The effects of insomnia and internet addiction on depression in Hong Kong Chinese adolescents: An exploratory cross-sectional analysis

Running head: Internet addiction, insomnia, and depression

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Abstract

The negative association of insomnia and internet addiction with mental health is widely documented in the literature; yet, little is known about their interrelationships. The primary aim of this study was to examine the interrelationships between insomnia, internet addiction, and depression. A total of 719 Chinese adolescents in Hong Kong participated in this school-based cross-sectional study. Participants completed the Chinese version of the Pittsburgh Sleep Quality Index (PSQI), the Chinese Internet Addiction Scale (CIAS), the 12-item version of General Health Questionnaire (GHQ-12), and questions assessing internet use pattern and socio-demographic characteristics. The classification of internet addiction and insomnia was based on the cutoff score of CIAS global score > 63 and PSQI global score > 5 respectively. Multiple regression analyses tested the effects of insomnia and internet addiction on depression. Among students with internet addiction (17.2%), 51.7% were also identified as insomniacs. Internet-addicts scored significantly poorer on all PSQI components, except sleep duration, than their non-addicts counterparts. After adjustment for gender and internet use time, both internet addiction ($\beta = 0.05$; Sobel test $z = 6.50$, $p < 0.001$) and insomnia ($\beta = 0.59$; Sobel test $z = 4.49$, $p < 0.001$) demonstrated significant association depression. Overall, the co-morbidity of internet addiction and insomnia is high. Both insomnia and internet addiction were emerged as significant explanatory factor, but they exerted differential effects on depression. Future research should be directed at determining the causal relationship between internet addiction and insomnia, and its underlying mechanism with depression.

Keywords: Internet addiction; Insomnia; Depression; Adolescent; Chinese.

Introduction

The negative impact of insomnia on the mental health of adolescents has been widely documented (Taylor et al, 2003). As high as 88% of the children and adolescents with anxiety disorders experienced at least one sleep dysfunction (Chorney et al, 2008). Among children with major depressive disorders, 72% had sleep disturbances, 53.5% had insomnia alone, and 10.1% had both disturbances (Liu et al, 2007). Epidemiologic studies suggested older age, heavy smoking, frequent alcohol consumption and coffee intake, lack of regular exercise, poor diet, and skipping breakfast were factors associated with short sleep duration and insomnia among adolescents (Fuligni and Hardway, 2006; Kaneita et al, 2006; Liu et al, 2000; Liu and Zhou, 2002; Ohida et al, 2004).

Research recently suggested the influence of problematic internet use or internet addiction on insomnia and other sleep disturbances. Increased time spent on internet significantly disrupted sleep-wake schedule and a higher rate of insomnia was found among heavy internet users (Rotunda et al, 2003; Jenaro et al, 2007; Thomee et al, 2007). Intensive mobile and computer usage were associated with waking-time tiredness and unhealthy sleep habits (Punamaki et al, 2007). Internet games-addicts had poor concentration and sleep quality, and high ratings on hopelessness and worthlessness measures (du Toit et al, 2004) The association between internet addiction and poor mental health among adolescents was also evident (Ha et al, 2007; Shaw and Black, 2008; Yen et al, 2008). Adolescent internet addicts were generally more severely depressed (Yen et al, 2007) and reported more suicidal thoughts (Kim et al, 2006).

Internet addiction, which is characterized as "a psychological dependence on the Internet, regardless of type of activity once logged on" (Kandell, 1998), is an emerging mental health problem among adolescents. The prevalence of internet addiction among adolescents in Norway and Italy was 1.98% (Johansson and Gotestam, 2004) and 5.4% (Pallanti et al, 2006)

respectively. In Asia, up to 7.5% Taiwanese adolescents were classified as internet-addicts (Ko et al, 2007). The prevalence of internet addiction among Chinese adolescents in Mainland China ranges between 2.4% and 5.5% (Gao and Su, 2007; Hu et al, 2007). Despite the increasing prevalence of internet addiction and its link with mental health and insomnia, relatively few studies have examined the nature of internet addiction's influence on insomnia and mental health among adolescents. Thomée et al (Thomee et al, 2007) reported internet use increased the risk of developing depressive symptoms and sleep disturbances among young adults; however, the nature of the relationships amongst the three variables was not examined. Another study suggested insomnia mediated the effects of internet use on perceived health among adolescents (Punamaki et al, 2007). Yet, as mental health measures were not included in the study, the question of whether insomnia and internet use exerted differential effects on mental health, particularly depression, remains unanswered.

