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FULL-LENGTH REPORT



Comparing generalized and specific problematic smartphone/internet use: Longitudinal relationships between smartphone application-based addiction and social media addiction and psychological distress

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ABSTRACT

Background and aims: The literature has proposed two types of problematic smartphone/internet use: generalized problematic use and specific problematic use. However, longitudinal findings on the associations between the two types of problematic use and psychological distress are lacking among East-Asians. The present study examined temporal associations between both generalized and specific problematic use of the smartphone/internet, and psychological distress. **Methods:** Hong Kong University students ($N = 308$; 100 males; mean age = 23.75 years; $SD \pm 5.15$) were recruited with follow-ups at three, six, and nine months after baseline assessment. All participants completed the Smartphone Application-Based Addiction Scale (for generalized problematic smartphone/internet use), the Bergen Social Media Addiction Scale (for specific problematic smartphone/internet use), and the Hospital Anxiety and Depression Scale (for psychological distress) in each assessment. Latent growth modeling (LGM) was constructed to understand temporal associations between generalized/specific problematic use and psychological distress. **Results:** The LGM suggested that the intercept of generalized problematic use was significantly associated with the intercept of psychological distress (standardized coefficient [β] = 0.32; $P < 0.01$). The growth of generalized problematic use was significantly associated with the growth of psychological distress ($\beta = 0.51$; $P < 0.01$). Moreover, the intercept of specific problematic use was significantly associated with the intercept of psychological distress ($\beta = 0.28$; $P < 0.01$) and the growth of psychological distress ($\beta = 0.37$; $P < 0.01$). **Conclusion:** The initial level of problematic use of

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smartphone/internet increased the psychological distress among university students. Helping young adults address problematic use of the smartphone/internet may prevent psychological distress.

KEYWORDS

problematic internet use, problematic smartphone use, longitudinal study, psychological distress, young adults

INTRODUCTION

Rapid improvements in internet and smartphone technologies have been accompanied by substantial growth in the use of internet-based applications and platforms (Cheng & Li, 2014; Kuss & Griffiths, 2012; Kuss, Griffiths, Karila, & Billieux, 2014; Ryan, Chester, Reece, & Xenos, 2014). Consequently, potential health problems and risks resulting from overuse and dependency on using such technologies have been observed and defined. Consequently, the American Psychiatric Association (2013) proposed internet gaming disorder (IGD) as a potential condition in the latest (fifth) edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). More recently, the World Health Organization (2018) also included gaming disorder in the eleventh revision of the International Classification of Diseases and Related Health Problems (ICD-11). Other evidence of health problems generated from overuse of internet and smartphone technologies includes musculoskeletal discomfort, poor sleep quality, daytime sleepiness, and depressed mood states (Alimoradi et al., 2019; Ikeda & Nakamura, 2014; Nathan & Zeitzer, 2013; Yang, Chen, Huang, Lin, & Chang, 2017).

Of the different types of health problems related to technology use, excessive use of the internet and smartphone warrants particular attention in relation to mental health (Csibi, Griffiths, Cook, Demetrovics, & Szabo, 2018; Griffiths, 2000; Monacis, De Palo, Griffiths, & Sinatra, 2017), even though there is no consensus regarding terms describing behavioral problems associated with problematic use of technologies (i.e., *addiction*, *disorder*, or *problematic use*). For example, Brand, Young, Laier, Wölfling, and Potenza (2016) have proposed using DSM-5 nomenclature, and Chen et al. (2020) do not specifically distinguish “addiction” and “disorder” to describe such behavioral problems. Nevertheless, the term *addiction* remains the most frequently used term in the international peer-reviewed literature (Brand et al., 2016). However, the present study uses the term “problematic smartphone/internet use” to avoid potential controversies regarding classification.

Two different forms of problematic use of digital technologies have been proposed: generalized internet addictions and specific internet addictions (i.e., generalized problematic smartphone/internet use and specific problematic smartphone/internet use) (Brand, Young, & Laier, 2014; Davis, 2001; Griffiths, 1998, 2000; Montag et al., 2015). Generalized

problematic smartphone/internet use indicates a multidimensional and general behavioral pattern of smartphone/internet overuse, which may cause negative consequences for individuals (Pontes, Kuss, & Griffiths, 2015). Such problematic smartphone/internet use has been associated with several comorbid disorders including attention deficit/hyperactivity disorder (Karaka, Canan, Saleh, & Potenza, 2017), depression (Sariyska, Reuter, Lachmann, & Montag, 2015) and substance abuse (Rücker, Akre, Berchtold, & Suris, 2015). Generalized problematic smartphone/internet use has been associated with other dysfunctions including impaired family functioning, lowered life satisfaction, problematic family interaction, poor emotional wellbeing, and decreased academic performance (Rücker et al. 2015; Wartberg, Kriston, Kammerl, Petersen, & Thomasius, 2015).

Specific problematic smartphone/internet use (Brand et al., 2014; Davis, 2001; Griffiths, 1998, 2000; Montag et al., 2015) indicates problematic engagement in a particular type of smartphone/internet activity (e.g., social-media use, gaming, gambling) and shares similar features to generalized problematic smartphone/internet use. Specific problematic smartphone/internet use has also been associated with poor health outcomes. Smartphone addiction may be viewed as both specific and generalized with respect to problematic use because some authors define smartphone addiction as a type of specific online addiction (for an overview, see: Billieux, Maurage, Lopez-Fernandez, Kuss, Griffiths, 2015), complicating distinction of the constructs. Other authors claim that individuals are no more addicted to smartphones than alcoholics are addicted to bottles (Kuss & Griffiths, 2017). Despite such polarized views, strong relationships exist between smartphone addiction and social media addiction, most likely because social media use is primarily engaged in via smartphones (Kuss & Griffiths, 2017; Sha, Sariyska, Riedl, Lachmann & Montag, 2019). However, smartphone addiction may be generalized because of the many different activities that can be engaged in using smartphones (e.g., gambling, gaming, social networking, and working) (Kuss & Griffiths, 2017). Therefore, the present study takes the similar view to Chen et al. (2020) that applications on smartphones can be a source of problematic behavior among a minority of individuals. Consequently, the present study used the Smartphone Application-Based Addiction Scale (SABAS) to assess generalized problematic smartphone/internet use and the Bergen Social Media Addiction Scale (BSMAS) to investigate one specific form of problematic smartphone/internet use.

