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The mediating role of Internet addiction in depression, social anxiety, and psychosocial well-being among adolescents in six Asian countries: a structural equation modelling approach



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ABSTRACT

Objectives: This study examines the associations of Internet addiction with social anxiety, depression, and psychosocial well-being among Asian adolescents. A self-medication model conceptualizing Internet addiction as a mediating role in relating depression and social anxiety to negative psychosocial well-being was tested.

Study Design: A cross-sectional survey.

Methods: In the Asian Adolescent Risk Behavior Survey (AARBS), 5366 adolescents aged 12–18 years from six Asian countries (China, Hong Kong, Japan, South Korea, Malaysia, and Philippines) completed a questionnaire with items of the Internet Addiction Test (IAT), Social Anxiety Scale for Adolescents (SAS-A), Center for Epidemiological Studies Depression Scale (CESD), Self-Rated Health of the Nation Outcome Scales for Children and Adolescents (HoNOSCA-SR) in the 2012–2013 school year. Structural equation modelling was used to examine the mediating role of Internet addiction in depression, social anxiety, and subjective psychosocial well-being.

Results: Significant differences on the scores of IAT, SAS-A, CESD, and HoNOSCA-SR across the six countries were found. The proposed self-medication model of Internet addiction received satisfactory goodness-of-fit with data of all countries. After the path from social anxiety to Internet addiction had been discarded in the revised model, there was a

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significant improvement of the goodness-of-fit in the models for Japan, South Korea, and the Philippines.

Conclusions: Depression and social anxiety reciprocally influenced, whereas depression associated with poorer psychosocial well-being directly and indirectly through Internet addiction in all six countries. Internet addiction mediated the association between social anxiety and poor psychosocial well-being in China, Hong Kong, and Malaysia.

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Introduction

Internet addiction was commented to be one of the most serious public health concerns with the widespread growth of Internet users.¹ In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)², problematic Internet use on gaming has been considered to merit inclusion in the future edition of DSM. Owing to variations of definitions of Internet addiction and diagnostic instruments for assessments,³ the prevalence estimates of Internet addiction vary widely. According to a recent meta-analysis reporting the prevalence of Internet addiction across 31 nations, Asian countries have a leading prevalence of 7.1% (95% CI = 5.3%–8.9%).⁴

Previous studies demonstrated the high comorbidity of Internet addiction with psychiatric symptoms and functional impairment in both adolescent and adult populations.^{3,5} Depression and social phobia have been repeatedly reported to be associated with Internet addiction for adolescents.^{6,7–10} In the study by Bernardi and Pallanti¹¹ among 50 adult patients with Internet addiction, 15% had a diagnosis of generalized anxiety disorder, 15% had social anxiety disorder, and 7% had dysthymia. With a prospective design, the incidence of depression and social phobia were found to predict the occurrence of Internet addiction in Taiwanese adolescents.¹² It was found that the diagnosis of depression and social phobia was associated with 1.56 and 1.35 times of rate of Internet addiction than the normal group two years later, respectively.

Consistent findings have been obtained that Internet addiction or problematic Internet use is associated with negative outcomes such as poor school performance,¹³ family function,¹⁴ psychosocial functioning,¹³ self-esteem and life satisfaction,¹⁵ and mental health.¹⁶ Based on these past findings, the self-medication hypothesis of addiction,^{17–19} in which addictive behaviours are characterized as maladaptive ways of coping with excessively difficult states of emotions or stress, may help understand the psychopathological pathway of Internet addiction. Under this model, Internet addiction emerges as a result of individual attempt to ‘self-treat’ their stress, anxiety, and depression. In other words, the Internet provides as an arena particularly for adolescents with social anxiety and interpersonal problems to develop the ‘ideal self-identity’ to compensate their imperfections in the real world.²⁰ In this sense, Internet use is like a double-edge sword which serves a compensatory function psychologically for the depressive and socially anxious individuals. At the same time,

it could deprive the persons from real-world social relationship due to the excessive amount of time spent online. Internet use as a coping strategy may leave adolescents even worse off if the underlying depression and social anxiety is left untreated at the developmental period of identity formation, when reliance on the Internet may become heavier and finally turn to be excessive and addictive.

Hypotheses

As discussed above, depression and social anxiety were found to have high comorbidity with Internet addiction.^{6,7–10} In line with the cognitive-behavioural model of pathological Internet use,²¹ depression and social anxiety are viewed as distal antecedents to Internet addiction in the proposed model. At the beginning, deficient self-regulation of Internet use may be initiated by self-reactive incentives to relieve boredom, engage in para-social relationship, and seek self-identity validation.^{22,23} Unfortunately, depression and social anxiety, which were demonstrated to frequently co-occur,^{24–26} together interfere with cognitions maintaining effective self-regulation, and hence downward spiral dysregulated use of Internet. For instance, people with social anxiety may attribute their unsuccessful interpersonal relationship to their lack of social skills or even their own incompetence and worthlessness. The immediate positive effect of Internet use in alleviating distress may motivate further Internet use for some individuals.

As a result, we first tested a model in which the association between Internet use and dysregulated emotion encompassing both depression and social anxiety, was positive. As suggested by LaRose et al.,²² deficient self-regulation of Internet addiction may occur to all Internet consumers, even among those whose consumption amount and patterns are generally considered normal. The construct of ‘Internet addiction’ is conceived as an indicator of risks or tendency to Internet addiction that could be found in the non-addictive population in this study.

Specifically, the following hypotheses were proposed:

Hypothesis 1 (H1): Depressive symptoms will be positively and directly related to Internet addiction.

Hypothesis 2 (H2): Social anxiety symptoms will be positively and directly related to Internet addiction.

Hypothesis 3 (H3): Social anxiety symptoms will be positively and directly correlated with depressive symptoms.

When Internet use becomes addictive, it in turn causes life problems. For instance, the excessive time spent online would take away valuable study time, result in academic setbacks

and reduced engagement in social activities, which may possibly cause confrontations with significant others.^{13,14} These negative life events, along with the untreated depression and social anxiety may further heighten dysphoric moods, leading to negative psychosocial and physical functioning. To notice, while emotional health is one of the key domains of general psychosocial well-being, the latter concept integrating both mental and physical health aspects to provide a more holistic approach to disease prevention and health promotion. The outcome measure of the proposed model could also serve as a metric for health policy makers gauging the effectiveness of their policies.

With these stipulations, we hypothesized that:

Hypothesis 4 (H4): Internet addiction level will be negatively and directly related to general psychosocial well-being.

Hypothesis 5 (H5): Depressive symptoms will be negatively and directly related to general psychosocial well-being.

Hypothesis 6 (H6): Social anxiety will be negatively and directly related to general psychosocial well-being.