This cross-sectional study aimed to fill these research gaps by exploring the interrelationships between internet addiction, insomnia, and depression. In a sample of Hong Kong-Chinese adolescents, we (1) compared the sleep pattern and level of depressive symptoms between internet-addicts and non-addicts, and (2) evaluated the possible differential effects of insomnia and internet addiction on depression. We decided to test these two explanatory pathways because although individuals with internet addiction might develop insomnia due to staying up late for late-night log-on, reverse explanatory pathway is also possible: internet addiction might reflect maladaptive coping by insomniacs. Hence, both insomnia and internet addiction may play a role as a causal variable antecedent or exogenous to certain criterion effects.

Method

Subjects

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After IRB approval, study subjects were recruited from a secondary school in Hong Kong. All student subjects and their parents provided written informed consent or assent, as appropriate, after receiving a complete description of the study. A total of 730 students completed the questionnaires. Eleven participants were excluded from analysis due to incomplete data, leaving the final sample of 719 secondary students.

Measures

Insomnia. Since the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) was developed based on the International Statistical Classification of Disease and Related Health Problems, 10th version (ICD-10) (World Health Organization, 1992) and the Diagnostic and Statistical Manual of Mental Disorder (DSM-IV) (American Psychiatric Association, 1994) criteria for classification of insomnia, it was employed in this study to assess insomnia and sleep disturbances. The PSQI differs from other insomnia scales as it evaluates multiple dimensions of sleep over a one-month period (Buysse et al, 1989). Nineteen individual items generate seven "component" scores (see the 7 components in Table 2), which are summed for one global score (range 0–21); higher scores represent poorer subjective sleep quality. The Chinese version of the PSQI has good overall reliability and test-retest reliability (Tsai et al., 2005). A PSQI global score 5/6 with a sensitivity of 98% and specificity of 55% was recommended as a cutoff for classifying insomnia (Buysse et al., 1989; Tsai et al., 2005).

Internet addiction. Internet addiction was assessed using the Chinese Internet Addiction Scale (CIAS) (Chen et al, 2003). Rating on a 4-point Likert scale, the CIAS consists of 26 items divided into 7 subscales (see the subscales in Table 1) and the sum of the subscales scores yields a total score (range: 26-104). The CIAS possesses good internal consistency

(Cronbach αs ranging from 0.79-0.93) (Chen et al, 2003). A cutoff of 63/64 with a sensitivity of 67.8%, specificity of 92.6%, and diagnostic accuracy of 87.6% was recommended for classifying internet addiction (Chen et al, 2003).

Depression. The 12-item version of General Health Questionnaire (GHQ-12), which was designed for screening depressive symptoms within 1 month, was employed to evaluate depression (Goldberg, 1978). The total score ranges from 0 to 36, with higher scores indicating higher level of depression. Acceptable internet consistency was demonstrated (Cronbach αs ranging from 0.78 to 0.85) (Ip, 2006; Kilic et al, 1997). The cutoff score of 11/12 yielded a sensitivity of 70% and specificity of 68% (Schmitz et al, 1999). The Chinese version of GHQ-12 possesses good psychometric properties (Chan and Chan, 1983).

Statistical Analysis

Basic descriptive statistics were calculated to determine sample characteristics, internet use pattern, and level of internet addiction (see subscales and descriptions in Table 1). Components of insomnia and depression were compared between internet-addicts and non-addicts. Independent *t*-tests were used to analyze the mean differences between two groups and chi-square tests were used to analyze proportional differences. A series of multiple regression analyses were performed to determine the effects of insomnia and internet addiction on depression. For insomnia to be an explanatory factor (Model 1), four criteria needed to be met (Baron and Kenny, 1986): (1) internet addiction should significantly predict insomnia, (2) insomnia should significantly predict depression, (3) internet addiction should significantly predict depression, and (4) after controlling for insomnia, the relationship between internet addiction and depression should be decreased or

become non-significant. Perfect explanatory relationship is established if the association between internet addiction and depression is reduced to zero. Sobel test (Mackinnon et al, 2002) determined whether insomnia carried the influence of internet addiction to depression. These criteria were also applied to test the effect of internet addiction on the relationship between insomnia and depression (Model 2). Pre-selection for entry of sociodemographic and pattern of internet use variables into the multivariate models required a *p* value of <0.05 in univariate regression analyses. The results of multicollinearity tests suggested low multicollinearity among predictor variables on depression. A 5% significance level was accepted for all the tests. All statistical analyses were performed using SPSS 15.0.