Although prior research suggests a relationship between different types of problematic smartphone/internet use and poor mental health (Pontes et al., 2015; Rücker et al. 2015), rarely has research used a longitudinal design to examine such relationships in an East-Asian context. Therefore, the present study utilized a longitudinal design to examine the relationships between problematic smartphone/internet use and psychological distress among university students in Hong Kong, a population that is substantially exposed to smartphone/internet use. Such relationships should be examined to provide directions for targeted interventions.



The present study used latent growth modeling (LGM) to understand trajectories of problematic internet/smartphone use in relation to psychological distress, and specifically whether the growth of problematic internet/smartphone use associated with changes in psychological distress. Generalized and specific forms of problematic smartphone/internet use were investigated separately to examine how the two types of problematic use related similarly or differently.

The purposes of the present study were to examine over a nine-month period (among a sample of Hong Kong University students), the temporal associations between psychological distress and (i) generalized problematic smartphone/internet use, and (ii) specific problematic smartphone/internet use. It was hypothesized that both generalized and specific problematic smartphone/internet use would be positively associated with psychological distress. It was also speculated that the magnitudes of the two associations would be different given that generalized problematic smartphone/internet use would encompass a wider range of problematic behaviors. This latter hypothesis was examined in an exploratory fashion.

METHODS

Participants and procedure

An online survey using *Google Forms* was used to collect data, including background information of the participants, generalized problematic smartphone/internet use, specific problematic smartphone/internet use, and psychological distress. The online survey began with details of the study's purpose and requirements followed by an informed consent form. Only after providing informed consent were participants able to continue the online survey. Convenience sampling was used and 400 students were invited to participate (response rate = 77%).

The online survey was disseminated using a hyperlink and a QR code, which were created for students to log onto *Google Forms* for participation. Several research assistants and teaching faculties recruited university students, including both undergraduates and postgraduates, during university lectures (with permission granted by the lecturers) or to students' email addresses between March and June 2018 for baseline assessment. Inclusion criteria were: (i) being aged 18 years or above; (ii) owning and using at least one smartphone; (iii) having internet access; and, (iv) being capable of understanding written Chinese in traditional characters. Those who self-reported as having mental health problems (e.g., mood disorders) were excluded. Furthermore, all participants were asked to provide a frequently used email account together with their smartphone number to (a) eliminate the possibility that a respondent completed the survey twice or more at baseline, or at each follow-up assessment; and, (b) be able to contact them for the three follow-up participations every three months after the baseline. A reminder with the hyperlink of the online survey was sent to the participants using both short message service and

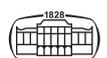
email to ask the participants completing follow-up assessments. Every participant received reminders three times (i.e., one reminder for each of the follow-up) irrespective of whether they had completed any of the follow-ups. Following this process, 308 Hong Kong students completed the baseline assessment; 114 Hong Kong students completed all the follow-up assessments; 58 completed two follow-ups; and 40 completed one follow-up.

Instruments

Smartphone Application-Based Addiction Scale (SABAS). Using Griffiths' (2005) six proposed criteria of addictions (salience, mood, modification, tolerance, withdrawal conflict, and relapse), the SABAS (Csibi et al., 2018) contains six items and assesses the single construct of being at risk of addiction to smartphone applications. Given that smartphone applications include a variety of activities that can be engaged in online, the SABAS was used to assess generalized problematic smartphone/internet use. The six SABAS items are rated on a six-point Likert type scale (1 = *strongly disagree* and 6 = *strongly agree*), and a higher SABAS score indicates more problematic smartphone use. The psychometric properties of the SABAS have been established using English (Csibi et al., 2018), Hungarian (Csibi et al., 2016), Persian (Lin et al., 2018), Taiwanese (Chen et al., 2020; Leung et al., 2019), and Hong Kong versions (Yam et al., 2019). The internal consistency of the SABAS was acceptable across all the assessments in the present study: $\alpha = 0.77$ and $\omega = 0.78$ at baseline; $\alpha = 0.80$ and $\omega = 0.81$ at first follow-up; $\alpha = 0.76$ and $\omega = 0.77$ at second follow-up; $\alpha = 0.76$ and $\omega = 0.78$ at third follow-up.

Bergen Social Media Addiction Scale (BSMAS). Similar to the SABAS, the BSMAS adopts the six criteria of the addiction components model (Griffiths, 2000; 2005) to assess problematic smartphone/internet use specifically related to social media addiction (Andreassen et al., 2016). The six BSMAS items are rated on a five-point Likert type scale (1 = *very rarely* and 5 = *very often*), and a higher BSMAS score indicates more problematic social media use. Moreover, a cutoff score (19 out of 30) has been proposed recently to indicate problematic use of social media in a large nationally representative study of nearly 6,000 Hungarian adolescents (Bányai et al., 2017). Additionally, the psychometric properties of the BSMAS have been established using English (Andreassen et al., 2016), Italian (Monacis et al., 2017), Persian (Lin, Broström, Nilsen, Griffiths, & Pakpour, 2017), Portuguese (Pontes, Andreassen, & Griffiths, 2016), Taiwanese (Chen et al., 2020; Leung et al., 2019), and Hong Kong versions (Yam et al., 2019). The internal consistency of the BSMAS was acceptable across all assessments in the present study: $\alpha = 0.83$ and $\omega = 0.83$ at baseline; $\alpha = 0.85$ and $\omega = 0.85$ at first follow-up; $\alpha = 0.85$ and $\omega = 0.85$ at second follow-up; $\alpha = 0.84$ and $\omega = 0.84$ at third follow-up.

