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Relationships between problematic Internet use and problem-gambling severity: Findings from a high-school survey

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Abstract

With the popularity of Internet use among adolescents, there is concern that some youth may display problematic or addictive patterns of Internet use. Although excessive patterns of Internet use was considered for inclusion in the DSM-5 with pathological gambling and substance-use disorders in a category of addictive disorders, it was determined that more research was needed on Internet-use behaviors before such actions be further considered and possibly undertaken. The present study is the first to investigate whether at-risk/problematic Internet use (ARPIU) may moderate the strength of association between problem-gambling severity and gambling-related characteristics and health and well-being measures in adolescents. Survey data from 1884 Connecticut high-school student stratified by Internet use (ARPIU vs. non-ARPIU) were examined in bivariate analyses and logistic regression models. Gambling-related characteristics and health and well-being measures were mostly positively associated with problem-gambling severity in both Internet use groups. Interaction odds ratio revealed that the strength of the

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Conflict of interest

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Contributors

Drs. Hoff, Krishnan-Sarin, Potenza and Steinberg designed the study. Dr. Pilver conducted statistical analyses. Ms. Yau conducted literature research and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.addbeh.2013.09.003>.

associations between problem-gambling severity and marijuana, alcohol and caffeine use were stronger amongst the non-ARPIU compared to the ARPIU group, suggesting that the relationships between these substance use behaviors and problem gambling may be partially accounted for by ARPIU. Future studies should examine the extent to which preventative interventions targeting both problematic Internet use and problem gambling may synergistically benefit measures of health and reduce risk-taking behaviors in adolescence.

Keywords

Problem gambling severity; Internet; Behavioral addiction; Substance use

1. Introduction

Both gambling and Internet use are prevalent behaviors, including among youth. With the wide availability and popular use of the Internet, there is concern that some individuals may exhibit excessive or problematic use. Problematic Internet use (PIU) has been associated with substance-use disorders (SUDs), mood disorders, incarceration, legal troubles, and poor physical and mental health (Ko, Yen, Yen, Chen, & Chen, 2012; Liu, Desai, Krishnan-Sarin, Cavallo, & Potenza, 2011; Milani, Osualdella, & Di Blasio, 2009; Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000; Shaw & Black, 2008); this pattern resembles that for problem gambling (PG) (Barry, Stefanovics, Desai, & Potenza, 2011; Morasco et al., 2006; Petry, Stinson, & Grant, 2005; Shaffer & Korn, 2002).

Adolescence may represent a vulnerable period for the development of problem behaviors including PG and PIU (Chambers & Potenza, 2003; DiClemente, Hansen, & Ponton, 1996; Ko, Yen, Chen, Yeh, & Yen, 2009). An estimated 95% of adolescents (aged 12–17 years) use the Internet; within this group, 46% go online multiple times daily (Pew Research, 2011). Prevalence estimates of PG and PIU among adolescents are generally higher than those among adults (Bakken, Wenzel, Götestam, Johansson, & Oren, 2009; Derevensky & Gupta, 2004; Johansson & Götestam, 2004; Liu et al., 2011; Shaffer, Hall, & Vander Bilt, 1999; Welte, Barnes, Tidwell, & Hoffman, 2008).

Although not included as a psychiatric diagnosis in the fourth edition (text revision) of the Diagnostic and Statistical Manual (DSM-IV-TR), PIU, or ‘Internet addiction’, has often been modeled after impulse-control disorders (American Psychiatric Association, 2000; Yau, Crowley, Mayes, & Potenza, 2012). The extent to which PIU exists as a distinct entity as opposed to the Internet serving as an outlet for other addictive behaviors (e.g., gambling, video-gaming, shopping) has been debated. In DSM-5, Internet gaming disorder has been introduced as a condition warranting further study. However, Internet gaming disorder focuses solely on the use of the Internet for video-gaming purposes, and PIU and problematic video-gaming may not overlap entirely and each may carry its own health correlates (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010; Liu et al., 2011). PIU, like PG, has been proposed as a non-substance or “behavioral” addiction (Holden, 2010; Leeman & Potenza, 2012; Potenza, 2006, 2008; Shaffer, 2001; Widyanto & Griffith, 2006; Yau, Crowley, et al., 2012). The behavioral-addiction perspective suggests that PIU and PG share characteristics of substance dependence such as tolerance, withdrawal and craving (Blanco, Moreyra, Nunes, Saiz-Ruiz, & Ibanez, 2001; Block, 2008; Grant, Brewer, & Potenza, 2006; Ko, Liu, et al., 2009). Individual addiction disorders (such as PIU and PG) may represent different expressions sharing common etiologies (Yau, Crowley, et al., 2012).

PIU frequently co-occurs with other psychiatric conditions, with one study indicating that 86% of individuals with PIU had another DSM-IV-TR diagnosis (Ahn, 2007). PIU may

preferentially co-occur with conditions related to the content browsed on the Internet (e.g., gambling, pornography or video-game-playing). In particular, parallels between Internet use and gambling have been proposed (Ko, Yen, Chen, Chen, & Yen, 2005; Tao et al., 2010; Yau, Potenza, & White, 2012; Young & Rogers, 1998). Personality traits that promote problematic engagement in Internet use might relate to gambling-related measures (e.g., tendencies to engage less in live-peer social forms of entertainment versus machine-based forms may relate to both PIU and online gambling) (Bernhard, Dickens, & Shapiro, 2012; Fioravanti, Dèttore, & Casale, 2012). It has been suggested that while “specific PIU” involves pathological use of the Internet for a specific purpose such as online gambling, “generalized PIU” describes a global set of behaviors that is both similar to and distinct from other behavioral addictions in availability and use of visual and auditory rewards—such differences may contribute to the unique features of PIU (Griffiths, 2003). Generalized PIU may exacerbate pre-existing problems associated with the contents to which it provides access. For example, individuals reporting problems controlling their engagement with technological devices (e.g., mobile phones, interactive television) that allow uninterrupted access to the Internet may be at greater risk of gambling-related problems (Phillips, Ogeil, & Blaszczyński, 2012).

