use resulting in clinical impairment,[24] one reason for the lack of gold standard definition is that the internet offers a variety of content that might be associated with addictive potential such as gaming, gambling, chatting or pornography. Young[25] pointed out that internet addiction covers a wide variety of behavioral impulse control problems and is categorized by five specific subtypes, including cybersexuality, cyber-relationships, net compulsions, information overload, and computer addiction.

Among these specific subtypes of PIU, "internet gaming disorder" and "gaming disorder" were included as a diagnosis in Section 3 of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)[26] and the latest revision of the International Classification of Diseases (ICD-11) by the World Health Organization (WHO).[27]

Although nongaming internet activities were not considered as a formal diagnosis because of a lack of evidence,[24] there are still concerns about addictive nongaming internet activities such as internet gambling,[28] social networking[29] and online pornography.[30]

However, despite these concerns about the various subtypes of PIU, studies exploring the differential addictive potentials based on specific internet services are lacking. A recent German study with 6,081 students aged 12–19 years investigated the distribution of intensely used Internet applications in PIU and non-PIU.[31] In the study of Rosenkranz et al[31] the most intensely used Internet applications were the social networking sites and chatting, and the most predictive Internet applications for PIU were gaming and gambling. However, studies exploring the distribution and addiction potential based on use of the specific internet service are still lacking; in fact, to our knowledge, there are no studies in Korea. Thus, the present study aimed to investigate the prevalence and correlates of PIU in a large sample of adolescents based on the subtype of internet use.

# Materials and Methods
## Participants

Our study was performed with data derived from the 2008, 2009 and 2010 Korean Youth Risk Behavior Web-based Survey (KYRBS). KYRBS is multiple-year cross-sectional study that has been conducted annually by the Korea Centers for Disease Control and Prevention (CDC) since 2005.[32] KYRBS focuses on health-risk behaviors among adolescents. The survey was performed with a questionnaire completed by the adolescents, which consists of 125 items, including information on tobacco use, alcohol use, obesity, physical activity, sexual behaviors, substance use, Internet use, and mental health. The target population is nationally representative middle- and high-school students aged 12–18 in Korea, sampled from 400 middle and 400 high-schools in every year. The total number of participants was 223,542, and the 2008, 2009 and 2010 KYRBS included 75,238, 75,066 and 73,238 participants, respectively. Before study entry, the full instructions about the purpose and methods of the study were given to the students by trained teachers, and written informed consent was obtained from the students. Students who agreed to participate completed the anonymous questionnaire, which was presented on a computer. The CDC's Institutional Review Board has approved the protocols for KYRBS.

## Assessment

To assess PIU, the Internet Addiction Proneness Scale for Youth-Short Form (KS scale) developed by Kim et al[33] was used. The KS scale is a 20-item self-report scale rated on a 4-point Likert scale (1=never, 2 = sometimes, 3=often, or 4= always). It consists of six subfactors: (1) disturbance of adaptive function (6 items), (2) positive anticipation (1 item), (3) withdrawal (4 items), (4) virtual interpersonal relationship (3 items), (5) deviant behavior (2 items), and (6) tolerance (4 items). The respondent is categorized based on the scores into one of three groups: definite PIU, probable PIU, and normal user of the internet. Definite PIU is defined by a total score of 53 or above or the presence of all of the following: adaptive functioning scores of 17 or above; withdrawal scores of 11 or above; and tolerance scores of 13 or above. Probable PIU is defined by a total score between 48 and 52 or the presence of all of the following: adaptive functioning scores of 15 or above; withdrawal scores of 10 or above; and tolerance scores of 12 or above. In the present study, the PIU group was defined as the participants in the definite and probable PIU groups.

The internet usage time was asked with the item "How many hours and minutes have you used the internet on weekdays and the weekend in the last 30 days?" The internet service that was mainly used by participants was asked by the item "What service do you usually use the internet for the most?" with the choice options including information searching, messenger/chatting, gaming, watching movies, listening to music, watching videos such as user-created content, email, shopping, pornography, blogging, etc. The presence of depressive episodes, suicidal ideation, and suicidal attempts were queried by an item for each experience in the last 12 months with 'yes' or "no" responses as follows: "Have you ever felt sad or desperate enough to stop your daily life for two weeks in the last 12 months?" for depression, "Have you thought about suicide seriously in the last 12 months?" for suicidal ideation, and "Have you attempted suicide in the last 12 months?" for suicidal attempts.