In view of the hypothesized relationship between depression/social anxiety and Internet addiction (H1 and H2), and that between Internet addiction and general psychosocial well-being (H4), depression and social anxiety was expected to have an indirect, negative impact on psychological and behavioural outcomes. Although Internet addiction, depression and social anxiety, may emerge as a result of complex interactions between various etiological factors, the proposed model has posited Internet use as a mediator. This was done to highlight that Internet could be used to compensate for the underlying emotional problems as advanced by the self-medication hypothesis, whilst the effectiveness of treatments with antidepressant medication²⁷ and cognitive-behavioural therapy.²⁸ We herein suggested:

Hypothesis 7 (H7): Depressive symptoms will be negatively and indirectly related to general psychosocial well-being via Internet addiction.

Hypothesis 8 (H8): Social anxiety will be negatively and indirectly related to general psychosocial well-being via Internet addiction.

The present study

In our previous study, we have provided an epidemiological profile of problematic and addictive Internet use, and the related cyberbehaviors among Asian adolescents.²⁹ This study extrapolated these results to examine the associations of internet addiction with depression, social anxiety, and psychosocial well-being among adolescents in the six Asian countries. In addition, we proposed a self-medication model of problematic Internet use, and the rival hypotheses generated from the model were tested. When the phenomenon of Internet addiction has been viewed as culturally universal, we hypothesized that the proposed self-medication model would be useful to conceptualize the problem of Internet addiction as a mediator for depression and social anxiety to negative general psychosocial well-being among adolescents in all the included countries. Such findings may contribute to the development of Internet addiction prevention and treatment programs from the mental health approach.

Methods

Participants

In the Asian Adolescent Risk Behavior Survey (AARBS), participants were 5366 adolescents aged 12–18 years from China ($n = 879$), Hong Kong ($n = 839$), Japan ($n = 744$), South Korea ($n = 936$), Malaysia ($n = 969$), and the Philippines ($n = 999$) in the school year 2012–2013. Schools from rural and urban areas in each country were randomly selected. Schools agreed to participate were from the southern and central regions of China (Shenzhen and Hunan), Kowloon and New Territories of Hong Kong; western regions of Japan (Shiga); northern and southern regions of South Korea (Seoul and Pusan); central western regions of Malaysia (Selayang); and northern and southern regions of the Philippines (Kapitolyo, Manila, Marikina, Novaliches, and Obando).

Administration

Students completed a 40-minute structured questionnaire translated to their teaching languages (Simplified Chinese for China; Traditional Chinese for Hong Kong; Japanese for Japan; Korean for South Korea; Chinese and English for Malaysia; and English for the Philippines). To ensure the quality of the translated items, the translation procedure was conducted by two independent bilingual translators, followed the face validity checking by researchers. All participation was voluntary, with informed consent from the students. Ethics approval was obtained from the university and hospital ethics committees.

Instruments

Internet addiction. The Internet Addiction Test (IAT) is a widely used instrument to assess Internet addictive behaviours.³⁰ It consists of 20 items rated on a Likert scale from 1 (rarely) to 5 (always) examining the degree of preoccupation and compulsiveness to go online, and the impact on life related to Internet usage. IAT has been translated into different Asian languages for use in Korean,³¹ Malay³² and Chinese³³ populations. Our earlier work on the psychometric properties of IAT revealed three factors: Withdrawal and Social Problems (W & SP), Time Management and Performance (TM & P), and Reality Substitute (RS) underlying the construct in Hong Kong adolescents.³⁴ High reliability estimates of IAT in the range of Cronbach's alpha from 0.90 (Philippines) to 0.93 (Hong Kong) were obtained in the present study.

Depressive symptoms. The Center for Epidemiologic Studies Depression Scale (CES-D) is a well-established self-report scale for measuring depressive symptoms in both the general community and psychiatric populations. It consists of 20 items on the scale from 0 (Rarely or None of the Time) to 3 (Most or Almost All the Time), concerning depressed mood representing major symptoms in the clinical syndrome of depression.³⁵ Possible scores ranging from 0 to 60, with high scores indicating more depressive symptoms. It has been shown to be a valid, internally consistent, temporarily reliable and useful in discriminating between psychiatric inpatients and the general population.^{35–37} Meta-analysis of factor

analyses of CES-D³⁸ suggested four specific underlying factors, which are generally described as Positive Affect (PA), Depressed or Negative Affect (DA), Somatic Symptoms (SOM), and Interpersonal Problems (IP). Reliability estimates of CES-D ranged from 0.81 (Philippines) to 0.96 (Hong Kong) in the present study.

Social anxiety symptoms. The Social Anxiety Scale for Adolescents (SAS-A),³⁹ was used to assess subjective experience of social anxiety. SAS-A was adapted from the well-established Social Anxiety Scale for Children – Revised.⁴⁰ It consists of 18 test items and four filler items rated on a 5-point Likert scale from 1 (Not at all) to 5 (All the time) divided into three subscales: Fear of Negative Evaluation (FNE: eight items), Social Avoidance and Distress specific to new situation or unfamiliar peers (SAD–New: six items), and Social Avoidance and Distress that is experienced more generally in the company of peers (SAD–General: four items). Higher scores indicate greater severity. Past studies showed that SAS-A is a valid and reliable assessment of social anxiety.^{39,41,42} SAS-A was demonstrated for its adequate test-retest reliability⁴³ and good construct validity as evidenced by its strong correlation with other instruments of general or unspecified anxiety and depressive symptomatology.⁴¹ Reliability estimates of SAS-A ranged from 0.91 (Malaysia) to 0.95 (Hong Kong) in the present study.

General psychosocial well-being. The self-rated version of Health of the Nation Outcome Scales for Children and Adolescents (HoNOSCA–SR), Section A, was used as an outcome measure of mental health and social/behavioral functioning.⁴⁴ Section A of HoNOSCA comprises 13 core scales rated on a 5-point scale, ranging from 1 (No problem) to 5 (Severely); hence, higher scores suggested worse general psychosocial well-being. The scales specifically address the following problems: disruptive/aggressive behaviours, over-activity/concentration problems, self-injury, substance misuse, scholastic skills, physical illness, hallucinations/delusions, nonorganic somatic symptoms, emotional symptoms, peer relationships, self-care, family relationships, and school attendance, which can possibly be organized around four sections: behaviours, symptomatology, disability, and social functioning.^{45,46} HoNOSCA–SR was found to be user-friendly for adolescents, and had satisfactory reliability, validity and sensitivity to change in mental health outcomes.⁴⁴ Reliability estimates of HoNOSCA–SR ranged from 0.83 (Malaysia) to 0.93 (Hong Kong) in the present study.