Separately, PG and PIU are related to similar psychological and neurobiological profiles. PG is associated with impaired impulse control, substance use, depression, anxiety, and aggressive behaviors in adult and adolescent populations (Brewer & Potenza, 2008; Derevensky & Gupta, 2004; Kessler, Chiu, Demler, & Walters, 2005; Verdejo-García, Lawrence, & Clark, 2008), and similar factors appear associated with PIU (Dowling & Quirk, 2009; Ko et al., 2008, 2012; Weinstein & Lejoyeux, 2010; Yen, Ko, Yen, Wu, & Yang, 2007; Zhou et al., 2011). Given these findings, PIU may share etiological factors and may moderate the relationship between PG and other risk measures. A recent study examining data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) found stronger associations between subsyndromal levels of gambling and psychopathology in non-nicotine-dependent (versus nicotine-dependent) respondents (Grant, Desai, & Potenza, 2009). A similar pattern of findings was observed with respect to alcohol use among adolescents, with abstainers/low-frequency (versus moderate to high-frequency) drinkers reporting stronger associations between gambling and measures of drug use (Duhig, Maciejewski, Desai, Krishnan-Sarin, & Potenza, 2007). Thus, co-occurring SUDs may account for some of the variance in the associations between gambling behaviors and psychopathology and therefore weaken the association between problem-gambling severity and adverse health measures. In other words, given higher rates of health and well-being problems in the substance-using groups (including in the non-gambling comparison groups), lower odds ratios would be observed between problem-gambling severity and adverse health measures within the substance-using groups as compared to the non-substance-using groups. By extension, such a pattern of moderation of PIU on the associations between health-related factors and problem-gambling severity might be anticipated. However, how PIU and PG may interact with respect to other risk behaviors and health and functioning measures in youth has not been examined directly.

Previous research among adult (Engwall, Hunter, & Steinberg, 2004; Morasco et al., 2006; Petry et al., 2005) and adolescent populations (Ellenbogen, Derevensky, & Gupta, 2007; Jackson, Dowling, Thomas, Bond, & Patton, 2008; Yip et al., 2011) suggest that an additive relationship may exist between levels of gambling engagement and vulnerability to substance use and other risk behaviors. However, there is currently no existing research that investigates the potential moderating effects that PIU may have upon such associations. The present study aimed to fill this knowledge gap by examining health, functioning and gambling-related measures associated with problem-gambling severity in adolescents separately for at-risk problematic Internet users (ARPIU—defined by the presence of one or

more features of PIU) and non-at-risk problematic Internet users (those who endorse no features of PIU). Given the findings summarized above, we hypothesized that individuals with ARPIU compared to those without would show differences in problem-gambling severity and attitudes/perceptions reflecting greater permissiveness towards gambling. Furthermore, we hypothesized at-risk/problem gambling (ARPG) would be more strongly associated with various gambling characteristics related to motivations and behavior among adolescents with ARPIU compared to those without. We additionally hypothesized that PIU would moderate the association between problem-gambling severity and dysphoria/depression, aggressive behavior, and substance use. We hypothesized that these associations would be weaker among adolescents with ARPIU compared to those without as ARPIU may account for some aspects of the relationship between problem-gambling severity and health and well-being measures.

2. Methods

2.1. Participants

The present study analyzed data from a survey of risk behaviors in high-school students in Connecticut. Characteristics of the survey and sample have been described previously (Desai et al., 2010; Liu et al., 2011; Potenza et al., 2011; Rahman et al., 2012). Briefly, all public 4-year and non-vocational or special-education high schools in the state of Connecticut were invited to participate. Schools were offered an assessment of the risk behaviors associated with their respective student bodies as incentive for participation. After the initial rounds of recruitment, the response was insufficient in representing all geographic regions of the state. Thus, additional targeted recruitment was conducted to ensure adequate representation of under-represented regions within the sample. Although not a random sample, the final sample ($N = 4523$) displayed demographics consistent with census data on Connecticut residents 14 to 18 years of age (Schepis, Desai, Smith, Potenza, & Krishnan-Sarin, 2008).

Of the 4523 adolescents taking the survey, only those who indicated any use of the Internet in a typical week, completed all questions related to Internet use, and completed all questions related to the inclusionary criteria for pathological gambling were included. From the entire sample, 2039 students were excluded for non-completion of the gambling sections (Yip et al., 2011), and a further 349 students were excluded for non-completion of the Internet sections. 251 students reported no Internet use in a typical week. Our final analytic sample included 1884 students (1050 males, 844 females). The racial/ethnic distribution was as follows: 75.5% Caucasian ($n = 1422$), 9.4% African-American ($n = 175$), 48.6% Asian ($n = 915$), 13.7% Hispanic ($n = 248$), and 14.1% Other ($n = 265$).

2.2. Survey procedures

Passive consent procedures were utilized to obtain parental permission for children to participate in the survey. This procedure was approved by the participating schools and the Yale School of Medicine's institutional review board. The survey was administered at each school on a single day by a research team. A member of the team described the survey and answered students' questions prior to the start of the survey. Students were reminded that participation was voluntary and answers were anonymous. Individuals wishing not to participate or those whose parents refused students' participation were instructed to sit quietly and complete other work. A pen was offered to each student for participation. The refusal rate for participation was lower than 1%.

Most measures in the survey were adapted directly from the CDC (Center for Disease Control) Youth Risk Behavior Survey (Eaton et al., 2006). Information regarding the reliability and validity of the core questionnaire is published elsewhere (Brener et al., 2002).

2.3. Socio-demographics

Socio-demographic variables assessed in the present analysis included self-reported gender, race (not mutually exclusive, binary; African-American, Caucasian, Asian, Other race), ethnicity (Hispanic, Not Hispanic), grade level (9th, 10th, 11th or 12th), grade average (A + B, C, D + F), and familial structure (living with one parent, two parents, or other [e.g., “foster family”, “grandparents”, and “other relatives”]).

2.4. At-risk/problematic Internet use

For those respondents who acknowledged any Internet use in a typical week, an additional six questions were asked (Liu et al., 2011; Yau, Potenza, et al., 2012): (1) “Have you ever tried to cut back on your Internet use?”, (2) “Has a family member ever expressed concern about the amount of time you use the Internet?”, (3) “Have you ever missed school, work, or important social activities because you were using the Internet?”, (4) “Do you think you have a problem with excessive Internet use?”, (5) “Have you ever experienced an irresistible urge or uncontrollable need to use the Internet?”, and (6) “Have you ever experienced a growing tension or anxiety that can only be relieved by using the Internet?” Given that there is no official threshold between problematic and non-problematic Internet use behavior and consistent with prior thresholding (Yau, Potenza, et al., 2012), individuals who endorsed one or more of the six PIU questions were classified as having “at-risk/problematic Internet use” (ARPIU). Those who endorsed none of the six questions were classified as non-ARPIU. These questions were based on those from the Minnesota Impulsive Disorder Interview (MIDI), a valid and reliable instrument used to screen for impulse-control disorders (Grant, 2008; Grant, Levine, Kim, & Potenza, 2005).

2.5. Problem-gambling severity

Problem-gambling-severity groups were based on *DSM-IV-TR* criteria (American Psychiatric Association, 2000) as assessed by questions from the Massachusetts Gambling Screen (MAGS; Shaffer, LaBrie, Scanlan, & Cummings, 1994), a valid and reliable measure (Shaffer et al., 1994). When more than a single MAGS item corresponding to the same criterion (e.g. tolerance) was endorsed, a single point was awarded for endorsing either item, as done previously (Potenza et al., 2011; Rahman et al., 2012). Participants who reported no gambling in the past-year were classified as being non-gambling (NG). Those who reported past-year gambling but did not acknowledge any *DSM-IV* criteria were classified as having low-risk gambling (LRG). Participants who endorsed one or more *DSM-IV* criteria were classified as having at-risk/problem gambling (ARPG), as in previous studies (Barry et al., 2011; Kundu et al., 2013; Potenza et al., 2011; Rahman et al., 2012).