## Statistics

Descriptive statistics were used for the analysis of demographic characteristics. To analyze the association between the most commonly used internet service, prevalence and correlates of PIU and descriptive statistics, the chi-square test and analysis of variance (ANOVA) were adopted. To examine the odds ratio for PIU according to the associated correlates, logistic regression with PIU as a dependent variable was used by two models. The first model included sex, grade, most used internet service, depressive episode, suicidal ideation and suicidal attempt as independent variables. Model 2 added socioeconomic status and school achievement as covariates to model 1. Statistical analyses were conducted using the software package SPSS 25.0 for Windows (SPSS Inc., Chicago, IL).

## Results

### Demographic Characteristics

Demographic characteristics are shown in Table 1. In total, 223,542 middle- and high-school students participated in the study, and 52.5% were male. The overall prevalence of PIU was 5.8%, and the high-risk internet user group among the PIU group was 3.2%. The prevalence of PIU based on sex was 7.7% in boys and 3.8% in girls. The proportion of participants who experienced a depressive episode, suicidal ideation, and suicidal attempt were 38.0%, 19.1%, and 4.8%, respectively.

### Prevalence and Correlates of PIU Based on the Most Used Internet Service

Among all participants, the most commonly used internet service was internet gaming (35.0%), followed by information searching (16.2%), chatting (14.1%), and blogging (12.1%) (Table 2 and Figure 1). However, the proportions of the most used internet services were different between boys and girls ($x2=9144.0$; $p<0.001$). While the most used service in boys was internet gaming (58.1%), girls used blogging (22.1%) and chatting (20.3%) the most.

The prevalence rate of PIU in the users of each specific internet service was also significantly different based on the most used internet service ($x2=3791.9$; $p<0.001$). The prevalence of PIU was the highest in the adolescents who used the internet for pornography the most (19.6%), followed by gaming (9.3%) and internet community (8.4%) (Table 2 and Figure 2). The proportion of internet gaming users among the total group of those with PIU was the highest as 56.0%.

The proportion of participants with experiences of depressive episode, suicidal ideation and attempt was also the highest among the adolescents who used the internet for pornography the most (50.0%, 31.1% and 13.7%, respectively), followed by chatting (48.2%, 25.3%, and 7.8%, respectively) and blogging (44.8%, 22.9%, and 6.1%).

**Table 1** Demographic Characteristics

|  | n (%) |
|---|---|
| Total | 223542 |
| **Year** | |
| 2008 | 75238 (33.7) |
| 2009 | 75066 (33.6) |
| 2010 | 73238 (32.8) |
| **Sex** | |
| Male | 117281 (52.5) |
| Female | 106261 (47.5) |
| **Grade** | |
| Middle-school 1st | 38219 (17.1) |
| Middle-school 2nd | 38423 (17.2) |
| Middle-school 3rd | 38280 (17.1) |
| High-school 1st | 37218 (16.6) |
| High-school 2nd | 36926 (16.5) |
| High-school 3rd | 34476 (15.4) |
| **PIU** | |
| Total | 13056 (5.8) |
| High risk user | 7183 (3.2) |
| Potential risk user | 5873 (2.6) |
| Depressive episode; yes | 84848 (38.0) |
| Suicidal ideation; yes | 42728 (19.1) |
| Suicidal attempt; yes | 10778 (4.8) |
| **Socioeconomic Status** | |
| High | 13775 (6.2) |
| High-middle | 48348 (21.6) |
| Middle | 105472 (47.2) |
| Low-middle | 41322 (18.5) |
| Low | 14625 (6.5) |
| **School Achievement** | |
| High | 25440 (11.4) |
| High-middle | 52399 (23.4) |
| Middle | 60448 (27.0) |
| Low-middle | 57183 (25.6) |
| Low | 28072 (12.6) |

**Abbreviation:** PIU, problematic internet use.

## Odds Ratios of Being in the PIU Group Based on Demographics and Internet Use Variables

Table 3 shows the odds ratios for being in the PIU group based on demographics and internet use variables. The odds ratio was significantly higher in boys than in girls (OR=1.520; p<0.001). Compared to the youngest participants, the older student groups showed significantly higher odds ratios, 1.274- to 1.319-fold higher, for PIU.

