

CHAPTER TWENTY FOUR

The Improvement Effect of Exercise on College Students' Internet Addiction

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ABSTRACT

In response to the rising trend of internet addiction among college students, we collected research on the influence of exercise on college students' internet addiction published in the past decade, to establish a basis for future research and practical interventions for internet addiction. Our review examines the following aspects: (1) the basic concepts of internet addiction, (2) the direct and indirect effects of exercise on internet addiction, (3) the causal effect of exercise as an intervention project for internet addiction, and (4) the corresponding physiological and psychological mechanisms behind these proposed causal relationships. This review also summarizes the shortcomings of the existing research; how future research should be improved in terms of diagnostic tools, intervention projects and effect evaluation; and further provides intervention suggestions for college students with internet addiction according to the types and methods of exercise.

Keywords: Physical Exercise, Internet Addiction, College Student, Mental Health.

INTRODUCTION

According to the 47th Statistical Report on Internet Development in China published by the China Internet Network Information Center (CNNIC, 2021), the number of China's internet users had reached 989 million by December 2020. These account for one-fifth of global internet users and corresponds to a globally above average internet penetration rate of 70.4%. College students are one of the most important groups of internet users. A meta-analysis found that the incidence of internet addiction (IA) among college students was 11.76% in China, which is considered high (Chen et al., 2020). This issue has therefore become a pressing concern for society as a whole.

Moreover, the influence of the global COVID-19 epidemic has only exacerbated the situation. College students are taking online courses, so their overall internet usage time has increased by necessity. For those with internet addiction excessive use adversely affects their physical and mental health, so interventions may be necessary to reduce IA in this population. Exercise as one of the interventions which is more economical, it can reduce the level of internet addiction and the time spent on the Internet (Koçak, 2019). Therefore, it is necessary to explore the improvement effect of exercise on college students' internet addiction.

Internet Addiction

Definition

The concept of internet addiction was first proposed as a new mental disorder by the psychiatrist Ivan Goldberg (Goldberg, 1995). He argued that internet addiction is an obvious social and psychological dysfunction caused by long term overuse. As the internet continued to develop in the following years, Young (1998) analyzed the character and severity of the problem through a questionnaire survey. He found IA to be similar to gambling addiction as an impulse-control disorder without the use of addictive substances. Armstrong (2001) believed that IA includes multiple behaviours and impulse-control problems, and divided it into five types: cybersexual addiction (which mean addiction to adult chat rooms or cyberporn), cyber-relationship addiction (which mean online friends made in chat rooms or cyberporn), net compulsion (which mean compulsive gambling, daily trading, or auction shopping), information overload (which mean compulsive Web or database surfing), and computer addiction (which mean compulsive game playing or programming).

The World Health Organization (WHO) defines internet addiction as a chronic or periodic state of addiction caused by excessive use of the internet and an irresistible desire to use it again. The pleasure brought by the internet can lead to long-term psychological or physical dependence. The addiction mostly manifests in the use of pornography, communication, games, information collection and compulsive internet behaviours (Yang & Zeng, 2017).

It is mentioned in an article that (Wang, 2001) Taiwanese scholar Zhou Qian defined internet addiction in alignment with the WHO, as a chronic or periodic state of obsession caused by repeated use of the internet. In Qian's definition, it also produces tension and

tolerance to increasing use time, and can lead to psychological and physiological dependence and causing withdrawal symptoms when not using. Because Zhou Qian's definition of IA is more in line with the characteristics of Chinese internet users, it has been more recognized and used in China.

Internet addiction is often associated with impulsivity, depression, anxiety, and obsessive-compulsive disorder (Alimoradi et al., 2019). Subtypes of IA include pathological internet use (Davis, 2001), problematic internet use (Davis et al., 2002), internet addiction disorder (Siomos & Angelopoulos, 2008) and online game addiction (Freeman, 2008).

At present, smartphones (i.e., mobile phones) are the most widespread internet user terminal, and the number of Chinese mobile phone netizens is growing rapidly. Liu et al. (2017) argued that mobile phone addiction (MPA) and internet addiction, although distinct, are very closely linked. Both are defined as behavioural addictions, and there is a partial overlap in their behaviours. At the same time, the terms of the two related measurement tools are also similar. Therefore, MPA is generally included in the category of IA for this discussion.