2.6. Gambling perceptions

Gambling behavior and characteristics were queried by gambling types and location, motivations to gamble, gambling frequency and age of gambling onset. Participants were informed that gambling constituted as “any game you bet on for money or anything else of value”. Gambling perception was assessed through questions probing adolescents’ perceptions of their own and their perceived parental attitudes towards gambling, importance of prevention strategies, and family concerns about gambling (coded as disapprove, neither approve nor disapprove, approve; yes/no; or important/not important), as described previously (Kundu et al., 2013).

2.7. Health and well-being measures

Involvement in extracurricular activities (yes, no) indicates past-year participation in any of the following activities: team sports, school clubs, or part-time employment. Past year dysphoria/depression (feelings of sadness or hopelessness almost every day for 2 or more weeks in a row) and aggression (carrying a weapon within the past 30 days or getting into physical fights in the past year) were also assessed. Weight was defined as one of the four categories based on the individual's body mass index (BMI): "underweight" (BMI < 18.5), "normal" (BMI = 18.6–24.9), "overweight" (BMI = 25–29.9) or "obese" (BMI ≥ 30).

Lifetime substance-use variables included cigarette smoking (never, occasionally, regularly) marijuana use (ever, never), alcohol use (ever, never), use of other drugs (ever, never).

Current alcohol use was coded into one of the four categories reflecting drinks per month: "never regular" (1–5 days), "light" (6–9 days), "moderate" (10–19 days), or "heavy" (20–30 days). Caffeine use was classified as one of the three categories: "none", "1–2 per day", and "3+ per day".

2.8. Gambling motivations and behavior

Types of gambling were assessed and coded as "strategic" (card games, craps and games of skill), "non-strategic" (traditional and instant (scratch card) lotteries and bingo), and "machine" (slot machine, poker machines, and other gambling machines). Participants were queried regarding where they have gambled (online, school and casino). Gambling urges were assessed through items regarding pressure to gamble ("Do you ever feel pressure to gambling when you do not gamble?") or gambling-related anxiety ("In the past year have you ever experienced a growing tension or anxiety that can only be relieve by gambling"). Gambling motivations were assessed with responses grouped in four categories including gambling for: excitement (fun and entertainment), financial reasons (to win money), escape (to relieve dysphoria), and social reasons (to socialize with friends or under peer pressure). Gambling partners were assessed and classified as gambling with "family", "friends", "other adults", "strangers", and "alone". Gambling duration was classified as either "1 h or less" or "2 or more hours" per week. Age of gambling onset was categorized as "8 years", "9–11 years", "12–14 years" and "15 years".

2.9. Data analysis

To ensure and verify accuracy, all data were double-entered from the paper surveys into the electronic database, reviewed to ensure within-range values and randomly spot-checked. Statistical analyses were conducted using SAS software v.9.4 (SAS Institute Inc., Cary, NC). Bivariate analyses were conducted with chi-squared tests of association. To calculate the unique effects of problem-gambling severity among ARPIU and non-ARPIU individuals, we fit separate binomial and multinomial logistic regression models for binary and categorical outcomes, respectively. To test whether the ARPIU moderated effects of problem-gambling severity, we constructed interaction models that included the main effects of ARPIU and problem-gambling severity, as well as the ARPIU-by-problem-gambling-severity interaction terms, using the full sample. These models were adjusted for gender, race, Hispanic ethnicity, grade level, grade average, and familial structure. We present the adjusted odds ratios (ORs) and corresponding 95% confidence intervals (CIs) for ARPIU and non-ARPIU individuals, as well as the interaction ORs and their corresponding 95% CIs. The interaction ORs are the ratios of effects among adolescents characterized as having ARPIU compared to adolescents characterized as not having ARPIU ($OR_{ARPIU}/OR_{NON-ARPIU}$). CIs that do not include 1.0 indicate statistical significance at $p < 0.05$. ORs greater than 2.0, 3.0, or 4.0 reflects a small, moderate or strong effect sizes, respectively, when the condition group (ARPIU) is more affected (Ferguson, 2009). ORs smaller than 0.5,

0.33, or 0.25 reflect a small, moderate or strong effect size respectively when the control group (non-ARPIU) is more affected (Ferguson, 2009).

3. Results

3.1. Prevalence estimates and socio-demographics

Almost half (48.6%) of the adolescents met criteria for ARPIU. Problem-gambling severity was associated with ARPIU ($\chi^2 = 18.66, p < .0001$); the proportions of PIU items endorsed by problem-gambling severity are presented (Table 1). The frequency of ARPG was higher among the ARPIU group compared to the non-ARPIU group (28.5% vs. 24.2%), and the frequency of LRG was lower among the ARPIU compared to non-ARPIU group (52.1% vs. 61.7%). ARPIU was associated with gender, Asian race, Hispanic ethnicity, and grade level (all $p < .05$; Supplementary Table 1).

3.2. Gambling perceptions

Bivariate analyses of gambling perceptions are presented (Supplementary Table 2). The ARPIU group, in contrast to the non-ARPIU group, was more likely to report that their parents disapproved of gambling ($\chi^2 = 15.72, p = .0004$) and that their family had expressed concerns regarding their gambling behavior ($\chi^2 = 6.31, p = .012$). Individuals generally considered all proposed gambling prevention strategies to be important; no significant differences were found between ARPIU and non-ARPIU individuals in most gambling-related perceptions and attitudes ($p > .05$).

3.3. Health and well-being measures

Bivariate analyses for health and well-being measures are presented (Supplementary Table 3). Among ARPIU respondents, problem-gambling severity was associated with participation in extracurricular activities, carrying a weapon, engaging in a serious fight, lifetime tobacco smoking, lifetime marijuana use, lifetime other drug use, and caffeine use (all $p < .05$). Similar associations were observed among non-ARPIU respondents; problem-gambling severity was associated with participation in extracurricular activities, carrying a weapon, engaging in a serious fight, tobacco smoking, marijuana use, alcohol use, and caffeine use (all $p < .05$).

