Prevalence and Clinical Correlates of Internet Addiction Symptoms and Their Association With Quality of Life in Adolescents With Major Depressive Disorder: A Multicenter Cross-Sectional Study

Song Wang1,2,3†, Lei Xia1,2,3†, Jiawei Wang2,1,4†, Xiaoping Yuan1,2,3, Yudong Shi1,2,3, Xixin Wang1,2,3, Xiaoyue Li1,2,3, Yu Hu2,3, Yulong Zhang1,2,3, Yating Yang1,2,3, Feng Geng2,3,5, Zhiwei Liu6, Changhao Chen7, Xiangwang Wen8, Xiangfen Luo9, Fei Gao10 and Huanzhong Liu2,1,3*†

1 School of Mental Health and Psychological Sciences, Anhui Medical University, Hefei, China, 2 Department of Psychiatry, Chaohu Hospital of Anhui Medical University, Hefei, China, 3 Anhui Psychiatric Center, Hefei, China, 4 Department of Psychiatry, Bozhou People’s Hospital, Bozhou, China, 5 Department of Psychiatry, Hefei Fourth People’s Hospital, Hefei, China, 6 Department of Psychiatry, Fuyang Third People’s Hospital, Fuyang, China, 7 Department of Psychiatry, Suzhou Second People’s Hospital, Suzhou, China, 8 Department of Psychiatry, Ma’anshan Fourth People’s Hospital, Ma’anshan, China, 9 Department of Psychiatry, The Second Affiliated Hospital of Bengbu Medical College, Bengbu, China, 10 Centre for Cognitive and Brain Sciences, University of Macau, Macao, Macao SAR, China

Background: Internet addiction (IA) symptoms are common among adolescents and negatively impact their academic performance and development. These symptoms are also associated with lower quality of life (QOL) and increased suicidality. This study aimed to examine the prevalence and the sociodemographic and clinical correlates of IA symptoms in adolescents with major depressive disorder (MDD) and their association with QOL.

Methods: This cross-sectional study was conducted in three general and four psychiatric hospitals in Anhui Province, China, from January to July 2021. Sociodemographic and clinical data were collected. The Internet Addiction Test (IAT), Center for Epidemiologic Studies of Depression Symptom Scale (CES-D), and World Health Organization Quality of Life Brief version (WHOQOL-BREF) were utilized to examine IA, depressive symptoms, and QOL, respectively.

Results: In a multicenter sample of 278 adolescents with MDD, the prevalence of IA symptoms in adolescents with MDD was 46.8% (95% CI: 40.9–52.7%). Logistic regression analysis showed that patients with more severe depressive symptoms (odds ratio [OR] = 1.05, 95% CI: 1.03–1.08), those living in a rural area (OR = 1.94, 95% CI: 1.15–3.27), and those with poor academic performance (OR = 2.90, 95% CI: 1.42–5.95) were more likely to have IA symptoms. After controlling for confounding factors, patients with IA symptoms had significantly poorer QOL in the physical, psychological, and environmental domains than those without IA symptoms.

Conclusion: IA symptoms are common in adolescents with MDD and appear to be associated with clinical symptoms. We could not infer a causal relationship...
Internet Addiction Among MDD Adolescents

INTRODUCTION

Internet addiction (IA) generally refers to the behaviors of uncontrolled and persistent use of the internet, which can lead to individuals' distress and social avoidance (1). IA symptoms are prevalent among adolescents and have received extensive attention from researchers around the world (2–4). A systematic review and meta-analysis reported that the prevalence rate of IA symptoms ranged from 0.6 to 50% worldwide, with a pooled prevalence of 2.0% in children and adolescents (5). Previous studies showed that the prevalence of IA symptoms was 26.8–32.5% among adolescents in China (6, 7).

