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Physical exercise and online aggressive behavior among college students: The mediating role of self-control

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ABSTRACT

Physical exercise may be an important measure for the prevention and control of online aggressive behavior. On this basis, we surveyed 516 students from two universities in Harbin, China, investigating their levels of physical exercise, online aggressive behavior, and self-control. We used SPSS 25.0 software for statistical analysis, employing Pearson correlation analysis and mediation effect testing. The results showed that, after controlling for relevant demographic variables, there was a significant correlation between physical exercise and online aggressive behavior, and self-control played a potential mediating role in the relationship between these variables. This suggests that by enhancing the self-control ability of college students through physical exercise, the occurrence of online aggressive behavior may be reduced.

KEYWORDS

physical exercise, online aggressive behavior, self-control, emotion regulation, digitalization

ARTICLE HIGHLIGHTS

We found a significant negative correlation between physical exercise and online aggressive behavior among college students.

Self-control played a mediating role in the relationship between physical exercise and online aggressive behavior.

Physical exercise may be an effective measure for reducing online aggressive behavior in this population.

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In the 21st century, the rapid advancement of information technology has led to the deep penetration of internet products and services into every aspect of daily life, making them integral and indispensable. According to the Editorial Board of Media (2024), the number of Chinese *netizens* (those who regularly use the internet, participate in online activities, and interact in online communities) was approaching 1.1 billion people by 2024, with an internet penetration rate of 78.0%, among which netizens under the age of 29 years accounted for 32.2%. Especially among youth, the internet has become the primary channel for obtaining information, with an average daily internet usage time exceeding 6 hours (Hu & Yin, 2024).

However, while the widespread adoption of the internet brings convenience, it has also given rise to new problems. One of these is *online aggressive behavior* (OAB), which refers to malicious actions carried out in the online environment, including insults, defamation, and intimidation (Ye et al., 2021). *Instrumental OAB* refers to situations where the perpetrator is not under threat or attack before carrying out the aggressive behavior, and the main purpose of this behavior is to obtain personal benefits or interests (F. Zhao & Gao, 2012). *Reactive OAB*, on the other hand, refers to situations where the attacker acts aggressively because they have been threatened or are in a state of anger (F. Zhao & Gao, 2012). This type of aggression is usually not for the purpose of obtaining benefits or interests, but rather to respond to threats or injuries, and is retaliatory in nature (F. Zhao & Gao, 2012).

Jin et al. (2023) found that 7.82% of Chinese college students reported having experienced cyberbullying in the past 12 months. In addition, Lee et al. (2023) reported that about 13% of medical students in Malaysia had participated in OAB. Engaging in aggressive behavior in online settings not only increases the likelihood of victims suffering from psychological health issues such as anxiety and depression (Mishna et al., 2018), but can also lead to the deterioration of social functioning in perpetrators, increasing their risk of engaging in antisocial behaviors in the future (Chan et al., 2019). Therefore, how to control OAB among youth has become a key focus of researchers who study aggressive behavior.

Physical exercise is a positive lifestyle habit and an important means to promote physical and mental health. Moreover, numerous studies (Caprara et al., 1986; Liu et al., 2024; Luce et al., 1980) have confirmed that physical exercise can effectively reduce anxiety and depression, maintain emotional stability, enhance the sense of happiness in life, and reduce potential aggressive behaviors. In addition, relevant systematic reviews and meta-analyses (Ouyang & Liu, 2023; Y. Yang et al., 2023) have provided further research evidence that physical exercise can effectively reduce aggression in children and adolescents, especially by significantly reducing the anger and hostility of aggressors. Therefore, researchers have suggested that schools arrange for students with aggressive behaviors to participate in low-intensity, noncontact physical exercise to reduce the incidence of bullying, violence, and other adverse events related to aggression (Y. Yang et al., 2023). In addition, Liu et al. (2024) found that physical exercise was significantly and negatively correlated with college students' depression and aggressive behavior, indicating that appropriate physical exercise may reduce aggressive behavior in young people. Extending the findings of these previous studies, OAB may potentially be regulated by physical exercise. However, there have been few empirical studies on the relationship between physical exercise and OAB.

