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Negative life events and Internet addiction among Mainland Chinese teenagers and young adults: A meta-analysis

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Many researchers believe Internet addiction is related to negative life events, but some scholars do not agree with this view. Therefore, we conducted a meta-analysis of 85 articles published in Chinese and English databases between 2003 and 2020, to explore the relationship between negative life events and Internet addiction among 86,833 Mainland Chinese teenagers and young adults. Results show that negative life events had a significant positive correlation with Internet addiction and that the correlation was moderated by regional location, gender, and social development. Compared with the results based on a sample of a single group, our findings are reliable and lay the foundation for further research on negative life events and Internet addiction.

Keywords

Internet addiction;
pathological Internet use;
addictive behavior;
negative life events;
teenagers; young adults;
adolescents

In the 45th China Statistical Report on Internet Development (China Internet Network Information Center, 2020), it was reported that, as of March 2020, the number of Chinese Internet users had reached 904 million. Chinese netizens spend an average of 30.8 hours per week on online activities, including instant messaging, social networking, watching videos, listening to audio files, playing games, shopping, and reading news (China Internet Network Information Center, 2020). Although, in some ways, the Internet greatly facilitates people's daily life tasks, excessive use of the Internet can result in addiction. Internet addiction not only decreases users' academic achievement, peer relationship quality, emotional intelligence, and self-esteem but also increases depressive symptoms and may even lead to suicidal behaviors (Kim et al., 2019; Peng et al., 2019; Y. Zhang et al., 2018). Teenagers and young adults represent the highest proportion of Chinese Internet users among all age groups (China Internet Network Information Center, 2020); therefore, it is necessary to study Internet addiction in this population.

Literature Review

Internet Addiction

Goldberg, an American scholar who studied addictive behavior, first proposed the concept of Internet addiction. He considered *Internet addiction* (IA) as a behavioral addiction involving the use of a coping mechanism, similar to drug addiction (Goldberg, 1995). In 2013 the American Psychiatric Association included IA in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V), defining it as a new mental disorder that results from Internet overuse, in which individuals primarily present with a strong desire for reuse of the Internet, withdrawal symptoms when stopping or reducing Internet use, and mental and physical symptoms. For example, in the DSM-V (American Psychiatric Association, 2013, pp. 796–797) Internet gaming disorder is described as a pattern of excessive and

prolonged Internet gaming that results in a cluster of cognitive and behavioral symptoms, including progressive loss of control over gaming, tolerance, and withdrawal symptoms, analogous to the symptoms of substance use disorders. As with substance-related disorders, individuals with Internet gaming disorder continue to sit at a computer and engage in gaming activities despite neglect of other activities. They typically devote from 8 to 10 hours or more per day to this activity and at least 30 hours per week. If they are prevented from using a computer and returning to the game, they become agitated and angry. They often go for long periods without food or sleep. Normal obligations, such as school or work, or family obligations are neglected.

Generalized and Specific Pathological Internet Use

Young (1998a, 1998b) proposed the similar concept of *pathological Internet use*, describing it as an impulse-control disorder similar to a gambling addiction that can produce negative behaviors (e.g., behavior leading to job loss, failure in school, impulsive behavior, or criminal behavior). To explain the causes of pathological Internet use, Young (1997) developed the anonymity, convenience, and escape model: *Anonymity* refers to the fact that people can hide their real identity online, so that individual behavior is no longer bound by the norms present in real life; *convenience* refers to the feature of the Internet that allows users to do what they want to do without leaving home, such as playing games, shopping, and dating using online forums; and *escape* refers to the use individuals can make of the Internet to avoid the pressure and complexity of reality.