Compared to the adolescents using the internet for information searching the most, the odds ratio for PIU in the adolescents who used the internet for pornography the most was the highest (OR=4.526, p<0.001), followed by those using internet for the community (OR=2.822, p<0.001) and gaming (OR=2.661, p<0.001). Those using the internet the most for listening to music (OR=0.733, p<0.001) and email (OR=0.658, p=0.042) showed significantly lower odds ratios than those of the adolescents using the internet for information searching. There were no significant differences in the odds ratios between the groups using the internet mostly for information searching and the groups watching movies, online shopping and blogging.

## Associations Between Psychopathology and Risk for PIU

The proportions of participants with an experience of depressive episode, suicidal ideation, and suicidal attempt in the last 12 months were the highest in groups that used the internet the most for pornography (50.0%, 31.1%, and 13.7%, respectively), followed by messenger/chatting (48.2%, 25.3%, and 7.8%, respectively) and blogging (44.8%, 22.9%, and 6.1%, respectively) (Table 2). The presence of depressive episode, suicidal ideation and suicidal attempt were also significantly associated with a higher odds ratio for PIU among the entire sample. (OR=1.725, p<0.001; OR=1.747, p<0.001; and 1.361, p<0.001, respectively) (Table 3).
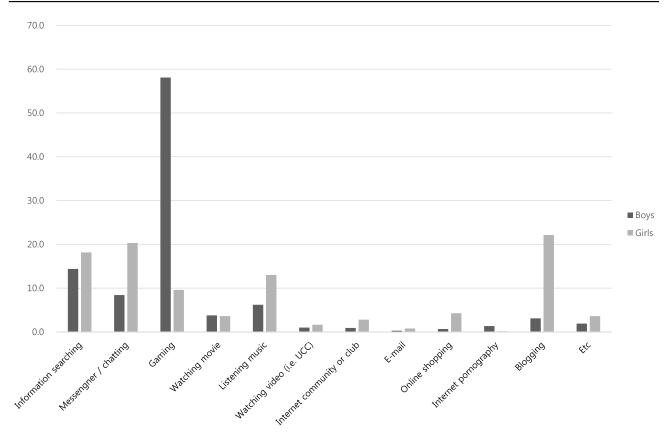
## Discussion

Our study investigated the prevalence and correlates of PIU in a large number of adolescents based on the most commonly used internet services. In our study, the overall prevalence of PIU was 5.4%, which is comparable with previous studies conducted in other countries. Multiple previous studies of PIU reported a wide range of PIU prevalence. For instance, a study conducted across nine European countries reported a prevalence of 25%, ranging from 14% to 55% across countries.[34] Another study conducted in six Asian countries reported that the prevalence of addictive internet use screened by the Internet Addiction Test (IAT) ranged from 1% in South Korea to 5% in the Philippines, and the prevalence of PIU ranged from 13% to 46%.[35] Other systematic reviews of internet addiction had also reported a wide range of prevalence rates from 1% to 18.7%[9] and from 0.8% to 26.7%.[8] These

