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Problematic Internet use among adults: A longitudinal European study

Uso problemático de internet entre adultos: Un estudio europeo longitudinal

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Abstract

There are few cross-cultural studies utilizing longitudinal analysis to explore problematic internet use (PIU), and almost none among adults. The present follow-up study compared three waves across 12-month period every six months and observed the natural course and trajectory of PIU in a European multi-country sample of adults from 11 countries (Finland, Germany, Italy, Spain, France, Switzerland, Hungary, Poland, UK, Norway, Belgium). A total of 139 participants (45.5% females) provided data across all three waves with an average age of 26.14 years (SD = 5.92). There were longitudinal effects in PIU, with statistical differences between at-risk users compared to healthy users in Waves 1 and 2, and Waves 1 and 3. The analyses of variance showed a longitudinal effect of waves on the PIU symptoms. PIU was significantly affected by time and type of user, with those classed as at-risk having higher scores than healthy users, although PIU decreased over time. In addition, the type of PIU detected in adults contained mild addictive symptoms. In conclusion, this study demonstrated that PIU was generally low among European adult population and tended to decrease over the one-year period, what contrasts with adolescent population findings.

Keywords: Internet addiction, problematic Internet use, longitudinal research, Europe, adults

Resumen

Existen pocos estudios transculturales que utilizan análisis longitudinales para explorar el uso problemático de internet (PIU), y apenas existen estudios en población adulta. El presente estudio de seguimiento ha comparado tres observaciones a lo largo de un período de 12 meses, una cada seis meses. Se observó el curso natural y la trayectoria del PIU en una muestra europea de adultos de 11 países (Finlandia, Alemania, Italia, España, Francia, Suiza, Hungría, Polonia, Reino Unido, Noruega, Bélgica). 139 participantes (45,5 % mujeres) con una edad promedio de 26,14 años (DE = 5,92) proporcionaron datos en las tres observaciones. Se detectaros efectos longitudinales en el PIU, con diferencias estadísticas entre usuarios en riesgo en comparación con usuarios sanos en las observaciones 1 y 2, y las correspondientes a las observaciones 1 y 3. Los análisis de varianza mostraron un efecto longitudinal de las observaciones en los síntomas del PIU. Se halló que el PIU fue significativamente afectado por los factores del tiempo y del tipo de usuario, y aquellos participantes clasificados como en posible riesgo de PIU obtuvieron puntuaciones más altas que los usuarios sanos, aunque el PIU disminuyó con el tiempo en ambos grupos. Además, el tipo de PIU detectado en adultos contenía una sintomatología adictiva leve. En conclusión, este estudio demostró que el PIU fue generalmente bajo entre la población adulta europea y, además, tendió a disminuir durante el período de un año, lo que contrasta con los resultados en población adolescente.

Palabras clave: adicción a internet, uso problemático de internet, investigación longitudinal, Europa, adultos

Contemporary research suggests that problematic internet use (PIU) is on the rise globally (Carbonell et al., 2009; Carbonell et al., 2016; Lopez-Fernandez, 2015; Sixto-Costolla et al., 2021; Tran et al., 2020) with specific online activities (such as online gaming and social media use) being its main driver (Pontes et al., 2015). For a small minority, the internet's immersive and interactive qualities through specific devices offer rewarding virtual experiences that can make such activity very time-consuming (Aboujaoude, 2010), even problematic. Research examining PIU has focused on the Internet's negative consequences on individuals' everyday functioning, including educational/occupational duties, social relationships and/or emotional well-being (Anderson, 2001). Over the past three decades, the internet and the applications on it have rapidly developed and become more accessible, the reason for which why more research is needed regarding the natural course of PIU over time (Aboujaoude, 2010, Anderson et al., 2017).

A systematic review on longitudinal research trends regarding internet use and PIU (Anderson et al., 2017) suggested such research has tended to concentrate on PIU among adolescents and emerging adults examining areas such as (i) lack of internet control and excessive time online, (ii) compulsive use of online applications, (iii) addictive behaviors regarding how PIU impacts the individual, and (iv) which internet applications are the most abused (typically online gaming). Very little of the longitudinal research concerned adult groups' use of the internet over time; therefore, this gap in the literature is addressed.