Davis (2001) further classified pathological Internet use into generalized and specific types, defining *generalized pathological Internet use* as a multidimensional concept associated with the use of Internet for social purposes, whereas *specific pathological Internet use* refers to the dependence of Internet users on a particular function of the Internet, such as online shopping, stock trading, or gambling. In addition, Davis proposed a cognitive-behavioral model of pathological Internet use, comprising a dynamic process consisting of etiology, development, maintenance, and outcomes. Maladaptive cognition is located at the proximal end of the etiology chain, which means it occurs before emotional or behavioral symptoms. Individuals experiencing pathological Internet use can have major cognitive impairments that include a ruminative cognitive style, feelings of self-consciousness, low self-worth, a depressogenic cognitive style, low self-esteem, and social anxiety (Davis, 2001), and which aggravate the symptoms of individual IA. Adverse tendencies, such as depression and substance dependence, and negative life events are located at the distal end of the etiology chain and are a necessary condition for the formation of pathological Internet use.

Internet Addiction and Negative Life Events

Researchers have explored various causes of IA in adolescents and young adults, including the level of social support, parenting style, the adolescent's coping style, and subjective well-being (Lei, Cheong et al., 2018; Lei et al., 2020; Lei, Li et al., 2018; S. Li et al., 2018). Among these causes, negative life events (NLEs) have been found to be an important factor (Sung et al., 2020). In 1967 Holmes and Rahe compiled the Social Readjustment Rating Scale, which opened up the way for quantitative research on life events. Since the 1980s, Chinese scholars have referred to domestic and international literature bases to compile a variety of life event scales based on Chinese characteristics, such as the Life Event Scale (M. Zhang et al., 1987), the Stressful Life Events Rating Scale (Zheng & Yang, 1990), and the Adolescent Self-Rating Life Events Checklist (Liu et al., 1997a, 1997b), the last of which has been the most widely used. The Adolescent Self-Rating Life Events Checklist consists of 27 NLEs that may cause psychological stress in adolescents, including interpersonal relationships, stress and pressure associated with schoolwork and examinations, being punished, loss of close relatives and property, and health and adaptation issues, such as changes in living habits, serious illness, or living away from family.

In general, NLEs have been found to be significantly and positively correlated with IA (Sung et al., 2020; Wei et al., 2014; Xu et al., 2019); however, the opposite conclusion has been reported by some researchers, who found a significant negative correlation between NLEs and IA (Mei et al., 2008). As such, the

relationship between these two variables remains unclear in the extant research. Therefore, we conducted a meta-analysis of studies conducted with samples comprising Mainland Chinese teenagers and young adults, to explore the relationship between NLEs and IA.

Moderators of the Relationship Between Internet Addiction and Negative Life Events

The inconsistencies in previous research findings may be attributed to the small sample sizes used or to confounding variables that may have affected the relationship between NLEs and IA (Lei, Li et al., 2018; S. Li et al., 2018; Shek et al., 2018). Therefore, we anticipated that measurement tools, the region the participants lived in, their education level, gender, and social development would each moderate the relationship between NLEs and IA.

The measurement tool used can affect the reliability of a meta-analysis. When exploring the relationship between NLEs and IA, many researchers utilized the Adolescent Self-Rating Life Events Checklist (Liu et al., 1997a, 1997b) as the measurement tool for NLEs; however, the scales used to measure IA vary widely. Some researchers used the Young Diagnostic Questionnaire (Young, 1998b), which comprises eight items developed with reference to the diagnostic criteria for pathological gambling specified in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 1995). Young (1998a) also compiled a revised version of the Internet Addiction Test comprising 20 items rated on a 5-point Likert scale, and this version has been utilized by some researchers. Others used the Revised Chen Internet Addiction Scale (Chen et al., 2003), which comprises 26 items classified into two dimensions: core symptoms of IA (three factors: compulsive Internet use, IA withdrawal response, and IA tolerance) and related problems of IA (two factors: interpersonal and health problems, and time management problems). Items are rated on a 4-point Likert scale, with scores reflecting the tendency toward IA (Chen et al., 2003). Others created their own IA assessment scales with each of these having different theoretical bases, dimensional construction, and number of items, which may have affected, to some extent, the relationship between NLEs and IA.