Hospital Anxiety and Depression Scale (HADS). The HADS assesses psychological distress related to the domains of



anxiety and depression, and has been widely used in various social or medical contexts. There are 14 items and all of them are rated on a four-point Likert-type scale (“Yes, definitely”, “Yes, sometimes”, “No, not much”, and “No, not at all”). A higher HADS score indicates higher levels of psychological distress. The construct validity of the HADS has been confirmed in Hong Kong adolescents (Chan, Leung, Fong, Leung, & Lee, 2010) with acceptable Cronbach’s alphas (0.79 for anxiety and 0.67 for depression). The internal consistency of the HADS was acceptable across all the assessments in the present study: $\alpha = 0.85$ and $\omega = 0.85$ at baseline; $\alpha = 0.84$ and $\omega = 0.84$ at first follow-up; $\alpha = 0.85$ and $\omega = 0.85$ at second follow-up; $\alpha = 0.85$ and $\omega = 0.85$ at third follow-up.

Data analysis

Participant characteristics were analyzed using descriptive statistics. A full information maximum likelihood (FIML) method was used to impute missing data in SABAS, BSMAS, and HADS scores for all the participants. The mean and SD of the SABAS, BSMAS, and HADS scores were calculated for the baseline and at each follow-up. Also, zero-order Pearson correlations between SABAS, BSMAS, and HADS scores were computed across all four time points.

Latent growth modeling (LGM) within structural equation modeling was then constructed to understand the impacts of problematic smartphone/internet use upon psychological distress. More specifically, two models were constructed adjusting for age and gender. The first model assessed the impacts of generalized problematic use (i.e., SABAS) on psychological distress, and the second model assessed the impacts of specific problematic use (i.e., BSMAS) on psychological distress. However, given that the direction between problematic use and psychological distress is still a matter of debate in the literature, another two models were constructed to examine whether psychological distress impacts on problematic use. More specifically, a third model assessed the impact of psychological distress on generalized problematic use (i.e., SABAS score), and a fourth model assessed the impacts of psychological distress on specific problematic use (i.e., BSMAS score). In each model, four repeated measures of problematic use (SABAS or BSMAS score) were used to estimate the latent intercept (the estimated initial level of problematic use) and latent slope (the estimated growth of problematic use). Four repeated measures of psychological distress (i.e., HADS score) were used to estimate its latent intercept and slope. For the first and second models, the impacts of the latent intercept from problematic smartphone/internet use on latent intercept and slope values from psychological distress were estimated. Also, the impacts of the latent slope values from problematic smartphone/internet use on latent slope values from psychological distress were estimated. For the third and fourth models, the impacts of the latent intercept from psychological distress on latent intercept and slope values from problematic smartphone/internet use were estimated. Also, the impacts of the latent slope values from psychological

distress on latent slope values from problematic smartphone/internet use were estimated.

The following indices were used to examine whether the LGM model was robust and supported: comparative fit index (CFI) >0.9 , root mean square of approximation (RMSEA) <0.1 , and SRMR (standardized root mean square residual) <0.08 (Browne & Cudeck, 1993; Lin, 2018; Pakpour et al., 2019). The demographic data and instrument scores were analyzed using SPSS 23.0 (IBM Corp., Armonk, NY, USA). LGM models and FIML imputation were conducted using LISREL 8.8 (Scientific Software International, Lincolnwood, IL, USA).

Ethics

The research proposal was approved by the Ethics Committee of the research team’s university. Before data collection, all ethical considerations including description of the study, privacy and confidentiality of data, anonymity, and freedom of participation (or withdrawal) were fully explained. Additionally, all participants signed written informed consent.

RESULTS

Participants ($N = 308$) had a mean age of 23.75 years ($SD = 5.15$) at baseline (Table 1). Slightly less than one-third of participants were female (32.5%), and very few participants reported being a current smoker (2.3%). The mean body mass index of the participants was 21.00 ($SD = 2.95$). On average, participants spent 4.75 hours ($SD = 3.30$) per day on their smartphones and 2.70 hours ($SD = 2.69$) per day on social media. The participants who completed all follow-ups were younger (22.39 years) and spent less time on smartphones (4.10 hours/day) and social media (2.26 hours/day) than those who only participated at baseline (mean age = 25.19 years; time on smartphone = 5.90 hours/day; time on social media = 3.59 hours/day). The participants who completed all the follow-ups comprised fewer males (21.1%) than those who only participated at baseline (41.7%).

After imputation, Table 2 shows the mean and SD of SABAS score, BSMAS score, and HADS score at baseline and follow-up assessments. Table 3 demonstrates the significant correlations between the SABAS score, BSMAS score, and HADS score in the four assessed time points ($r = 0.174$ to 0.854 ; p -values < 0.01).

All LGM models (Figs 1 and 2) had satisfactory fit indices in CFI (0.970–0.980), TLI (0.950–0.960), and SRMR (0.037 and 0.042). The fit index of RMSEA (0.083–0.092) was close to the suggested cutoff. However, its 90% CI covers acceptable cutoff scores and does not exceed the worst value for RMSEA (i.e., 0.10), except for the fourth model (Fig. 2b; 90% CI of RSMEA = 0.110). Moreover, there is a Heywood case in the third model (Fig. 2a; a standardized coefficient is larger than 1). Together, considered with the other fit indices, the first two LGM models were supported (i.e., the LGM models supported more the direction from



