



Mediating Effect of Internet Addiction on the Association between Resilience and Depression among Korean University Students: A Structural Equation Modeling Approach

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Objective This study examined the mediating role of internet addiction in the association between psychological resilience and depressive symptoms.

Methods 837 Korean university students completed a survey with items of demographic information, Connor-Davidson Resilience Scale (CD-RISC), Internet Addiction Test (IAT), and Patient Health Questionnaire (PHQ-9) in 2015. The complex associations among psychological resilience, internet addiction, and depressive symptoms were delineated using structural equation models.

Results In the most parsimonious model, the total effect and indirect effect of resilience on depressive symptoms via internet addiction, were statistically significant. The goodness of fit of the measurement model was satisfactory with fit indices, normed fit index (NFI) of 0.990, non-normed fit index (NNFI) of 0.997, comparative fit index (CFI) of 0.998, root mean square error (RMSEA) of 0.018 (90%CI=0.001–0.034); and Akaike Information Criterion (AIC) of -21.049.

Conclusion The association between psychological resilience and depressive symptoms was mediated by internet addiction in Korean university students. Enhancement of resilience programs could help prevent internet addiction and reduce the related depression risks.

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Key Words Mediation, Internet addiction, Resilience, Depression, University students.

INTRODUCTION

Depressive symptoms are important to the diagnosis of sub-threshold types of depression in psychiatric practices.¹ The UK National Institute for Health and Care Excellence (NICE) guidance of diagnostic and management of depression advises healthcare professionals to maintain a high awareness of depressive symptoms among young people.² Although depression is a major internalizing disorder in adolescents,³ not everyone could acquire the respective coping

strategies.⁴ Furthermore, tracking of depression from adolescence to adulthood is not uncommon.⁵

Transition from adolescence to adulthood provides an opportunity for individuals to further develop their psychological resilience.⁶ Psychological resilience is a concept derived from the vulnerability principle,⁷ with emerging neurological evidence of its self-regulatory function.⁸ A 10-year cohort study has reported that CACNA1C SNP rs1006737 was a predisposition of resilience to depressive symptoms.⁹ Magnetic resonance imaging (MRI) studies have shown high grey matter volumes at the right middle and superior frontal gyri¹⁰ and high fractional anisotropy (FA) in the anterior corpus callosum (CC) among resilient adolescents when compared with others.¹¹ Hippocampal volume also served as a valid neural marker for assessing both psychological resilience and depression.¹²

Epidemiological studies have also shown the relationships between health-related behaviors and psychological resilience to negative affects in adolescents.¹³ School-based resil-

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ience trials for reducing substance use were found to be effective in adolescents.^{14,15} In young adults, related resilience findings are mostly on substance uses, such as smoking¹⁶ and drug use.¹⁷ Individuals with addictive internet behaviors shared certain personality features with alcohol dependents,¹⁸ including impulsivity.¹⁹ A systematic review has stipulated depression and anxiety as the psychological symptoms of addictive internet behaviors.²⁰ While there are findings showing the mediation model among resilience, internet addiction, and depression in children, no corresponding results in youth is available for clinical references.²¹

This study examined the possible associations between resilience, depressive symptoms, and internet addiction with the following hypotheses: Hypothesis 1 (H1) is that resilience is negatively associated with the likelihood of internet addiction; Hypothesis 2 (H2) is that internet addiction is positively associated with depressive symptoms; Hypothesis 3 (H3) is that resilience is negatively associated with depressive symptoms.

Hypothesis 1

We hypothesize that better resilience will be associated with a lower likelihood of internet addiction. Previous studies have shown that psychological resilience was negatively associated with the risk of Internet addiction in children²¹ and adolescents ($\beta = -0.030$).²² Similar associations were found in university students.^{23,24} In Korean university students, the correlation coefficient between CD-RISC scores and IAT scores was -0.12 ²⁵ and smartphone users (mean=59.06) had a significantly lower CD-RISC-determined resilience in at-risk than normal users (mean=66.54).²⁶