In the past decade, despite the increased research interest in PIU among youth, a slight decrease has been observed in some countries when investigating the developmental trajectories of PIU, focused on adolescent population. The understanding of these trajectories informs theory development in psychopathology course and clinical judgments regarding risk and prognosis (O'Connor et al., 2020). Longitudinal PIU research has relied on self-screening tools (Anderson et al., 2017), such as the Compulsive Internet Use Scale (CIUS) (Meerkerk et al., 2009), which operationalize PIU as follows: (i) they consider PIU to be on a continuum with varying degrees of symptomology, (ii) they assume PIU impacts the individuals and their context, (iii) they all apply Likert-scales to the items, and (iv) they tend to be used on community samples. The present study used a short form of the CIUS because it has been cross-nationally validated (Lopez-Fernandez et al., 2019) to address the gap regarding the lack of longitudinal research comprising European cross-country sample of adults.

A Spanish longitudinal study (Carbonell et al., 2018) with four waves between 2006-2017, reported an initial increase in PIU among emerging adults between the two first waves (2006-2013), which were followed by a decrease between waves two and three (2013-2015). and no increase between waves three and four (2015-2017). Other similar Asiatic longitudinal studies performed with adolescent populations reported a decrease rate of PIU over time (Choi et al., 2019; Li et al., 2019; Yu & Sheck, 2013), even with no effect regarding the type of internet user (i.e., high-risk vs. low-risk users) (Choi et al., 2019; Li et al., 2019). It is important to test the stability or fluctuation of PIU because there is little empirical evidence regarding the natural trajectory of PIU (Lau et al., 2017), especially in adult population.

A one-year follow up study examining spontaneous remission of PIU among German adolescents showed that efficient emotion regulation was a predictor of decreasing PIU (Wartberg & Lindenberg, 2020). However, to date, no longitudinal study has addressed the natural trajectory of PIU among adults, except for one study that examined the trajectory of problematic online gaming (King et al., 2013). This three-wave study examined an 18-month trajectory among Australian adult regular online gamers and found problem and non-problem users' groups experienced a significant decline in problem online gaming. Similarly, the present study examined whether PIU would remain stable or fluctuate over a one-year period to address the gap on empirical evidence associated with the natural trajectory of PIU.

In light of the aforementioned literature, the primary aim of the present study was to longitudinally examine PIU in a sample of European countries across three waves to investigate the natural course and trajectory of PIU in relation to risky and non-risky internet use across each wave.

Method

Participants
The present study comprised a convenience sample with similar characteristics from 11 European countries (Finland, Germany, Italy, Spain, France, Switzerland, Hungary, Poland, UK, Norway, Belgium) to study PIU in Europe (Lopez-Fernandez et al., 2023). The countries selected were part of Tech Use Disorders Marie Curie project, which among other aims was to longitudinally examine the trajectory of PIU over a one-year period. The Catholic University of Louvain (UCLouvain) in Belgium was the coordinating center. The total sample of this follow-up comprised 139 participants (45.5% females) with an average age of 26.14 years ($SD = 5.92$), which are those who provided data across all three waves.

Procedure
Therefore, the longitudinal study comprised three waves (i.e., one every six months). Data were collected from February to May 2015 in the first wave, with baseline evaluations

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performed in all countries. The subsequent data collections for the following two waves were only performed at six-month and 12-month follow-ups (i.e., the data for second wave were collected from September to December 2015, and the data for the third wave were collected from February to May 2016). Participants were recruited mainly from academic environments through an online survey adapted to the country languages studied in which the descriptive cross-cultural sociodemographic and usage patterns were published elsewhere (Lopez-Fernandez et al., 2023). The method of recruitment consisted inviting students and staff from universities (through university networks both online and offline) as well inviting other adults (e.g., though QR codes disseminated by social networks). Data collection was carried out by academics with expertise in the PIU research field, and who participated in the multilingual adaptation of the German Short CIUS with five items (Besser et al., 2017), namely CIUS-5 (Lopez-Fernandez et al., 2019).

Ethical approval was obtained from the ethics committee of the Psychological Sciences Research Institute at UCLouvain validated by the European Commission. There was a consent form in the first webpage in which a code was created by the participant following the instructions (Lopez-Fernandez et al., 2022), plus an email was requested to invite to the follow-up surveys. Anonymity and confidentiality were provided to participants in the longitudinal study.

Measures

The online survey was administered using *Qualtrics* software, which included questions concerning sociodemographic information, online activities, and PIU, among other instruments not included in the present study. For more detailed information see the previously published papers of the TUD project (Lopez-Fernandez et al., 2019, 2022, 2023).