In multivariate analyses (Table 2), amongst ARPIU respondents, LRG adolescents were more likely than NG adolescents to report participation in extracurricular activities (OR = 1.71, 95% CI [1.11, 2.64]), occasional (OR = 1.76, 95% CI [1.11, 2.79]) and regular smoking (OR = 2.51, 95% CI [1.20, 5.25]), and caffeine use 3+ times per day (OR = 1.98, 95% CI [1.09, 3.58]). Amongst ARPIU respondents, ARPG adolescents compared to NG adolescents were more likely to report participation in extracurricular activities (OR = 2.69, 95% CI [1.58, 4.59]), dysphoria/depression (OR = 1.95, 95% CI [1.18, 3.22]), carrying a weapon (OR = 2.96, 95% CI [1.60, 5.46]), engaging in a serious fight (OR = 3.93, 95% CI [1.62, 9.51]), occasional (OR = 2.65, 95% CI [1.56, 4.50]) and regular smoking (OR = 5.13, 95% CI [2.31, 11.38]), marijuana use (OR = 2.14, 95% CI [1.31, 3.50]), heavy alcohol use (OR = 10.79, 95% CI [2.12, 54.93]), and other drug use (OR = 3.56, 95% CI [1.51, 8.39]). Amongst non-ARPIU respondents, LRG adolescents were more likely than NG adolescents to report carrying a weapon (OR = 2.97, 95% CI [1.41, 6.17]), occasional smoking (OR = 2.23, 95% CI [1.26, 3.93]), marijuana use (OR = 2.75, 95% CI [1.67, 4.53]), moderate (OR = 2.68, 95% CI [1.24, 5.83]) and heavy alcohol use (OR = 3.21, 95% CI [1.01, 10.23]), and caffeine use 1–2 times per day (OR = 2.27, 95% CI [1.39, 3.71]) and 3+ times per day (OR = 5.26, 95% CI [2.64, 10.48]). Amongst non-ARPIU respondents, ARPG adolescents compared to NG adolescents were more likely to report extracurricular activities (OR = 1.85, 95% CI [1.04, 3.29]), carrying a weapon (OR = 5.46, 95% CI [2.55, 11.72]), occasional

(OR = 3.78, 95% CI [2.01, 7.11]) and regular smoking (OR = 2.53, 95% CI [1.17, 5.47]), marijuana use (OR = 4.09, 95% CI [2.32, 7.21]), light (OR = 2.63, 95% CI [1.13, 6.11]), moderate (OR = 5.96, 95% CI [2.45, 14.50]) and heavy alcohol use (OR = 8.23, 95% CI [2.37, 28.59]), and caffeine use 3+ times per day (OR = 4.28, 95% CI [2.00, 9.15]).

Interaction odds ratios tested whether the odds ratio for ARPIU were significantly different than those for non-ARPIU. ARPIU moderated the relationships between problem-gambling severity and several measures of health and well-being (Fig. 1). The associations among non-ARPIU were generally stronger, and in several cases the differences reach statistical significance across PIU groups. For example, LRG was less strongly associated with marijuana use (Interaction OR = 0.44, 95% CI [0.23, 0.84]) and caffeine use 3+ times per day (Interaction OR = 0.36, 95% CI [0.15, 0.88]) among ARPIU compared to non-ARPIU youth. ARPG was less strongly associated with light alcohol use (Interaction OR = 0.32, 95% CI [0.11, 0.95]) and moderate alcohol use (Interaction OR = 0.23, 95% CI [0.07, 0.72]) among ARPIU compared to non-ARPIU youth.

Within both the ARPIU and non-ARPIU groups, and as compared to the NG group, estimates of co-occurring health and well-being problems were typically higher in the LRG group and higher still in the ARPG group. This pattern of stepwise progression for increasingly large odds ratio with increasing problem-gambling severity was more pronounced among non-ARPIU compared to ARPIU youth, potentially as a result of higher frequencies of health and well-being problems in ARPIU youth included in the non-gambling baseline comparison group (Fig. 1). This effect was observed in marijuana use and moderate alcohol use and was arguably most clear in caffeine use of 3 or more drinks per day. However, the relationship with respect to light alcohol use appeared to reflect a decrease in the proportion of ARPIU individuals acknowledging light alcohol use with increasing problem-gambling severity (Fig. 1).

3.4. Gambling motivations and behaviors

Bivariate analyses for gambling characteristics are shown in supplementary Table 4. Among ARPIU respondents, ARPG was significantly associated with gambling characteristics including mechanized gambling, location, urges, motivations, partners, and duration. Similar associations were observed among non-ARPIU respondents. In both Internet-use groups, strategic gambling type, non-strategic gambling type and age of onset of gambling were not associated with ARPG. Interaction ORs (supplementary table 5) did not reach statistical significance for any measures (all $p > 0.05$), suggesting that the associations between ARPG and gambling characteristics are not moderated by ARPIU.

4. Discussion

4.1. Summary of results

To our knowledge, the present study is the first to directly investigate the potential moderating effects that ARPIU may have on the relationships between problem-gambling severity and various health, functioning and gambling measures in a large sample of adolescents. In both Internet use groups, problem-gambling severity was associated with greater likelihood of reporting gambling-related motivations and behaviors as well as adverse health and well-being measures. Moderating effects were found with respect to the association between problem-gambling severity and several measures of substance use; consistent with our *a priori* hypothesis, these associations were weaker amongst the ARPIU compared to the non-ARPIU group.

4.2. Relationships between ARPIU and gambling—frequencies of problem-gambling severity and gambling-related attitudes and behaviors

Analyses revealed a significant relationship between ARPIU and problem-gambling severity that suggested that ARPG is more frequent amongst ARPIU adolescents than amongst non-ARPIU adolescents. This is similar to findings from previous small-scale studies that suggest PG and PIU exhibit frequent co-occurrence among adults (Shapira et al., 2000; Young, 1998) and youths (Dowling & Brown, 2010). Thus, prevention and treatment strategies that target PIU may also help diminish underage involvement in gambling, although this possibility warrants direct examination.

Adolescent's belief about activities such as gambling may be shaped by information from and behavior of parents (Bandura, 1986; Furnham, 1986). The present study found that ARPIU adolescents, in comparison to non-ARPIU adolescents, were more likely to report parental disapproval of and family concern for gambling behaviors. One possible explanation for this finding in the setting of the association between ARPIU and problem-gambling severity is that the familial concern for gambling reflects the relationship between ARPIU and problem-gambling severity, with greater disapproval of gambling and family concern for gambling relating to ARPG behaviors. Alternatively, the findings may reflect an environment characterized by parental over-protection in which adolescents may, in rebellion of their parents, engage in behaviors of which their parents disapprove (Baumrind, 1987). Previous research indicate that higher parental protection in combination with low parental care ('affectionless control') is associated with PG (Floros, Siomos, Fisoun, & Geroukalis, 2013; Grant & Kim, 2002) as well as SUDs (Schweitzer & Lawton, 1989; Torresani, Favaretto, & Zimmermann, 2000); further research that directly assess these measures in the context of PIU is needed. While some types of parenting behavior may be risk factors for PG, it is likely that PG's etiology is multifactorial and alternate domains (e.g., schools, peers, impaired impulse control) are important to consider in the relationships between ARPG and ARPIU and those between ARPIU and gambling-related attitudes and behaviors.

