Prevalence of Internet Addiction and Its Correlates among Adolescents during the COVID-19 Pandemic: A Cross-Sectional Study in Nanchang, China

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Abstract:

Background: Internet addiction (IA) is one of the most prevalent mental health problems among adolescents. Several studies have reported that the prevalence of IA among adolescents has increased during the COVID-19 pandemic. However, with China's ongoing regular epidemic prevention and control, it is unclear whether the prevalence among adolescents is still at such high levels in China during the COVID-19 pandemic. Therefore, we conducted a cross-sectional study from December 2020 to January 2021 that aims to understand the prevalence and related factors of IA among adolescents in Nanchang, China, during the pandemic. *Methodology:* The cross-sectional survey was conducted in seven secondary schools in Nanchang. Participants completed a questionnaire comprising Young's Diagnostic Questionnaire for internet addiction (YDQ), International Physical Activity Questionnaire Short Form, and questions regarding demographic characteristics, outdoor activity time, and sleep quality. *Results:* A total of 6,553 secondary school students participated in the survey. Of the total, 14.4% (946/6553) were classified as addicted internet users (YDQ ≥5). The risk of IA was higher among students of older age (*OR*=1.17) and with poorer subjective sleep quality (*OR*=1.27-2.56). Urban household registration (*OR*=0.80), high level of physical activity (*OR*=0.68), 1-2 hours of outdoor activity per day (*OR*=0.69), long sleep duration (*OR*=0.60), and normal sleep duration (*OR*=0.74) were protective factors of IA. *Conclusions:* During the COVID-19 pandemic, adolescents in China reported some risks for IA. Age, household registration, outdoor activity time, level of physical activity, subjective sleep quality, and sleep duration were the key factors affecting IA. Therefore, extended school and family support should be provided for vulnerable adolescents in this extraordinary period.

Keywords: Internet addiction; Adolescent; Secondary school student; COVID-19; Pandemic

1. Introduction

In late December 2019, the Coronavirus disease 2019 (COVID-19) emerged in Wuhan, Hubei Province, China, and spread rapidly across the country (Sharma et al., 2021). Since the outbreak, COVID-19 has become a pandemic in more than 200 countries and territories worldwide (Peng, 2020). With the active response by the Chinese government, the prevention and control of the COVID-19 epidemic in China is showing a positive trend and has entered the regular epidemic prevention and control stage. However, in this stage, Chinese students may still face restrictions such as school opening delays, staying at home, and online learning, which significantly increase their excessive internet use and may develop into internet addiction.

Internet addiction is also known as internet addiction disorder or problematic internet use, which refers to one's excessive use of the internet and inability to control his/her internet-using behavior (Dong et al., 2020; Pan, Chiu & Lin, 2020). Internet addiction seriously affects adolescents' physical and mental health. Previous studies have shown that psychological and behavioral problems such as depression, aggressiveness, substance abuse, and suicidal behaviors are significant negative consequences among students addicted to the internet (Marin, Nuñez, & de Almeida, 2021). Therefore, the risk of internet addiction among school-age adolescents deserves more attention in this unprecedented period.

Previous studies have reported that the prevalence of internet addiction ranged from 3.1% to 47.4% in Asian countries (Bickham, 2021). During the COVID-19 pandemic, several studies have been conducted regarding internet use problems in China. Internet addiction showed a prevalence of 36.7% among the general population (Y. Y. Li et al., 2021), 31.2% among adolescents with psychiatric disorders (Z. L. Li et al., 2021), and almost 36.0% among children and adolescents (Dong et al., 2020). However, a gap may exist regarding the prevalence in different periods during the COVID-19 pandemic. For example, would the prevalence among adolescents still be at such high levels with the in-depth development of China's regular epidemic prevention and control? In addition, a lack of evidence exists regarding whether the factors associated with internet addiction, such as demographic characteristics, physical activity, and sleep quality, differ from those before the COVID-19 pandemic era in China. Therefore, we conducted a survey at secondary schools in Nanchang, China, to explore internet addiction and its related factors among adolescents during the regular epidemic prevention and control stage of the COVID-19 pandemic. The research questions were: During the pandemic, especially in the regular epidemic prevention and control stage, (1) What is the prevalence of internet addiction among adolescents in China? (2) Does the prevalence of internet addiction among adolescents correlate with their demographic characteristics, physical activity, and sleep quality? The results of this study may assist in identifying changes in the internet addiction prevalence among Chinese adolescents and in planning interventions to prevent them from developing internet addiction during the COVID-19 pandemic.