PIU was assessed using a short version of the CIUS with five items (CIUS-5; Besser et al., 2017, translated and psychometrically adapted with measurement invariance by Lopez-Fernandez et al., 2019), known as the short CIUS. It uses five items of the original 14-item CIUS (Meerkerk et al., 2009). The CIUS-5 is rated on a five-point Likert scale (i.e., from 0 'never' to 4 'very often') and the overall score ranges from 0 to 20, with higher scores indicating greater severity of PIU. Regarding the cut-off score, those who scored higher than or equal to 15 were considered as at-risk of PIU (i.e., which corresponds to scoring at least 3 ['often'] on each item). The original cut-off score proposed by Besser et al. was 7 out of 20 (Besser et al., 2017), which performed best for case detection and yielded a sensitivity of 0.95 and a specificity of 0.87 in a German sample. However, based on previous cross-cultural studies with the short versions of the CIUS (Lopez-Fernandez et al., 2019, 2023) a higher cut-off score from European cross-cultural samples constitutes a more conservative cut-off score to estimate potential at-risk users versus those who were defined as healthy users. The CIUS-5 has good validity and reliability (e.g., Cronbach's alphas [α] = 0.77; Besser et al., 2017). In the present study, the Cronbach alphas were adequate in all three waves (Wave 1: α = 0.74; Wave 2: α = 0.77; Wave 3: α = 0.76).

Statistical analyses

In Wave 1, descriptive analyses (i.e., means [M] and standard deviations [SD] for continuous variables, and the proportions [N] and percentages [%] for categorical variables) were computed for the sample to determine sociodemographic characteristics and the prevalence of PIU. To test the reliability of the CIUS-5 in each wave, Cronbach alpha coefficients were calculated. To carry out item analysis of the CIUS-5 in each wave (descriptives, and factor loadings), individual exploratory factor analyses (EFAs) for each wave were carried out to test the unidimensional model using the principal components technique, with the Kaiser-Mayer-Olkin index (KMO) and Bartlett's test of sphericity to confirm the adequacy of the sample and procedure respectively. The analysis yielded one factor with eigenvalues above 1 (factor loading>0.6) which was acceptable based on its explained variance. Regarding the three waves, the natural course and trajectory of PIU was investigated for both potential 'at risk' and 'healthy' internet users across all three waves using the conservative approach from the cut-off scores (15 out of 20; Lopez-Fernandez et al., 2019). To examine the trajectories, a one-way analysis of variance (ANOVAs) for a factor (CIUS-5 with each cut-off score) was performed to estimate the main effects of each wave on CIUS-5 scores longitudinally. IBM SPSS 21 software was used for all the analyses.

Results

Sociodemographics and the Problematic Internet Use

From the 139 users in the three Waves, the CIUS-5 average scores slightly decreased at each time point (Wave 1: M = 6.50, SD = 3.84; Wave 2: M = 5.73, SD = 3.27, Wave 3: M = 5.65, SD = 3.26). The associastion between age and each of the wave scores showed significant inverse relationships between age and the CIUS-5 score in each wave (r_{wave1} = -0.27, p = 0.002; r_{wave2} = - 0.24, p = 0.004; r_{wave3} = - 0.19, p = 0.023). However, when comparing the gender and each of the wave scores, none of the results were significant, meaning there was no gender effect concerning CIUS-5 results in the study (Wave 1: t_{137} = - 0.37, p = 0.716; Wave 2: t_{137} = 0.12, p = 0.902; Wave 3: t_{137} = 4.22, p = 0.674).

Item analysis of the CIUS-5 in the three waves

Table 1 shows the item analysis of each of the five items in the short CIUS within each Wave. The factor validity of the Wave 1 with EFA (KMO=0.77; Bartlett's test: χ^2 (10)=139.99; p < 0.001) yielded one factor with eigenvalues

Table 1
Item analysis (item number, item statement, mean, standard deviation, factor load) by each Wave

Item	CIUS-5 Statement	M (SD), FL Wave 1	M (SD), FL Wave 2	M (SD), FL Wave 3
1	Do you find it difficult to stop using the Internet when you are online?	1.73 (1.15), 0.77	1.50 (0.91), 0.75	1.49(0.90), 0.78
2	Do others (e.g., partner, children, and parents) say you should use the Internet less?	0.78 (1.08), 0.64	0.62 (0.75), 0.72	0.59 (0.84), 0.64
3	Are you short of sleep because of the Internet	1.12 (1.12), 0.77	1.04 (0.95), 0.72	0.99 (0.97), 0.75
4	Do you neglect your daily obligations (work, school, or family life) because you prefer to go on the Internet?'	0.90(1.04), 0.69	0.67(0.88), 0.78	0.71(0.88), 0.73
5	Do you go on the Internet when you are feeling down	1.97 (1.09), 0.63	1.90 (1.01), 0.67	1.86 (0.99), 0.65