4.3. Relationships between ARPIU, problem-gambling severity and health and functioning

Consistent with previous data (Goldstein, Walton, Cunningham, Resko, & Duan, 2009; Lynch, Maciejewski, & Potenza, 2004; Yip et al., 2011), findings from the present study indicate that problem-gambling severity can be associated with a range of adverse health consequences, with the largest odds typically observed in association with more severe gambling pathology. In the non-ARPIU group, associations between problem-gambling severity and measures of lifetime marijuana and heavy caffeine use at the level of LRG and measures of light and moderate current alcohol use at the level of ARPG were significant. The finding that the relationships between these substance-use measures and problem-gambling severity were weaker in the ARPIU group as compared to the non-ARPIU group suggests that some aspects of the relationships between greater problem-gambling severity and substance use are attributable to ARPIU. These aspects may include shared biological factors and/or temperamental characteristics. For example, elevated impulsivity may contribute similarly to participation in these addiction-related behaviors (Dong, Lu, Zhou, & Zhao, 2010; Dong, Zhou, & Zhao, 2011; Kim et al., 2011; Leeman & Potenza, 2012; Yuan et al., 2011). These and other possibilities need further study.

4.4. Limitations and future directions

Potential factors underlying the relationship between PIU and PG (e.g., genetic factors, early life stressors, and personality traits) warrant additional investigation, particularly within a developmental framework. Identifying specific vulnerability factors that may promote maladaptive participation in Internet use, gambling or risk-taking behaviors could aid in

school-based and clinical interventions. Public health policies that adopt a multi-modal approach that targets both Internet and gambling may synergistically benefit in limiting the onset of at-risk behaviors. Education and increasing awareness of the negative health outcomes and risks associated with PIU and PG may help teach adolescents how best to cope with the challenges of convenient Internet use and gambling in all their forms. Similar information should also be made available to parents, teachers, health professionals and other practitioners. Specific interventions (e.g., age verification, monitoring school computers, and enforcing time limits) warrant consideration, as do behavioral and pharmacological approaches to PIU and PG.

The current study presents novel results from a large sample of adolescents. Nonetheless, the findings should be considered within the context of several limitations. First, the sample was not nationally representative; therefore, generalizability may be limited to adolescents within the geographic region sampled. Second, the self-report methodology employed is subject to biases that may lead to either over-reporting or under-reporting. It is possible, for example, a “badge-of-honor” effect may motivate adolescents to claim endorsement of Internet use items as a sign of a serious or experienced user leading to an exaggerated prevalence estimate. Third, the present study did not account for the different contexts of Internet use (Block, 2008). It is possible that particular contexts of Internet use (e.g., online gaming that share structural characteristics of gambling including visual stimulus rewards, rewards for winning or “correct” behavior, and keeping of a digital score) may be more strongly associated with problem-gambling severity. Future research is needed to investigate these potential relationships. Fourth, the data are cross-sectional. Longitudinal studies are needed to examine the extent to which gambling and Internet-use behaviors may interact over developmental epochs, and to examine the implications on health throughout the lifespan. Fifth, although a strength of the study lies in the use of criteria based on symptoms/features of PIU rather than on the basis of frequency of use, the current lack of formal diagnostic criteria for PIU limits the study and the field in general. Moreover, although the low-level pattern of engagement and dichotomous categorization of ARPIU and non-ARPIU have been associated with negative health measures in previous studies during adolescence (Liu et al., 2011) and later in life (Yau, Potenza, et al., 2012), this approach may dilute the effects by grouping together individuals with more and less severe patterns of behavior. Further studies employing measures with more dimensions (e.g., distinguishing at-risk from more severe PIU in larger samples) may generate a better understanding of PIU and how it interacts with other conditions and behaviors.

5. Conclusion

Adolescence represents a vulnerable developmental period for the engagement in risk behaviors and development of addictions (Chambers & Potenza, 2003; Chambers, Taylor, & Potenza, 2003). Not surprisingly, high frequencies of adolescents reported features of PIU and/or PG. Importantly, the current study suggests that adolescents who exhibit features of both excessive gambling and Internet-use behaviors may represent a distinct category separate from individuals who only exhibit features of excessive gambling. This study is the first to consider the potential moderating effects that ARPIU may have on the relationships between problem-gambling severity and various measures of health, well-being and gambling-related motivations and behaviors. The findings indicate that the strengths of the associations between problem-gambling severity and measures of substance use may be moderated by whether individuals endorse features of PIU. Importantly, the current data raise concern that even at-risk engagement in gambling and Internet use may be associated with a range of adverse health measures in an interactive fashion. Given the popularity of both gambling and Internet use as recreational activities, it is important to be aware of the potential public health concerns posed by subsyndromal levels of engagement in these

behaviors (Shaffer et al., 2004). Partaking in addictive behaviors like at-risk or problematic gambling during adolescence may have long-lasting effects into adulthood (Gupta & Derevensky, 1998; Welte, Barnes, Wieczorek, Tidewell, & Parker, 2001); future research that addresses the potential moderating effect PIU may have on such relationships over time is needed, as are the potential long-term relationships with ARPIU on health and well-being. Treatment and prevention strategies that target both PIU and PG may synergistically improve multiple measures of health and reduce risk-taking behaviors (particularly those related to substance use) in adolescence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

PIU	Problematic Internet Use
ARPIU	At-risk/Problematic Internet Use
PG	Problem Gambling
NG	Non-Gambling
LRG	Low-Risk Gambling
ARPG	At-risk/Problem Gambling

References

- Ahn, DH. Korean policy on treatment and rehabilitation for adolescent's internet addiction; Paper presented at the International Symposium on the Counselling and Treatment of Youth Internet Addictions; Seoul, Korea. 2007.
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed.. 2000. text rev.
- Bakken IJ, Wenzel HG, Gøtestam KG, Johansson A, Oren A. Internet addiction among Norwegian adults: A stratified probability sample study. *Scandinavian Journal of Psychology*. 2009; 50(2):121–127. [PubMed: 18826420]
- Bandura, A. Social foundations of thought and action: A social cognitive theory. Prentice Hall; Englewood Cliffs, NJ: 1986.
- Barry DT, Stefanovics EA, Desai RA, Potenza MN. Gambling problem severity and psychiatric disorders among Hispanic and white adults: Findings from a nationally representative sample. *Journal of Psychiatric Research*. 2011; 45(3):404–411. [PubMed: 20800852]
- Baumrind D. A developmental perspective on adolescent risk taking in contemporary America. *New Directions for Child and Adolescent Development*. 1987; 1987(37):93–125.
- Bernhard BJ, Dickens DR, Shapiro PD. Gambling alone? A study of solitary and social gambling in America. *UNLV Gaming Research & Review Journal*. 2012; 11(2):1.