Internet use. Adolescents were asked to fill out questions about using Internet, namely surfing and instant messenger (IM) services. Participants were first asked to make an estimation of the average weekly amount and frequency spent on chatting or surfing. They have to fill in the average number of hours spent online daily during school days and holidays, to respond on a 6-point scale from 1 (Once a week or less) to 6 (More than three times a day) for the question on frequency of Internet use.

Data analysis

The proposed model depicting the relationships among depression, social anxiety, Internet addiction and general psychosocial well-being are summarized in Fig. 1. In each

measurement model, subscale of each latent factor was modelled as a reflective indicator with no inter-related error variances. Maximum likelihood parameter estimation was employed as the estimation method. Given that the χ^2 -difference test is very sensitive to sample size, particularly in models with a large number of estimated parameters, other fit indexes, including the comparative fit index (CFI);⁴⁷ the normed fit index (NFI), the non-normed fit index (NNFI);⁴⁸ and the root mean square error of approximation (RMSEA);⁴⁹ were reported to complement the χ^2 -difference test in assessing the model fit. Acceptable goodness-of-fit was determined by a value of CFI, NFI and NNFI exceeding 0.90, and RMSEA value less than 0.08.⁵⁰

As a last step, non-significant paths were eliminated from the model if the Wald test indicated that removing the paths would not result in a significant decrease in model fit. The normal Chi-square likelihood ratio test was conducted to detect any significant differences in the goodness-of-fit between the models,^{51,52} whereas Akaike's Information Criterion (AIC)⁵³ and consistent AIC (CAIC)⁵⁴ were used for judging parsimony of the model along with its goodness-of-fit. The two indices reflect the extent to which parameter estimates from the original sample will cross-validate in future samples.⁵⁵ Smaller values of AIC and CAIC indicate a better fit to the hypothesized model.

Structural equation modelling (SEM) analyses were performed separately for the six countries using EQS 6.1.⁵⁶ Other statistical analyses, including item analysis and analysis of variance (ANOVA) were conducted by SPSS 19.0. A total of 149 cases (China: $n = 88$, Hong Kong: $n = 1$, Japan: $n = 0$, South Korea: $n = 6$, Malaysia: $n = 49$, and Philippines: $n = 5$) with missing scores of subscales in the proposed model were excluded from the SEM analysis. Only a subgroup ($n = 511$) of participants from South Korea has filled in HoNOSCA–SR, and thus included in the SEM analysis and calculation of Cronbach's alpha of HoNOSCA–SR.

Results

Descriptive statistics

Table 1 presents the means and standard deviations of the variables separated by countries. Participants were 55.8% females, with an average age of 15.61 years ($SD = 1.56$). The age and sex distributions of the participants of each country are shown in Table 1. Table 2 presents the results of ANOVA and the Bonferroni post-hoc comparisons with country membership as the independent variable. Analyses indicated that there were significant differences on the total and subscale scores of IAT, SAS-A, CESD, and HoNOSCA–SR across the six countries. Filipino adolescents showed the highest risks of Internet addiction (mean = 41.66, $sd = 14.15$) and social anxiety (mean = 48.53, $sd = 13.57$), whereas Hong Kong and Malaysian adolescents had relatively higher level of depressive symptoms (mean = 19.29, $sd = 7.83$), and poorer psychosocial well-being (mean = 24.48, $sd = 8.03$), respectively. Post hoc analyses indicated that South Korean scored significantly lower on all independent variables measured, except on social anxiety when compared with mainland Chinese (see Table 2).

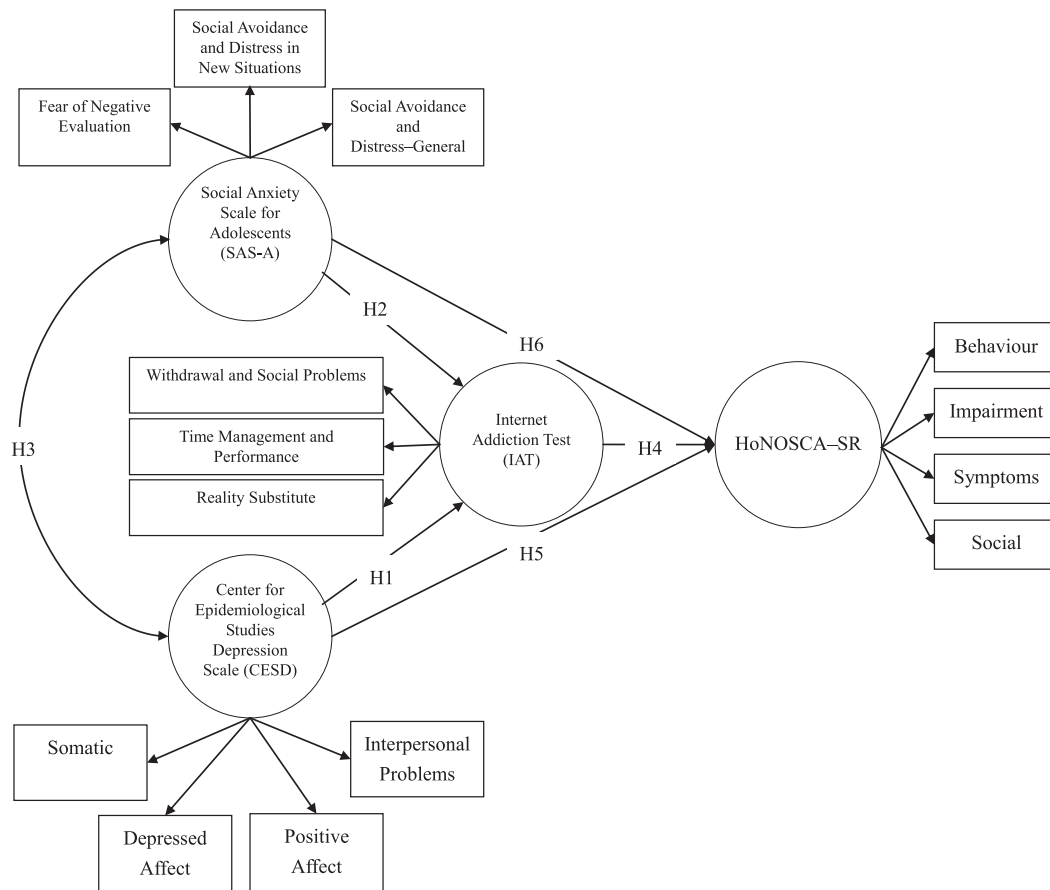


Fig. 1 – Hypothesized structural equation model of the relationships between depression, social anxiety, Internet addiction and general psychosocial well-being. Circles represent latent variables and rectangles represent measured variables. HoNOSCA-SR = Self-rated Health of the Nation Outcome Scales for Children and Adolescents.

Structural equation modeling

Table 3 shows the goodness of fit indices of the proposed model in the six countries. The proposed model revealed a good fit to the data in all the Asian countries studied, whereas the proposed model fitted particularly well in mainland Chinese, and the least in Filipino adolescents.