Diagnostic Criteria

The diagnostic criteria for internet addiction were a hot topic among scholars at the 1996 and 1997 annual meetings of the American Psychology Association (APA) (Chen et al., 2003). Seven types of IA symptoms were standardized, such as tolerance and withdrawal symptoms. According to these new criteria, if an internet user has more than three of the listed symptoms for any 12 months period, it is considered internet addiction.

The Internet Addiction Diagnostic Questionnaire (IADQ) compiled by Young (1998) is one of the earliest diagnostic tools for IA. Using a two-point scoring scale, participants who answer "yes" to five or more of the criteria are classified as dependent internet users (dependents; i.e., addicted), and the remainder are classified as nondependent internet users (nondependents; i.e., not addicted). Young posited several typical characteristics of IA: significant symptoms; enhanced tolerance; mood changes; withdrawal symptoms; intense psychological conflicts; and recurrent episodes. The two-point scoring questionnaire was subsequently expanded into the more widely used five-point scale by Young (2004).

In a study of internet addiction in college students, Morahan-Martin and Schumacher (2000) defined IA in terms of symptoms—that is, mood-altering use of the internet, failure to fulfil major role obligations, guilt, and craving. They compiled a 13-question pathological internet use questionnaire, to which answers of “yes” to four or more questions indicates pathological internet use (i.e., addiction). The revised version of the Chinese Internet Addiction Scale (CIAS-R) developed by Chen (2003) in China similarly uses psychological symptoms for diagnostic criteria. Another similar scale is the Davis Online Cognition Scale (DOCS; Davis et al., 2002), which contains 36 items rated on a 7-point scale comprising four factors: social comfort, loneliness/depression, diminished impulse control and distraction. If total DOCS score exceeds 100, or the score on any one of the four dimensions reaches or exceeds 24, they are diagnosed with internet addiction.

Internet Addiction among Chinese College Students

With the rapid technological and economic seen in China in modern times, the internet has become an indispensable part of college students' studies and lives in China as it has around the world. A study has shown that the largest proportion of internet users are between age 20 and 29 (Fu & Liu, 2016). Various games and digital media on the internet also attract college students, which presents additional risk of addiction. According to the 47th Statistical Report on Internet Development in China (CNNIC, 2021), college students represent the majority of China's netizens and have a higher incidence of IA than in past reports, showing a significant upward trend (Liu et al., 2021). Two recent meta-analyses on the incidence of IA among college students found that it was higher than 10% (Chen et al., 2020; Liu et al., 2021); among them, the incidence from 2010 to 2018 was higher than that from 2005 to 2010. This trend should arouse the attention of the country to the need to change the current situation.

The negative impact on learning is the most direct effect internet addiction has on college students. It can severely damage cognitive functions, seriously threatening their academic performance. It can also deprive them of rest and sleep, which is also a serious detriment to their physical and mental health development and can lead to interpersonal disorders and poor psychological health. Zhang et al. (2017) found that internet-addicted students had significantly lower levels of social satisfaction and ability to reduce impulses, and significantly higher levels of loneliness/depression, avoidance, and withdrawal than non-internet-addicted college students. They also found the symptom of nonadaptive cognition is extremely prominent among internet-addicted students.

According to a CiteSpace analysis by Li et al. (2020), in the keyword frequency table

of internet addiction, the keywords “college students” occurred 234 times with centrality of 0.13, while “adolescents” occurred 233 times with centrality of 0.29. Higher centrality indicates a higher status of the keyword and more importance researchers attach to research in this area. This reflects the fact that internet addiction among college students and adolescents is a hot topic for researchers because of how common IA is among adolescents and college students. College students represent the future of the country and the pillars of society, so the importance of this problem should not be underestimated.