Table 1. Participant characteristics

	Entire sample (<i>N</i> = 277–308)	Sample completed all follow-ups (<i>n</i> = 101–114)	Sample that lost one follow-up (<i>n</i> = 57–58)	Sample that lost two follow-ups (<i>n</i> = 39–40)	Sample that lost three follow-ups (<i>n</i> = 85–96)
Age	23.75 (5.15)	22.39 (3.74)	23.56 (4.50)	24.80 (6.48)	25.19 (6.01)
Gender (Male)	100 (32.5%)	24 (21.1%)	17 (29.3%)	19 (47.5%)	40 (41.7%)
Time on smartphone (hours/day)	4.75 (3.30)	4.10 (2.25)	4.53 (2.73)	4.14 (2.49)	5.90 (4.48)
Time on social media (hours/day)	2.70 (2.69)	2.26 (1.66)	2.29 (1.58)	2.42 (1.71)	3.59 (4.03)
Current smoker (No)	301 (97.7%)	113 (99.1%)	57 (98.3%)	39 (97.5%)	92 (95.8%)
Height (cm)	165.17 (8.13)	163.83 (7.31)	163.93 (8.74)	166.41 (8.49)	167.09 (8.19)
Weight (kg)	57.29 (10.72)	54.27 (7.98)	56.18 (11.74)	55.98 (8.57)	62.09 (12.19)
Body mass index (kg/m ²)	21.00 (2.95)	20.22 (2.15)	20.91 (3.69)	20.22 (2.48)	22.24 (3.10)

problematic use to psychological distress rather than the opposite direction). More specifically, the LGM model assessing the impacts of generalized problematic smartphone/internet use suggests that the intercept of problematic use was significantly associated with the intercept of psychological distress (standardized coefficient = 0.32; $p < 0.01$); the growth of problematic use was significantly associated with the growth of psychological distress (standardized coefficient = 0.51; $p < 0.01$). The LGM model assessing the impacts of specific problematic smartphone/internet use (i.e., social media) suggests that the intercept of problematic use was significantly associated with the intercept of psychological distress (standardized coefficient = 0.28; $p < 0.01$) and the growth of psychological distress (standardized coefficient = 0.37; $p < 0.01$).

DISCUSSION

The present study's findings echo the current evidence concerning the associations between problematic smartphone/internet use and mental health (Bányai et al., 2017; Csibi et al., 2018; Monacis et al., 2017; Sha et al., 2019). More specifically, the present study used LGM modeling and found that baseline generalized problematic smartphone/internet use was positively associated with baseline psychological distress. Similarly, the growth of the generalized problematic smartphone/internet use was positively associated with the growth of psychological distress. Regarding specific problematic smartphone/internet use, the present

study showed that the initial level of the problematic use of social media was positively associated with both the initial level and the growth of psychological distress. Therefore, the present study extends the evidence of association between problematic smartphone/internet use and mental health problems (Bányai et al., 2017; Csibi et al., 2018; Monacis et al., 2017; Sha et al., 2019) from cross-sectional to longitudinal findings. In other words, the temporal associations found in the present study suggest that problematic smartphone/internet use may lead to psychological distress.

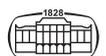
The associations between the two types of problematic use in smartphone/internet and psychological distress may relate to core features of addiction. Griffiths (2000, 2005) has proposed salience, mood, modification, tolerance, withdrawal conflict, and relapse as the six main criteria for addiction and these have been modeled to assess generalized or specific problematic smartphone/internet use. The present study corroborates and extends prior findings (Bányai et al., 2017; Csibi et al., 2018; Monacis et al., 2017; Sha et al., 2019) that problematic smartphone/internet use is associated with (and may further impact) psychological distress among individuals with problematic smartphone/internet use.

Although generalized and specific problematic smartphone/internet uses were similarly associated with psychological distress, the present findings further identified some differences. The growth of generalized problematic smartphone/internet use had impacts on the growth of psychological distress. This association was not shown in specific problematic use of social media. However, the magnitude of

Table 2. Problematic smartphone use, problematic social media use, and psychological distress across time

	Mean (SD)			
	Time 1	Time 2	Time 3	Time 4
Smartphone addiction	19.37 (5.12)	19.17 (4.40)	19.09 (4.35)	18.96 (4.54)
Social media addiction	14.45 (4.08)	13.99 (3.40)	13.89 (3.54)	14.37 (3.56)
Psychological distress	10.47 (5.44)	9.82 (5.15)	10.15 (5.44)	10.13 (5.41)

Problematic smartphone use was assessed using the Smartphone Application-Based Addiction Scale; problematic social media use was assessed using the Bergen Social Media Addiction Scale; psychological distress was assessed using the Hospital Anxiety and Depression Scale. Time 1 = baseline; Time 2 = first follow-up; Time 3 = second follow-up; Time 4 = third follow-up.