Table 4 presents the unstandardized, standardized coefficient and standard errors of the proposed model. The pattern of factor loadings of the measurement models was consistent across countries, except for the positive relationship between PA and SAS-A in Japanese. The factor loadings were high and significant by the Wald test, supporting the validity of the measurement models.

Regarding the direct effects of the proposed model, H1, H3, H4 and H5 were supported in all countries. Depressive symptoms was positively related to Internet addiction (H1) and negatively related with general psychosocial well-being (i.e. higher HoNOSCA-SR scores) (H5), and positively correlated with social anxiety (H3). As expected, Internet addiction was also negatively related with general psychosocial well-being (H4). However, H2 was supported in three countries only, China, Hong Kong, and Malaysia. The relationship between social anxiety and Internet addiction was not significant in Japan, South Korea and the Philippines. H6 was not

supported in Japan and the Philippines, suggesting that social anxiety did not significantly relate with general psychosocial well-being in these two countries.

Due to the insignificant direct effect from SAS-A to IAT, H8 was not supported in Japan, South Korea and the Philippines. Along with the insignificant relationship between social anxiety and general psychosocial well-being, the total effect from social anxiety and general psychosocial well-being was not significant in Japan and the Philippines. However, H7 was supported in all countries. As we hypothesized, depressive symptoms mediated by Internet addiction to negatively affect adolescents' general psychosocial well-being. Together the variables in the model accounted for 18.2% (Japan) to 36.1% (Hong Kong) of the variance in Internet addiction, 31.8% (the Philippines) and 70.2% (Japan) of variance in general psychosocial outcomes.

Since the hypothesized path from social anxiety to negative psychological/behavioral functioning outcomes was not supported in Japan, South Korea and the Philippines, the respective path was discarded in the revised model. The revised model was then tested in these three countries, and are presented in Fig. 2. The Chi-square likelihood ratio test indicated that the revised model has been significantly improved in all these three countries, Japan: $\Delta\chi^2(30, N = 744) = 130.94, P < .001$; South Korea: $\Delta\chi^2(30,$

Table 1 – Mean (SD) of Internet Addiction Test (IAT), Social Anxiety Scale for Adolescents (SAS-A), Center for Epidemiological Studies Depression Scale (CESD), and Self-rated Health of the Nation Outcome Scales for Children and Adolescents (HoNOSCA – SR) scores by countries.

	China n = 879	Hong Kong n = 839	Japan n = 744	South Korea n = 936	Malaysia n = 969	Philippines n = 999	Total n = 5366
IAT							
W & SP	13.31 (6.23)	15.19 (6.37)	15.33 (5.98)	12.55 (4.87)	15.63 (6.38)	17.84 (6.54)	15.02 (6.34)
TM & P	9.91 (5.03)	12.50 (5.14)	14.11 (5.51)	9.98 (3.95)	12.21 (5.24)	12.99 (4.90)	11.91 (5.18)
RS	5.23 (2.60)	6.27 (2.84)	5.81 (2.66)	4.08 (1.80)	5.93 (2.84)	6.43 (2.86)	5.63 (2.75)
Total	31.02 (14.08)	37.45 (14.17)	39.99 (14.25)	29.57 (10.65)	37.14 (14.59)	41.66 (14.15)	36.13 (14.40)
SAS-A							
FNE	17.02 (7.22)	18.50 (6.91)	20.91 (6.31)	16.21 (6.78)	20.02 (6.58)	21.83 (6.23)	19.12 (6.98)
SAD-N	12.81 (5.58)	14.32 (5.65)	16.46 (5.50)	12.13 (5.34)	15.27 (5.79)	16.34 (5.12)	14.56 (5.73)
SAD-G	7.45 (3.74)	7.83 (3.50)	9.31 (3.30)	7.15 (3.27)	8.81 (3.48)	10.36 (3.55)	8.52 (3.66)
Total	37.19 (15.44)	40.65 (15.12)	46.67 (13.77)	35.46 (14.55)	44.03 (14.44)	48.53 (13.57)	42.16 (15.26)
CESD							
Somatic	4.79 (4.34)	4.92 (4.55)	4.95 (3.56)	3.26 (3.42)	5.35 (3.41)	5.77 (3.26)	4.86 (3.85)
DA	4.01 (4.71)	4.35 (4.98)	3.92 (3.91)	2.56 (4.17)	3.97 (4.13)	4.59 (3.71)	3.90 (4.32)
PA	9.05 (2.99)	9.11 (2.92)	6.23 (2.88)	6.81 (3.39)	5.27 (3.12)	5.33 (3.01)	6.89 (3.45)
IP	0.96 (1.54)	0.90 (1.45)	0.85 (1.31)	0.85 (1.50)	1.49 (1.51)	1.33 (1.46)	1.08 (1.49)
Total	18.73 (7.55)	19.29 (7.83)	15.95 (8.78)	13.48 (8.59)	16.03 (8.27)	17.02 (7.38)	16.71 (8.29)
HoNOSCA–SR							
Behaviour	5.74 (2.69)	5.29 (2.48)	5.86 (2.59)	4.68 (2.32)	6.78 (2.62)	5.67 (2.37)	5.76 (2.59)
Impairment	3.43 (1.64)	3.44 (1.60)	3.65 (1.38)	3.03 (1.41)	3.67 (1.49)	3.42 (1.55)	3.47 (1.54)
Symptoms	4.48 (2.33)	4.18 (2.20)	4.28 (1.93)	3.79 (1.67)	4.90 (2.22)	4.93 (2.29)	4.50 (2.19)
Social	6.59 (3.38)	6.04 (3.20)	7.40 (3.46)	5.49 (2.58)	7.72 (3.45)	7.22 (3.11)	6.86 (3.33)
Total	21.50 (8.84)	20.23 (8.88)	23.09 (8.00)	18.21 (7.09)	24.48 (8.03)	22.73 (7.83)	22.03 (8.40)

Note. W & SP = Withdrawal and Social Problems; TM & P = Time Management and Performance; RS = Reality Substitute; FNE = Fear of Negative Evaluation; SAD-N = Social Avoidance and Distress in New Situations; SAD-G = Social Avoidance and Distress-General; DA = Depressed Affect; PA = Positive Affect; IP = Interpersonal Problems.

$N = 505$) = 87.63, $P < .001$; the Philippines: $\Delta\chi^2(30, N = 994) = 234.32, P < .001$. For the data of South Korean, both AIC and CAIC suggested that the original model was preferred. However, inconsistent results were found from the data of Japan and the Philippines. While AIC favoured the revised model, CAIC suggested that the original model is better. As shown in Table 5, the beta coefficients of the revised model indicating the direct (H1a, H4a, and H5a), indirect (H7a) and total effects of depression on general psychosocial well-being through Internet addiction were significant in all three countries.