Self-control is the process by which individuals consciously regulate their cognition, emotions, and behaviors when faced with desires and impulses, and take actions that are in line with long-term interests or goals (Logue, 1988; Turner & Piquero, 2002). Self-control involves factors such as willpower, self-regulation, and cognitive resource allocation, and it is a comprehensive manifestation of positive psychology (Bowlin & Baer, 2012). Denson et al. (2012), DeWall, Deckman, et al. (2011), and DeWall, Finkel, and Denson (2011) found that failures in self-control often predict the occurrence of aggression, while strengthening self-control can reduce aggression. In addition, longitudinal studies have further confirmed the causal relationship between these variables. For example, Denson et al. (2011) conducted a 2-week self-control training program to explore its intervention effects on individuals with high aggressive traits, and found that participants who received the training showed significantly reduced anger levels compared to the control group. Thus, we inferred that individuals with higher self-control may be less likely to post malicious comments or invade others' privacy in cyberspace, whereas individuals

with lower self-control may exhibit more pronounced moral disengagement, find it difficult to restrain their words and deeds, and tend to engage in extreme behaviors online (X. Chen, 2022; H. Li et al., 2023). In summary, we inferred there would be a significant negative correlation between self-control and OAB.

Regular physical exercise can enhance the operation of individuals' prefrontal cortex (Basso et al., 2015), which is an important functional area responsible for planning, decision making, inhibitory control, and self-regulation (Friedman & Robbins, 2022; Knoch & Fehr, 2007). Numerous studies have also confirmed there is a positive correlation between physical exercise and self-control. For instance, Kinnunen et al. (2012) found that leisure-time physical exercise, aerobic fitness activities, and muscle-strengthening activities are significantly and positively correlated with self-control. In addition, Zhong et al. (2021) found that physical exercise has a positive effect on college students' self-control and, through the intermediary factor of self-control, plays an inhibitory role in cell phone dependence. In contrast, Fan and Jin (2014) and Wills et al. (2007) found that lower levels of self-control in adolescents are associated with less physical exercise. An experimental study (Guiney & Machado, 2013) and a systematic review based on experimental studies (Shi et al., 2022) also confirmed that physical exercise can improve performance on executive function tasks, and self-control is an important indicator of executive function. Therefore, there is substantial evidence to suggest that there is a significant positive correlation between physical exercise and self-control.

On this basis, we explored the link between physical exercise and OAB among college students, and examined the mediating role of self-control in this relationship. Our aim was to provide new perspectives and strategies for understanding and preventing OAB among young people, and to provide a scientific basis for promoting mental health and network literacy education in this population. Our findings may act as a reference for colleges and universities to formulate relevant policies and intervention measures to create a safe and harmonious network environment. Thus, we proposed the following hypotheses:

Hypothesis 1: Physical exercise will have a significant negative correlation with online aggressive behavior in college students.

Hypothesis 2: Self-control will play a mediating role in the relationship between physical exercise and online aggressive behavior among college students.

Method

Participants and Procedure

This study used convenience sampling to survey college students from two universities in Harbin, Heilongjiang Province, China. Physical education majors were excluded from the sample to avoid the potential ceiling effect of the variable of physical exercise. We sent a QR code to students' WeChat or QQ groups, linking to the online survey platform Questionnaire Star (https://www.wjx.cn/). We received responses from 615 college students, 69 of which were deemed invalid because of too-short response times (< 5 minutes) or patterned responses, such as consistently selecting the same answer to all questions. After screening, we retained 516 valid questionnaires. This study was approved by the Scientific Research Ethics Committee of Harbin Sport University and was conducted with the informed consent of the students.

Measures

Demographic Information

Demographic information collected in this study included grade, gender, and major. We divided grade into four categories: freshman, sophomore, junior, and senior; gender categories were male and female; and major categories were science and engineering, or liberal arts.