Regional differences among respondents may cause the relationship between NLEs and IA to differ significantly. Mainland China can be delineated into coastal and noncoastal areas, with the coastal areas featuring more developed economies and a higher average socioeconomic status of the residents, factors that have been found to be associated with a weaker relationship between NLEs and IA among students (Lin, 2007). In contrast, a moderately positive correlation has been reported between IA and NLEs among students from noncoastal areas (M. Li, 2019; Xu et al., 2019).

The level that students are at in their education can also influence the relationship between NLEs and IA. Lin (2007) reported a weak positive correlation between NLEs and IA among university students, whereas M. Li (2019) and Xu et al. (2019) found moderately positive correlations between NLEs and IA among middle-school students.

Gender may also cause a significant difference in the relationship between NLEs and IA. It has been reported in past studies that NLEs have a moderately positive correlation with IA among boys and men (Wei et al., 2014), whereas a weakly positive correlation has been found among girls and women (Huang, 2009).

Finally, social development can also affect the relationship between NLEs and IA. Some researchers have found that the positive correlation coefficient between NLEs and IA increases in strength as social development advances (Huang, 2009; Mei et al., 2008; Wei et al., 2014). Others found that the positive correlation coefficient between NLEs and IA decreased with greater development of society (Wei et al., 2014; Xu et al., 2019).

Therefore, we conducted a meta-analysis of studies on the relationship between NLEs and IA conducted with students in Mainland China to answer the following questions:

Research Question 1: What are the direction and the degree of the relationship between negative life events and Internet addiction?

Research Question 2: Do the measure used by researchers, and the regional location, education level, gender, and social development of participants affect the relationship between negative life events and Internet addiction?

Method

Literature Search

We searched China National Knowledge Infrastructure, VIP Information, Wanfang Data, China Doctoral Dissertations/Masters' Theses Full-Text Databases, Baidu Scholar, ProQuest Dissertations and Theses, Web of Science, Google Scholar, Springer Link, Taylor & Francis SSH, EBSCOhost, PsycINFO, and Elsevier SDOL databases to locate studies published between January 2003 and February 2020 on NLEs and IA that had been conducted with participants living in Mainland China. The Chinese and English keywords we used to search for studies on NLEs were negative life events, Adolescent Self-Rating Life Events Checklist, and stressor, and those used to search for studies on IA were Internet addiction, Internet abuse, Internet dependence, pathological Internet use, problematic Internet use, excessive Internet use, and maladaptive Internet use. We retrieved 465 articles from this search after preliminary screening.

The studies were further screened according to the following criteria: (a) both an NLEs scale and an IA scale were used, and the statistical reports included either Pearson product-moment correlation coefficients (r) or t test and analysis of variance (F) values that could be converted to r ; (b) sample size was reported; (c) the participants were individuals living in Mainland China who did not have any medical condition or a criminal background; and (d) for multiple publications of the same data, only data published in professional academic journals were included. After excluding articles that did not meet these requirements, we identified 85 articles to include in our meta-analysis.

Variable Coding

We used feature coding to process the following aspects of the included studies: author names, publication date, regional location (coastal or noncoastal area), education level (university, high school or below), sample size, correlation coefficient between NLEs and IA, type of measurement tools used to assess NLEs and IA, and percentage of females in the sample. Effect size was extracted according to the following criteria: (a) the correlation coefficient between NLEs and IA was coded; (b) the independent samples were coded once, and if a reference indicated n independent samples, these were coded separately; and (c) when the effect size in a category was calculated, each original dataset was allowed to appear only once in the category to ensure the independence of effect size calculation.

Effect Size Calculation

We also conducted a meta-analysis of the Pearson product-moment correlation coefficient to calculate the sample size (Borenstein et al., 2005). Next, Fisher's z transformation was applied to r , weighted based on the sample size with 95% confidence interval (CI).