Previous studies suggested a possible link between depression and addictive behaviors. People with higher levels of depression are more likely to have problem gambling (8) and compulsive buying (9). Young adults with compulsive sexual behavior have more depressive symptoms than those without compulsive sexual behavior (10). Many studies have found that IA symptoms in children and adolescents are associated with psychiatric problems, including autism spectrum disorder (11), attention-deficit/hyperactivity disorder (ADHD) (12), and somatization/obsessive-compulsive symptoms (13). A previous study also found a bidirectional relationship between IA symptoms and depression in adolescents (14). Some neurobiological correlates [e.g., lower levels of oxytocin (15, 16), and the same biogenetic basis with “short” alleles of the 5HTTLPR polymorphism (17, 18)] can explain the clinical association between IA symptoms and depression.

Internet addiction symptoms negatively impact the academic performance and development of adolescents and may even lead to violence and crime (7, 19). These symptoms are also associated with lower quality of life (QOL) (20–22). A longitudinal survey found that more severe IA symptoms at an earlier time can predict higher levels of depression in adolescents and young adults later in life (23). Additionally, a recent study found that adolescents with IA symptoms were 2.2 times more likely to have suicidal ideation than those without IA symptoms (24). Targeting and managing IA symptoms among adolescents with major depressive disorder (MDD) at an early stage could potentially lead to improvements in psychological health and well-being, and a reduction of suicidality (25). There is a need to reveal the characteristics of IA symptoms in adolescents with MDD, which would facilitate the development of a new therapeutic target for the management of this patient population.

A study in Turkey found that the prevalence of IA symptoms in adolescents with MDD during the first assessment in the outpatient clinic was 30%, and the symptoms were associated with hopelessness (25). Another study in China reported that the prevalence in clinically stable adolescents with MDD was 36.9% (2). However, none of these studies explored the clinical correlates of IA symptoms in adolescents with MDD, such as the severity or duration of depression, or their association with QOL. Thus, the present study aimed to investigate the prevalence and clinical correlates of IA symptoms and their association with QOL in adolescents with MDD in China.

MATERIALS AND METHODS

Study Design and Participants

This cross-sectional study was conducted in three general hospitals (Chaohu, Bengbu, and Bozhou) and four psychiatric hospitals (Hefei, Ma’anshan, Suzhou, and Fuyang) in Anhui Province, China, from January to July 2021. Participants were consecutively recruited from psychiatric outpatients and inpatients in these hospitals if they met the following criteria: (1) aged between 12 and 18 years; (2) had a diagnosis of MDD assessed by two psychiatrists using a structured clinical interview for DSM-V. Patients who met the DSM-V criteria for a diagnosis of other psychiatric or neurological disorders and/or intellectual disability were excluded.

All eligible participants and their guardians provided written consent forms after being informed of the method and purpose of the study. The Medical Ethics Committee of Chaohu Hospital of Anhui Medical University approved the study protocol (202009-kyxm-04) before the study.

Data Collection and Measurements

Under the guidance of trained investigators, all adolescents participated in an interview that involved their guardians’ participation. A predesigned questionnaire was used to collect sociodemographic characteristics of the participants, including age (years), gender (male/female), living area (urban/rural) (26), geographical location (northern, central, or southern Anhui Province), academic performance (good, fair, or poor) (27), one-child status (a reply of “yes” or “no” to the question “Are you the only child in the family?”), and duration of illness (months). Specifically, the duration of illness was defined as the time range from the first onset of clinical symptoms to the time of participation in the evaluation (28). In this study, the Internet Addiction Test (IAT) was used to assess IA symptoms (29), which has been widely used in various populations worldwide, and the Chinese version has been validated among Chinese adolescents (Cronbach's \( \alpha \) coefficient = 0.93) (30). The scale included 20 questions about the actual frequency of online and related scenes, with an individual score ranging from 1 to 5 and a total score that ranged from 20 to 100. The adolescents...
with an IAT total score ≥50 were defined as “having IA” (7, 31–33), and the split-half reliability and Cronbach’s α coefficient were 0.86 and 0.90, respectively (31). In addition, the Center for Epidemiologic Studies of Depression Symptom Scale (CES-D) was used to assess the severity of depressive symptoms in patients with individual item scores of 0 to 3 (34). Furthermore, the Chinese version of the World Health Organization Quality of Life Brief version (WHOQOL-BREF) was used to evaluate QOL in the physical, psychological, social, and environmental domains (35, 36).