Results

Sample characteristics

The characteristics of the sample are reported in Table 1. Of the 719 participants, 60.4% were male, 48.8% aged from 10-14 years, and 56.2% was in junior forms.[i] Except one student, all students indicated they had accessed to internet (>99%) in the past 1 week, with average weekly hours of internet use of 10.98 hours (*SD*=14.49). Based on the CIAS cutoff score of 63/64, 17.2% of the sample were classified as internet-addicts.

Comparison on components of insomnia between internet addicts and non-addicts

As shown in Table 2, the average sleep latency of the present sample was 21.56 minutes (*SD*=60.99), with 15.3% being unable to fall asleep within 30 minutes. The average sleep duration was 7.68 hours (*SD*=1.66) and 27.5% slept less than 7 hours. The average habitual sleep efficiency was 85.17% (*SD*=21.24%). Most of the participants did not use

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[i]In the Hong Kong education system, teenagers enter secondary school at the age of around 12 years and leave after 5 years of study (i.e., Form 1 to Form 5). They then enter a two-year matriculation education (i.e., Form 6 and Form 7) before entering university. Secondary education is compulsory. Junior form refers to Form 1 to Form 3 classes, which are equivalent to Grade 7 to Grade 9 in the International Baccalaureate system.

sleep medication (92.8%). The mean scores for subjective sleep quality, sleep disturbances, and daytime dysfunction were 1.04 (*SD*=0.89), 1.07 (*SD*=0.58), and 0.51 (*SD*=0.83) respectively. Based on the PSQI cutoff, 30.7% of the sample was classified as insomniacs.

Except sleep duration (*p*>0.05), significant differences were found between internet-addicts and non-addicts on all PSQI components (all *p*<0.05). Specifically, internet-addicts had longer sleep latency (mean=36.39; *t*=-2.69, *p*<0.05), lower sleep efficiency (mean=78.33; *t*=3.32, *p*<0.001), more frequent use of sleep medication (13% for once or twice a week; χ^2=43.13, *p*<0.001), poorer subjective quality (mean=1.48; *t*=-5.93, *p*<0.001), more sleep disturbances (mean=1.36; *t*=-5.93, *p*<0.001), and more day time dysfunction (mean=0.79; *t*=-4.02, *p*<0.01). Significantly more internet-addicts (51.7%) were being classified as insomniacs than their non-addicts counterparts (26.3%) (χ^2=-7.84, *p*<0.001). Also, 45.2% of the sample was classified as depressed based on the GHQ-12 cutoff. The mean score of GHQ-12 was significantly higher among internet-addicts (mean=13.34; *t*=-4.69, *p*<0.001) than their non-addicts counterparts, with 58.90% of internet-addicts being classified as depressed.

Insomnia as a mediator between internet addiction and depression

The results of Model 1 (Table 3) showed that internet addiction was significantly associated with insomnia (*β*=0.08, *p*<0.001) and depression (*β*=0.10, *p*<0.001). Insomnia was significantly associated with depression (*β*=0.67, *p*<0.001). When internet addiction was controlled, internet addiction was significantly associated with depression (*β*=0.05, *p*<0.001), demonstrating a partial explanatory effect of insomnia between internet addiction and depression (Sobel *z*=6.50, *p*<0.001) (Figure 1a).

Internet addiction as a mediator between insomnia and depression

In Model 2, insomnia was significantly associated with internet addiction (β=1.73, p<0.001). When internet addiction was controlled, insomnia remained significantly associated with depression (β=0.59, p<0.001) (Sobel z=4.49, p<0.001) (Figure 1b).