2. Data and Methods

2.1. Research design and participants

The survey was conducted from December 2020 to January 2021. A stratified cluster sampling method was applied. Seven secondary schools, including four junior high schools and three senior high schools, were randomly selected from fifteen municipal state-funded secondary

schools in Nanchang. All students in the sampled schools were recruited. Finally, a total of 6,575 students were enrolled in this study.

With the coordination of the schools, the on-site survey was performed by the investigators who had received unified training. The students were first informed of the survey's purpose and content. A self-administered anonymous questionnaire was then distributed to them. Upon returning the questionnaire, the investigators checked for missing or incorrect responses and asked the students to add or correct the information. Finally, 6,553 valid questionnaires were returned, with an effective recovery rate of 99.7%. This study was approved by the Medical Ethics Committee of the Affiliated Eye Hospital of Nanchang University (approval number [2020] No. 048, date of approval 2020-09-01). Informed consents were obtained from the schools, students, and their parents.

2.2. Measures

Data were collected through a questionnaire comprising Young's Diagnostic Questionnaire (YDQ), International Physical Activity Questionnaire Short Form (IPAQ-SF), and questions regarding demographic characteristics, outdoor activity time, and sleep quality.

Internet addiction was assessed using the Chinese version of YDQ (Li et al., 2012). The YDQ consists of 8 items, with a "Yes" or "No" response (one point for "Yes" and zero point for "No") for each. Students who scored five or above in YDQ were classified as addicted internet users (Young, 1998). The Chinese version of IPAQ-SF, consisting of 7 items, was used to evaluate the students' weekly physical activity (Qu & Li, 2004). The students were categorized into three groups: low physical activity level, moderate physical activity level, and high physical activity level. In order to evaluate the students' outdoor activities, we designed an additional question ("How many hours per day did you spend outdoors over the past month?"). In addition, two items from Pittsburgh Sleep Quality Index (Guo et al., 2016) were extracted to assess the students' subjective sleep quality and sleep duration. The demographic information, including gender, age, household registration, and only-child status, was also collected using the questionnaire.

2.3. Data analysis

The numbers and constituent ratios were used in the descriptive analysis. The χ^2 test and logistic regression analysis were used to determine the correlation between the prevalence of internet addiction and its associated factors. A significant level of $p=0.05$ was selected.

3. Results

3.1. Characteristics and prevalence of internet addiction of the participants

As shown in Table 1, the prevalence of internet addiction among the 6,553 secondary school students was 14.4% (946/6,553). There were significant differences in the prevalence of internet addiction among students of different age groups, household registration, physical activity level, time spent outdoors, subjective sleep quality, and sleep duration (all $p<0.05$).

Table 1
Comparison of the prevalence of internet addiction among students of different characteristics