Discussion

Internet addiction has been conceptualized as similar to impulse control or addictive disorders, which excessive usage, severe withdrawal symptoms, mood modification, tolerance, and negative repercussions were commonly adopted criteria.^{30,57–60} However, there is still a debate of whether Internet addiction should be considered as a primary disorder. Some researchers have argued that the engagement in Internet activities is only another way where gamblers, shopping addicts, and sex addicts manifest their diseases.^{59,61,62} This argument is supported by the high comorbidity between Internet addiction and substance dependence,^{63,64} smoking, alcohol use,^{65–67} impulse-control disorders,⁶⁸ and obsessive compulsive, antisocial and borderline personality disorders.^{11,68}

Regardless of whether Internet addiction should be viewed as a primary disorder, the negative association of internet addiction and general psychological well-being is widely documented in the literature. However, little is currently known about their inter-relationships when depression and social anxiety, two affective disorders frequently comorbid with Internet addiction, are considered concurrently. The present study has empirically tested the model that Internet addiction plays a mediating role between depression and social anxiety in worsening individual health and psychosocial outcomes. This proposed model falls under the conceptual framework of “self-medication” hypothesis that depressed and socially anxious people try to alleviate their dysregulated moods through Internet use. Nevertheless, Internet use when becomes excessive and addictive may cause additional adaptation stresses, and degrade one’s psychosocial well-being along with the dysregulated moods.

Our findings have demonstrated that there are significant relationships among these variables. The original model encompassing both social anxiety and depression was acceptable for data from all six countries. Consistent with the past findings that excessive use of the Internet was causing academic, social, and interpersonal problems^{8,69} and psychiatric symptoms,⁷⁰ scores on IAT (indicating one’s risk to Internet addiction) was positively related to self-reported mental health and social/behavioral problems. Previous studies have stated that increased level of depression is associated with the risks to become addicted to the Internet;¹⁶ our results tended to support this. Critically, the hypothesis

Table 2 – Comparison of Internet Addiction Test (IAT), Social Anxiety Scale for Adolescents (SAS-A), Center for Epidemiological Studies Depression Scale (CESD), and Self-rated Health of the Nation Outcome Scales for Children and Adolescents (HoNOSCAeSR) scores across countries.

Country 1	ANOVA		Bonferroni post-hoc comparisons														
	F ^a	η ²	CN	CN	CN	CN	CN	HK	HK	HK	HK	JP	JP	JP	SK	SK	MY
Country 2			HK	JP	SK	MY	PH	JP	SK	MY	PH	SK	MY	PH	MY	PH	PH
IAT																	
W & SP	86.81	0.08	1.65***	1.79***	-0.98*	2.22***	4.30***	-0.13	2.63***	-0.56	-2.64***	2.77***	0.43	-2.51***	3.20***	-5.27***	-2.08***
TM & P	94.86	0.08	2.46***	4.08***	-0.04	2.32***	2.96***	-1.62***	2.50***	0.14	-0.50	4.12***	-1.76***	1.12***	2.36***	-3.00***	-0.64
RS	99.43	0.09	1.03***	0.57***	-1.15***	0.69***	1.20***	0.46**	2.19***	0.34	-0.16	1.72***	0.12	-0.63***	1.84***	-2.35***	-0.51***
Total	109.54	0.09	5.74***	8.28***	-2.09*	5.95***	9.94***	-2.54***	7.82***	-0.21	-4.20***	10.36***	-2.33**	-1.66	8.03***	-12.03***	-3.99***
SAS-A																	
FNE	100.19	0.09	1.43***	3.83***	-0.86	3.04***	4.76***	-2.41***	2.28***	-1.62***	-3.33***	4.69***	-0.79	-0.92	3.90***	-5.61***	-1.71***
SAD-N	94.30	0.08	1.46***	3.60***	-0.71	2.47***	3.48***	-2.13***	2.18***	-1.01***	-2.01***	4.31***	-1.13***	0.12	3.18***	-4.19***	-1.01***
SAD-G	115.51	0.10	0.38	1.86***	-0.31	1.36***	2.91***	-1.48***	0.68***	-0.98***	-2.53***	2.16***	-0.49	-1.05***	1.67***	-3.22***	-1.55***
Total	116.55	0.10	3.26***	9.28***	-1.88	6.87***	11.14***	-6.02***	5.15***	-3.61***	-7.88***	11.17***	-2.41**	-1.86	8.75***	-13.02***	-4.27***
CESD																	
SOM	47.76	0.04	0.10	0.12	-1.55***	0.56*	0.95***	-0.03	1.65***	-0.46	-0.85***	1.67***	0.43	-0.82***	2.11***	-2.50***	-0.39
DA	24.80	0.02	0.32	-0.10	-1.45***	-0.04	0.57	0.42	1.77***	0.36	-0.25	1.35***	0.06	-0.67*	1.41***	-2.02***	-0.61*
PA	288.00	0.21	0.00	-2.88***	-2.27***	-3.81***	-3.79***	2.89***	2.28***	3.82***	3.79***	-0.61***	-0.93***	0.90***	-1.54***	1.51***	-0.03
IP	32.44	0.03	-0.06	-0.11	-0.11	0.53***	0.38***	0.05	0.05	-0.59***	-0.43***	0.00	0.64***	-0.49***	0.64***	-0.48***	0.15
Total	60.90	0.05	0.37	-2.97***	-5.39***	-2.77***	-1.90***	3.34***	5.75***	3.13***	2.26***	2.41***	0.21	-1.07	2.62***	-3.49***	-0.87
HoNOSCA-SR																	
Behaviour	55.69	0.05	-0.46***	0.12	-1.05***	1.05***	-0.07	-0.58***	0.60***	-1.51***	-0.39*	1.17***	0.93***	0.19	2.11***	-0.98***	1.12***
Impairment	13.66	0.01	0.01	0.22	-0.40***	0.24*	-0.01	-0.22	0.40***	-0.23*	0.01	0.62***	0.02	0.23*	0.64***	-0.39***	0.25**
Symptoms	29.83	0.03	-0.31	-0.21	-0.68***	0.42***	0.44***	-0.10	0.37*	-0.73***	-0.75***	0.47***	0.63***	-0.65***	1.10***	-1.12***	-0.02
Social	48.74	0.05	-0.57***	0.79***	-1.12***	1.11***	0.61***	-1.36***	0.54	-1.69***	-1.18***	1.91***	0.33	0.18	2.23***	-1.73***	0.50**
Total	50.92	0.05	-1.39**	1.47**	-3.34***	2.93***	1.11	-2.86***	1.96***	-4.32***	-2.50***	4.81***	1.46***	0.36	6.28***	-4.46***	1.82***

Note. CN = China; HK = Hong Kong; MY = Malaysia; JP = Japan; PH = Philippines; SK = South Korea; W & SP = Withdrawal and Social Problems; TM & P = Time Management and Performance; RS = Reality Substitute; FNE = Fear of Negative Evaluation; SAD-N = Social Avoidance and Distress in New Situations; SAD-G = Social Avoidance and Distress-General; SOM = Somatic; DA = Depressed Affect; PA = Positive Affect; IP = Interpersonal Problems.