Hypothesis 2

We hypothesize that internet addiction will be associated with depressive symptoms. Together with anxiety, depression is one of the major psychological factors of internet addiction in young people.²⁷ The associations between depressive symptoms and Internet addiction are well-established from studies with vary measurement scales.²⁸⁻³¹ Longitudinal study results also showed the causation between addicted online relationships and depressive symptoms in adolescents.³² Depressive symptoms were also linked to poor psychosocial wellbeing via internet addiction in cross-population adolescent studies.³³ In adults, Internet addicted group was more likely to have depressive symptoms than others.³⁴ In university students, internet addiction was related to a higher risk of Beck Depression Inventory (BDI)-determined depression in Turkey.²⁷

Hypothesis 3

We hypothesize that better psychological resilience will be associated with less symptoms of depressive symptoms. According

to the depression model proposed by Beck and Bredemeier,³⁵ positive predisposing, precipitating, and resilience factors all could reduce depressive symptoms. A youth cohort in Australia found that CD-RISC determined resilience led to Goldberg Depression and Anxiety Inventory-determined depressive symptoms.³⁶ In Korean adults with parental alcoholism, CD-RISC-determined resilience helped prevent the development of Beck Depression Inventory-determined depressive symptoms.³⁷

Based the three associations, several adolescent studies have further investigated the role of internet addiction in the associations between psychological resilience and negative affects. Resilience could mitigate the negative effects (measured by the Watson's Positive and Negative Affect Scales) of internet addiction in US adolescents aged 13 to 17.³⁸ A previous study among Chinese adolescents suggested that life events could mediate the association between internet addiction and depression.³⁹ Another Korean high school study suggested that psychological resilience could be associated with internet addiction via stress.⁴⁰

According to the 2016 Epidemiological Survey of Mental Disorders by the Ministry of Health and Welfare, the lifetime prevalence of major depressive disorder in Korean adults was 5.0%. Among university students in Korea, keen academic competitions and career uncertainties are common and depression was a major risk factor of suicides.⁴¹ However, the behavioral risk factors of suicidal ideation could be different between university men and women in Korea.⁴² This study aimed to delineate the complex relationships of resilience, depressive symptoms, and internet addiction among Korean university students with a structural equation modeling approach.

METHODS

Administration

Students from a university in the Chungcheong Province of Korea were invited to complete a questionnaire in Korean language online in 2015. Informed consent was sought and their participations were voluntary and no incentive was provided. A total of 1184 students were invited, with 846 completed questionnaires received and 837 agreed to provide the information for research. Ethics approval was obtained from the Institutional Review Board of Kongju National University (KNU_IRB_2015-38).

Measures

In addition to demographic information, students responded to the following scale measures, Connor-Davidson Resilience Scale (CD-RISC) (25 items), Internet Addiction Test (IAT) (20 items), and Patient Depression Questionnaire (PHQ-9) (9 items). The 25-item Connor-Davidson Resil-

ience Scale is a common scale to assess psychological resilience,⁴³ although its short-form 10-item Connor-Davidson Resilience Scale is available.⁴⁴ The five factors for CD-RISC are a) Personal Competence, b) Trust and Tolerance, c) Acceptance and Relationship Security, d) Control, and e) Spiritual influence. The responses are 5-point Likert scale (“Not true At all,” “Rarely true,” “Sometimes true,” “Often true,” “True nearly all of the time”). The possible total scores for CD-RISC are from 0 to 100, with higher score representing a better resilience level. Internet Addiction Test (IAT) has six responses (“Never or not applicable,” “Rarely,” “Occasionally,” “Sometimes,” “Often,” “Always”). The possible scores for IAT are 0 to 100, with higher score representing a higher risk of internet addiction. Besides, IAT has been translated and tested in college students across countries,⁴⁵⁻⁴⁷ including Korean college students⁴⁸ in which four factor structure was revealed. The PHQ-9 has four responses, including “not at all,” several days,” “more than half the days,” “nearly every day.” In addition, PHQ-9 has been tested among US⁴⁹ and Chinese college students.⁵⁰ An one-factor structure of PHQ-9 was found to be reliable (Cronbach’s alpha=0.837), test-retest reliable (r=0.650), and valid against Depression Inventory (BDI) and Perceived Stress Scale (PSS) (r=0.509 to 0.807) among Korean medical students.⁵¹ The possible scores range from 0 to 27, with a higher score indicating more depressive symptoms.