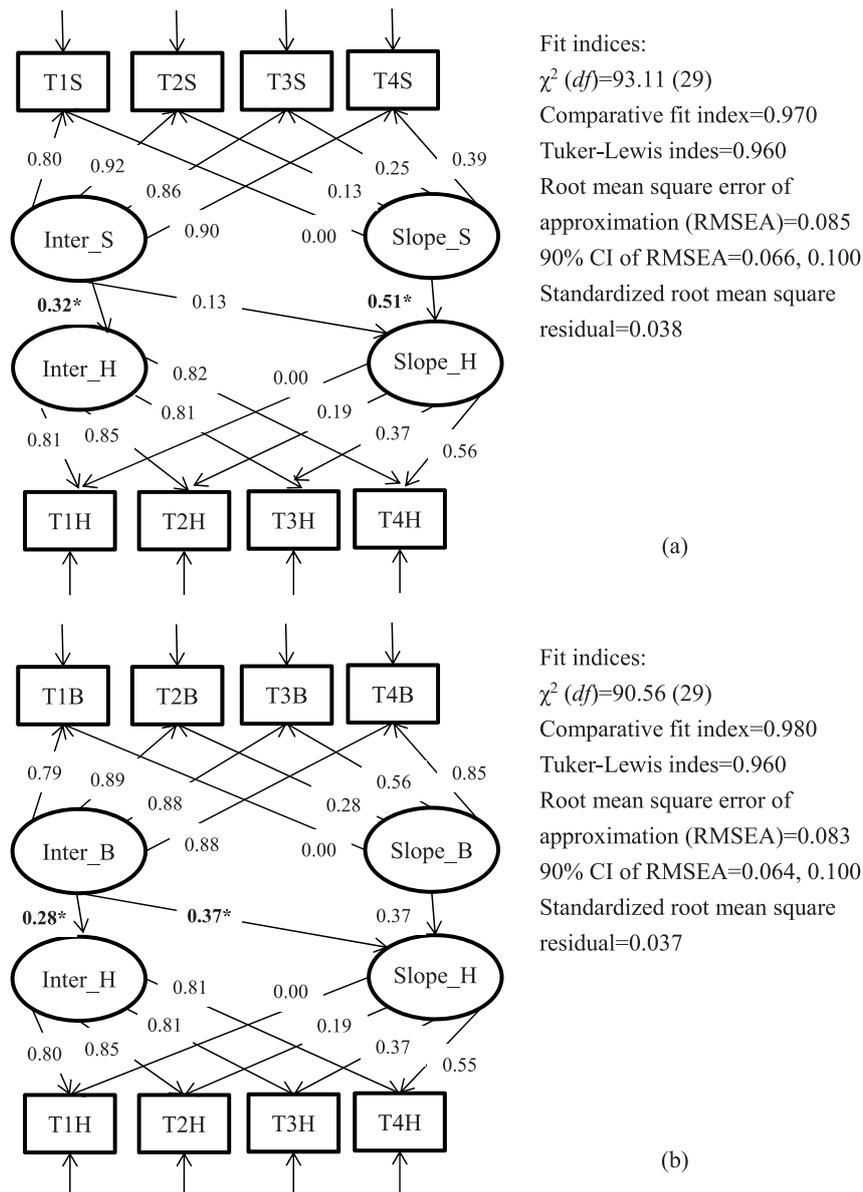


Fig. 1. Standardized coefficients and fit indices of latent growth models that examined the impacts of problematic internet use on psychological distress. Inter = intercept; B = Bergen Social Media Addiction Scale; S = Smartphone Application-Based Addiction Scale; H = Hospital Anxiety and Depression Scale; T1 = Time 1 (baseline); T2 = Time 2 (first follow-up); T3 = Time 3 (second follow-up); T4 = Time 4 (third follow-up). All models controlled age and gender. Significant coefficients are in bold with *. (a) Generalized problematic smartphone/internet use of smartphone application. (b) Specific problematic smartphone/internet use of social media

the association was of note (0.37, a moderate effect size; Cohen, 1988). In other words, both generalized and specific problematic smartphone/internet uses are potential risk factors for increasing psychological distress. Consequently, future studies with a large sample size are needed to corroborate our findings. Moreover, the initial level of specific problematic use in social media was associated with the growth of psychological distress, while this association was not found with generalized problematic smartphone/internet use. This finding supports those scholars who distinguish generalized problematic smartphone/internet use from specific problematic use (Brand et al., 2014; Davis, 2001; Griffiths, 1998, 2000; Montag et al., 2015).

By raising awareness concerning distinct types of problematic smartphone/internet use, healthcare providers may gain a more detailed insight regarding specific types of problematic smartphone/internet use. Taking the present study as an example, the initial level of problematic social media use may be particularly important given its impact on subsequent growth of psychological distress. Consequently, healthcare providers may specifically target problematic social media use. On the other hand, the growth of generalized problematic smartphone/internet use showed a greater impact than that of the specific problematic social media use on psychological distress. Therefore, a broader focus on problematic smartphone/internet use is also important.

Table 3. Correlation matrix among problematic smartphone use, problematic social media use, and psychological distress

	R											
	SA_T1	SA_T2	SA_T3	SA_T4	SMA_T1	SMA_T2	SMA_T3	SMA_T4	P_T1	P_T2	P_T3	P_T4
SA_T1	–											
SA_T2	0.744	–										
SA_T3	0.652	0.786	–									
SA_T4	0.696	0.828	0.787	–								
SMA_T1	0.546	0.507	0.438	0.546	–							
SMA_T2	0.494	0.607	0.530	0.639	0.719	–						
SMA_T3	0.534	0.539	0.635	0.620	0.702	0.777	–					
SMA_T4	0.599	0.581	0.582	0.748	0.731	0.747	0.742	–				
P_T1	0.280	0.187	0.221	0.307	0.213	0.174	0.290	0.277	–			
P_T2	0.214	0.244	0.235	0.341	0.212	0.224	0.270	0.285	0.716	–		
P_T3	0.252	0.280	0.335	0.339	0.298	0.214	0.362	0.310	0.782	0.801	–	
P_T4	0.263	0.279	0.270	0.431	0.372	0.331	0.394	0.436	0.765	0.854	0.832	–

SA = problematic smartphone use, assessed using the Smartphone Application-Based Addiction Scale; SMA = problematic social media use, assessed using the Bergen Social Media Addiction Scale; P = psychological distress, assessed using the Hospital Anxiety and Depression Scale; T1 = Time 1 (baseline); T2 = Time 2 (first follow-up); T3 = Time 3 (second follow-up); T4 = Time 4 (third follow-up).

All *P*-values < 0.01.

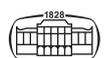
Practical and clinical implications

Based on the results of the present study, there are a number of implications. First, results of the present study showed that both generalized and specific types of problematic smartphone/internet use appear to have significant impacts on the development of psychological distress among young adults. The results suggest that educational awareness and prevention programs in schools concerning digital health and mental wellbeing are warranted. Second, the results of the present study provided insights into the debate concerning whether problematic smartphone/internet use should be considered as an independent diagnosis or a negative consequence of other disorders (Pies, 2009). Based on the findings of the present study, results suggest that problematic smartphone/internet use can be considered as an independent disorder. Therefore, healthcare providers within university settings should attempt to prevent future psychological distress by introducing awareness programs and promoting the screening problematic smartphone/internet use. From a clinical point of view for those seriously affected, psychological interventions (cognitive-behavioral therapy, motivational interviewing, and mindfulness interventions; Young, 2013) in the treatment of behavioral disorders (e.g., problematic smartphone/internet use) may be useful in helping overcome psychological distress among young adults.