The Improvement Effect of Exercise on Internet Addiction

Recently, a growing number of researchers have realized that exercise can be beneficial for addressing internet addiction. In a meta-analysis by Qiao et al. (2020), sports intervention ranked second in intervention effect for IA. In another meta-analysis by Liu et al. (2017), it was found that exercise interventions improved depression, anxiousness, aggressiveness, somatization, social insecurity, phobic anxiety, paranoid ideation, and psychoticism. In addition to improving interpersonal and health issues, time management skills, tolerance, and compulsive internet use, withdrawal symptoms were also improved after treatment, and the improvement in withdrawal symptoms is not achieved by other intervention methods (Liu et al., 2017).

Thus, this section will overview the impact of exercise on college students' IA from two realms: cross-sectional survey research and intervention research. In survey-type cross-sectional studies, most research participants are surveyed through questionnaires or interviews

to explore the relationship between exercise and IA. In intervention studies, researchers mainly carry out experimental interventions by carefully selecting suitable exercise methods to explore whether exercise can effectively alleviate internet addiction in college students.

Cross-sectional Survey Studies

Direct Effects of Exercise. From the perspective of time and the definition of internet addiction, spending more time on the internet is negatively correlated with exercise time. This phenomenon can be explained by various theories (Melkevik et al., 2010). One theory emphasizes that more screen time leads to less time engaged in sports activities. The negative correlation between IA and exercise is also reflected in the frequency and intensity of exercise (Zhang, 2011), motivation, attitude (Ma & Cheng, 2015), and interest (Zhu, 2017a). Although the time spent on the internet leaves less time for exercise, comparative studies of college students with and without IA, have found exercise to directly reduce dependence on the internet. For example, Ma and Cheng (2015) showed that college students' active participation in exercise activities reduces their dependence on the internet, and that exercise has a positive effect on the internet withdrawal. Similarly, Zhang (2011) also showed that exercise helped to inhibit college students' internet addiction.

Indirect Effects of Exercise. A third variable may mediate or moderate the effect of exercise on IA. As emphasized in a meta-analysis (Guo et al., 2019), studies need to further explore whether this is the case. Therefore, in this section we consider other variables to reassess the relationships between them and the effect of exercise on IA to better explain this

relationship.

According to Young's (1998) definition and symptoms, internet addiction is a kind of "impulsivity-control disorder," with tolerance, withdrawal symptoms, cravings, and other related manifestations. People with weak self-control are less able to resist automatic habitual actions, such as using mobile phones, and are more inclined to pursue immediate gratification, current desires, and novel experiences. They tend to have poor planning ability and low response inhibition, and to feel a loss of control when without their mobile phone. There are many similarities between these symptoms and those of IA; thus, it is easy to make assumptions that self-control is closely related to IA. Relevant research results also confirm that self-control is negatively correlated with IA (Hou et al., 2013; Zhang, 2020).

In the relationship between exercise and self-control, many studies have shown that exercise can improve individual self-control (e.g., Burke et al., 2012; Kamijo et al., 2007; Schöndube et al., 2017). Based on the correlation between the three variables, the researchers have tested a mediation model of exercise, self-control, and internet addiction. The results show that exercise can have an indirect effect on IA through its effect on self-control, and that self-control plays a mediating role in the effect of exercise on IA (Zhang, 2020; Zhong et al., 2020). In addition to self-control, researchers have also tested the mediating role of coping style (Zheng & Ma, 2020) and social support (Qiu, 2018) in the relationship between exercise and IA. The results show that active coping plays a complete mediating role in the relationship between physical exercise and mobile phone addiction (MPA), and that social support has a partial mediating effect on the relationship between exercise and IA. Exercise has both a direct

and indirect impact on IA, via social support (Qiu, 2018).

In addition to simple mediating variables, researchers have studied more complex mediating models as well. In a study of young Chinese adults, Ding et al. (2021) found that self-control in internet use (SCIU) directly mediates the relationship between physical exertion and subjective well-being (SWB), while MPA negatively mediates the interaction between physical exercise and SWB. Their results also showed the multiple SCIU-MPA serial frameworks between physical exercise and SWB to be statistically significant, indicating that the relationships between SCIU and MPA may be unique mediators in the relationship between physical exercise and SWB. This study not only proposes a relationship model of MPA, exercise, SWB, and SCIU but also improves the relationship between two variables of exercise and MPA. The authors also provide suggestions for interventions to improve internet users' self-control abilities and reduce MPA.