Note. Instructions were "How often…"; M=mean, SD= standard deviation, FL= factor load; ***p<0.001, all are standardized loadings.

above 1 and factor loadings greater than 0.6 (see Table 1). The PIU factor among European adults explained 49.45% of the total variance. This was similar in both Wave 2 (KMO=0.83; Bartlett's test: χ^2 (10)=162.09; $p < 0.001$; variance 53.15%), and Wave 3 (KMO=0.80; Bartlett's test: χ^2 (10)=147.09; $p < 0.001$; variance 50.86).

It can be observed that the symptoms with higher average scores were Item 5 and Item 1 which refer to the symptomatology concerning mood modification and loss of control, respectively. The symptoms concerning more severe addiction symptomatology, such as Item 2 and Item 4 (conflict withs other areas of the individual's life [i.e., functional impairment]) had lower scores. One symptom associated with general psychopathology appeared to have a moderately low presence (i.e., sleeps problems associated to internet use).
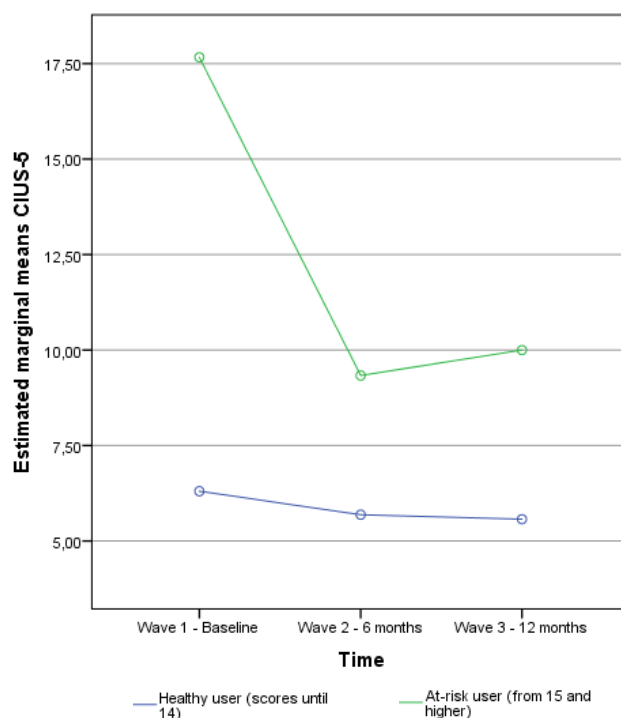
Prevalence

Applying the conservative approach to determinate probable risk of PIU (Lopez-Fernandez et al., 2023), there was a clear higher CIUS-5 scores only in Wave 1 ($M_{Wave1} = 17.67$, $SD = 2.08$, $M_{Wave2} = 9.33$, SD = 8.50, and $M_{Wave3} = 10.00$, $SD = 3.61$), whereas healthy users had lower CIUS-5 scores. The pattern offers clarity regarding those with a higher potential risk of PIU, who were different from those who had no PIU, and who remained highly comparable across all three waves ($M_{Wave1} = 6.30$, $SD = 3.46$, $M_{Wave2} = 5.69$, $SD = 3.08$, and $M_{Wave3} = 5.57$, $SD = 3.20$). Indeed, observing Figure 1, a considerable number of at-risk users in Wave 1 were no longer at-risk at Waves 2 and Wave 3 apart from a slight increase in the third wave but this was not significant between the last two waves among this problematic group. In fact, they became 'healthy' users (i.e., scores under 15 on the CIUS-5).