Limitations

Several limitations exist when interpreting the findings of the present study. First, data on when participants began using social media or smartphones were not collected. Such information may provide greater insight into trajectories of smartphone/internet use and related clinical

correlates. Second, although participants who self-reported having any mental illness were excluded, such diagnoses were not confirmed by formal psychiatric interviews or data from medical records. Therefore, potential influences of psychiatric disorders on the study results cannot be excluded. Third, only university students (with the majority from one university) were recruited using convenience sampling. Therefore, the results of the present study may not generalize to other university students, other age populations such as retired people or high school students. Fourth, although missing data in the present study appeared not to be missing at random, significant differences were found between those completing the survey only once, those completing twice, those completing three times, and those completing all four assessments in age, hours spent on using smartphone per day, and hours spent on using social media per day. As such, generalizability of the current findings among university students warrants additional investigation. Fifth, data were collected from Hong Kong and the extent to which the findings generalize to other populations also warrants further investigation. Sixth, data on impactful life events (e.g., receiving psychological treatment, stressful life events like death of a family member) were not collected between baseline and follow-up assessments. Therefore, the confounding effects of these impactful life events cannot be excluded. Seventh, all data were self-reported using *Google Forms* and are subject to biases including memory recall and social desirability. Finally, only one type of specific smartphone/internet problematic use (i.e., social media use) was assessed. Given that other specific forms of smartphone/internet use (e.g., shopping, pornography viewing, gaming, gambling) may be problematic, these also require examination in future investigations.



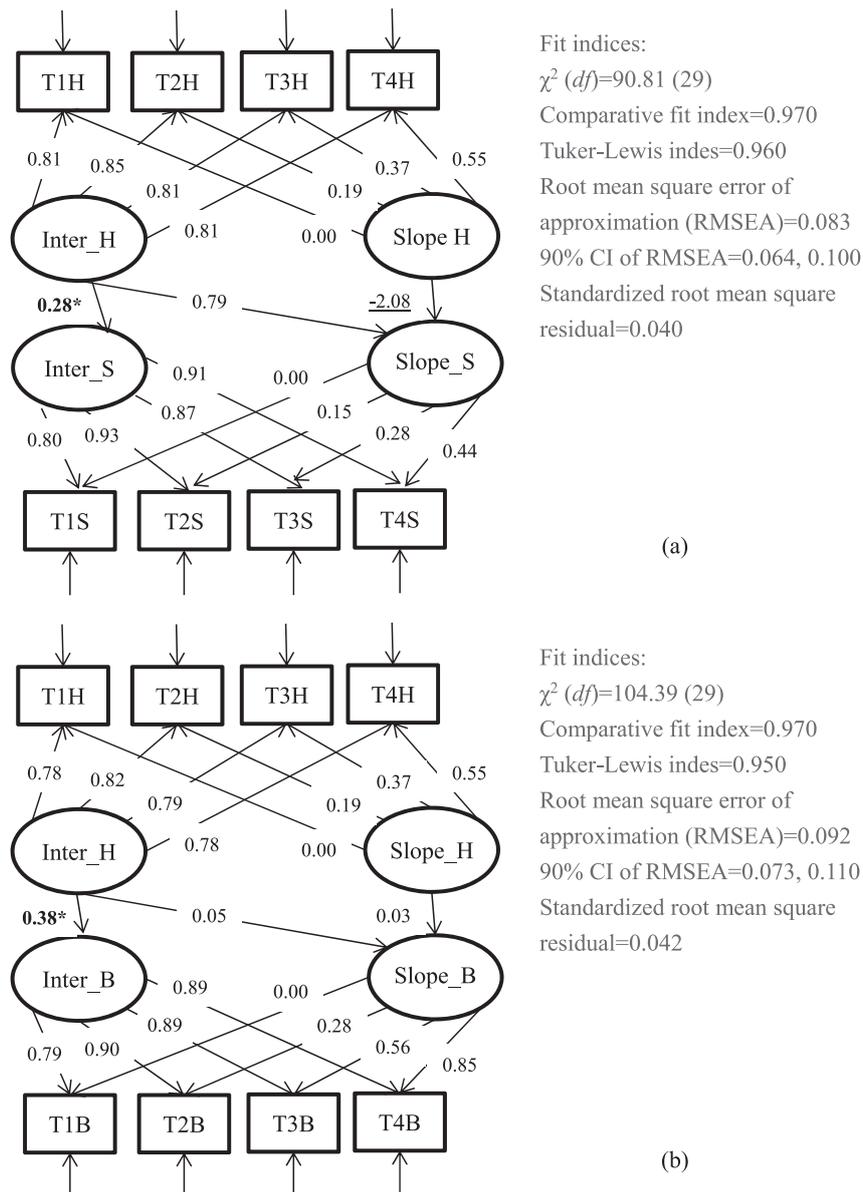


Fig. 2. Standardized coefficients and fit indices of latent growth models that examined the impacts of psychological distress on problematic internet use. Inter = intercept; B = Bergen Social Media Addiction Scale; S = Smartphone Application-Based Addiction Scale; H = Hospital Anxiety and Depression Scale; T1 = Time 1 (baseline); T2 = Time 2 (first follow-up); T3 = Time 3 (second follow-up); T4 = Time 4 (third follow-up). All models controlled age and gender. Significant coefficients are in bold with *. The coefficient underlined is a Heywood case; that is, an improper solution. (a) Generalized problematic smartphone/internet use of smartphone application. (b) Specific problematic smartphone/internet use of social media

CONCLUSIONS

The present study found that problematic smartphone/internet use was positively associated with psychological distress longitudinally among university students. More specifically, the initial level of generalized problematic use only increased the initial level of psychological distress, and the initial level of problematic use in social media increased both the initial level and growth of psychological distress. Additionally, growth of generalized smartphone/internet problematic use increased the growth of

psychological distress, while the growth of the problematic use in social media did not show the same relationship. The present study findings provide insights that may help foster and develop appropriate and effective programs to prevent psychological distress among young adults.