- Blanco C, Moreyra P, Nunes EV, Saiz-Ruiz J, Ibanez A. Pathological gambling: Addiction or compulsion? *Seminars in Clinical Neuropsychiatry*. 2001; 6(3):167–176. [PubMed: 11447568]
- Block JJ. Issues for DSM-V: Internet addiction. *The American Journal of Psychiatry*. 2008; 165(3):306–307. [PubMed: 18316427]
- Brener ND, Kann L, McManus T, Kinchen SA, Sundberg EC, Ross JG. Reliability of the 1999 Youth Risk Behavior Survey Questionnaire. *Journal of Adolescent Health*. 2002; 31(4):336–342. [PubMed: 12359379]
- Brewer JA, Potenza MN. The neurobiology and genetics of impulse control disorders: Relationships to drug addictions. *Biochemical Pharmacology*. 2008; 75(1):63–75. [PubMed: 17719013]
- Chambers RA, Potenza MN. Neurodevelopment, impulsivity, and adolescent gambling. *Journal of Gambling Studies*. 2003; 19(1):53–84. [PubMed: 12635540]
- Chambers RA, Taylor JR, Potenza MN. Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *The American Journal of Psychiatry*. 2003; 160(6):1041. [PubMed: 12777258]
- Derevensky JL, Gupta R. Adolescents with gambling problems: A synopsis of our current knowledge. *Electronic Journal of Gambling Issues: eGambling*. 2004:10.
- Desai RA, Krishnan-Sarin S, Cavallo D, Potenza MN. Video-gaming among high school students: Health correlates, gender differences, and problematic gaming. *Pediatrics*. 2010; 126(6):1414–1424.
- DiClemente, RJ.; Hansen, WB.; Ponton, LE. *Handbook of adolescent health risk behavior*. Plenum; New York: 1996.
- Dong G, Lu Q, Zhou H, Zhao X. Impulse inhibition in people with Internet addiction disorder: Electrophysiological evidence from a Go/NoGo study. *Neuroscience Letters*. 2010; 485(2):138–142. [PubMed: 20833229]
- Dong G, Zhou H, Zhao X. Male Internet addicts show impaired executive control ability: Evidence from a color-word Stroop task. *Neuroscience Letters*. 2011; 499(2):114–118. [PubMed: 21645588]
- Dowling NA, Brown M. Commonalities in the psychological factors associated with problem gambling and Internet dependence. *Cyberpsychology, Behavior and Social Networking*. 2010; 13(4):437–441.
- Dowling NA, Quirk KL. Screening for Internet dependence: Do the proposed diagnostic criteria differentiate normal from dependent Internet use? *Cyberpsychology & Behavior*. 2009; 12(1):21–27. [PubMed: 19196045]
- Duhig AM, Maciejewski PK, Desai RA, Krishnan-Sarin S, Potenza MN. Characteristics of adolescent past-year gamblers and non-gamblers in relation to alcohol drinking. *Addictive Behaviors*. 2007; 32(1):80–89. [PubMed: 16814934]
- Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris WA, et al. Youth risk behavior surveillance —United States, 2005. *Journal of School Health*. 2006; 76(7):353–372. [PubMed: 16918870]
- Ellenbogen S, Derevensky JL, Gupta R. Gender differences among adolescents with gambling-related problems. *Journal of Gambling Studies*. 2007; 23(122-43)
- Engwall D, Hunter R, Steinberg MA. Gambling and other risk behaviors on university campuses. *Journal of American College Health*. 2004; 52(245-55)
- Ferguson CJ. An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice*. 2009; 40(5):532.
- Fioravanti G, Dèttore D, Casale S. Adolescent Internet addiction: Testing the association between self-esteem, the perception of internet attributes, and preference for online social interactions. *Cyberpsychology, Behavior and Social Networking*. 2012; 15(6):318–323.
- Floros GD, Siomos K, Fisoun V, Geroukalis D. Adolescent online gambling: The impact of parental practices and correlates with online activities. *Journal of Gambling Studies*. 2013; 29(1):131–150. [PubMed: 22271406]
- Furnham A. Children's understanding of the economic world. *Australian Journal of Education*. 1986; 30:219–240.
- Goldstein AL, Walton MA, Cunningham RM, Resko SM, Duan L. Correlates of gambling among youth in an inner-city emergency department. *Psychology of Addictive Behaviors*. 2009; 23(1):113–121. [PubMed: 19290695]

- Grant, JE. Impulse control disorders. Norton and Co; New York, NY: 2008.
- Grant JE, Brewer JA, Potenza MN. The neurobiology of substance and behavioral addictions. *CNS Spectrums*. 2006; 11(12):924–930. [PubMed: 17146406]
- Grant JE, Desai RA, Potenza MN. Relationship of nicotine dependence, subsyndromal and pathological gambling, and other psychiatric disorders: Data from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry*. 2009; 70(3):334–343. [PubMed: 19254518]
- Grant JE, Kim SW. Parental bonding in pathological gambling disorder. *Psychiatric Quarterly*. 2002; 73(3):239–247. [PubMed: 12143085]
- Grant JE, Levine L, Kim D, Potenza MN. Prevalence of impulse control disorders in adult psychiatric inpatients. *American Journal of Psychiatry*. 2005; 162:2184–2188. [PubMed: 16263865]
- Griffiths M. Internet gambling: Issues, concerns and recommendations. *CyberPsychology & Behavior*. 2003; 6:557–568. [PubMed: 14756922]
- Gupta R, Derevensky JL. Adolescent gambling behavior: A prevalence study and examination of the correlates associated with problem gambling. *Journal of Gambling Studies*. 1998; 14(4):319–345. [PubMed: 12766444]
- Holden C. Behavioral addictions debut in proposed DSM-V. *Science*. 2010; 327(5968):935. [PubMed: 20167757]
- Jackson A, Dowling NA, Thomas S, Bond L, Patton G. Adolescent gambling behavior and attitudes: A prevalence study and correlates in an Australian population. *International Journal of Mental Health and Addiction*. 2008; 6(325-52)
- Johansson A, Götestam KG. Internet addiction: Characteristics of a questionnaire and prevalence in Norwegian youth (12-18 years). *Scandinavian Journal of Psychology*. 2004; 45(3):223–229. [PubMed: 15182240]
- Kessler RC, Chiu WT, Demler O, Walters EE. Prevalence, severity and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey replication. *Archives of General Psychiatry*. 2005; 62(6):617–627. [PubMed: 15939839]
- Kim SH, Baik S-H, Park CS, Kim SJ, Choi SW, Kim SE. Reduced striatal dopamine D2 receptors in people with Internet addiction. *NeuroReport*. 2011; 22(8):407–411. [PubMed: 21499141]
- Ko C-H, Liu G-C, Hsiao S, Yen J-Y, Yang M-J, Lin W-C, et al. Brain activities associated with gaming urge of online gaming addiction. *Journal of Psychiatric Research*. 2009; 43(7):739–747. [PubMed: 18996542]
- Ko C-H, Yen J-Y, Chen C-C, Chen S-H, Yen C-F. Proposed diagnostic criteria of Internet addiction for adolescents. *The Journal of Nervous and Mental Disease*. 2005; 193(11):728–733. [PubMed: 16260926]
- Ko C-H, Yen J-Y, Chen C-S, Yeh Y-C, Yen C-F. Predictive values of psychiatric symptoms for internet addiction in adolescents: A 2-year prospective study. *Archives of Pediatrics & Adolescent Medicine*. 2009; 163(10):937–943. [PubMed: 19805713]
- Ko CH, Yen JY, Yen CF, Chen CS, Chen CC. The association between Internet addiction and psychiatric disorder: A review of the literature. *European Psychiatry*. 2012; 27(1):1–8. [PubMed: 22153731]
- Ko C-H, Yen J-Y, Yen C-F, Chen C-S, Weng C-C, Chen C-C. The association between Internet addiction and problematic alcohol use in adolescents: The problem behavior model. *CyberPsychology & Behavior*. 2008; 11(5):571–576. [PubMed: 18785835]
- Kundu PV, Pilver CE, Desai RA, Steinberg MA, Rugle L, Krishnan-Sarin S, et al. Gambling-related attitudes and behaviors in adolescents having received instant (scratch) lottery tickets as gifts. *The Journal of Adolescent Health*. 2013; 52(4):456–464. [PubMed: 23299004]
- Leeman RF, Potenza MN. Similarities and differences between pathological gambling and substance use disorders: A focus on impulsivity and compulsivity. *Psychopharmacology*. 2012; 219(2):469–490. [PubMed: 22057662]
- Liu TC, Desai RA, Krishnan-Sarin S, Cavallo DA, Potenza MN. Problematic Internet use and health in adolescents: Data from a high school survey in Connecticut. *The Journal of Clinical Psychiatry*. 2011; 72(6):836–845. [PubMed: 21536002]