Statistical Analysis
SPSS software version 23.0 (SPSS Inc., Chicago, Illinois, United States) was used for statistical analyses. Demographic and clinical data are presented as means, standard deviations (SDs), and frequency distributions (%). We compared sociodemographic and clinical variables between participants with and without IA symptoms using independent-samples t-tests for continuous variables with a normal distribution, Mann–Whitney U tests for continuous variables with a non-normal distribution, and chi-square tests for categorical variables. Analysis of covariance (ANCOVA) was used to compare QOL scores between groups with and without IA symptoms after controlling for the demographic and clinical variables that significantly differed between the two groups. Binary logistic regression analysis with the “Enter” method was used to examine the independent correlates of IA symptoms by treating the variables with significant group differences as independent variables and the presence of IA symptoms as the dependent variable. We calculated the sample size using PASS version 11.0 (NCSS Statistical Software, Kaysville, UT, United States) with the relevant parameters: the estimated prevalence of IA symptoms (30%), confidence level/1-α (0.95), and acceptable error (0.06). A minimum sample size of 239 was needed. Statistical significance was evaluated by a threshold of \( P < 0.05 \) (two-tailed).

RESULTS

Participant Characteristics
The sociodemographic and clinical data of adolescents with MDD are presented in Table 1. Of 300 adolescents who were invited to participate in this study, 278 completed the evaluation and were included in the analysis, indicating a participation rate of 92.7%. The adolescent sample included 74 males (26.6%) and 204 females (73.4%). The mean age was 15.26 ± 1.70 years. Of these adolescents, 114 (40.3%) were the only child in their families, and 128 (46.0%) were living in a rural area.

Comparisons Between Groups With and Without Internet Addiction Symptoms
The prevalence of IA symptoms was 46.8% (95% CI: 40.9–52.7%) in the total sample. There was no significant difference in the prevalence between males and females (40.5% vs. 49.0%, respectively; \( P = 0.210 \)). The adolescents with IA symptoms had more severe depressive symptoms, worse academic performance, and a higher proportion of living in a rural area than those without IA symptoms (all \( P < 0.05 \)). In addition, the adolescents with IA symptoms had lower scores in all domains of QOL than those without IA symptoms. ANCOVA showed that differences in physical (\( F = 8.49, P = 0.004 \)), psychological (\( F = 10.30, P = 0.001 \)), and environmental QOL scores (\( F = 5.03, P = 0.026 \)) between the two groups remained significant after controlling for CES-D total score, living area, and academic performance. However, the group difference in the social domain was not statistically reliable (\( F = 0.02, P = 0.886 \)).

Independent Correlates of Internet Addiction Symptoms
The results of multiple logistic regression analysis with the independent correlates associated with IA symptoms are presented in Table 2. We found that more severe depressive symptoms (OR = 1.05, 95% CI: 1.03–1.08, \( P < 0.001 \)), living in a rural area (relative to an urban area) (OR = 1.94, 95% CI: 1.15–3.27, \( P = 0.013 \)), and poor academic performance (compared to good academic performance) (OR = 2.90, 95% CI: 1.42–5.95, \( P = 0.004 \)) were independently associated with IA symptoms in the adolescents with MDD.