Results

Relationship Between Negative Life Events and Internet Addiction

In the 85 studies on the relationship between NLEs and IA that we included in this meta-analysis, there were 86,833 participants and sample sizes ranged from 54 to 10,158. First, we calculated weighted effect sizes (r), sample sizes (k), 95% CIs, and homogeneity statistics using a fixed effects model. As predicted, the results show there was a significant positive correlation between NLEs and IA, $r = .29$, $z = 18.41$, $p < .001$, k

= 85, 95% CI [.264, .323]. These effect sizes were determined to be suitable for moderation analysis.

Moderation Analysis

To examine whether the effect of NLEs on IA was moderated by the factors of measurement tools, regional location, education level, social development, and gender, we used homogeneity tests to examine the average effect size of the relationship between NLEs and IA. Results show there was a significant homogeneity coefficient between NLEs and IA ($Q = 1801.18, p < .001, I^2 = 95.34$). This indicates that each of these factors moderated the effect of NLEs on teenagers' and young adults' IA.

Measurement Tools

Results of the homogeneity test of the measurement tools used to assess IA ($Q = 5.90, df = 2, p > .05$) indicate that the relationship between NLEs and IA was not affected by the measure used in each study.

Regional Location

Results of a homogeneity test ($Q = 10.01, df = 2, p < .01$) of the regional location variable indicate that region moderated the relationship between NLEs and IA. The correlation coefficient between NLEs and IA for coastal areas was .29, 95% CI [.232, .337], and that for noncoastal areas was .31, 95% CI [.269, .347].

Education Level

A homogeneity test of the participants' education level ($Q = 1.18, df = 2, p > .05$) indicates that the relationship between NLEs and IA was not moderated by this variable.

Social Development

Meta-regression analysis results, Q Model [1, $k = 85$] = 88.24, $p < .001$, suggest that social development moderated the relationship between NLEs and IA, such that the strength of the positive correlation between NLEs and IA increased as the development of society advanced.

Gender

Meta-regression results, Q Model [1, $k = 85$] = 67.21, $p < .001$, demonstrate that the relationship between NLEs and IA was moderated by gender, such that the strength of the positive correlation between NLEs and IA decreased as the proportion of females in the sample increased.

Publication Bias

To examine whether the results were biased because of effect sizes being obtained from various sources, we drew a funnel plot. Results indicate that the 85 effect sizes were symmetrically distributed above and below the average, and an Egger's regression test revealed no significant bias, $t(83) = 1.10, p > .05$. This result shows that the overall correlation observed between NLEs and IA was stable in this study.

Discussion

Our meta-analysis results indicate that there was a moderate positive correlation between NLEs and IA across 85 studies conducted with teenagers and young adults in Mainland China. These findings support the cognitive-behavioral model of pathological Internet use (Davis, 2001), according to which NLEs exacerbate individuals' maladaptive cognition (e.g., poor self-esteem and low emotional intelligence; Peng et al., 2019), have a negative effect on psychological health (Maciejewski et al., 2020), and aggravate symptoms of IA, resulting in more behavioral and emotional problems (Song et al., 2020). Furthermore, according to the model proposed by Young (1997), the anonymity, convenience, and escape characteristics of the Internet make it extremely easy for people to become addicted. Therefore, students experiencing NLEs seek to hide themselves in virtual networks to escape their reality.