- Lynch WJ, Maciejewski PK, Potenza MN. Psychiatric correlates of gambling in adolescents and young adults grouped by age at gambling onset. *Archives of General Psychiatry*. 2004; 61(11):1116–1122. [PubMed: 15520359]
- Milani L, Osualdella D, Di Blasio P. Quality of interpersonal relationships and problematic Internet use in adolescence. *CyberPsychology & Behavior*. 2009; 12(6):681–684. [PubMed: 19788382]
- Morasco BJ, Pietrzak RH, Blanco C, Grant BF, Hasin D, Petry NM. Health problems and medical utilization associated with gambling disorders: Results from the National Epidemiological Survey on Alcohol and Related Conditions. *Psychosomatic Medicine*. 2006; 68(976-84)
- Petry NM, Stinson FS, Grant BF. Comorbidity of DSM-IV pathological gambling and other psychiatric disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *The Journal of Clinical Psychiatry*. 2005; 66(5):564–574. [PubMed: 15889941]
- Pew Research. Who's online: Internet user demographics (Teens). 2011. Retrieved from. [http://pewinternet.org/Trend-Data-\(Teens\)/Whos-Online.aspx](http://pewinternet.org/Trend-Data-(Teens)/Whos-Online.aspx)
- Phillips JG, Ogeil RP, Blaszczynski. Electronic interests and behaviours associated with gambling problems. *International Journal of Mental Health and Addiction*. 2012; 10:585–596.
- Potenza MN. Should addictive disorders include non-substance-related conditions? *Addiction*. 2006; 101(1):142–151. [PubMed: 16930171]
- Potenza MN. The neurobiology of pathological gambling and drug addiction: An overview and new findings. *Philosophical Transactions of the Royal Society B*. 2008; 363(1507):3181–3189.
- Potenza MN, Wareham JD, Steinberg MA, Rugle LJ, Cavallo D, Krishnan-Sarin S, et al. Correlates of at-risk/problem Internet gambling in adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2011; 50(2):150–159. [PubMed: 21241952]
- Rahman AS, Pilver CE, Desai RA, Marvin SA, Rugle LJ, Krishnan-Sarin S, et al. The relationship between age of gambling onset and adolescent problematic gambling severity. *Journal of Psychiatric Research*. 2012; 46(5):675–683. [PubMed: 22410208]
- Schepis T, Desai RA, Smith A, Potenza MN, Krishnan-Sarin S. Impulsive sensation seeking, parental history of alcohol problems, and current alcohol and tobacco use in adolescents. *Journal of Addiction Medicine*. 2008; 2(4):185–193. [PubMed: 19956365]
- Schweitzer RD, Lawton PA. Drug abusers' perceptions of their parents. *British Journal of Addiction*. 1989; 84(3):309–314. [PubMed: 2706386]
- Shaffer HJ. Strange bedfellows: A critical view of pathological gambling and addiction. *Addiction*. 2001; 94:1445–1448. [PubMed: 10790897]
- Shaffer HJ, Hall MN, Vander Bilt J. Estimating the prevalence of disordered gambling behavior in the United States and Canada: A research synthesis. *American Journal of Public Health*. 1999; 89(9):1369–1376. [PubMed: 10474555]
- Shaffer HJ, Korn DA. Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health*. 2002; 23:171–212.
- Shaffer HJ, LaBrie R, Scanlan KM, Cummings HM. Pathological gambling among adolescents: Massachusetts Gambling Screen (MAGS). *Journal of Gambling Studies*. 1994; 10:339–362. [PubMed: 24234969]
- Shaffer HJ, LaPlante DA, LaBrie R, Kidman RC, Donato AN, Stanton MV. Toward a syndrome model of addiction: Multiple expressions, common etiology. *Harvard Review of Psychiatry*. 2004; 12:367–374. [PubMed: 15764471]
- Shapira NA, Goldsmith TD, Keck PE, Khosla UM, McElroy SL. Psychiatric features of individuals with problematic internet use. *Journal of Affective Disorders*. 2000; 57(1-3):267–272. [PubMed: 10708842]
- Shaw M, Black DW. Internet addiction. *CNS Drugs*. 2008; 22(5):353–365. [PubMed: 18399706]
- Tao R, Huang X, Wang J, Zhang H, Zhang Y, Li M. Proposed diagnostic criteria for internet addiction. *Addiction*. 2010; 105(3):556–564. [PubMed: 20403001]
- Torresani S, Favaretto E, Zimmermann C. Parental representations in drug-dependent patients and their parents. *Comprehensive Psychiatry*. 2000; 41(2):123–129. [PubMed: 10741891]
- Verdejo-García A, Lawrence AJ, Clark L. Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience & Biobehavioral Reviews*. 2008; 32(4):777–810. [PubMed: 18295884]