DISCUSSION
In this study, we examined the prevalence and clinical correlates of IA symptoms and explored their associations with QOL in Chinese adolescents with MDD. We found that the prevalence of IA symptoms in the patient sample was 46.8% (95% CI: 40.9–52.7%), which is much higher than that in Chinese adolescents in extant studies. For example, a survey of 10,158 adolescents from Anhui Province showed that the prevalence of IA symptoms was 10.4% (37). A more recent study involving 31,954 adolescents in Beijing, a more developed area, reported a prevalence of 6.2% (38). Several notable factors could contribute to the high prevalence of IA symptoms in adolescents with MDD. First, adolescents with MDD often stay home from school, which provides much leisure time and less family supervision and enables young patients to easily access and indulge in using the internet (39, 40). Second, adolescents with MDD are more likely to indulge in the virtual cyber world instead of the real world, because they can have more fun, which counteracts the negative effects of depression (41).

Specifically, the prevalence rate of IA symptoms in our study was approximately 1.5 times the rates reported in adolescents with MDD during an initial assessment in a Turkish outpatient clinic (30%) (25) and in clinically stable adolescents with MDD in China (36.9%) (2). The discrepancy could be attributed to patient characteristics. This current study recruited adolescents with MDD, including not only stable patients but also those with more severe depressive symptoms. In light of our findings, adolescents with more severe depressive symptoms are more likely to have IA symptoms, which is consistent with previous findings in the school sample of Chinese adolescents (7, 42). In addition, adolescents with more severe depressive symptoms...
are prone to report having deficient social skills and seek social connections online (43). Excessive reduction in real-world social activities may further lead to IA symptoms (44). Importantly, for individuals who are addicted to the internet, isolation from the real world increases the severity of depressive and anxiety symptoms (45, 46). Costa et al. found that a lack of adequate sensory contact and physical feedback in online communication can bring about feelings of loneliness in adolescents and young adults (47), which may further contribute to depressive symptoms. Given that depressive symptoms and IA symptoms in adolescents reinforce each other, improving depressive symptoms should be considered an effective intervention as a priority for reducing the risk of IA symptoms. In the meantime, the adoption of interventions for IA symptoms could be beneficial for depressive symptom mitigation.

In addition, we found that IA symptoms were associated with poor academic performance in adolescents with MDD, which replicated previous findings in general adolescents (7, 37) and college students (48, 49). Existing evidence shows that poor academic performance and IA symptoms interact with each other in a vicious cycle. Adolescents with poor academic performance feel pessimistic about their future and give up their studies, as they cannot meet the expectations of their parents and teachers. This could lead to their excessive use of the internet and development of IA symptoms. In addition, adolescents with IA symptoms often spend limited time on course work, thus resulting in a consequent decline in academic performance. A survey of middle-school students in northern Taiwan revealed that the patterns of internet use affected students’ academic performance, as online socializing and gaming led to poorer exam performance a year later (50).

Moreover, we found that adolescents living in rural areas were more likely to report IA symptoms than those living in urban areas. This difference might be closely linked to their differing living conditions and habits. For adolescents living in rural areas, the dominant way to spend time is through online
socializing, gaming, and shopping due to the lack of diverse recreational activities. Previous studies have shown that without parental supervision, adolescents left alone in rural areas have unrestricted access to the internet, which could further enhance IA symptoms (40, 51). In contrast, a previous study reported a lower rate of IA symptoms among adolescents in rural areas than urban areas, which was attributed to the fact that adolescents in rural areas had less access to the internet (52). However, with increasing availability of the internet in China in recent years, access to and the convenience of the internet in rural areas have become comparable to those in urban areas (53). Therefore, to reduce the high rate of IA symptoms and limit their adverse effects in rural adolescents, there is a strong need to take effective measures to reduce excessive internet use, such as installing more recreational facilities (e.g., basketball courts, table tennis equipment) in rural areas, establishing regular physical activity schedules, and strengthening parental supervision of internet use among adolescents.