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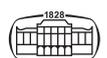


Authors' contributions: I-HC, AHP, and C-YL created and organized the study and collected the data. I-HC analyzed the data; I-HC and C-YL wrote the first draft, analyzed and interpreted the data. AHP and HL provided the directions of data analysis. MNP and MDG supervised the entire study and were responsible for all final editing. AHP, C-YL, HL, MNP, J-AS, and MDG critically reviewed the manuscript and provided constructive comments.

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REFERENCES

- Alimoradi, Z., Lin, C. -Y., Broström, A., Bülow, P. H., Bajalan, Z., Griffiths, M. D. (2019). Internet addiction and sleep disorders: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 47, 51–61. <https://doi.org/10.1016/j.smrv.2019.06.004>.
- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Association.
- Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorder: A large-scale cross-sectional study. *Psychology of Addictive Behaviors*, 30(2), 252–262. <https://doi.org/10.1037/adb0000160>.
- Bányai, F., Zsila, Á., Király, O., Maraz, A., Elekes, Z., Griffiths, M. D. (2017). Problematic social media use: Results from a large-scale nationally representative adolescent sample. *PLoS One*, 12(1), <https://doi.org/10.1371/journal.pone.0169839>.
- Billieux, J., Maurage, P., Lopez-Fernandez, O., Kuss, D. J. & Griffiths, M. D. (2015). Can disordered mobile phone use be considered a behavioral addiction? An update on current evidence and a comprehensive model for future research. *Current Addiction Reports*, 2, 154–162. <https://doi.org/10.1007/s40429-015-0054-y>.
- Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience*, 8, 1–13. <https://doi.org/10.3389/fnhum.2014.00375>.
- Brand, M., Young, K. S., Laier, C., Wölfling, K., & Potenza, M. N. (2016). Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neuroscience & Biobehavioral Reviews*, 71, 252–266. <https://doi.org/10.1016/j.neubiorev.2016.08.033>.
- Browne, M. W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.). *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.
- Chan, Y. F., Leung, D. Y. P., Fong, D. Y., Leung, C. M., & Lee, A. M. (2010). Psychometric evaluation of the Hospital Anxiety and Depression Scale in a large community sample of adolescents in Hong Kong. *Quality of Life Research*, 19(6), 865–873. <https://doi.org/10.1007/s11136-010-9645-1>.
- Cheng, C., & Li, A. Y. (2014). Internet addiction prevalence and quality of (real) life: A meta-analysis of 31 nations across seven world regions. *Cyberpsychology, Behavior, and Social Networking*, 17, 755–760. <https://doi.org/10.1089/cyber.2014.0317>.
- Chen, I. -H., Strong, C., Lin, Y. -C., Tsai, M. -C., Leung, H., Lin, C. -Y. (2020). Time invariance of three ultra-brief internet-related instruments: Smartphone application-based addiction scale (SABAS), Bergen social media addiction scale (BSMAS), and the nine-item internet gaming disorder scale- short form (IGDS-SF9) (study Part B). *Addictive Behaviors*, 101, 105960. <https://doi.org/10.1016/j.addbeh.2019.04.018>.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.
- Csibi, S., Demetrovics, Z., & Szabo, A. (2016). Hungarian adaptation and psychometric characteristics of brief addiction to smartphone scale (BASS) [in Hungarian]. *Psychiatria Hungarica*, 31(1), 71–77.
- Csibi, S., Griffiths, M. D., Cook, B., Demetrovics, Z., & Szabo, A. (2018). The psychometric properties of the smartphone application-based addiction scale (SABAS). *International Journal of Mental Health and Addiction*, 16(2), 393–403. <https://doi.org/10.1007/s11469-017-9787-2>.
- Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in Human Behavior*, 17(2), 187–195. [https://doi.org/10.1016/S0747-5632\(00\)00041-8](https://doi.org/10.1016/S0747-5632(00)00041-8).
- Griffiths, M. D. (1998). Internet addiction: Does it really exist? In Gackenbach, J. (Ed.), *Psychology and the internet: Intrapersonal, interpersonal and transpersonal applications* (pp. 61–75). New York: Academic Press.
- Griffiths, M. D. (2000). Internet addiction – time to be taken seriously? *Addiction Research*, 8(5), 413–418. <https://doi.org/10.3109/16066350009005587>.
- Griffiths, M. D. (2005). A ‘components’ model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10, 191–197. <https://doi.org/10.1080/14659890500114359>.
- Ikeda, K., & Nakamura, K. (2014). Association between mobile phone use and depressed mood in Japanese adolescents: A cross-sectional study. *Environmental Health and Preventive Medicine*, 19, 187–193. <https://doi.org/10.1007/s12199-013-0373-3>.
- Karaka, S., Canan, F., Saleh, A., & Potenza, M. N. (2017). Comorbidity between behavioral addictions and attention deficit/hyperactivity disorder: A systematic review. *International Journal of Mental Health and Addiction*, 15(3), 701–724.
- Kuss, D. J., & Griffiths, M. D. (2012). Online gaming addiction in children and adolescents: A review of empirical research. *Journal of Behavioral Addictions*, 1, 3–22. <https://doi.org/10.1556/JBA.1.2012.1.1>.
- Kuss, D. J. & Griffiths, M. D. (2017). Social networking sites and addiction: Ten lessons learned. *International Journal of Environmental Research and Public Health*, 14, 311. <https://doi.org/10.3390/ijerph14030311>.
- Kuss, D. J., Griffiths, M. D., Karila, L., & Billieux, J. (2014). Internet addiction: A systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design*, 20, 4026–4052. <https://doi.org/10.2174/13816128113199990617>.
- Leung, H., Pakpour, A. H., Strong, C., Lin, Y. -C., Tsai, M. -C., Griffiths, M. D. (2019). Measurement invariance across young adults from Hong Kong and Taiwan among three internet-