*P < .05, **P < .01, ***P < .001.

^a All F-values of Analysis of Variance (ANOVA) are significant at P < .001.

Table 3 – Summary of indexes of goodness-of-fit of the originally proposed model in six countries and the revised model in Japan, South Korea and the Philippines.

	χ^2	df	χ^2/df	NFI	NNFI	CFI	RMSEA	90% CI	AIC	CAIC
Original model										
China	236.46	71	3.33	0.95	0.96	0.97	0.042	0.034–0.050	27.31	–375.49
Hong Kong	505.48	71	7.12	0.92	0.91	0.93	0.070	0.062–0.077	217.15	–189.75
Japan	315.64	71	4.45	0.93	0.93	0.95	0.060	0.052–0.067	115.83	–282.62
South Korea	306.84	71	4.32	0.93	0.94	0.95	0.060	0.050–0.070	52.39	–314.65
Malaysia	324.90	71	4.58	0.95	0.95	0.96	0.056	0.049–0.063	132.31	–281.22
Philippines	523.19	71	7.37	0.91	0.90	0.92	0.076	0.070–0.082	336.55	–82.48
Revised model										
Japan	184.70	41	4.50	0.95	0.95	0.96	0.069	0.059–.079	102.70	–127.39
South Korea	219.21	41	5.35	0.94	0.93	0.95	0.095	0.083–0.108	137.21	–74.91
Philippines	288.88	41	7.05	0.93	0.92	0.94	0.078	0.070–0.087	206.88	–35.10

Note. Estimation method: Maximum Likelihood. *df* = degree of freedom; NFI = normed fit index; NNFI = non-normed fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval; AIC = Akaike's Information Criterion; CAIC = Consistent Akaike's Information Criterion.

that depression has both direct and indirect effect on general health and psychosocial outcomes was supported. This highlights the possible role of emotion dysregulation as a preceding factor of Internet addiction in affecting individual psychosocial well-being.

Apart from depression, social anxiety has also been well-documented in leading significant distress and impairments in social, daily routine, academic, and family functioning,^{71,72} and often followed by substantial emotional distress, namely dysphoria and depression.⁷³ Although we found a high correlation between social anxiety and depression, the link between social anxiety and general psychosocial well-being was not significant in Japan and the Philippines. Socially anxious people are characterized by strong fear of embarrassment and negatively evaluation from others in social situations. Computer-mediated communication (CMC) may become particularly appealing when being compared with the normal in-person interaction, as CMC offers greater anonymity and control due to its asynchronous nature.⁷⁴ It was also found that people with interpersonal difficulties experienced less negative feedback cues from others via CMC.⁷⁵ Nevertheless, our results showed that the relationships among social anxiety, Internet addiction and general psychosocial well-being were equivocal and varied according to country membership. Internet addiction served a mediating role in China, Hong Kong and Malaysia. In accordance, the revised model with the mediating pathway from social anxiety discarded has resulted in further improvement of goodness-of-fit for Japan, South Korea and Philippine data.

The scope of our results does not provide an explanation of the non-significant indirect effects of social anxiety on Internet addiction in certain countries. We suggest that cultural backgrounds could be one of the factors that influences the relationship between social anxiety and Internet addiction, given the evidence that culture contributes to the experience and manifestation of social anxiety.^{76,77} Future studies may explore how culture influences on people's Internet use as a way to alleviate their interpersonal problems, which may in turn lead to problematic Internet use. On the other hand, we noticed that Japan and the Philippines, and South Korea have fallen on the upper and lower ranks on the scores of IAT,

SAS-A and HoNOSCA-SR, respectively. Ceiling and floor effects may explain the differences across countries mathematically. It is also possible that anxiety and fear of negative evaluation in social interactions only increases the risk of pathological Internet use when the person does not have clinical level social anxiety or is not extremely indifferent to interpersonal interactions. Perhaps to a certain level of social anxiety, even communicating with others on the Internet would be regarded as intimating, thus not leading to addictive Internet use.

Although the originally proposed and the revised model received certain support, this model might not be the only representation for the data, other models may fit the data to the same degree. For instance, the relationship between depression and social anxiety to Internet addiction may be reversed^{78,79} or bi-directional. Similarly, it is highly probable that existing psychosocial problems may predispose individuals to develop maladaptive cognitions associated with their Internet use.

It is equally possible that Internet addiction and various psychiatric disorders arise together as a result of common etiology. Evidence has emerged that the vulnerability to Internet addiction and the psychiatric comorbidities is genetically transmitted.^{80,81} Lee et al. (2008) reported that the homozygous short alleles (SS) of the serotonin transporter gene promoter region (5HTTLPR) are more frequent among excessive internet users and such genotype was associated with depressive disorder.⁸² Additional factors such as attachment,⁸³ environmental stress, parenting styles⁸⁴ and family structure⁸⁵ may also confound the association between Internet addiction and one's psychiatric outcomes. In a nutshell, we believe that the relationships between depression, social anxiety and addictive Internet use are complicated and multifold. Future research should be directed at determining the causal relationship between Internet addiction and the various psychiatric comorbidities, and examining the underlying etiological mechanism, such as how Internet addiction progressed from initiation, transition to ongoing use, addiction, and maintenance. Assessing the patterns of online communication such as amount, topics, partners, and purposes in a more detailed manner could be a research

Table 4 – Parameter estimates of the structural paths for Internet addiction and general psychosocial well-being of the originally proposed model.