In this study, adolescents with IA symptoms had lower levels of QOL in all domains than those without IA symptoms, which is consistent with the findings in a large-sample study with 12,285 adolescents in Spain (54) and a multicenter study in China (22). First, excessive internet use can lead to multiple physical health issues, such as headache (55), oral diseases (56), musculoskeletal pain (57), obesity (58, 59), hypertension (60), and eating disorders (61). Moreover, adolescents with IA symptoms often experience distress symptoms, familial conflicts, and social withdrawal (62). Interestingly, after controlling for the severity of depressive symptoms, living area, and academic performance, the difference in social QOL between the two groups disappeared. This finding is consistent with a previous study of adolescents in China (22). Our interpretation is that IA symptoms are associated with social QOL but may not be independent from sociodemographic and clinical factors in adolescents with MDD. Collectively, these findings imply that improving IA symptoms could increase QOL among adolescents with MDD.

Several limitations in this study should be noted. First, because the current design was cross-sectional, the direction of causality between IA symptoms and clinical factors or QOL in adolescents with MDD might not be adequately established. Second, although the prevalence of IA symptoms among adolescents has been widely reported, there was no age- and gender-matched healthy control group in this study. As such, we were unable to make direct comparisons of IA symptom prevalence and QOL between MDD adolescents and those in school or community samples. Third, depressive symptoms were assessed by the CES-D, a self-report tool, rather than an objective measure for depressive symptoms, such as the Hamilton Depression Rating Scale (HAMD). Finally, relevant factors associated with IA symptoms, such as parental internet use, economic conditions, and social support, were not examined. These limitations could be addressed by future studies.

CONCLUSION
In summary, IA symptoms are common in adolescents with MDD, particularly in those with more severe depressive symptoms, living in a rural area, and with poor academic performance. Given the negative impact of IA symptoms on QOL in adolescents with MDD, effective and proactive interventions, including regular screening, improving depressive symptoms, enriching recreational activities, and strengthening parental supervision, should be undertaken in this population.

DATA AVAILABILITY STATEMENT
The data used for this study are available from the corresponding author on reasonable request.

ETHICS STATEMENT
The studies involving human participants were reviewed and approved by the Medical Ethics Committee of Chaohu Hospital of Anhui Medical University. Written informed consent to participate in this study was provided by the participants’ legal guardian/next of kin.

AUTHOR CONTRIBUTIONS
HL: study design. SW, LX, JW, XY, YS, XW, XL, and YH: collection, analyses, and interpretation of data. SW, LX, and JW: drafting of the manuscript. FG and HL: critical revision of the manuscript. All authors approval of the final version for publication.

FUNDING
This study was supported by the National Clinical Key Specialty Project Foundation (CN).

REFERENCES
1. Young KS. Internet addiction a new clinical phenomenon and its consequences. *Am Behav Sci.* (2004) 48:402–15. doi: 10.1177/0002764204270278
2. Li ZL, Liu R, He F, Li SY, Zhao YJ, Zhang WY, et al. Prevalence of internet addiction disorder and its correlates among clinically stable adolescents with psychiatric disorders in China during the COVID-19 outbreak. *Front Psychiatry.* (2021) 12:686177. doi: 10.3389/fpsyt.2021.686177
3. Zhang Y, Sindermann C, Kendrick KM, Becker B, Montag C. Individual differences in tendencies toward internet use disorder, internet literacy and their link to autistic traits in both China and Germany. *Front Psychiatry.* (2021) 12:638655. doi: 10.3389/fpsyt.2021.638655
4. Al-Khani AM, Saqib J, Rajab AM, Khaliwa MA, Almazrou A, Saqib N. Internet addiction in Gulf countries: a systematic review and meta-analysis. J Behav Addict. (2021) 10:601–10. doi: 10.1556/2006.2021.00057

5. Paulus FW, Ohmann S, von Gottard A, Popow C. Internet gaming disorder in children and adolescents: a systematic review. Dev Med Child Neurol. (2018) 60:645–59. doi: 10.1111/dmcn.13754