Discussion

We know of no prior study that examined the effects of insomnia and internet addiction on depression among adolescents. Our results showed that of the 17.2% of internet addicts identified in this Chinese adolescent sample, over half of them were also identified as insomniacs (51.7%) and depressed (58.9%). After controlling for potential confounding factors (including gender and internet use time), both insomnia and internet addiction were significantly associated with depression. These data imply the possible complex mechanisms exist between insomnia, internet addiction, and depression.

In line with previous studies (Ha et al, 2007; Shaw and Black, 2008; Yen et al, 2008), internet-addicts in the present adolescent sample displayed significantly more depressive symptoms than non-addicts. More importantly, our study extended previous data regarding the relationships between insomnia, internet addiction, and insomnia (Thomee et al, 2007; Punamaki et al, 2007) that insomnia and internet addiction carried differential effects on depression. Our findings showed that when insomnia was the explanatory factor, it accentuated the negative effects of internet addiction on depression. The indirect effect of insomnia on the relationship between internet addiction and depression was 0.05 ("without mediation" minus "with mediation"), indicating about 5% of the effect of internet addiction on depression went through the explanatory factor, that is insomnia, and 95% of the effect was direct. When internet addiction was the explanatory factor, internet addiction accentuated the negative effects of insomnia on depression. The indirect effect of internet addiction on the insomnia-depression pathway was 0.12, suggesting that about 12% of the

effect of insomnia on depression went through the mediator, that is internet addiction, and 88% of the effect was direct. If considering solely the explanatory effect, internet addiction (Model 2: 12%) exerted stronger effect than insomnia (Model 1: 5%). This suggests internet addiction had a higher practical value when considered as a mediator given the higher indirect effect it carried. Yet, with a higher z score (=6.50), Model 1, in which insomnia being the explanatory factor, as a whole contributed a higher precision than Model 2 (z=4.49), where internet addiction being the explanatory factor, in explaining the variance of the link between the three variables. One explanation for these interesting findings is that the nature of the relationship amongst the three variables is, at least partially, dynamic and influenced by the causal relationship between insomnia and internet addiction. While our data showed a high co-morbidity of insomnia and internet addiction (51.7%), the cross-sectional design of this study did not allow us to determine, among those with these co-morbid conditions, the proportion of adolescents who had insomnia as a primary condition and internet addiction as a secondary condition, and vice versa. Longitudinal and prospective research is therefore needed to provide a final determination regarding the causal associations between insomnia, internet addiction, and depression.

Our data evidenced internet-addicts had significantly longer sleep latency, lower habitual sleep efficiency, poorer sleep quality, more sleep disturbances and daytime dysfunction, and more frequent use of sleep medication than non-addicts. Previous studies suggested that internet addiction impaired sleep quality as internet addicts stayed up late at night or even lost sleep for late-night logons (Nalwa and Anand, 2003; Young, 2004). Our data however yielded no significant differences between internet-addicts and non-addicts on sleep duration. These discrepant findings suggest that the link between insomnia and internet addiction may not be going through a simple path of sleep deprivation, but possibly

through a more complex mechanism where there is an interaction between psychological, cognitive, and physiological processes. This awaits further elucidation.

Our data offered tentative evidence for the differential effects of insomnia and internet addiction on depression. Despite the significant findings, the cross-sectional design of this study did not allow us to infer causality; caution is therefore warranted in interpreting and generalizing the current findings in other populations. Future research that uses more rigorous design is needed to delineate the causal associations of the three variables and their underlying mechanism in other populations and culture. Besides, the rate of internet addiction in the current sample (17.2%) is higher than that previous Chinese adolescent samples (Gao and Su, 2007; Hu et al, 2007). These discrepant findings are likely due to methodological differences in data collection. Caution should therefore be exercised when interpreting the current rates of internet addiction viz-a-viz other populations. Finally, insomnia and internet addiction are unlikely the only two explanatory factors of depression. Other covariates may include low self-esteem, social support, and loneliness (Leung, 2004; Morahan and Schumacher, 2003). This suggestion is plausible considering the multi-faceted nature of internet addiction and insomnia. The possible range of interaction between variables that can derive from the link of internet addiction and insomnia with depression is therefore wide. This should also be addressed in future studies.