Future research should further investigate these mediating variables in the relationship between exercise and IA, and more intervention studies should be carried out. Specific exercise intervention projects should also be designed to reveal the causal effect by which exercise improves IA.

Intervention Studies

In recent years, many studies have found that exercise can be used as an effective intervention method to alleviate the symptoms of internet addiction among college students and has a positive therapeutic effect. In the meta-analysis by Guo et al. (2019), exercise had a

significant intervention effect on adolescent IA, and suggested that different types of exercise (collective and individual events, antagonistic and non-antagonistic events, etc.) and specific sports behaviours (exercise intensity, frequency, duration) need to be studied in more detail to explore the moderating effects of various intervention programmes.

Intervention Effects of Various Exercise Types. In a study by Dong (2020), 60 college students were intervened with one of six types of exercise: cycling, running, equipment, fitness, dance, and ball sports. After 15 weeks, fitness, dance, and ball sports had the most obvious mitigation effect on MPA. Similar research results were also obtained in a 16-week intervention experiment by Xu (2019), which found that exercise significantly reduces college students' MPA, and that the effect varies significantly by type of exercise. Ball sports had the most obvious effect on reducing MPA, followed by dance and cycling sports, but running and exercise with fitness equipment had a weaker effect. The researchers speculated this might be because ball games require teamwork and can result in friendships through cooperation, effectively promoting individual communication and cooperation skills and making college students more willing to spend time doing it.

Research has also found that students often enjoy dancing sports, which often involves exciting and cheerful rhythmic music and provide distractions for college students with MPA (Li & Wang, 2019; Xu, 2019; Zhu, 2017b). And because dancing is also a group activity, it can help students express themselves socially and build friendships. Therefore, aerobics (Li & Wang, 2019) and rhythmic dancing (Xu, 2019; Zhu, 2017) exercises have good potential for interventions to improve internet addiction behaviours.

Relatively speaking, running and exercise with fitness equipment static and boring, often lacking interaction with others, which may explain the lack of effectiveness in reducing the temptation of internet use. Moreover, college students often record their exercise through mobile phone apps, requiring use of the internet, which may counteract some of the improvement (Dong, 2020; Li & Wang, 2019).

In another study various sports interventions on college students' MPA, Liu (2019) found that both open motor skills (which mean they requires stimulation and conditioning of one's own movements with reference to the external environment, which changes as the environment changes.)and locked motor skills (which mean they rely primarily on internal, proprioceptive information to achieve regulation, without reference to external factors and with fixed patterns) can decrease MPA but open sports had a stronger effect. According to Liu, learning open skills not only occupies time that cannot be devoted to mobile phone use, but also exercises group cognition through open exercise activities. More group cognitive resources are needed to cope with unpredictable changes in the environment, resulting in group cognitive training, which can improve attention ability (Liu, 2019). Wang (2005) noted that exercise can shift attention and eliminate dependence on the internet. However, these findings are inconsistent with those of another meta-analysis that found people with MPA who participated in closed motor skill exercise experienced a significantly greater reduction in MPA than those with open motor exercise (Liu et al., 2019).

Researchers have studied the intervention effects of various exercise combinations. Zhu (2017b) conducted intervention experiments on college students with IA using a combination

of 24-style Tai Chi Chuan sets of exercise, track, and field (fast running), ball games, competitions, aerobics and yoga as the main practice content. The results showed that college students have a strong interest in the curriculum which contain multiple sports. The difficulty, artistry and cooperation of sports events are highly involved in cultivating physical and mental enjoyment of participants. Through exercise, the total score of college students' MPA tendency was effectively reduced because of the recreational function of exercise replaces the entertainment function of cell phone. Zhu explained the improvement effect of each sport on IA, among them, her explanation of Tai Chi Chuan, jogging and yoga is very original.

- Tai Chi Chuan is characterized by slow movements under the guidance of minds. It is different from other sports, involving increasingly complex cerebral cortex regions for physical and mental regulation and control.
- Jogging and yoga involve working the whole body. In the process of exercise, blood circulation is accelerated, which can reduce fatigue, inspire the spirit, improve self-achievement, provide positive cognitive and emotional experiences, and have better inhibitory effects on anxiety and depression.