6. Shek DT, Yu L. Adolescent Internet Addiction in Hong Kong: prevalence, change, and correlates. J Pediatr Adolesc Gynecol. (2016) 29:522–30. doi: 10.1016/j.pjag.2015.10.005

7. Xu DD, Lok KI, Liu HZ, Cao XL, An FR, Hall BJ, et al. Internet addiction among adolescents in Macau and mainland China: prevalence, demographics and quality of life. Sci Rep. (2020) 10:16222. doi: 10.1038/s41598-020-73023-1

8. Dowling NA, Butera CA, Merkouris SS, Yousuf GJ, Rodda SN, Jackson AC. The reciprocal association between problem gambling and mental health symptoms/substance use: cross-lagged path modelling of longitudinal cohort data. J Clin Med. (2019) 8:1888. doi: 10.3390/jcm811888

9. Brook JS, Zhang C, Brook DW, Leukfeldt CG. Compulsive buying: earlier illicit drug use, impulse buying, depression, and adult ADHD symptoms. Psychiatry Res. (2015) 228:312–7. doi: 10.1016/j.psychres.2015.05.095

10. Odlaug BL, Lust K, Schreiber LR, Christenson G, Derbyshire K, Harvanko A, et al. Serotonergic dysfunction: a familial and twin study in adults with major depressive disorder. Acta Psychiatr Scand. (2019) 140:1084–95. doi: 10.1111/acps.12964

11. Tereshchenko S, Kasparov E. Neurobiological risk factors for the development of internet addiction in adolescents. Cyberpsychol Behav Neurosci. (2017) 20:606–12. doi: 10.1089/cabn.2016.0033294117724447

12. Wang BQ, Yao NQ, Zhou X, Liu J, Lv ZT. The association between attention deficit/hyperactivity disorder and internet addiction: a systematic review and meta-analysis. BMC Psychiatry. (2017) 17:260. doi: 10.1186/s12888-017-1408-x

13. Zamboni L, Portoghese I, Congiu A, Carli S, Munari R, Federico A, et al. Online game addiction as a new risk factor. J Adolesc Health. (2017) 61:845–52. doi: 10.1016/j.jadohealth.2017.07.007

14. Lau JTF, Walden DL, Wu AMS, Cheng KM, Lau MCM, Mo PKH. Bidirectional predictions between Internet addiction and problematic internet use, depressive symptoms and sleep disturbance among Southern Chinese adolescents. BMC Public Health. (2018) 20:252. doi: 10.1186/s12889-020-02640-x

15. Wu XS, Zhang ZH, Zhao F, Wang WJ, Li YF, Bi L, et al. Prevalence of internet addiction in adolescents. J Pediatr Psychol. (2013) 38:794–807. doi: 10.1016/j.jpeds.2012.04.014

16. de Diego-Adeliño J, Portella MJ, Puigdemont D, Pérez-Egea R, Alvarez E, Pérez A. A short duration of untreated illness (DUI) improves response outcomes in first depressive episodes. J Affect Disord. (2010) 120:221–5. doi: 10.1016/j.jad.2009.03.012

17. Young KS. Internet addiction: the emergence of a new clinical disorder. Cyberpsychol Behav. (2009) 1:237–44. doi: 10.1089/cpb.1998.1.237

18. Lai CM, Mak KK, Watanabe H, Ang RP, Pang JS, Ho RC. Psychometric properties of the internet addiction test in Chinese adolescents. J Pediatr Psychol. (2013) 38:794–807. doi: 10.1016/j.jpeds.2012.04.014

19. Cao H, Sun Y, Wan Y, Hao J, Tao F. Problematic internet use in Chinese adolescents and its relation to psychosomatic symptoms and life satisfaction. BMC Public Health. (2011) 11:802. doi: 10.1186/1471-2458-11-802

20. Tan Y, Chen Y, Lu Y, Li L. Exploring associations between problematic internet use, depressive symptoms and sleep disturbance among Southern Chinese adolescents. Int J Environ Res Public Health. (2016) 13:531. doi: 10.3390/ijerph.13030313