Data analysis

A total of 837 students were included in the main analysis. Gender differences of and correlations between the scales were tested using t-test and Pearson correlation coefficient, respectively. Possible conceptual models (Models 1 to 4) for modeling the relationships between resilience, depression, and internet addiction were constructed for comparisons (Figure 1). Structural equation modeling (SEM) was conducted to compute the model fit indices using the robust maximum likelihood method. Goodness-of-fit was regarded as acceptable if the values of normed fit index (NFI), and non-normed fit index (NNFI);⁵² and comparative fit index (CFI);⁵³ were above 0.90; as well as root mean square error of approximation (RMSEA)⁵⁴ were below 0.08.⁵⁵ The significance of the paths in the model was indicated by the Wald test. Models with smaller normal Akaike’s Information Criterion (AIC) values were preferred. All analyses were performed using SPSS 21.0 for Windows (IBM Inc., Armonk, NY, USA) and EQS 6 (Multivariate Software, Encino, CA ,USA).

RESULTS

Descriptive statistics

As shown in Table 1, university men had significantly

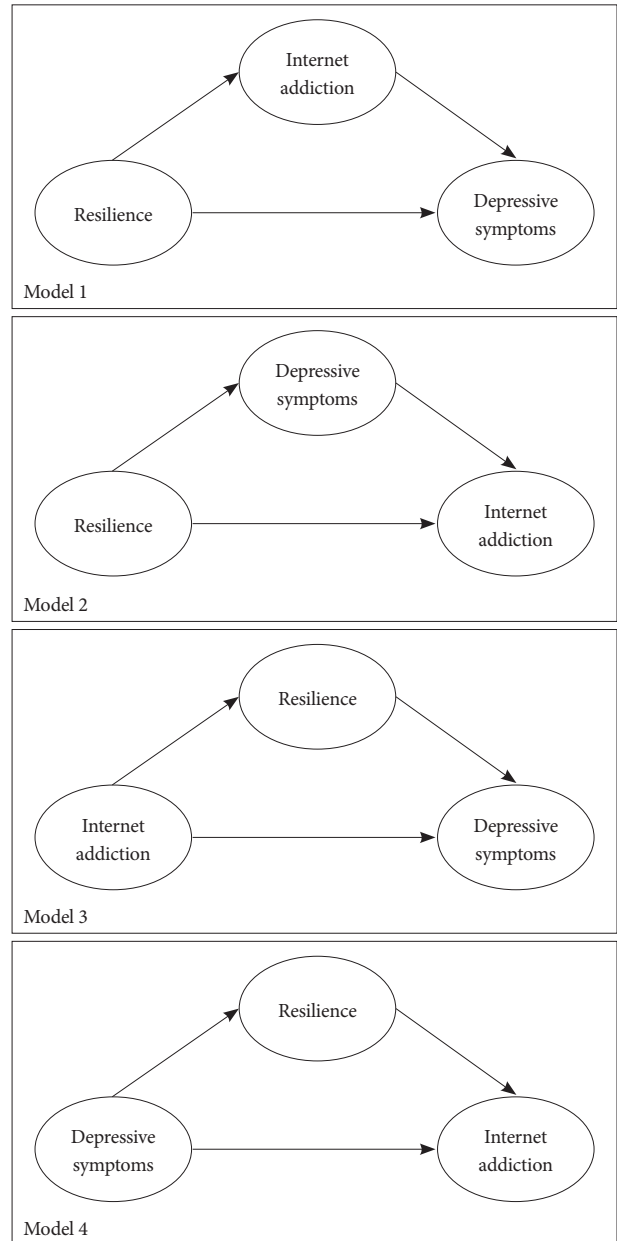


Figure 1. Conceptual models for structural equation modeling.