	China			Hong Kong			Japan			South Korea			Malaysia			Philippines		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Measurement model																		
Path																		
IAT → W & SP	1	–	0.89	1	–	0.87	1	–	0.90	1	–	0.96	1	–	0.87	1	–	0.89
IAT → TM & P	0.81***	0.03	0.87	0.78***	0.027	0.85	0.84***	0.03	0.83	0.67***	0.03	0.82	0.81***	0.03	0.86	0.69***	0.02	0.82
IAT → RS	0.39***	0.01	0.81	0.42***	0.015	0.81	0.43***	0.01	0.87	0.32***	0.01	0.87	0.44***	0.01	0.83	0.37***	0.01	0.76
SAS-A → FNE	1	–	0.97	1	–	0.98	1	–	0.95	1	–	0.98	1	–	0.93	1	–	0.94
SAS-A → SAD-N	0.72***	0.02	0.90	0.77***	0.01	0.93	0.81***	0.02	0.88	0.74***	0.02	0.94	0.85***	0.02	0.89	0.76***	0.02	0.87
SAS-A → SAD-G	0.42***	0.01	0.78	0.41***	0.01	0.79	0.39***	0.02	0.71	0.42***	0.01	0.84	0.39***	0.02	0.68	0.45***	0.02	0.75
CESD → SOM	1	–	0.89	1	–	0.91	1	–	0.77	1	–	0.90	1	–	0.80	1	–	0.78
CESD → DA	1.16***	0.03	0.94	1.14***	0.02	0.95	1.21***	0.05	0.84	1.21***	0.04	0.93	1.32***	0.05	0.86	1.18***	0.05	0.81
CESD → PA	–0.69***	0.02	–0.90	–0.65***	0.01	–0.93	0.26***	0.04	0.24	–0.30***	0.05	–0.30	–0.12**	0.04	–0.10	–0.21***	0.04	–0.18
CESD → IP	0.30***	0.01	0.76	0.28***	0.01	0.80	0.34***	0.02	0.71	0.35***	0.01	0.83	0.37***	0.02	0.67	0.36***	0.02	0.62
HoNOSCA-SR → Behaviour	1	–	0.73	1	–	0.80	1	–	0.77	1	–	0.84	1	–	0.70	1	–	0.63
HoNOSCA-SR → Impairment	0.58***	0.03	0.70	0.61***	0.03	0.76	0.43***	0.03	0.61	0.54***	0.03	0.75	0.45***	0.03	0.56	0.68***	0.04	0.65
HoNOSCA-SR → Symptoms	0.89***	0.04	0.75	0.91***	0.03	0.82	0.55***	0.04	0.56	0.62***	0.04	0.72	0.65***	0.05	0.54	1.13***	0.07	0.74
HoNOSCA-SR → Social	1.47***	0.07	0.85	1.45***	0.05	0.90	1.31***	0.07	0.75	1.00***	0.06	0.75	1.49***	0.07	0.79	1.58***	0.09	0.76
Structural model																		
Direct effect																		
H1: CESD → IAT	0.51***	0.06	0.37	0.59***	0.06	0.44	0.73***	0.11	0.37	0.67***	0.09	0.45	0.66***	0.09	0.33	0.94***	0.10	0.41
H2: SAS-A → IAT	0.11***	0.03	0.15	0.18***	0.03	0.22	0.08	0.05	0.08	0.07	0.04	0.10	0.15***	0.04	0.17	0.067	0.04	0.07
H3: CESD ↔ SAS-A	14.20***	1.15	0.53	18.06***	1.22	0.64	10.52***	0.85	0.64	15.24***	1.43	0.61	9.52***	0.73	0.58	7.34***	0.63	0.49
H4: IAT → HoNOSCA-SR	0.05***	0.01	0.15	0.11***	0.01	0.32	0.05**	0.01	0.13	0.07***	0.02	0.18	0.03**	0.01	0.09	0.04***	0.01	0.17
H5: CESD → HoNOSCA-SR	0.26***	0.02	0.50	0.026**	0.01	0.50	0.57***	0.04	0.78	0.21***	0.03	0.38	0.38***	0.03	0.57	0.27***	0.03	0.01
H6: SAS-A → HoNOSCA-SR	0.09***	0.01	0.30	0.24***	0.02	0.09	–0.002	0.02	–0.01	0.09***	0.01	0.31	0.09***	0.01	0.28	0.003	0.01	0.46
Indirect effect																		
H7: CESD → IAT → HoNOSCA-SR	0.03***	0.01	0.05	0.07***	0.01	0.14	0.03***	0.01	0.05	0.05***	0.01	0.08	0.02*	0.01	0.03	0.04***	0.01	0.07
H8: SAS-A → IAT → HoNOSCA-SR	0.01**	0.00	0.02	0.02***	0.004	0.07	0.004	0.003	0.01	0.005	0.003	0.02	0.004*	0.002	0.01	0.003	0.002	0.01
Total effect																		
CESD → HoNOSCA-SR	0.28***	0.02	0.55	0.30***	0.02	0.16	0.60***	0.04	0.83	0.26***	0.03	0.46	0.40***	0.03	0.59	0.31***	0.03	0.412
SAS-A → HoNOSCA-SR	0.09***	0.01	0.32	0.05***	0.01	0.64	0.001	0.02	0.00	0.09***	0.01	0.33	0.09***	0.01	0.29	0.006	0.01	0.067

Note. Dashes indicate the standard error was not estimated. B = unstandardized coefficient; SE = standard errors; β = standardized coefficient. IAT = Internet Addiction Test; SAS-A = Social Anxiety Scale for Adolescents; CESD = Center for Epidemiological Studies Depression Scale; HoNOSCA-SR = Self-rated Health of the Nation Outcome Scales for Children and Adolescents; W & SP = Withdrawal and Social Problems; TM & P = Time Management and Performance; RS = Reality Substitute. SOM = Somatic; DA = Depressed Affect; PA = Positive Affect; IP = Interpersonal Problems; FNE = Fear of Negative Evaluation; SAD-N = Social Avoidance and Distress in New Situations; SAD-G = Social Avoidance and Distress-General.

*P < .05, **P < .01, ***P < .001.

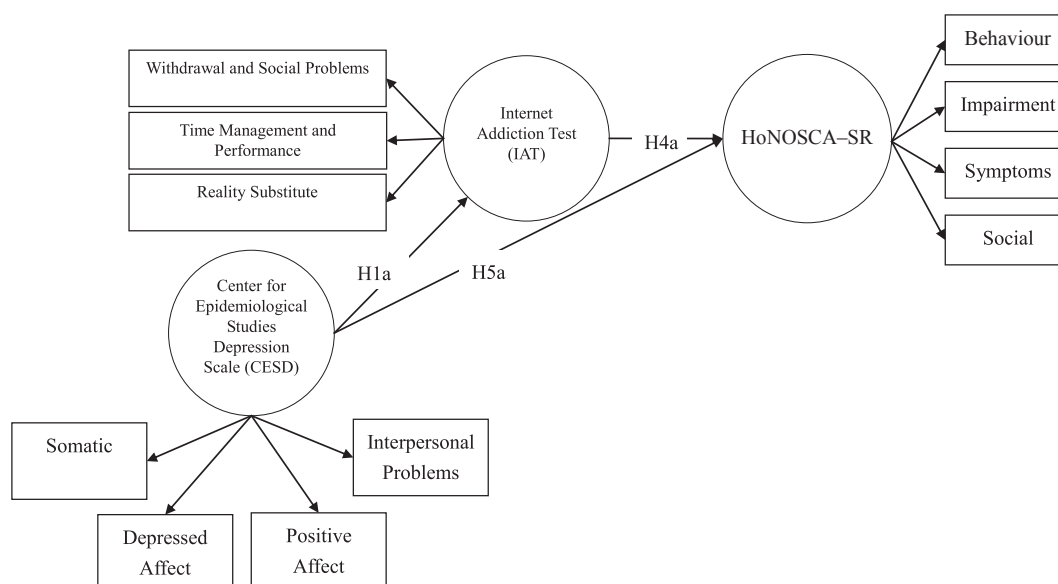


Fig. 2 – Revised structural equation model of the relationships between depression, Internet addiction and general psychosocial well-being. Circles represent latent variables and rectangles represent measured variables. HoNOSCA–SR = Self-rated Health of the Nation Outcome Scales for Children and Adolescents.