In Figure 1, the findings of the second ANOVA showed a longitudinal effect of waves on the CIUS-5 (Greenhouse-Geisser $F_{(1.69, 229.85)} = 14.56$, $p < 0.001$, $\eta^2 = .10$). Mauchly's test indicated the assumption of sphericity was also violated, ($\chi^2 = 27.35$, $p < 0.001$), therefore multivariate tests

were utilized ($\varepsilon = 0.85$). Time (i.e., the three waves) and type of user (i.e., healthy vs. at-risk users) significantly affected PIU, with those classed as at-risk having higher scores than healthy users, especially in Wave 1 ($V = 0.14$, $F_{(2, 135)} = 10.55$, $p < 0.001$, $\eta^2 = .14$). These findings suggest the CIUS-5 scores were not stable over time, especially between Wave 1 and Wave 2 (M difference = 4.47, $p < 0.001$) and Wave 1 and Wave 3 (M difference = 4.20, $p < 0.001$) because there were no significant differences between Waves 2 and 3 (M difference = -0.27, $p = 1.000$). Therefore, the results indicate that PIU decreased over time in the present study.

Figure 1
Mean trajectories of problem internet use symptoms assessed with CIUS-5 for at-risk vs. healthy users according to Lopez-Fernandez et al.'s cut-off point in three waves every six months

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Discussion

The aim of the present study was to investigate PIU longitudinally by analyzing a sample extracted from 11 European countries included in the TUD project and to investigate the natural course and trajectory of PIU in relation at-risk and healthy internet use across one-year period in an adult population and addressing several gaps in the literature, a population groups with scarce follow-up studies.

The present study is noteworthy in that it provides a longitudinal analysis of PIU among adults. More specifically, the study defines PIU as the compulsive use of various online applications. This level of detail helps to clarify and deepen the understanding of this complex phenomenon (Anderson et al., 2017). The present study utilized a brief version of the original CIUS (Meerkerk et al., 2009), the short CIUS (Besser et al., 2017), in its cross-cultural adaptations (Lopez-Fernandez et al., 2019). The sample was mainly young and middle-aged adults, as although the average age was 26 years, the range was 38 years across the whole sample. According to a recent meta-analysis on internet addiction between 2017-2020 (Lozano-Blasco et al., 2022), the mean age was 23.55 years old, which means that the present study's mean age is higher than recent studies. Moreover, the inverse association found between the age and PIU is a typical finding in the field and highlights the fact that younger users tend to have greater PIU. However, when considering gender issues, although the sample was imbalanced, it did not produce any significant differences regarding the PIU measure, which may be due to the age groups and the fact that generalized PIU was studied rather than specific PIU (Davis, 2001), such as online gaming or social media use.

With regard to the findings derived from the analysis of the CIUS-5 items, it is noteworthy that the main addictive symptomatology was mood modification and loss of control, which in the case of mood modification is one of the less severe addiction symptoms. Loss of control has been debated in the literature. For instance, Griffiths (2013) has argued that loss of control is not always present in behavioral addictions although he does mention loss of control under the core component of conflict. Moreover, those items associated with functional impairment had lower scores on the CIUS, which supports the notion that the short CIUS assesses more the compulsive aspects of PIU rather than the addictive aspects of it. It opens the debate whether PIU assessed with the CIUS-5 can be considered a medical disorder (Telles Correira et al., 2022). The construct (Anderson et al., 2017) clearly has a psychosocial component of distress and disability regarding a generalized online usage pattern of devices, but the biological component is not yet clear. However, sleep problems emerged as a moderate symptom which much of the literature has shown to be associated with PIU (Aboujaoude, 2010), although usually more often related to adolescent populations (Kokka et al., 2021).

Prevalence of PIU in the present study was estimated during a one-year period of study on three different occasions. The use of present authors' conservative approach (Lopez-Fernandez et al., 2023) was probably more accurate in estimating the true proportion of those at risk of PIU given the significantly lower prevalence estimates. In relation to the longitudinal aspect of the present study, the prevalence estimation method showed that the same users tended to decrease their online use even at the six-month follow-up (Wave 2). The findings indicated that PIU symptoms (i.e., lack of control, sleep disturbance, neglecting obligations, feeling sad, and mood modification) fluctuated over time for both at-risk and healthy internet users. These findings suggest a natural decrease of PIU over time, even possible natural recovery of the PIU among adults.

Despite the many prevalence studies assessing PIU, there is still limited understanding of the natural recovery process without interventions or factors which may predict the healing process (Lau et al., 2017). However, recent studies have shown a reduction in addictive symptoms, indicating low temporal symptom stability and high spontaneous remission rates over a year (Lindenberg et al., 2022; Wartberg & Lindenberg, 2020). It is worth noting that this could be a regression to the mean effect or an increased awareness of the problem (Rothmund et al., 2018), especially among adult users in the present study. Indeed, only one study has examined spontaneous remission and its causes longitudinally, reporting that higher self-efficacy, lower levels of maladaptive emotion regulation strategies, lower depression and anxiety, and lower procrastination could be promising protective factors (Wartberg & Lindenberg, 2020).