21. Radloff LS. The use of the Center for Epidemiologic Studies Depression Scale in adolescents and young adults. J Youth Adolesc. (1991) 20:149–66. doi: 10.1007/bf01537606

22. Skevington SM, Dehner S, Gillison FB, McGrath EJ, Lovell CR. How appropriate is the WHOQOL-BREF for assessing the quality of life of adolescents and young adults? J Adolesc. (2008) 31:893–1004. doi: 10.1016/j.adolescence.2007.10.020

23. Cao F, Su L. Internet addiction among Chinese adolescents: prevalence and psychological features. Child Care Health Dev. (2007) 33:275–81. doi: 10.1111/j.1365-2214.2006.00715.x

24. Huang Y, Xu L, Mei Y, Wei Z, Wen H, Liu D. Problematic Internet use and the risk of suicide ideation in Chinese adolescents: a cross-sectional analysis. Psychiatry Res. (2020) 290:112963. doi: 10.1016/j.psychres.2020.112963

25. Alvastam AH, Soylu N, Kocak U, Guzel H. Problematic Internet use was more common in Turkish adolescents with major depressive disorders than controls. Acta PaeDIatr. (2016) 105:695–700. doi: 10.1111/apa.13555

26. National Bureau of Statistics of China. Provisions on the Statistical Division of Urban and Rural Areas. Beijing: National Bureau of Statistics of China (2006). Available online at: http://www.stats.gov.cn/tjzybz/200601/200601018_8666.html

27. Qi S, Qin Z, Wang N, Tse LA, Qiao H, Xu F. Association of academic performance, general health with health-related quality of life in primary and high school students in China. Health Qual Life Outcomes. (2020) 18:339. doi: 10.1186/s12955-020-01950-y

28. Li K, Su L, Wang WJ, Li YF, Bi L, et al. Prevalence of internet addiction among Chinese adolescents: prevalence and psychological features. Child Care Health Dev. (2007) 33:275–81. doi: 10.1111/j.1365-2214.2006.00715.x

29. Cao F, Su L. Internet addiction among Chinese adolescents: prevalence and psychological features. Child Care Health Dev. (2007) 33:275–81. doi: 10.1111/j.1365-2214.2006.00715.x
43. Caplan SE. Theory and measurement of generalized problematic Internet use: a two-step approach. *Comput Hum Behav.* (2010) 26:1089–97. doi: 10.1016/j.chb.2010.03.012

44. Elhai JD, Levine JC, Hall BJ. The relationship between anxiety symptom severity and problematic smartphone use: a review of the literature and conceptual frameworks. *J Anxiety Disord.* (2019) 62:45–52. doi: 10.1016/j.janxdis.2018.11.005

45. Elhai JD, Levine JC, Hall BJ. Proneness to boredom mediates relationships between problematic smartphone use with depression and anxiety severity. *Soc Sci Comput Rev.* (2017) 36:707–20. doi: 10.1177/0894439317741087

46. Costa RM, Patrão I, Machado M. Problematic internet use and feelings of loneliness. *Int J Psychiatry Clin Pract.* (2019) 23:160–2. doi: 10.1080/13651501.2018.1539180

47. Turel O, Serenko A. The benefits and dangers of enjoyment with social networking websites. *Eur J Inf Syst.* (2017) 26:1089–97. doi: 10.1016/j.ejis.2012.1.017

48. Taha MH, Shehzad K, Alamro AS, Wadi M. Internet use and addiction among medical students in Qassim University, Saudi Arabia. *Sultan Qaboos Univ Med J.* (2019) 19:e142–7. doi: 10.18295/squmj.2019.19.02.010

49. Azizi SM, Soroush A, Khatony A. The relationship between social networking addiction and academic performance in Iranian students of medical sciences: a cross-sectional study. *BMC Psychol.* (2019) 7:28. doi: 10.1186/s40359-019-0305-0