Characteristics		Students n (%)	Internet addiction n (%)	Prevalence (%)	χ^2	P
Gender	Boy	3293 (50.3)	454 (48.0)	13.8	2.26	0.133
	Girl	3260 (49.7)	492 (52.0)	15.1		
Age (years)	<15	3038 (46.4)	383 (40.5)	12.6	15.34	<0.001
	≥15	3515 (53.6)	563 (59.5)	16.0		
Household registration	Rural	1742 (26.6)	289 (30.5)	16.6	8.91	0.003
	Urban	4811 (73.4)	657 (69.5)	13.7		
Only-child status	Yes	1710 (26.1)	248 (26.2)	14.5	0.01	0.927
	No	4843 (73.9)	698 (73.8)	14.4		
Physical activity level	Low	5261 (80.3)	801 (84.7)	15.2	15.65	<0.001
	Moderate	692 (10.6)	87 (9.2)	12.6		
	High	600 (9.2)	58 (6.1)	9.6		
Time spent outdoors over the past month (hours per day)	<1	3238 (49.4)	552 (58.4)	17.0	37.55	<0.001
	1-2	2049 (31.3)	229 (24.2)	11.2		
	2-3	537 (8.2)	69 (7.3)	12.8		
	>3	729 (11.1)	96 (10.1)	13.2		
Subjective sleep quality	Very good	1503 (22.9)	183 (19.3)	12.2	96.75	<0.001
	Good	2351 (35.9)	264 (27.9)	11.2		
	Fair	2015 (30.7)	327 (34.6)	16.2		
	Poor	505 (7.7)	121 (12.8)	24.0		
	Very poor	179 (2.7)	51 (5.4)	28.5		
Sleep duration	Short (<6 h)	625 (9.5)	135 (14.3)	21.6	38.19	<0.001
	Normal (6-9 h)	5227 (79.8)	742 (78.4)	14.2		
	Long (>9 h)	701 (10.7)	69 (7.3)	9.8		
Total		6553 (100.0)	946 (100.0)	14.4		

3.2. Factors associated with internet addiction risk

The factors related to internet addiction were assessed through multivariate logistic regression analysis. As shown in Table 2, students of older ages (*OR*=1.17, 95% *CI*: 1.00-1.36) and with poorer sleep quality ("fair" vs. "very good", *OR*=1.27, 95% *CI*: 1.04-1.54; "poor" vs. "very good", *OR*=2.09, 95% *CI*: 1.61-2.72; "very poor" vs. "very good", *OR*=2.56, 95% *CI*: 1.78-3.70) were at higher risk of internet addiction. In contrast, those with urban residence (*OR*=0.80, 95% *CI*: 0.68-0.93), 1-2 hours of outdoor activities (*OR*=0.69, 95% *CI*: 0.58-0.81), high physical activity level (*OR*=0.68, 95% *CI*: 0.51-0.91), and longer sleep duration ("normal" vs. "short", *OR*=0.74, 95% *CI*: 0.60-0.92; "long" vs. "short", *OR*=0.60, 95% *CI*: 0.43-0.84) reported a lower risk of internet addiction.

Table 2
Logistic regression analysis of factors related to internet addiction among students (n=6553)

Variables		β	SE	Wald χ^2	P	OR	95% CI
Age (years)	<15	-	-	-	-	-	-
	≥15	0.16	0.08	3.98	0.046	1.17	1.00-1.36
Household registration	Rural	-	-	-	-	-	-
	Urban	-0.23	0.08	8.49	0.004	0.80	0.68-0.93
Physical activity level	Low	-	-	-	-	-	-

	Moderate	-0.12	0.13	0.97	0.325	0.88	0.69-1.13
	High	-0.38	0.15	6.73	0.009	0.68	0.51-0.91
Time spent outdoors over the past month (hours per day)	<1	-	-	-	-	-	-
	1-2	-0.38	0.09	18.86	<0.001	0.687	0.58-0.81
	2-3	-0.21	0.14	2.17	0.14	0.813	0.62-1.07
	>3	-0.16	0.12	1.65	0.199	0.853	0.67-1.09
Subjective sleep quality	Very good	-	-	-	-	-	-
	Good	-0.12	0.10	1.39	0.238	0.89	0.72-1.08
	Fair	0.24	0.10	5.42	0.020	1.27	1.04-1.54
	Poor	0.74	0.13	30.82	<0.001	2.09	1.61-2.72
	Very poor	0.94	0.19	25.21	<0.001	2.56	1.78-3.70
Sleep duration	Short (<6 h)	-	-	-	-	-	-
	Normal (6-9 h)	-0.30	0.11	7.48	0.006	0.74	0.60-0.92
	Long (>9 h)	-0.52	0.17	8.85	0.003	0.60	0.43-0.84