higher CD-RISC total scores than women (63.88 SD=15.33 vs. 55.60 SD=15.70). However, university women had significantly higher PHQ-9 scores than men (6.25, SD=4.68 vs. 4.96, SD=5.07). There was no significant difference of IAT and its subscale scores between university men and women. Their respective IAT total scores were 22.14 (SD=15.22) and 22.41 (SD=16.97). The major scales, CD-RISC, PHQ-9, and IAT showed good internal consistency with corresponding Cronbach’s alpha values of 0.940, 0.865, and 0.946. In Table 2, CD-RISC-Total significantly (p<0.01) and negatively correlated with PHQ-9-Total (r=-0.500) and IAT-Total (r=-0.320). The correlation between PHQ-9-Total and IAT-Total was

Table 1. Basic characteristics and measure scores

	Men (N=361) Mean (SD)	Women (N=476) Mean (SD)	t-value	p-value
Age	22.7 (2.37)	21.7 (1.82)	7.246	<0.001
CD-RISC-total (Cronbach's $\alpha=0.940$)	63.88 (15.33)	55.6 (15.70)	7.655	<0.001
CD-RISC personal competency and tenancy (8 items)	20.57 (5.72)	17.30 (5.79)	8.133	<0.001
CD-RISC trust and tolerance (7 items)	17.27 (4.60)	14.44 (4.67)	8.784	<0.001
CD-RISC acceptance of change and relationship security (5 items)	13.98 (3.44)	12.87 (3.47)	4.590	<0.001
CD-RISC control (3 items)	7.40 (2.49)	6.71 (2.55)	3.946	<0.001
CD-RISC spiritual influences (2 items)	4.66 (1.54)	4.29 (1.74)	3.293	0.001
PHQ (9-items) (Cronbach's $\alpha=0.865$)	4.96 (5.07)	6.25 (4.68)	-3.749	<0.001
IAT-total (20 items) (Cronbach's $\alpha=0.946$)	22.14 (15.22)	22.41 (16.97)	-0.239	0.81
IAT-time management (9 items)	13.35 (8.87)	13.04 (9.49)	-0.925	0.355
IAT-dependence (5 items)	4.17 (3.71)	4.27 (4.31)	-0.350	0.727
IAT-withdrawal (3 items)	1.91 (2.19)	1.93 (2.52)	-0.105	0.916
IAT-avoidance of reality (3 items)	2.71 (2.39)	2.27 (2.49)	2.578	0.010

CD-RISC: Connor-Davidson Resilience Scale, PHQ-9: Patient Health Questionnaire, IAT: Internet Addiction Test, SD: standard deviation

Table 2. Pearson correlation coefficients among measure scores

	CD-RISC-total	PHQ-9-total	IAT-total
Men			
CD-RISC-total	1		
PHQ-9-total	-0.469*	1	
IAT-total	-0.400*	0.332*	1
Women			
CD-RISC-total	1		
PHQ-9-total	-0.503*	1	
IAT-total	-0.282*	0.237*	1
All			
CD-RISC-total	1		
CD-RISC-PCT		-0.436*	-0.327*
CD-RISC-TT		-0.438*	-0.232*
CD-RISC-ACRS		-0.481*	-0.296*
CD-RISC-C		-0.456*	-0.328*
CD-RISC-SI		-0.279*	-0.111*
PHQ-9-total		1	
IAT-total	-0.320*	0.275*	1
IAT-TM	-0.302*	0.253*	
IAT-D	-0.314*	0.260*	
IAT-W	-0.246*	0.188*	
IAT-AR	-0.223*	0.254*	

* $p < 0.01$. CD-RISC: Connor-Davidson Resilience Scale, CD-RISC-PCT: CD-RISC Personal Competency and Tenancy, CD-RISC-TT: CD-RISC Trust and Tolerance, CD-RISC-ACRS: CD-RISC-Acceptance of Change and Relationship Security, CD-RISC-C: CD-RISC Control, CD-RISC-SI: CD-RISC Spiritual Influences, IAT: Internet Addiction Test, IAT-TM: IAT-Time Management, IAT-D: IAT-Dependence, IAT-W: IAT-Withdrawal, IAT-AR: IAT-Avoidance of Reality, PHQ-9: Patient Health Questionnaire

also significant ($p < 0.01$) and positive ($r = 0.275$). Significant correlations of same directions between these scale total values were found after stratification by sex. In addition, the subscales of CD-RISC, PHQ-9, and IAT also significantly correlated with each other.