50. Chen Y, Fu YC. Internet use and academic achievement: gender differences in early adolescence. *Adolescence.* (2009) 44:797–812. doi: 10.1016/j.adbeh.2007.07.016

51. Cai J, Wang Y, Wang F, Lu J, Li L, Zhou X. The association of parent-child communication with internet addiction in left-behind children in China: a cross-sectional study. *Int J Public Health.* (2021) 66:630700. doi: 10.3389/ij.ph.2021.630700

52. Chen Y, Kang Y, Gong W, He L, Jin Y, Zhu X, et al. Investigation on Internet addiction disorder in adolescents in Anhui, People's Republic of China. *Neuropsychiatr Dis Treat.* (2016) 12:2233–6. doi: 10.2147/ndt.S110156

53. China Internet Network Information Center [CNNIC]. The 48th Statistical Report on China’s Internet Development. Beijing: China Internet Network Information Center (2021). Available online at: http://www.cnnic.net.cn/hlwzhjy/hlwzxbg/hlwzjbq/202109/20210915_71543.htm

54. Machimbarrena JM, González-Cabrera J, Ortega-Barón J, Beranuy-Fargues M, Álvarez-Bardón A, Tejero B. Profiles of problematic internet use and its impact on adolescents’ health-related quality of life. *Int J Environ Res Public Health.* (2019) 16:3877. doi: 10.3390/ijerph1603877

55. Średniawa A, Jarczewska D, Żabicka K, Ułman M, Pilarska A, Tomasiak T, et al. Internet addiction among graduates of general secondary schools in Cracow and its correlation with body mass index and other health problems. *Pol Merkur Lekarski.* (2015) 39:31–6.

56. Do KY, Lee KS. Relationship between problematic internet use, sleep problems, and oral health in Korean adolescents: a national survey. *Int J Environ Res Public Health.* (2018) 15:1870. doi: 10.3390/ijerph15091870

57. Yang G, Gao J, Li Y, Cheng P, Liu B, Hao Z, et al. Association between internet addiction and the risk of musculoskeletal pain in Chinese college freshmen - a cross-sectional study. *Front Psychol.* (2019) 10:1959. doi: 10.3389/fpsyg.2019.01959

58. Durmus G, Orttabag T, Ozdemir S. Determining the relationship between obesity and problematic internet use among adolescents. *Iran J Public Health.* (2021) 50:1796–804. doi: 10.18502/ijph.v50i9.7052

59. Yilmaz Kafali H, Uçaktürk SA, Mengen E, Akpinar S, Erguvan Demirts M, Uneri ÖS. Emotion dysregulation and pediatric obesity: investigating the role of Internet addiction and eating behaviors on this relationship in an adolescent sample. *Eat Weight Disord.* (2021) 26:1767–79. doi: 10.1007/s40519-020-00999-0

60. Cassidy-Bushrow AE, Johnson DA, Peters RM, Burmeister C, Joseph CL. Time spent on the internet and adolescent blood pressure. *J sch Nurs.* (2015) 31:374–84. doi: 10.1177/1059840515556772

61. Alpaslan AH, Koçak U, Avci K, Uzel Taş H. The association between internet addiction and disordered eating attitudes among Turkish high school students. *Eat Weight Disord.* (2015) 20:441–8. doi: 10.1007/s40519-015-0197-9

62. Cermiglia L, Zoratto F, Cinino S, Laviola G, Ammaniti M, Adriani W. Internet addiction in adolescence: neurobiological, psychosocial and clinical issues. *Neurosci Biobehav Rev.* (2017) 76:174–84. doi: 10.1016/j.neubiorev.2016.12.024

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Wang, Xia, Wang, Yuan, Shi, Wang, Li, Hu, Zhang, Yang, Geng, Liu, Chen, Wen, Luo, Gao and Liu. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.