Despite these shortcomings, our findings point to the high co-occurrence of internet addiction and insomnia and their significant association with depression among adolescents. School-based health programs may consider incorporating internet use as part of the routine assessment. Programs that promote sleep hygiene may also address the adverse impact of problematic internet use on sleep quality and mental health. We hope this study will generate more research on this important issue given the rising trend of internet addiction and sleep problems among adolescents worldwide.

Disclosure Statement

No competing financial interests exist.

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References

American Psychiatric Association. Sleep Disorders. In: Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Publishing, Washington, DC, 1994 (Forth edition).

Baron, R.M., Kenny, D,A. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*, 1986: 1173-1182.

Buysse, D.J., Reynolds, C.F., Monk, T.H., et al. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Res*, 1989, 28:193-213.

Chan, D.W., Chan, T.S. Reliability, validity and the structure of the General Health Questionnaire in a Chinese context. *Psychological Medicine,* 1983, 13: 363-371.

Chen, S.H., Weng, L.J., Su, Y.J., Wu, H.M., Yang, P.F. Development of a Chinese Internet Addiction Scale and Its Psychometric Study. *Chinese Journal of Psychology,* 2003, 45: 279-294.

Chorney, D,B., Detweiler, M.F., Morris, T.L., Kuhn, B.R. The interplay of sleep disturbance, anxiety, and depression in children. *J Pediatr Psychol*, 2008, 33:339-348.

du Toit, R.M., Millson, R.C., Heaton, J.P., Adams, M.A. Priapism. *Can J Psychiatry*, 2004, 49: 870-871.

Fuligni, A.J., Hardway, C. Daily variation in adolescents' sleep, activities, and psychological well-being. *J Res Adolesc*, 2006,16: 353-378.

Gao, F., Su, L. Internet addiction among Chinese adolescents: Prevalence and psychological features. *Child Care Health Dev*, 2007, 33: 275-281.

Goldberg, D.P. Manual of the General Health Questionnaire. NFER, Windsor, UK, 1978.

Ha, J.H., Kim, S.Y., Bae, S.C., et al. Depression and internet addiction in adolescents. *Psychopathology*, 2007, 40: 424-430.

Hu, M., Zheng, L., Xia, Q., Deng, Y.X. An investigation on the prevalence of internet addiction disorder in middle school students of Huanan province. *Zhonghua Liu Xing Bing Xue Za Zhi*, 2007, 8: 445-448.

Ip, Y. Factor structure of the Chinese version of the 12-item General Health Questionnaire. *J Reprod Infant Psychol*, 2006, 24: 87-98.

Jenaro, C., Flores, N., Gómez-Vela, M., Gonzalez-Gil, F., Caballo, C. Problematic Internet and cell-phone use: Psychological behavioral, and health correlates. *Addict Res Theory*, 2007, 15: 309-320.

Johansson, A., Gotestam, K.G. Internet addiction: Characteristics of a questionnaire and prevalence in Norwegian youth (12-18 years). *Scand J Psychol*, 2004, 45: 223-229.

Kandell, J. Internet Addiction on Campus: The Vulnerability of College Students. *Cyberpsychol Behav*, 1998, 1: 11-17.

Kaneita, Y., Ohida, T., Osaki, Y., et al. Insomnia among Japanese adolescents: A nationwide representative survey. *Sleep*, 2006, 29:1543-1550.

Kilic, C., Rezaki, M., Rezaki, B., et al. General Health Questionnaire (GHQ12&18): Psychometric properties and factor structure of the scales in a Turkish primary care sample. *Soc Psychiatry Psychiatr Epidemiol*, 1997, 32: 327-331.

Kim, K., Ryu, E., Chon, M., et al. Internet addiction in Korean adolescents and its relation to depression and suicidal ideation: A questionnaire survey. *Int J Nurs Stud*, 2006, 43:185-192.

Ko, C.H., Yen, J.Y., Yen, C.F., Lin, H.C., Yang, M.J. Factors predictive for incidence and remission of internet addiction in young adolescents: a prospectively study. *Cyberpsychol Behav*, 2007, 10: 545-551.