**Table 2** Association Between Most Used Internet Service and Prevalence and Correlates of PIU

| Most Used Internet Service | Information Searching | Messenger / Chatting | Gaming | Watching Movie | Listening Music | Watching Video (i.e. UCC) | Internet Community or Club | E-Mail | Online Shopping | Internet Pornography | Blogging | Etc | Total | Statistics F or $\chi^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | | | | | | | | | | | | | | |
| n | 36,150 | 31,446 | 78,325 | 8248 | 21,075 | 2896 | 4032 | 1147 | 5315 | 1716 | 27,142 | 6050 | 223,542 | |
| % | 16.2 | 14.1 | 35.0 | 3.7 | 9.4 | 1.3 | 1.8 | 0.5 | 2.4 | 0.8 | 12.1 | 2.7 | 100.0 | |
| **Sex** | | | | | | | | | | | | | | |
| Male; n | 16,857 | 9873 | 68,139 | 4415 | 7257 | 1158 | 1064 | 313 | 780 | 1565 | 3637 | 2223 | 117,281 | 69144.0* |
| % | 14.4 | 8.4 | 58.1 | 3.8 | 6.2 | 1.0 | 0.9 | 0.3 | 0.7 | 1.3 | 3.1 | 1.9 | 100.0 | |
| Female ; n | 19,293 | 21,573 | 10,186 | 3833 | 13,818 | 1738 | 2968 | 834 | 4535 | 151 | 23,505 | 3827 | 102,434 | |
| % | 18.2 | 20.3 | 9.6 | 3.6 | 13.0 | 1.6 | 2.8 | 0.8 | 4.3 | 0.1 | 22.1 | 3.6 | 100.0 | |
| **Internet Use Time; Mean (SD)** | | | | | | | | | | | | | | |
| Weekday; hours | 1.1 (1.3) | 1.6 (1.6) | 1.6 (1.8) | 1.3 (1.5) | 1.1 (1.3) | 1.4 (1.4) | 1.7 (1.5) | 1.0 (1.2) | 1.3 (1.3) | 2.0 (3.0) | 1.4 (1.4) | 1.5 (1.7) | | 457.5* |
| Weekend; hours | 1.8 (1.8) | 2.4 (2.1) | 3.1 (2.5) | 2.4 (2.1) | 1.8 (1.7) | 2.4 (2.1) | 3.0 (2.2) | 1.5 (1.7) | 2.1 (1.8) | 2.8 (3.4) | 2.2 (1.9) | 2.4 (2.3) | | 1112.5* |
| **KS Scale** | | | | | | | | | | | | | | |
| Mean | 27.8 | 29.6 | 33.0 | 29.1 | 27.0 | 29.8 | 32.9 | 26.4 | 27.8 | 36.2 | 28.7 | 28.6 | | 1298.4* |
| SD | 8.6 | 9.0 | 10.5 | 8.9 | 7.7 | 8.9 | 9.7 | 7.7 | 7.8 | 18.1 | 8.1 | 8.9 | | |
| **Total PIU; Yes** | | | | | | | | | | | | | | |
| n | 1217 | 1534 | 7317 | 334 | 516 | 122 | 339 | 25 | 149 | 336 | 911 | 256 | 13,056 | 3791.9* |
| % | 3.4 | 4.9 | 9.3 | 4.0 | 2.4 | 4.2 | 8.4 | 2.2 | 2.8 | 19.6 | 3.4 | 4.2 | 5.8 | |
| **Only Definite PIU; Yes** | | | | | | | | | | | | | | |
| n | 666 | 817 | 4026 | 195 | 272 | 60 | 174 | 11 | 84 | 269 | 456 | 153 | 7183 | 2624.9* |
| % | 1.8 | 2.6 | 5.1 | 2.4 | 1.3 | 2.1 | 4.3 | 1.0 | 1.6 | 15.7 | 1.7 | 2.5 | 3.2 | |
| **Depressive Episode; Yes** | | | | | | | | | | | | | | |
| n | 13,412 | 15,171 | 24,081 | 3307 | 8288 | 1104 | 1585 | 443 | 2225 | 858 | 12,149 | 2225 | 84,848 | 3867.8* |
| % | 37.1 | 48.2 | 30.7 | 40.1 | 39.3 | 38.1 | 39.3 | 38.6 | 41.9 | 50.0 | 44.8 | 36.8 | 38.0 | |
| **Suicidal Ideation; Yes** | | | | | | | | | | | | | | |
| n | 6107 | 7947 | 12,307 | 1662 | 3999 | 545 | 876 | 212 | 1100 | 533 | 6,208 | 1,232 | 42,728 | 1918.0* |
| % | 16.9 | 25.3 | 15.7 | 20.2 | 19.0 | 18.8 | 21.7 | 18.5 | 20.7 | 31.1 | 22.9 | 20.4 | 19.1 | |
| **Suicidal Attempt; Yes** | | | | | | | | | | | | | | |
| n | 1332 | 2458 | 2813 | 401 | 972 | 102 | 180 | 58 | 274 | 235 | 1665 | 288 | 10,778 | 1386.4* |
| % | 3.7 | 7.8 | 3.6 | 4.9 | 4.6 | 3.5 | 4.5 | 5.1 | 5.2 | 13.7 | 6.1 | 4.8 | 4.8 | |