4. Discussion

The present study shows that the prevalence of internet addiction among adolescents in Nanchang, China was 14.4% during the COVID-19 pandemic. It is lower than the prevalence among Chinese adolescents reported during the COVID-19 pandemic (Dong et al., 2020; Z. L. Li et al., 2021) but close to the prevalence among adolescents in China before the COVID-19 outbreak, ranging from 15.3% to 26.5% (Chi, Hong & Chen, 2020; Xin et al., 2017; Xu et al., 2020). The difference may be due to the active behavior management and psychosocial intervention conducted in China during the COVID-19 pandemic, which may restrict the adolescents' time spent on internet use, alleviate their psychosocial problems, and further decrease the prevalence of internet addiction among them. It may also be explained by differences in assessment tools (e.g., YDQ vs. IAT), study design (e.g., cross-sectional vs. longitudinal), and population characteristics (Pan et al., 2020). Nevertheless, considering the limited literature on adolescents' risk of internet addiction in this unprecedented period, further research is warranted to confirm the prevalence scale.

Age was found to be one of the demographic correlates of the prevalence of internet addiction in this study. We found that the incidence of internet addiction was higher in students of older age, which is consistent with other findings that internet addiction grows with age (Dong et al., 2020; Lin, 2020). Nowadays, the internet use among children and adolescents in China has become common. The popularity of internet use among adolescents may increase their later internet addiction. Therefore, preventing addictive or problematic internet use should start at a younger age.

Household registration is another demographic characteristic related to internet addiction in the present study. Interestingly, the results showed a lower risk of internet addiction in students with urban household registration compared to those with rural household registration. It contrasts with most studies (Chen et al., 2016; Pawłowska et al., 2015; Stavropoulos, Alexandraki & Motti-Stefanidi, 2013) but is consistent with findings from a nationally representative sample study conducted in China in 2014 (Li et al., 2014). The possible reason is that online learning during the COVID-19 pandemic increases exposure to electronic devices and internet use among students with rural residence. Also, rural parents may find it difficult to supervise their children's internet

use since they lack the knowledge (Li et al., 2014). Therefore, students with rural residence spent more time on internet use during the survey and reported a higher risk for internet addiction.

This study found that high physical activity level and 1-2 hours of outdoor activities per day were protective factors for internet addiction. It is consistent with other studies suggesting a negative association between physical activity and the risk of internet addiction (Alaca, 2020; Han et al., 2021; Khan, Shabbir & Rajput, 2017; Ye et al., 2021). Indeed, most adolescents with high physical activity level spend most of their leisure time on physical activities instead of using the internet or electronic devices, thus decreasing their risk of developing addictive or problematic internet use.

Our study also supports the findings that sleep quality was significantly associated with the risk of internet addiction among school-aged adolescents. Students with poorer subjective sleep quality reported a higher risk of internet addiction, while those with longer sleep duration were at a lower risk of internet addiction. A meta-analysis supports this relationship between sleep quality and internet addiction, suggesting a significant risk of sleep problems and a decreased sleep duration among those with internet addiction (Alimoradi et al., 2019). In addition, sleep disturbances were associated with mood disorders, such as depression and anxiety (Chellappa & Aeschbach, 2022; Fang et al., 2019), which are also related to internet addiction (Cerniglia et al., 2017). These findings underscore the importance of cognitive-behavioral intervention for preventing both pathological internet use and sleep problems among adolescents.

This study had several limitations. First, the cross-sectional design of the present study limits the causal inference. Second, this study was only conducted in one city in China. Although Nanchang is a representative region in central China, further research on a larger sample is needed. Third, the present study did not include factors such as negative emotions, family function, or social support. Thus, the association between psychosocial factors and internet addiction was not examined. Future studies should collect this information to explore the risk factors of internet addiction among adolescents in the COVID-19 pandemic era.

5. Conclusion

In summary, our study indicates that adolescents in China are still at risk of developing internet addiction during the regular epidemic prevention and control stage of the COVID-19 pandemic. Age, household registration, physical activity level, time spent outdoors, subjective sleep quality, and sleep duration were the key factors affecting internet addiction among adolescents in China. The results of this study can help governments develop evidence-based policies to prevent internet addiction in the COVID-19 pandemic era.

Authors' Contribution:

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Data Analysis: Yufei Xie, Hanze Sun
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