Leung, L. Net-generation attributes and seductive properties of the internet as predictors of online activities and internet addiction. *Cyberpsychol Behav*, 2004, 7: 333-348.

Liu, X., Buysse, D.J., Gentzler, A.L., et al. Insomnia and hypersomnia associated with depressive phenomenology and comorbidity in childhood depression. *Sleep*, 2007, 30: 83-90.

Liu, X., Uchiyama, M., Okawa, M., Kurita, H. Prevalence and correlates of self-reported sleep problems among Chinese adolescents. *Sleep*, 2000, 23: 27-34.

Liu, X., Zhou, H. Sleep duration, insomnia and behavioral problems among Chinese adolescents. *Psychiatry Res*, 2002, 111: 75-85.

MacKinnon, D.P., Lockwood, C.M., Hoffman, J.M., West, S.G., Sheets, V. A comparison of methods to test mediation and other intervening variable effects. *Psychol Meth* 2002, 7: 83-104.

Morahan, M.J., Schumacher, P. Loneliness and social uses of the Internet. *Comput Hum Behav*, 2003, 19: 659-671.

Nalwa, K., Anand, A.P. Internet addiction in students: A cause of concern. *Cyberpsychol Behav*, 2003, 6: 653-656.

Ohida, T., Osaki, Y., Doi, Y., et al. An epidemiologic study of self-reported sleep problems among Japanese adolescents. *Sleep*, 2004, 27: 978-985.

Pallanti, S., Bernardi, S., Quercioli, L.. The Sorter PROMIS questionnaire and the Internet Addiction Scale in the assessment of multiple addictions in a high school population: Prevalence and related disability. *CNS Spectr*, 2006, 11: 966-974.

Punamäki, R., Wallenius, M., Nygård, C., Saarni, L.m Rimpela, A. Use of information and communication technology (ICT) and perceived health in adolescence: The role of sleeping habits and waking-time tiredness. *J Adolesc*, 2007, 30: 569-585.

Rotunda, R.J., Kass, S.J., Sutton, M.A., Leon, D.T. Internet use and misuser: Preliminary findings from a new assessment instrument. *Behav Modif*, 2003, 27 484-504.

Schmitz, N., Kruse, J., Tress, W. Psychometric properties of the General Health

Questionnaire (GHQ-12) in a German primary care sample. *Acta Psychiatr Scand*, 1999, 100: 462-468.

Shaw, M., Black, D.W. Internet addiction: Definition, assessment, epidemiology and clinical management. *CNS Drugs*, 2008, 22: 353-365.

Taylor, D.J., Lichstein, K.L., Durrence, H.H. Insomnia as a health risk factor. *Behav Sleep Med*, 2003, 1: 227-247.

Thomée, S., Eklöf, M., Gustafsson, E., Nilsson, R. Hagberg, M. Prevalence of perceived stress, symptoms of depression and sleep disturbances in relation to information and communication technology (ICT) use among young adults - an explorative prospective study. *Comput Human Behav*, 2007, 23: 1300-1321.

Tsai, P.S., Wang, S.Y., Wang, M.Y., et al. Psychometric evaluation of the Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) in primary insomnia and control subjects. *Qual Life Res*, 2005, 14: 1943-1952.

World Health Organization. The ICD-10 classification of mental and behavioral disorders: Clinical description and diagnostic guidelines. The ICD-10. World Health Organization, Geneva, 1992.

Yen, J., Ko, C., Yen, C., Chen, S.H., Chung, W.L., Chen, C.C. Psychiatric symptoms in adolescents with Internet addiction: Comparison with substance use. *Psychiatry Clin Neurosci*, 2008, 62: 9-16.

Yen, J.Y., Yen, C.F., Chen, C.C., Chen, S.H., Ko, C.H. Family factors of internet addiction and substance use experience in Taiwanese adolescents. *Cyberpsychol Behav*, 2007, 10: 323-329.

Young, K.S. Internet addiction. A new clinical phenomenon and its consequences. *Am Behav Sci*, 2004, 48: 402-415.

Figure caption

Figure 1a. Regression coefficients in the insomnia explanatory pathway from internet addiction to depression. *$p<0.001$.

Figure 1b. Regression coefficients in the internet addiction explanatory pathway from insomnia to depression. *$p<0.001$.