Although which kind of exercise best improves internet addiction cannot be determined from the current research results, group ball sports have the better improvement effect on IA. The characteristics of ball sports, including strong cooperation, meeting more friends and high interest from students, means it may require a greater time investment than other types of sports. Despite myriad studies on the intervention effects of various exercise types on IA, but these researches only use one type of exercise in intervention, which means that they examined the

effect of one exercise type. Only two use more than two types of exercise in different intervention group in order to examine differences in the intervention effects of different exercise types on IA. (Liu, 2019; Zhu, 2017b). Moreover, intervention programs can include multiple types of exercise to take their unique contributions. In future studies, when selecting a type of exercise program, we should clearly explain the reasons for the selection and analyze its unique contribution to internet addiction intervention.

Intervention Effect of Exercise Duration. In the intervention study by Zhu (2017b), the metrics for MPA tendency, withdrawal symptoms, salience behaviour, mood change and social comfort were recorded at three points during the intervention program: in the initial stage, in the 4th week, and in the 8th week. The largest improvement occurred between the initial stage and the 4th week, with a smaller but still significant improvement between the 4th and 8th weeks.

Other studies have similarly tested and compared the symptoms and indicators of IA in two-way designs with experimental and control groups before and after the intervention, but without this mid-way measurement (Fu & Liu, 2016; Long, 2016; Zhang, 2012; Zhang, 2013). Over a long intervention period, only before and after comparisons were performed, missing any change process in IA symptoms between these, and making it impossible to determine the best intervention period. A meta-analysis by Liu et al. (2019) showed that MPA was significantly lower in those who participated in sports for 12 weeks or more, and the duration of exercise played a mediating role the relationship between exercise and addiction symptoms. Overall, long-term exercise is associated with less MPA and less withdrawal and mood-related

symptoms.

The Mechanism of the Effect of Physical Exercise on Internet Addiction

Physiological Mechanism

Intervention based on exercise has been proven to reduce internet addiction, and to a certain extent, it can predict it. The neurobiological mechanism behind IA has attracted increasing attention from researchers. Neurobiology and neuroimaging techniques have shown that IA can lead to changes in the neural structure of brain areas related to reward, decision-making, memory, and cognitive control, reducing the activity of the dopamine system and limiting the cognitive function of individuals (Li et al., 2020).

Exercise as a natural reward which can change mesolimbic and nigrostriatal dopamine circuits involved in motor activity and reward. (Greenwood, 2019). Simultaneously, animal experiments have shown that both acute and chronic exercise increases reward-related dopamine activity in the striatum (Greenwood et al., 2011; McMorris, 2016). These results show that exercise can control the reward impulse, which would help to explain why exercise reduces IA. Additionally, long-term exercise promotes the growth of the prefrontal cortex, improving learning, memory, and cognitive function (Chaddock et al., 2010; Li et al., 2020; Weinstein et al., 2012).

Similarly, exercise and good health are associated with larger individual hippocampal volumes, and this volume increase is most obvious in the anterior part of the hippocampus related to emotion and motivation (Thomas et al., 2016). The long-term effects of exercise on

IA may therefore be explained by increased prefrontal cortex and hippocampus volume. Moreover, exercise promotes functional connectivity between the frontal and executive networks associated with cognitive control (Voss et al., 2010). In short, exercise can help individuals reduce the degree of IA by improving the functional connectivity between brain regional networks.

The hypothalamic-pituitary-adrenal (HPA) axis is involved in internet addiction (Heinze et al., 2016). While Exercise affects HPA by reducing stress responses and producing healthy responses (Li et al., 2020), but it can also activate the HPA axis and increase cortisol levels (Drogos et al., 2019). At the same time, exercise also reverses the increase in corticosterone and decrease in glucocorticoid receptors caused by chronic stress and induces the HPA axis adaptive stress response (Stranahan et al., 2008). This dual role on hypothalamic axis activation and adaptation may help explain why exercise alleviates IA.