Physical Activity Rating Scale

This study used the Physical Activity Rating Scale-3 revised by Liang and Liu (1994) to assess the participants' physical exercise levels. The scale consists of three dimensions containing one item each: intensity, which is rated on a 5-point Likert scale ranging from 1 (*low intensity*) to 5 (*high intensity*); exercise frequency, which is rated on a 5-point Likert scale ranging from 1 (*less than once a month*) to 5 (*approximately once a day*); and exercise duration, which is rated on a 5-point Likert scale ranging from 0 (*less than 10 minutes*) to 4 (*more than 60 minutes*).

The formula for calculating physical exercise is as follows: intensity × duration × frequency, with scores ranging from 0 to 100 points. We then placed total scores into one of three categories, with 19 points or fewer indicating low exercise volume, 20 to 42 points indicating moderate exercise volume, and 43 or more points indicating high exercise volume. The scale has shown good reliability and validity (Liang & Liu, 1994), and is widely used in surveys of physical exercise among youth groups in China (Liang & Liu, 1994; G. Yang et al., 2021; Y. Zhao, 2021).

Adolescent Online Aggressive Behavior Scale

This study employed the Adolescent Online Aggressive Behavior Scale developed by F. Zhao and Gao (2012) to assess participants' OAB. The scale comprises 31 items divided across two dimensions: instrumental OAB (15 items, e.g., "I threaten or intimidate someone on their personal space or blog") and reactive OAB (16 items, e.g., "I engage in verbal fights with others through instant messaging tools such as QQ, MSN, or WeChat"). Participants rate the frequency of the described behaviors on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*). Higher scores indicate a greater likelihood of participants engaging in aggressive behavior online. The scale has demonstrated good structural validity and internal consistency (F. Zhao & Gao, 2012) and has been applied in studies with college students (Guo et al., 2023; L. Zhang et al., 2017).

Self-Control Scale

This study employed the Self-Control Scale revised by Tan and Guo (2008) to assess participants' self-control levels. It includes 19 items, with four items being positively scored (e.g., "I can resist temptations well") and 15 items being negatively scored (e.g., "It is difficult for me to break bad habits"). Items are rated on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). The final score is calculated by adding up the points, with high scores indicating a high level of self-control. Tan and Guo (2008) confirmed that the scale has good reliability and validity.

Data Analysis

This study used SPSS 25.0 software and the PROCESS 3.0 macro for data processing and statistical analysis. First, we screened all collected questionnaires, and imported the data from the valid questionnaires into SPSS 25.0 for summarization and organization. Second, we used descriptive statistics in the form of frequency and percentage to describe the participants' grade, gender, academic classification, level of physical exercise, and incidence of OAB. Third, we used a correlation analysis to explore the correlations between physical exercise, self-control, and OAB. Finally, using PROCESS 3.0, we conducted a mediation effects test to examine the potential mediating role of self-control between physical activity and OAB.

Results

Demographic Information of Participants

Information about the gender, year of study, major, physical exercise level, and OAB of the participants is detailed in Table 1.

Table 1. *Demographic Information of the Participants*

Variables	Category	*n*	%	Variables	Category	*n*	%
Year	Freshman	134	25.97	Physical exercise level	Low	215	41.67
	Sophomore	106	20.54		Medium	178	34.50
	Junior	135	26.12		High	123	23.84
	Senior	141	27.33	Online aggressive	Never	11	2.13
Gender	Men	245	47.48	behavior	Occasionally	376	72.87
	Women	271	52.52		Often	58	11.24
Major	Humanities	234	45.35		Always	71	13.76
	Science and engineering	282	54.65				

Correlation Analysis

There was a significant positive correlation between physical exercise and self-control. Both physical exercise and self-control had a significant negative correlation with OAB, instrumental OAB, and reactive OAB. In addition, OAB had a significant positive correlation with both instrumental OAB and reactive OAB, and instrumental OAB and reactive OAB were positively correlated with each other. The close relationships among physical exercise, self-control, and OAB (see Table 2) provided the basis for our subsequent research into the potential mediating role of self-control in the relationship between physical exercise and OAB.