**Note:** *$p < 0.001$.
**Abbreviations:** PIU, Problematic internet use; UCC, User-created content; KS scale, Internet Addiction Proneness Scale for Youth-Short Form; SD, standard deviation.
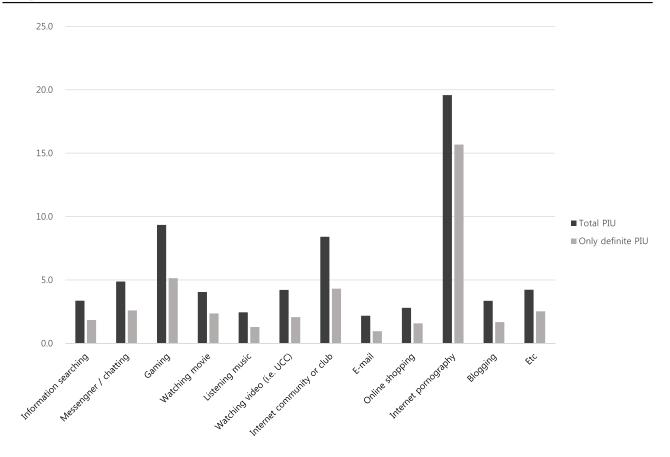
UCC : User-created contents

**Figure 1** Most used internet service according to sex (%).

studies argued that these wide ranges of prevalence rates for PIU might have been caused by the lack of consistency in the methodology, such as the definitions, assessment tools and cutoffs for PIU.[8,36] Thus, future studies with more agreed-upon definitions and assessment tools for PIU are needed to confirm the prevalence of PIU. Nevertheless, a meta-analysis with 27 studies from 1998 to 2006 reported an average prevalence of internet gaming disorder of 4.7%, despite a wide range of prevalence rates,[37] which is consistent with our study.

In our study, boys showed a higher prevalence of PIU than girls by approximately two-fold. This is a consistent finding with multiple previous studies that reported that male sex is a risk factor for PIU.[38–40] However, other studies have reported the opposite pattern of sex differences for the prevalence of PIU. For instance, Durkee et al[39] reported that small variations in the prevalence rate of PIU were found between the sexes in a study with adolescents from 11 European countries despite some cross-cultural differences. A Canadian study also reported no sex differences in the prevalence of PIU.[15] In addition, a study with adults from 9 European countries

reported that overall PIU was more prevalent in women than in men.[34] These discrepancies regarding sex differences in PIU could be caused by cross-cultural differences. However, to understand these discrepancies in the sex differences in the prevalence of PIU, exploring the specific services used through the internet by both sexes should also be taken into account.

In our study, the most commonly used internet service among all participants was internet gaming followed by information searching, messenger/chatting, and blogging. However, the distribution of the most used internet services was significantly different between the sexes. Whereas the boys overwhelmingly used the internet for gaming the most, girls used the internet for blogging and messenger/chatting the most. These tendencies are consistent with findings in previous studies. Girls were reported to be more likely to use instant messaging (74%) and social network services (70%) than boys aged 15 to 17 (62% and 54%, respectively).[14,41] Dufour et al[15] also reported that the proportion of excessive use of social networks and blogs was higher in girls than boys. In contrast, the use of internet gaming has been consistently

PIU: Problematic internet use; UCC: user-created content

**Figure 2** Prevalence of PIU according to the most used internet service (%).
**Abbreviations:** PIU, problematic internet use; UCC, user-created content.