Structural equation modeling

In Model 1, resilience had a significant and negative total effect on depressive symptoms ($\beta = -0.981$, $SE = 0.514$, $p < 0.001$). When internet addiction was considered as a mediator, resilience had a significant and negative indirect effect on depressive symptoms ($\beta = -0.073$, $SE = 0.183$, $p < 0.001$). The direct effects of resilience on depressive symptoms ($\beta = -0.908$) and internet addiction ($\beta = -0.350$) were significant and negative (Figure 2). In addition, the direct effect of depressive symptoms on internet addiction was significant and positive ($\beta = 0.208$). The values of the fit indices for Model 1 were as follow: NFI of 0.990, NNFI of 0.997, CFI of 0.998, RMSEA of 0.018 (90%CI=0.001–0.034), and AIC of -21.049 (Table 3 and 4).

In Model 2, resilience had a significant and negative total effect on Internet addiction ($\beta = -0.350$, $SE = 0.065$, $p < 0.001$). With depressive symptoms acting as a mediator, resilience had a significant and negative indirect effect on internet addiction ($\beta = -0.337$, $SE = 0.110$, $p < 0.001$). The fit indices for Model 2 were satisfactory with NFI of 0.974, NNFI of 0.972, CFI of 0.982, and RMSEA of 0.052 (90%CI=0.040–0.063), and AIC of 35.412 (Table 3 and 4). In Model 3, internet addiction had a significant and positive total effect on depressive symptoms ($\beta = 0.506$, $SE = 0.202$, $p < 0.001$). Internet addiction had a significant and positive indirect effect on depressive symptoms, via resilience ($\beta = 0.306$, $SE = 0.113$,