Table 5 – Parameter estimates of the structural paths for Internet addiction and general psychosocial well-being of the revised model.

	Japan			South Korea			Philippines		
	B	SE	β	B	SE	β	B	SE	β
Measurement model									
Path									
IAT → W & SP	1	–	0.90***	1	–	0.96***	1	–	0.89***
IAT → TM & P	0.84***	0.03***	0.83***	0.67***	0.03***	0.82***	0.69***	0.02***	0.82***
IAT → RS	0.43***	0.01***	0.87***	0.32***	0.01***	0.86***	0.37***	0.01***	0.76***
CESD → SOM	1	–	0.78**	1	–	0.89**	1	–	0.76***
CESD → DA	1.21***	0.05***	0.86***	1.22***	0.04***	0.93***	1.27***	0.06***	0.85***
CESD → PA	0.25***	0.04***	0.24***	–0.29***	0.05***	–0.28***	–0.16***	0.04***	–0.13***
CESD → IP	0.32***	0.02***	0.68***	0.36***	0.02***	0.83***	0.36***	0.02***	0.61***
HoNOSCA-SR → Behaviour	1	–	0.77***	1	–	0.84***	1	–	0.63***
HoNOSCA-SR → Impairment	0.43***	0.03***	0.61***	0.54***	0.03***	0.74***	0.68***	0.04***	0.66***
HoNOSCA-SR → Symptoms	0.55***	0.04***	0.57***	0.62***	0.04***	0.72***	1.14***	0.07***	0.74***
HoNOSCA-SR → Social	1.31***	0.07***	0.75***	1.00***	0.06***	0.76***	1.58***	0.09***	0.76***
Structural model									
Direct effect									
H1a: CESD → IAT	0.81***	0.08***	0.42***	0.75***	0.07***	0.50***	1.02***	0.09***	0.43***
H4a: IAT → HoNOSCA-SR	0.05***	0.01***	0.13***	0.08***	0.02***	0.21***	0.04***	0.01***	0.17***
H5a: CESD → HoNOSCA-SR	0.55***	0.04***	0.77***	0.31***	0.03***	0.56***	0.28***	0.03***	0.47***
Indirect effect									
H7a: CESD → IAT → HoNOSCA-SR	0.04***	0.01***	0.06***	0.06***	0.01***	0.10***	0.05**	0.01***	0.07***
Total effect									
CESD → HoNOSCA-SR	0.59***	0.03***	0.83***	0.37***	0.03***	0.66***	0.33***	0.03***	0.54***

Note. Dashes indicate the standard error was not estimated. B = unstandardized coefficient; SE = standard errors; β = standardized coefficient. IAT = Internet Addiction Test; CESD = Center for Epidemiological Studies Depression Scale; HoNOSCA–SR = Self-rated Health of the Nation Outcome Scales for Children and Adolescents; W & SP = Withdrawal and Social Problems; TM & P = Time Management and Performance; RS = Reality Substitute. SOM = Somatic; DA = Depressed Affect; PA = Positive Affect; IP = Interpersonal Problems.

P < .01, *P < .001.

direction, given emerging evidence that different purposes and activities of Internet use affect psychological adjustment and well-being in differential ways.^{79,86,87}

Clinical implications

Past studies have revealed high comorbidities of Internet addiction with other psychiatric disorders,^{9,10,68,88} including depression and social anxiety.^{10,89} Based on our findings, it is concluded that assessment of suspected cases of Internet addiction should include evaluation of their depression and social anxiety level. While Internet could be used to cope with developmental stressors,^{59,90} crucial on Internet addiction assessment is whether online social experiences have replaced the real-world relationships among people.^{8,91} Unlike smoking, drinking and substance use, Internet use is legal and common among adolescents, frequently leading to their incautiousness of its maladaptive and addictive potential. Psychoeducation about healthy usage of Internet may be considered for adolescents with emotion regulation problems and high intensity of Internet use. Finally, the current study has found significant associations of Internet addiction with depression (Pearson's r of IAT total and CESD total = 0.38, $P < .001$) and social anxiety (Pearson's r of IAT total and SAS-A total = 0.39, $P < .001$). In accordance, we urged for further investigation of the strength of association between Internet addiction and other psychiatric comorbidities, before it could be regarded as a new psychiatric disorder, as 'dual diagnosis' could impact significantly on the patients and existing treatment services.

Strengths and limitations

There are several limitations to be considered when interpreting these results. First, limited by the self-reported survey method, under-reporting of Internet use and other psychosocial problems may be possible, due to social desirability and perceived negative consequences. Second, the age and sex compositions of respondents varied across countries, and may not be a nationally representative sample. Including other Asia-Pacific countries, such as Taiwan and Australia in future studies would provide a better spectrum of the relationships between Internet addiction and mental health outcomes. It is also important to note that the patterns of internet use and individual psychosocial well-being may be different between Asian and non-Asian populations. Therefore, one should be cautious in generalizing the current findings. Third, a cross-sectional survey design was employed; hence, we could not ascertain the causal relationships between variables in the proposed model. As discussed above, possible confounders not accounted for in this study may affect the relationships between Internet addiction, depression, and social anxiety. Similar studies with longitudinal design are warranted.

Despite these limitations, our study has adopted a confirmatory approach, as suggested by Byun et al.⁹² in testing a model linking the antecedents (i.e. depression and social anxiety) and consequences (i.e. subjective psychosocial well-being) of Internet addiction. With using the SEM analysis in

large samples from different countries, the proposal model is supposed to be well-specified and robust.

To conclude, the current study lent some support to the model paralleling the concept of 'self-medication' hypothesis that depression and social anxiety – two affective disorders commonly co-occur with Internet addiction^{10,89} acting as antecedents of Internet addiction, and demonstrated that the affective disorders and the problem of pathological Internet use might impair individual psychosocial well-being simultaneously. The current finding also provided an updated profile of levels of Internet addiction, depression, and social anxiety, as well as psychosocial well-being of adolescents in six Asian countries.

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Competing interests

None.

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