reported to be higher in males than in females.[15,26,34,42] Although the exact reasons for these sex-related differences in internet use are not well understood,[42] previous studies to explain sex differences in computer game involvement focused on aspects such as the content and design of typical games, violence of the games, competitive structures of the games, and social interactions within the games.[43] Our results for the higher use of the internet for blogging and chatting and a lower use of the internet for gaming in girls than boys might be related to well-established evidence that females are more interpersonally oriented, while males are more information/task oriented.[44]

In our study, the number of individuals with PIU was the highest in the internet gaming users (composing more than 50% of the total PIU group), and the odds ratio for PIU was also very high in internet gaming users. These findings provide supportive evidence for the prevailing concern for internet gaming and the inclusion of internet gaming disorder in diagnostic criteria systems.[26,27] Nevertheless, the

addictive potential of the internet pornography should also be noted. The proportions of internet pornography as the most used internet service were not high (0.8%) and even rarer in girls (0.1%). However, the odds ratio for PIU among those who used the internet mostly for pornography was the highest, which implicates the strong addictive potential of internet pornography compared to other internet services. Of course, consuming pornography is not a problem caused by only the internet. It has been argued that excessive internet users are not internet addicts but only use the internet as a medium for other addictive behaviors.[45,46] However, previous studies have pointed out that online pornography use is on the rise, and the increased "triple A" (accessibility, affordability, and anonymity) provided by the internet has enhanced the potential risk for the problematic use of online pornography.[47] In addition, our findings are inconsistent with the results of the previous study of Rosenkranz et al[31] which reported the relatively lower addictive potential of sexual content compared to gaming and gambling. These differential results regarding the

**Table 3** Logistric Regression for the PIU with Covariates

| Variables | Model 1 | | | | Model 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | | p | OR | 95% CI | | p |
| **Sex** | | | | | | | | |
| Female | referent | | | | | | | |
| Male | 1.501 | 1.432 | to | 1.573 | .000 | 1.520 | 1.450 | to | 1.593 | .000 |
| **Grade** | | | | | | | | |
| Middle-school 1st | referent | | | | | | | |
| Middle-school 2nd | 1.303 | 1.223 | to | 1.387 | .000 | 1.274 | 1.196 | to | 1.357 | .000 |
| Middle-school 3rd | 1.368 | 1.285 | to | 1.457 | .000 | 1.327 | 1.246 | to | 1.413 | .000 |
| High-school 1st | 1.334 | 1.251 | to | 1.423 | .000 | 1.286 | 1.205 | to | 1.373 | .000 |
| High-school 2nd | 1.310 | 1.226 | to | 1.399 | .000 | 1.238 | 1.158 | to | 1.323 | .000 |
| High-school 3rd | 1.404 | 1.313 | to | 1.501 | .000 | 1.319 | 1.232 | to | 1.411 | .000 |
| **Most Used Internet Service** | | | | | | | | |
| Information searching | referent | | | | | | | |
| Messenger / chatting | 1.378 | 1.274 | to | 1.490 | .000 | 1.285 | 1.188 | to | 1.391 | .000 |
| Gaming | 2.824 | 2.644 | to | 3.015 | .000 | 2.661 | 2.491 | to | 2.843 | .000 |
| Watching movie | 1.127 | .995 | to | 1.276 | .060 | 1.096 | .967 | to | 1.241 | .152 |
| Listening music | .743 | .668 | to | .825 | .000 | .733 | .660 | to | .814 | .000 |
| Watching video (i.e. UCC) | 1.287 | 1.063 | to | 1.559 | .010 | 1.278 | 1.055 | to | 1.548 | .012 |
| Internet community or club | 2.785 | 2.453 | to | 3.162 | .000 | 2.822 | 2.485 | to | 3.206 | .000 |
| E-mail | .682 | .456 | to | 1.019 | .062 | .658 | .440 | to | .985 | .042 |
| Online shopping | .893 | .750 | to | 1.063 | .203 | .873 | .733 | to | 1.040 | .128 |
| Internet pornography | 4.944 | 4.311 | to | 5.670 | .000 | 4.526 | 3.941 | to | 5.198 | .000 |
| Blogging | 1.058 | .967 | to | 1.158 | .217 | 1.023 | .935 | to | 1.120 | .616 |
| Etc | 1.341 | 1.167 | to | 1.541 | .000 | 1.335 | 1.162 | to | 1.535 | .000 |
| **Depressive Episode** | | | | | | | | |
| No | referent | | | | | | | |
| Yes | 1.782 | 1.710 | to | 1.857 | .000 | 1.725 | 1.655 | to | 1.798 | .000 |
| **Suicidal Ideation** | | | | | | | | |
| No | referent | | | | | | | |
| Yes | 1.813 | 1.728 | to | 1.903 | .000 | 1.747 | 1.664 | to | 1.833 | .000 |
| **Suicidal Attempt** | | | | | | | | |
| No | referent | | | | | | | |
| Yes | 1.450 | 1.353 | to | 1.553 | .000 | 1.361 | 1.270 | to | 1.459 | .000 |