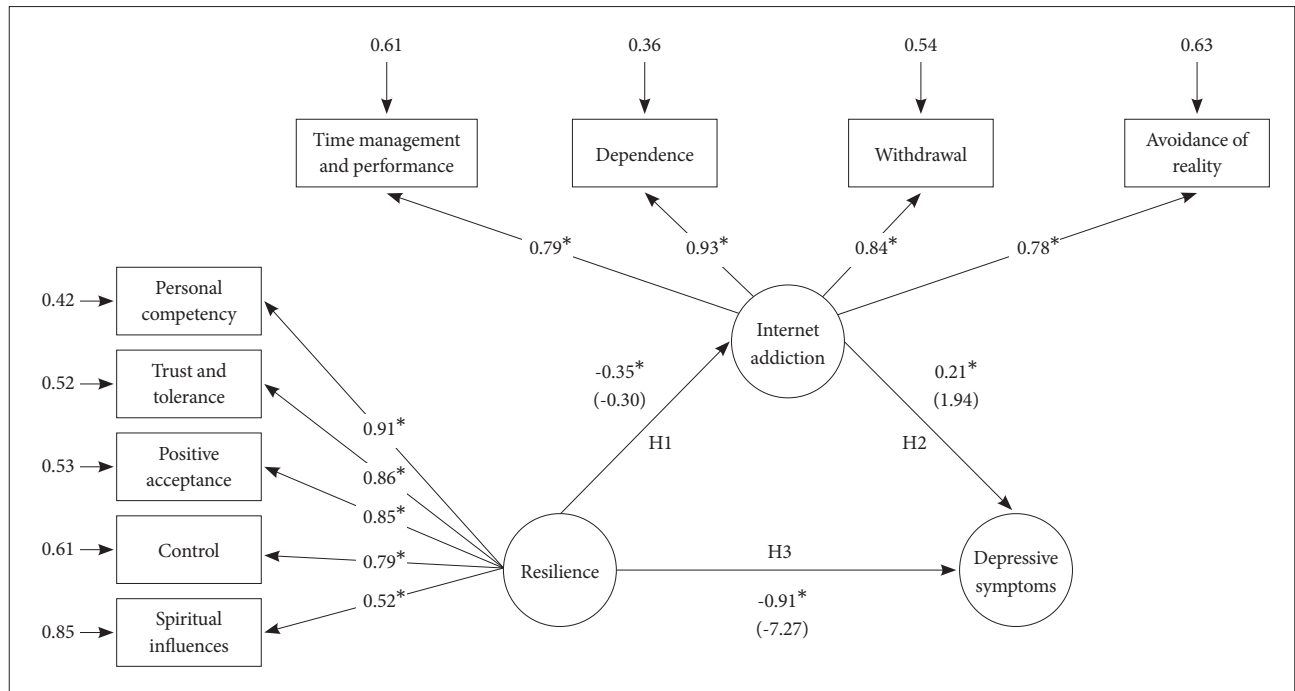


Figure 2. Measurement model (Model 1) for internet addiction, resilience, and depressive symptoms. Unstandardized parameter estimates are shown in parentheses under the standardized parameter estimates. * $p < 0.05$. Resilience was measured by Connor-Davidson Resilience Scale (CD-RTSC). Internet Addiction was measured by Internet Addiction Test (IAT). Depressive symptoms was measured by Patient Health Questionnaire (PHQ-9).

Table 3. Fit indices for the tested measurement models

	χ^2	df	χ^2/df	NFI	NNFI	CFI	RMSEA (90%CI)	AIC
Model 1	36.951	29	1.27	0.990	0.997	0.998	0.018 (0.001–0.034)	-21.049
Model 2	93.412	29	3.22	0.974	0.972	0.982	0.052 (0.040–0.063)	35.412
Model 3	104.070	29	3.59	0.971	0.967	0.979	0.056 (0.044–0.067)	46.070
Model 4	113.791	29	3.92	0.968	0.968	0.976	0.058 (0.047–0.069)	52.791

NFI: normed fit index, NNFI: non-normed fit index, CFI: comparative fit index, RMSEA: root mean square error of approximation, CI: confidence interval, AIC: Akaike Information Criterion

$p < 0.001$). The fit indices for Model 3 were as follow: NFI of 0.971, NNFI of 0.967, CFI of 0.979, RMSEA of 0.056 (90%CI=0.0044–0.067), and AIC of 46.070 (Table 3 and 4). In model 4, internet addiction had a significant and positive total effect on depressive symptoms ($\beta = 0.485$, $SE = 0.120$, $p < 0.001$); and a significant and negative indirect effect on internet addiction through resilience ($\beta = -0.442$, $SE = 0.150$, $p < 0.001$). The fit indices for Model 4 were as follow: NFI of 0.968, NNFI of 0.968, CFI of 0.976, RMSEA of 0.058 (90%CI=0.047–0.069), and AIC 52.791 (Table 3 and 4). Among Models 1 to 4, Model 1 was regarded as the most parsimonious model with satisfactory model fit (Table 3).

DISCUSSION

This study reported the mediating role of internet addiction between psychological resilience and depressive symp-

toms among Korean university students, using a structural equation modeling approach. In our descriptive results, the higher level of resilience in university men than women is consistent to the previous findings from a twin study.⁵⁶ Moreover, university women were found to have more depressive symptoms than men in this study. Such a sex difference was also reported previously in university students from Korea and US,⁵⁷ as well as Europe.⁵⁸ The average age of university men was higher than that of women in this sample, owing to the mandatory military services for Korean men. This may also contribute to the observed sex differences of the scores of major measures.

From the structural equation models, students with a lower level of resilience are generally more vulnerable to addictive internet behaviors which is consistent to the previous findings.⁵⁹ Indeed, a poor defense or maladaptation system could be associated with Internet addiction.⁶⁰ A meta-analy-

Table 4. Decompositions of effects in the tested structural equation models

	B (SE)	p
Model 1		
Total effect	-0.981 (0.514)	<0.001
Resilience → Depressive symptoms		
Indirect effect	-0.073 (0.183)	<0.001
Resilience → Internet addiction → Depressive symptoms		
Model 2		
Total effect	-0.350 (0.065)	<0.001
Resilience → Internet addiction		
Indirect effect	-0.337 (0.110)	<0.001
Resilience → Depressive symptoms → Internet addiction		
Model 3		
Total effect	0.506 (0.202)	<0.001
Internet addiction → Depressive symptoms		
Indirect effect	0.306 (0.113)	<0.001
Internet addiction → Resilience → Depressive symptoms		
Model 4		
Total effect	0.485 (0.120)	<0.001
Depressive symptoms → Internet addiction		
Indirect effect	-0.442 (0.150)	<0.001
Depressive symptoms → Resilience → Internet addiction		