- Weinstein AM, Lejoyeux M. Internet addiction or excessive internet use. *The American Journal of Drug and Alcohol Abuse*. 2010; 36(5):277–283. [PubMed: 20545603]
- Welte JW, Barnes GM, Tidwell M-CO, Hoffman JH. The prevalence of problem gambling among U.S. adolescents and young adults: Results from a national survey. *Journal of Gambling Studies*. 2008; 24:119–133. [PubMed: 18097737]
- Welte JB, Barnes GM, Wieczorek WF, Tidwell MC, Parker JDA. Alcohol and gambling pathology among U.S. adults: Prevalence, demographic patterns and comorbidity. *Journal of Studies on Alcohol*. 2001; 62(5):706–712. [PubMed: 11702810]
- Widyanto L, Griffith MD. Internet addiction: A critical review. *International Journal of Mental Health and Addiction*. 2006; 4:31–51.
- Yau YHC, Crowley MJ, Mayes LC, Potenza MN. Are Internet use and video-game-playing addictive behaviors? Biological, clinical and public health implications for youths and adults. *Minerva Psichiatrica*. 2012; 53:153–170. [PubMed: 24288435]
- Yau YHC, Potenza MN, White MA. Problematic internet use, mental health and impulse control in an online survey of adults. *Journal of Behavioral Addictions*. 2012:1–10.
- Yen J-Y, Ko C-H, Yen C-F, Wu H-Y, Yang M-J. The comorbid psychiatric symptoms of Internet addiction: Attention deficit and hyperactivity disorder (ADHD), depression, social phobia, and hostility. *The Journal of Adolescence Health*. 2007; 41(1):93–98.
- Yip SW, Desai RA, Steinberg MA, Rugle LJ, Cavallo D, Krishnan-Sarin S, et al. Health/functioning characteristics, gambling behaviors, and gambling-related motivations in adolescents stratified by gambling problem severity: Findings from a high school survey. *The American Journal of Addictions*. 2011; 20(495-508)
- Young KS. Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*. 1998; 1(3):237–244.
- Young KS, Rogers RC. The relationship between depression and Internet addiction. *CyberPsychology & Behavior*. 1998; 1(1):25–28.
- Yuan K, Qin W, Wang G, Zeng F, Zhao L, Yang X, et al. Microstructure abnormalities in adolescents with internet addiction disorder. *PLoS One*. 2011; 6(6):e20708. [PubMed: 21677775]
- Zhou Y, Lin FC, Du YS, Qin LG, Zhao ZM, Xu KR, et al. Grey matter abnormalities in Internet addiction: A voxel-based morphometry study. *European Journal of Radiology*. 2011; 79:92–95. [PubMed: 19926237]

HIGHLIGHTS

- Investigated associations between problem-gambling severity and health measures.
- Examined whether ARPIU moderated the strengths of these associations.
- Weaker associations with substance-use behaviors in ARPIU adolescents.
- ARPIU accounts for some of the links between gambling and substance-use behaviors.

Fig. 1.

Percentages and interactions with ARPIU in the association between health and well-being measures and gambling severity. ARPIU = At-risk/Problematic Internet Use; non-ARPIU = Non-At-risk/Problematic Internet Use. NG = Non-Gamblers; LRG = Low-risk Gambling; ARPG = At-risk Problematic Gambling. * Significant Interaction Odds Ratio.

Table 1

Number of PIU item endorsement by gambling severity status.

Number of PIU items endorsed	<u>NG</u>		<u>LRG</u>		<u>ARPG</u>	
	N	%	N	%	N	%
1	73	41.2	214	44.9	85	32.6
2	49	27.7	120	25.2	53	20.3
3	25	14.1	63	13.2	52	19.9
4	10	5.7	45	9.5	46	17.6
5	11	6.2	24	5.0	17	6.5
6	9	5.1	11	2.3	8	3.1

PIU = Problematic Internet Use; NG = Non-Gamblers; LRG = Low-risk Gambling; ARPG = At-risk Problematic Gambling.

Table 2

Multivariate-adjusted associations with health and well-being measures.

Variable	ARPIU			Non-ARPIU			Interaction OR (ARPIU vs. non-ARPIU)					
	LRG vs NG		OR	LRG vs NG		OR	LRG vs NG		OR	LRG vs NG		OR
	95% CI	ARPG vs NG		95% CI	ARPG vs NG		95% CI	ARPG vs NG		95% CI	ARPG vs NG	
Academic/Extracurricular												
Any extracurricular activities	1.71	1.11–2.64	2.69	1.58–4.59	1.52	0.94–2.44	1.85	1.04–3.29	1.01	0.54–1.89	1.13	0.55–2.35
Mood												
Dysphoria/Depression	1.26	0.82–1.96	1.95	1.18–3.22	1.28	0.67–2.44	2.28	1.09–4.78	0.96	0.45–2.06	0.86	0.38–1.97
Aggression												
Carry weapon	1.48	0.83–2.66	2.96	1.60–5.46	2.97	1.43–6.17	5.46	2.55–11.72	0.51	0.20–1.29	0.59	0.23–1.52
Serious fight	1.89	0.80–4.44	3.93	1.62–9.51	1.60	0.46–5.58	3.52	0.98–12.70	1.09	0.25–4.89	1.19	0.26–5.36
Substance use												
Smoking												
Never	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Occasionally	1.76	1.11–2.79	2.65	1.56–4.50	2.23	1.26–3.93	3.78	2.01–7.11	0.79	0.38–1.62	0.73	0.33–1.59
Regularly	2.51	1.20–5.25	5.13	2.31–11.38	1.89	0.97–3.69	2.53	1.17–5.47	1.31	0.49–3.49	2.40	0.83–6.89
Marijuana	1.23	0.80–1.89	2.14	1.31–3.50	2.75	1.67–4.53	4.09	2.32–7.21	0.44	0.23–0.84	0.53	0.26–1.07
Alcohol, current												
Never regular	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Light	0.70	0.34–1.44	0.65	0.29–1.47	1.68	0.82–3.43	2.63	1.13–6.11	0.46	0.17–1.24	0.32	0.11–0.95
Moderate	1.01	0.48–2.13	1.06	0.45–2.47	2.68	1.24–5.83	5.96	2.45–14.50	0.40	0.14–1.15	0.23	0.07–0.72
Heavy	4.39	0.93–20.81	10.79	2.12–54.93	3.21	1.01–10.23	8.23	2.37–28.59	1.23	0.18–8.34	0.90	0.13–6.48
Other drug	0.92	0.40–2.11	3.56	1.51–8.39	1.37	0.61–3.11	1.54	0.62–3.83	0.64	0.20–2.01	2.46	0.75–8.03
Caffeine use												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
1–2 per day	1.27	0.77–2.09	1.40	0.76–2.59	2.27	1.39–3.71	1.27	0.71–2.28	0.54	0.27–1.06	0.94	0.43–2.07
3 + per day	1.98	1.09–3.58	3.30	0.76–2.59	5.26	2.64–10.48	4.28	2.00–9.15	0.36	0.15–0.88	0.70	0.26–1.85

ARPIU = At-risk/Problematic Internet Use; non-ARPIU = Non-At-risk/Problematic Internet Use; NG = Non-Gamblers; LRG = Low-risk Gambling; ARPG = At-risk Problematic Gambling.