More importantly, being at-risk PIU was generally low and tended to change over time in a positive way because PIU significantly decreased after six months and the tendency was maintained in the following six months (i.e., a year after initial data collection). This suggests there may be a decrease of PIU over time across countries, not only in adolescent populations (O'Connor et al., 2020; Yu & Shek, 2013), but also among adults (i.e., a score of less than 15 on the CIUS-5 being considered as not at-risk Lopez-Fernandez et al., 2023). These findings are similar to other longitudinal studies regarding the progressively lower scores for PIU over time (Carbonell et al., 2009, 2016, 2018; Choi et al., 2019, Li et al., 2019, Yu & Shek, 2013). The observed decline in PIU over the course of a year may be because of various internal and external protective factors. With regards to the internal factors, the majority of users were young and middle-aged adults with a higher level of education and, as an adult population, they may have possibly developed coping skills over the course of a year (Kalaitzaki et al., 2022), or demonstrated positive psychological attributes, such as happiness, resilience, hope,

self-control, and self-management skills (Hidalgo-Fuentes et al., 2023; Yilmaz & Yilmaz, 2023). With regards to the external factors, a stable family environment and supportive surroundings, may have contributed to the decrease. These findings suggest that protective factors may play a crucial role in mitigating PIU.

The limitations of the present study include non-probabilistic samples collected through online snowball sampling and the data being based on self-report (Lopez-Fernandez et al., 2023). Furthermore, due to the attrition rate, only those who completed the survey across all three waves were longitudinally analyzed resulting in a small sample size (3.51% of the total initial sample). For this reason, cross-country comparison was not possible. Also, the data were collected in 2015-2016, but there are few longitudinal studies among this age group in Europe. These elements influence the generalizability of the current findings. However, internal validity has been ensured based on the measure used (CIUS-5 cross-country validated; Lopez-Fernandez et al., 2019), and the follow-up of the same participants during three waves in one year, which is a strength of the present longitudinal study not achieved for all previous similar studies (Choi et al., 2019; Li et al., 2019). It is important to note that the data were collected prior to the onset of the COVID-19 pandemic, necessitating some degree of caution when interpreting the findings. Of particular note is the fact that, to the best of authors' knowledge, no longitudinal study examining PIU has been published with adult populations. Given the ongoing relevance of this issue, further research is warranted to better understand the long-term implications of PIU among adults.

Although PIU is present in industrialized societies, it appears that as people get older, PIU diminishes. However, a small proportion of users still have a problem and that it is primarily related to mood swings, loss of control and sleep problems, regardless of gender. The present study provides evidence that PIU is longitudinally associated with distress, dysfunction, and consequences such as sleep problems which appear to be useful from a diagnostic standpoint (Kokka et al., 2021). It appears important to continue providing follow-up studies with adult populations, and even older ones, if possible, as current problem users are growing in age. It seems that PIU (even though it diminishes as individuals get older) can still remain a longer-term problem for a minority of adults. Regarding PIU in both general and specific forms, there is also need for longitudinal studies among specific forms (e.g., social media use, online gambling, online shopping, etc.). Moreover, more individual and contextual information is likely to offer more accurately reflect the kinds of factors related to (and associated with) the use of current online technologies, such as drug use, academic/labor factor, and psychosocial problems (Secades-Villa et al., 2014).

In conclusion, the present study addresses a number of research gaps regarding the need for longitudinal studies examining PIU among adult populations with validated scales for cross-cultural comparisons. To date, no previous longitudinal study including adults in a European sample has been conducted exploring the trajectory of PIU comparing those screened as potentially at-risk of PIU with online healthy users. More importantly, it appears self-reported risk for PIU was generally low across the samples and positively changed (i.e., PIU decreased across the course of the three waves at six months of follow up) demonstrating potential remission or natural recovery. However, caution must be taken due to the small sample size of those who provided data across all three study waves.

Author contributions

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Conflicts of interest

The authors declare no conflict of interest except Mark D. Griffiths, who has received research funding from *Norsk Tipping* (the gambling operator owned by the Norwegian government). He has also received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling, and gambling treatment from Gamble Aware (formerly the Responsibility in Gambling Trust), a charitable body which funds its research program based on donations from the gambling industry. He undertakes consultancies for various gambling companies in the area of social responsibility in gambling.

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