We also found that region was an important factor moderating the relationship between NLEs and IA. The correlation coefficient between NLEs and IA was lower among teenagers in coastal areas compared to noncoastal areas. This indicates that socioeconomic level may affect the correlation between NLEs and IA. According to the family investment model, teenagers from families with a higher (vs. lower) socioeconomic status possess more development capital, such as financial and social resources, which leads to their positive development and weakens the relationship between NLEs and IA. The investments in the model involve several dimensions of family support, including the learning materials available in the home, the parent stimulation of their children's learning both directly and through support of advanced or specialized tutoring or training, the family's standard of living as regards adequate food, housing, clothing, and medical care, and residing in a location that fosters the child's competent development. For example, wealthier families are expected to reside in an area with access to good schools, and where there is involvement in a neighborhood or community environment that provides resources for the developing child, such as parks and child-related activities. Thus, according to the model, parental material investments and child-rearing activities are expected to foster the academic and social success of a child (Conger & Donnellan, 2007). Moreover, according to the family stress model (Masarik & Conger, 2017), high economic pressure can increase parents' psychological burden, which leads to negative parenting behaviors. This, in turn, results in adolescent underdevelopment and strengthens the connection between NLEs and IA. Such negative parenting behaviors may develop when economic stress depletes the psychological and relational resources of adults with children. The parents may then resort to inconsistent or harsh disciplinary practices, may monitor their children less frequently, or may withdraw their support and affection. Findings of several recent studies provide support for the hypothesis that these kinds of parenting practices are prospectively linked to externalizing problems in early childhood as well as adolescence; for example, adolescent problems associated with drinking alcohol, an increase in conduct disorders during childhood and adolescence, problems with emergent literacy and numeracy abilities of preschoolers, internalizing symptoms in early childhood, middle childhood as well as in adolescence, and even poor physical health (Masarik & Conger, 2017).

Gender was also found to moderate the relationship between NLEs and IA. The correlation coefficient between NLEs and IA showed a downward trend as the proportion of girls or women in the sample increased, which indicates that the relationship between these variables was weaker for females than for males. According to the Internet availability hypothesis (Mann, 2005), availability is the most important determinant of addictive behavior (Su et al., 2019). Women have far lower Internet penetration rates than men do (International Telecommunication Union, 2016), and, therefore, also have lower rates of IA. Further, according to the social norms hypothesis, addiction represents a cultural and biological phenomenon (Becker et al., 2016). Social culture and customs restrict women's Internet use (Becker et al., 2016; Hafkin & Huyer, 2007); consequently, IA rates are lower among women than among men. Finally, compared with adolescent boys, adolescent girls are more likely to adopt healthy coping strategies, such as asking for help or seeking cooperation, when they encounter NLEs (Feng & Peng, 2017), which reduces the strength of the correlation between NLEs and IA.

Finally, our findings show that social development moderated the relationship between NLEs and IA. The correlation coefficient between NLEs and IA showed an upward trend as social development increased, which may be attributable to three factors. First, greater social development increases the accessibility of the Internet, and IA rates increase in accordance with this accessibility (H. Li & Wang, 2008). Second, more advanced social development means that Internet technology becomes more advanced, is used more widely, and is more attractive, all of which increase the likelihood of IA occurring. Third, most teenagers in China are the only children in their families. Compared with children who have siblings, only children are more inclined to adopt negative coping methods (Mao, 2019), which increases the strength of the relationship between NLEs and IA.

Limitations and Directions for Future Research

This research has some limitations. First, our data were based on participants' self-reports, and we recommend that future researchers combine multiple data collection methods and strategies to increase understanding of the relationship between NLEs and IA. Second, our participants were all teenagers and young adults. To increase the generalizability of our results, future samples could be collected from a broader population that spans other societal sectors, such as office workers and farmers. Third, we confined our moderation analysis to the variables of measurement tools, regional location, education level, gender, and social development. In future studies, other latent moderating variables could be examined, such as whether the teenagers are in a single-parent family and/or whether they live in at school. Last, the Mainland Chinese researchers included in our meta-analysis primarily performed cross-sectional studies, with few conducting longitudinal research. Therefore, we recommend that longitudinal research studies be included in future meta-analyses.

Conclusion

We conducted a meta-analysis of data collected from 86,833 Mainland Chinese teenagers and young adults previously investigated in 85 articles. The results show that there was a significantly positive overall correlation between NLEs and IA, and that this correlation was affected by participants' regional location, gender, and social development. Specifically, the positive correlation between NLEs and IA was lower in coastal compared to noncoastal areas, and among women compared with men. In addition, greater development of society was associated with an increase in the positive correlation between NLEs and IA.

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Supplementary information including references for studies used in the meta-analysis can be requested by writing to the authors.

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