- related addiction scales: Bergen social media addiction scale (BSMAS), smartphone application-based addiction scale (SABAS), and internet gaming disorder scale-short form (IGDS-SF9) (study Part A). *Addictive Behaviors*, *101*, 105969. <https://doi.org/10.1016/j.addbeh.2019.04.027>.
- Lin, C. -Y., Broström, A., Nilsen, P., Griffiths, M. D., & Pakpour, A. H. (2017). Psychometric validation of the Persian Bergen social media addiction scale using classic test theory and Rasch models. *Journal of Behavioral Addiction*, *6*(4), 620–629. <https://doi.org/10.1556/2006.6.2017.071>.
- Lin, C. -Y., Imani, V., Broström, A., Nilsen, P., Fung, X. C., Griffiths, M.D. (2018). Smartphone application-based addiction among Iranian adolescents: A psychometric study. *International Journal of Mental Health & Addiction*, *17*, 765–780. <https://doi.org/10.1007/s11469-018-0026-2>.
- Monacis, L., De Palo, V., Griffiths, M. D., & Sinatra, M. (2017). Social networking addiction, attachment style, and validation of the Italian version of the Bergen Social Media Addiction Scale. *Journal of Behavioral Addictions*, *6*(2), 178–186. <https://doi.org/10.1556/2006.6.2017.023>.
- Montag, C., Bey, K., Sha, P., Li, M., Chen, Y. -F., Liu, W. -Y. (2015). Is it meaningful to distinguish between generalized and specific internet addiction? Evidence from a cross-cultural study from Germany, Sweden, Taiwan and China. *Asia-Pacific Psychiatry*, *7*(1), 20–26. <https://doi.org/10.1111/appy.12122>.
- Nathan, N., & Zeitzer, J. (2013). A survey study of the association between mobile phone use and daytime sleepiness in California high school students. *BMC Public Health*, *13*, 840. <https://doi.org/10.1186/1471-2458-13-840>.
- Pakpour, A. H., Chen, C. -Y., Lin, C. -Y., Strong, C., Tsai, M. -C., & Lin, Y. -C. (2019). The relationship between children's overweight and quality of life: A comparison of sizing me up, PedsQL, and Kid-KINDL. *International Journal of Clinical and Health Psychology*, *19*(1), 49–56. <https://doi.org/10.1016/j.ijchp.2018.06.002>.
- Pies R. (2009). Should DSM-V designate “internet addiction” a mental disorder? *Psychiatry (Edgmont)*, *6*(2), 31–37.
- Pontes, H. M., Andreassen, C. S., & Griffiths, M. D. (2016). Portuguese validation of the Bergen Facebook addiction scale: An empirical study. *International Journal of Mental Health and Addiction*, *14*, 1062–1073. <https://doi.org/10.1007/s11469-016-9694-y>.
- Pontes, H. M., Kuss, D. J., & Griffiths, M. D. (2015). Clinical psychology of internet addiction: A review of its conceptualization, prevalence, neuronal processes, and implications for treatment. *Neuroscience and Neuroeconomics*, *4*, 11–23. <https://doi.org/10.2147/NAN.S60982>.
- Rücker, J., Akre, C., Berchtold, A., & Suris, J. -C. (2015). Problematic internet use is associated with substance use in young adolescents. *Acta Paediatrica*, *10*(5), 504–507. <https://doi.org/10.1111/apa.12971>.
- Ryan, T., Chester, A., Reece, J., & Xenos, S. (2014). The uses and abuses of Facebook: A review of Facebook addiction. *Journal of Behavioral Addictions*, *3*, 133–148. <https://doi.org/10.1556/JBA.3.2014.016>.
- Sariyska, R., Reuter, M., Lachmann, B., & Montag, C. (2015). Attention deficit/hyperactivity disorder is a better predictor for problematic internet use than depression: Evidence from Germany. *Journal of Addiction Research & Therapy*, *6*, 209. <https://doi.org/10.4172/2155-6105.1000209>.
- Sha, P., Sariyska, R., Riedl, R., Lachmann, B., & Montag, C. (2019). Linking internet communication and smartphone use disorder by taking a closer look at the Facebook and WhatsApp applications. *Addictive Behaviors Reports*, *9*, 100148. <https://doi.org/10.1016/j.abrep.2018.100148>.
- Wartberg, L., Kriston, L., Kammerl, R., Petersen, K. U., & Thomasius, R. (2015). Prevalence of pathological internet use in a representative German sample of adolescents: Results of a latent profile analysis. *Psychopathology*, *48*(1), 25–30. <https://doi.org/10.1159/000365095>.
- World Health Organization (2018). *Gaming disorder*. Retrieved from <https://www.who.int/features/qa/gaming-disorder/en/> [access on 4 Feb, 2020].
- Yam, C. -W., Pakpour, A. H., Griffiths, M. D., Yau, W. -Y., Lo, C. -L. M., Ng, J. M. T. (2019). Psychometric testing of three Chinese online-related addictive behavior instruments among Hong Kong university students. *Psychiatric Quarterly*, *90*(1), 117–128. <https://doi.org/10.1007/s11126-018-9610-7>.
- Yang, S. -Y., Chen, M. -D., Huang, Y. -C., Lin, C. -Y., & Chang, J. -H. (2017). Association between smartphone use and musculoskeletal discomfort in adolescent students. *Journal of Community Health*, *42*, 423–430. <https://doi.org/10.1007/s10900-016-0271-x>.
- Young, K. S. (2013). Treatment outcomes using CBT-IA with Internet-addicted patients. *Journal of Behavioral Addictions*, *2*(4), 209–215. <https://doi.org/10.1556/JBA.2.2013.4.3>.