**Notes:** Model 1 included the sex, grade, most used internet service, depressive episode, suicidal ideation and suicidal attempt as covariates. Model 2 included socioeconomic status and school achievement as covariates in addition to model 1.
**Abbreviations:** PIU, problematic internet use; UCC, user-created content

addictive potential of sexual content between the studies might be caused by socio-environmental differences. Thus, further studies to understand and protect adolescents from the risk of problematic use of internet pornography are needed.

Another notable finding of our study was the significant association between a higher overall odds ratio for PIU and psychopathology, including depression and suicidal ideation and attempt, which is consistent with findings from a previous study[24] that reported that the group

of students with PIU were more likely to show more depression and suicidal and self-injurious behavior than the normal internet use group. In particular, it is interesting that the proportion of 'yes' responses to depressive episodes, suicidal ideation and suicidal attempts were higher in the users of messenger/chatting and blogging than the users of other services, with the exception of users of internet pornography, and this proportion was the lowest in the internet gaming users. These findings imply that depressed adolescents pursue social interaction

more by the internet than entertainment. These findings are consistent with a previous study[24] that also reported that there was a higher risk of depression in students with nongaming PIU than in students with gaming PIU. In addition, the proportion of "yes" responses to depressive episodes, suicidal ideation and suicidal attempt was the highest in internet pornography users. These findings suggest that using the internet primarily for pornography is associated with severe psychopathology, such as depression and suicide, as well as a strong addictive potential.

## Limitations

Our study has some limitations that should be noted. Although we conducted the study with a large sample of adolescents, our study is based on a cross-sectional design, which limits the interpretation of causality. For instance, depressive episodes, suicidal ideation and suicidal attempts are associated with higher odds ratios of PIU, and we cannot determine the direction of causality. Thus, future studies with a longitudinal design are warranted. Second, although we tried to include a variety of internet services that the adolescents use in the questionnaires, we did not include all services. For instance, internet gambling is one of the major concerns about internet use,[28] which was not included in the questionnaires. Third, our study was based on the self-report of the adolescents alone, which could bias the report. The reporting of psychiatric symptoms is known to be discrepant among informants, such as parents and adolescents.[48] Thus, obtaining information from multiple informants, including parents, is important for the exact evaluation of psychiatric symptoms. Fortunately, a previous study reported that reports based on self-report by the adolescents for the symptoms of addictive disorders such as alcohol and substance abuse were much more coincident with actual diagnoses than reports from the parents.[48] In addition, we utilized simplified categorical items assessing depression, suicidal ideation, and suicidal attempts and did not include validated assessment tools. Although these simplified items were adopted to improve the response rate by a parsimonious questionnaire for a large number of participants, this might result in a lack of detailed information and distortion of the real association between PIU and adolescent psychology, such as depression and suicide. Finally, information on family characteristics, such as parent-child interactions and parenting style, was not included in the study, which is an important

factor moderating PIU in adolescents.[16] Thus, future studies including more detailed information on the psychopathology of adolescents and family characteristics from multiple informants are warranted to confirm the present findings.

## Conclusions

Despite some limitations, our study identified clinically important information about PIU in adolescents. The distribution of the most used internet services has different patterns based on sex. The prevalence of PIU also showed significant differences based on the use of specific internet services. Future studies of PIU with well-defined methodology and assessment tools for each specific internet service are needed to develop strategies to protect individual adolescents from the risk of PIU.

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