Internet addiction leads to a decrease in neurotrophic factors (Jeong et al., 2019) and is related to dysfunction of the dopamine system while exercise can also promote the secretion of neurotrophic factors and neurotransmitters and increase the length of telomeres (Li et al., 2020). which can help explain how physical exercise affects IA from the perspective of neurobiology.

Mental Mechanism

Exercise promotes more sound personality development, as confirmed in many researches (eg. Li et al., 2011; Su, 2019). From the causes of the formation of internet

addiction, IA patients like to be alone, are sensitive, and tend toward abstract thinking, alertness, and disobeying social norms (Yan, 2001). Ren (2007) found that middle school students with anxiety, depression, fear, paranoia, hostility, or other personality problems are more likely to become internet addicted in college. Exercise can optimize individual personality traits associated with Internet addiction (e.g., lower anxiety scores) (Yuan & Liu, 2004), and could thereby prevent the formation of IA in adolescents.

The pleasurable experience of exercise can serve as a substitute for the pleasurable experience of internet use (Liu & Dan, 2009). For example, some can get this through the “runner’s high,” resulting in physical and mental pleasure; disconnecting from time, space, and obstacles; forgetting oneself; and feeling full of vitality (Sachs, 1980). According to Bandura's self-efficacy theory, after repeated experiences of this pleasure, successfully completing an exercise task will cause a desire to try it again. If individuals can form exercise habits, it will improve their sense of success and self-efficacy and help offset negative emotions such as depression and anxiety (Zhang, 2000). Meanwhile, Ren et al. (2014) mentioned that exercise can give internet addicts the excitement they seek online.

Internet addiction may be an intermediary variable between life events and psychological problems (Li, 2018). The results shows that Solving mobile phone addiction involves developing positive coping styles , of which exercise is an ideal example.

Additionally, exercise can cultivate and improve many healthy psychological qualities, such as self-control, active coping styles, correct cognition, self-confidence, and role responsibilityconsciousness, which can help individuals avoid the temptation of the

online world (Liu & Dan, 2009). Positive psychological qualities and coping styles in the face of stress make for a better life for the individual, and exercise as a positive stress resource and coping style can therefore directly or indirectly promote physical and mental health, including alleviation of IA (Liu, 2015).

Exercise can also divert an addict's attention away from pre-occupation with the internet. Liao and Huang (2011) proposed the feasibility of an IA exercise intervention that draws individual attention from the internet, noting that when exercise takes up students' spare time, internet use time will necessarily be reduced. The positive emotional experiences of exercise can reduce the depression, loneliness, emptiness, and anxiety which are the common negative emotions caused by IA. Therefore, it can reduce the probability and degree IA (Liao & Huang, 2011).

Lastly, exercise can broaden individuals' social circles and reduce their online time. Group sports interventions to reduce the symptoms of IA are particularly outstanding. As group sports provide college students more opportunities for interpersonal communication, their social circles can be widened, resulting in real-world friends and promoting good interpersonal relationships, possibly leading them to no longer indulge in the virtual world of the internet (Dong, 2020).

The Future Research Trend

Internet addiction is considered a serious mental disorder that can lead to cognitive and behavioural problems with time management skills, interpersonal skills, health, compulsive

internet use tolerance, and withdrawal (Young, 1998; Young, 2004). It may also cause psychological distress and disorders such as social or general anxiety, depression, and inferiority complex (Caplan, 2002). And as has been reviewed in the previous sections, research has established that exercise has an intervention effect on IA.

Through physical exercise intervention, college students' IA has been greatly improved (Zhang, 2013), particularly with fitness, dancing, and ball sports (Dong, 2020). However, there is still a lack of domestic research in China on this subject. In the future, we can consider combining exercise intervention and psychotherapy to address college students' IA, which may be more effective.

Both investigation research and intervention research have shown it to be generally necessary to select the appropriate tools to screen college students for IA and properly evaluate their degree of addiction. In continuing this research, selecting appropriate and efficient diagnostic tools and intervention methods will therefore be critically important.