Resilience was measured by Connor-Davidson Resilience Scale (CD-RISC), Internet Addiction was measured by Internet Addiction Test (IAT), Depressive symptoms was measured by Patient Health Questionnaire (PHQ-9)

sis of internet addiction studies in Korea also revealed that poor coping of stress is a risk factor of internet addiction.⁶¹ In reverse, better coping styles⁶² and adaptations⁶⁰ are protective against the risks of addictive internet behaviors. The association between internet addiction and more depressive symptoms could be viewed as one of the psychiatric comorbidities of internet addiction, as shown in a meta-analysis.⁶³ At the same time, the association of higher resilience with less depressive symptoms observed is probably due to more effective coping strategies against adverse conditions for the resilient group than others.^{64,65} A further examination of the domains of the scales being used to assess psychological resilience and internet addiction could help explain the association between psychological resilience and risks of internet addiction. One of the characteristics of addictive internet behaviors is poor time management. Resilient students with better personal competency (awareness and self-management) and stress tolerance could avoid entering into an adap-

tive state of developing internet dependence and later withdrawal. Finally, resilient students could better trust in own instinct, to maintain healthy spirituality and control themselves from avoiding reality. When applying these results to real life, students with stronger resilience would be less susceptible to the comorbidity of internet addiction than their peers, and have a better transition from adolescents to young adults.

There are some limitations to the interpretation of results and applications to health promotion and clinical practices. With a cross-sectional study design, the casual relationships between the major variables could not be established. The major variables used to construct the measurement models were based on self-reported information. Social desirability and recall biases recall biases could affect the internal validity. According to Soule et al.,⁶⁶ there are six major forms of internet addiction, including communication addiction and game addiction. The mediation effect of internet addiction on the association between psychological resilience and depressive symptoms found in this study may not be generalized to all forms of internet addiction. Unlike PHQ-15, PHQ-9 does not screen for somatic symptoms, which could be related to depression.⁶⁷ However, three typical depressive symptoms, namely depressed mood, anhedonia, and reduced energy from DSM-IV-TR and ICD-10 are covered by PHQ-9. PHQ-9 has also been used to screen depressive symptoms related to maladaptive use of information technology, such as Facebook.⁶⁸ Personality which is one of the key determinants of internet behaviors,⁶⁹ as well as other potential mediators including social support,⁷⁰ coping styles,⁷¹ and coping flexibility⁷² were not investigated in this study. In addition, sleep quality which could mediate internet addiction and depression in university students⁷³ was not included.

According to the Korean Education Statistics Service, there are 183483 male (51.6%) and 172289 (48.4%) female students enrolled in universities in Korea. When comparing this ratio with that of our sample, only a small Cohen effect size of 0.12 was found. This suggests a representative sample being used in this study. To ensure the parsimoniousness of the resulting model, possible mediation models with depression⁷⁴ and resilience as mediators³⁸ were enumerated and tested before the final model was confirmed. Furthermore, all candidate models were tested with stratification by sex, as a sensitivity test. Although available literature stated that using gaming as maladaptive coping strategies are relatively more common in men than women,⁷⁵ our final model was applicable to both university men and women.

The current results have important implications for future development of guidelines of resilience-based interventions of negative affects.⁷⁶ Exercise-based intervention was found to be effective in reducing psychological symptoms relating

to internet addiction, including depression (standardized mean difference = -0.85, 95%CI = -1.20 to -0.49) in a meta-analysis among East Asian studies. Exercise-based resilience strengthening programs could potentially be incorporated into clinical practices for reducing depressive symptoms.⁷⁷

In conclusion, internet addiction mediates the associations between resilience and depressive symptoms in Korean university students. Enhancing resilience is important to prevent addictive internet behaviors and the related depressive symptoms among young people.

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