Diagnostic Tools

There have been many studies on the development of internet addiction tools, but it is necessary to continuously improve the existing research tools to make them more ecologically valid. Liu (2020) used the system evaluation method to sort the literature related to the development of the IA scales, compared the performance of each scale through standardized procedures, and selected some scales with better measurement performance. The author believes that it is vital to consider age when choosing a questionnaire. This provides a reference

for the selection of diagnostic tools in follow-up studies of college students' IA. However, with the increase in mobile phone addiction, it should be considered MPA factors in the diagnostic tools.

Potential Interventions

College students cannot be completely separated from smartphones in learning or life, but smartphone exercise apps can change their exercise attitudes and behaviour habits, enhance their exercise goals and motivation, and improve their evaluation of exercise behaviour (Chen & She, 2019). Intervening in college students' exercise behaviours through smartphone apps to address IA should therefore be considered in the future.

In addition, virtual reality (VR) technology can be applied to exercise interventions (Wang, 2020), which could broaden the exercise horizons of college students and enhance their interest in it. Many exercises can be completed indoors with this platform, making it easier for college students to be physically active, and prevent or alleviate IA.

Scholar in China claim that achievement, interpersonal relationships, immersion, and other factors promote interest shift in online gaming, and that parental monitoring and other factors inhibit online game addiction (Xu, 2009). Liu (2015) further carried out research on this basis and found that the comprehensive intervention method of combining parent-child participation in leisure sports and special sports training had a better intervention effect on internet addicts. This suggests that group exercise, especially with family members and friends, could have a better effect on IA for college students.

In addition to group projects, high-intensity interval training (HIIT) can also be used to great benefit (Su, 2020). HIIT involves intermittent rounds of multiple short-term high-intensity exercises separated by low-intensity exercises or complete rest. Compared with medium-intensity continuous exercise, HIIT can save time and have similar or greater health benefits (Su, 2020). In the future, this method can be considered for interventions with college students with IA to evaluate the intervention effect.

Effect Evaluation

Research shows that exercise can increase dopamine levels and reduce the stress hormones of adolescents with online game addiction (Kang & So-Hyung, 2017). Long-term exercise may be effective in fighting IA partly because it increases the volume of the hippocampus and prefrontal cortex (Chaddock et al., 2010; Li et al., 2020; Weinstein et al., 2012), and partly because exercise leads to a better fitness level—which is also related to a larger hippocampus volume (Thomas et al., 2016). Exercise also reduces IA by promoting the release of dopamine and norepinephrine in the hypothalamus (Hasegawa et al., 2011) and promoting plasticity of the striatum (Dimsdale & Moss, 1980). At present, there is a lack of detailed measurements of various physiological indicators of IA patients before and after exercise interventions. In future research, the changes in subjective perception of IA after exercise intervention should be measured, increased the frequency of monitoring of objective physiological indicators monitoring of objective physiological indicators should be strengthened, and a comprehensive assessment of the combination of physiological indicators

and subjective perception should be considered.

CONCLUSION

The incidence of internet addiction among college students has been steadily increasing for years, and this problem has become increasingly in need of social attention. As a quick and economical intervention method, exercise has been shown to be a good option. The duration, frequency, and intensity of exercise, as well as motivation toward, attitude toward, and interest in exercise, are all negatively related to IA. Internet addiction and other related symptoms can therefore be directly improved through exercise. Exercise can also indirectly improve IA through intermediary variables such as self-control, social support, and coping styles.

As an intervention method, group exercise (especially ball sports) has the most obvious improvement effect on IA. However, there appear to be differences in the improvement effects of exercise involving closed and open motor skills, which should be confirmed by additional intervention studies. There is still a lack of detailed longitudinal studies on the method, content and duration of exercise, and intervention plans should be continuously improved.

Physiologically, physical exercise affects the volume of the hippocampus, dopamine circuit, and neurotrophic factors, thereby decreasing IA. Psychologically, IA can be reduced by exercise through increased self-efficacy, forming exercise habits, diverting attention, optimizing personality traits, and broadening one's circle of friends.

Future research should optimize the measurement tools for IA, and consider the use of VR technology to attract college students' interest. For the design of intervention programs,



the intervention effects of exercise should be determined by evaluating IA at multiple stages of the program. By studying the effect of these interventions over time, the effect of exercise on internet addiction can be given a stronger empirical and theoretical basis and have increased practical benefits.



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