Table 2. *Correlation Analysis of Study Variables*

Variables	1	2	3	4	5
1. Physical exercise	1				
2. Self-control	.76**	1			
3. OAB	−.76**	−.65**	1		
4. Instrumental OAB	−.64**	−.53**	.76**	1	
5. Reactive OAB	−.54**	−.47**	.79**	.20**	1

Note. OAB = online aggressive behavior.
** $p < .01$.

Test of the Mediating Effect of Self-Control

After controlling for relevant demographic variables, physical exercise had a significant positive predictive effect on self-control (see Table 3). In addition, both physical exercise and self-control negatively predicted OAB after controlling for relevant demographic variables. On this basis, there was a potential mediating effect of self-control.

We further examined the proposed mediating effect by using the bootstrapping procedure with 5,000 resamples. As shown in Table 4, physical exercise directly and negatively predicted OAB. In addition, self-control played a mediating role between physical exercise and online aggressive behavior. The mediation path is visually depicted in Figure 1.

Table 3. *Multiple Linear Regression Analysis Results*

Dependent variable	Independent variable	β	*t*	Dependent variable	Independent variable	β	*t*
Self-control	Physical exercise	.39	25.80**	Online aggressive behavior	Physical exercise	–.27	–9.37**
	Grade	.40	1.91		Self-control	–.13	–2.64**
	Gender	.36	0.78		Grade	–.30	–1.28
	Major	.39	0.83		Gender	.02	0.05
					Major	.30	0.58

Note. OAB = online aggressive behavior.
** $p < .01$.

Table 4. *Mediation Effect Analysis of Self-Control Between Physical Exercise and Online Aggressive Behavior*

Effect	Effect value	*SE*	95% CI	
			LL	*UL*
Direct effect	–0.27	0.03	–0.32	–0.21
Indirect effect	–0.05	0.02	–0.08	–0.02
Total effect	–0.32	0.02	–0.42	–0.23

Note. The indirect effect refers to the path from physical exercise to online aggressive behavior through self-control. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

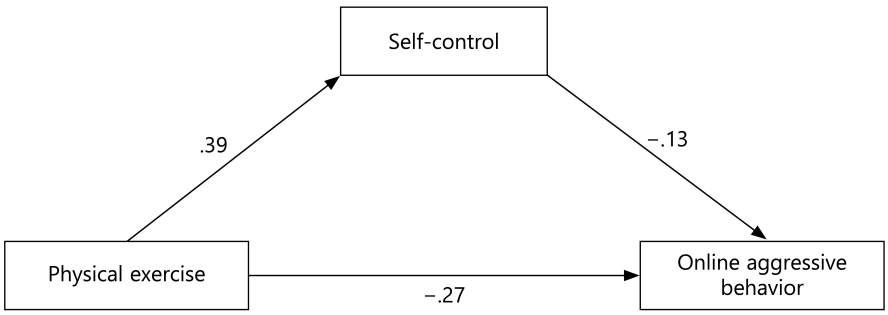

Figure 1. *Path Diagram of Mediating Effect*

Discussion

Physical Exercise and Online Aggressive Behavior

The results of this study revealed a significant negative relationship between physical exercise and OAB among college students after controlling for relevant demographic variables. This result is consistent with Hypothesis 1 and the results of previous studies exploring the relationship between physical exercise and aggressive behavior in college students (Ubago-Jiménez et al., 2021; Yu et al., 2024), which revealed that individuals with higher levels of physical exercise have lower aggressive behaviors, and, in turn, reduced OAB. Although there are some differences between OAB and aggression in traditional real-world situations, both are emotionally driven behaviors that result in harm to the victim, whether psychologically or physically, or property damage. Our finding of a significant negative correlation between physical exercise and OAB is consistent with previous results on the relationship between physical exercise and traditional forms of aggressive behavior.

The reasons and mechanisms underlying the significant negative correlation between physical exercise and OAB may be similar to those for aggressive behavior in traditional real-life situations. First, physical exercise helps to release stress and negative emotions, reducing the occurrence of OAB (Verona et al., 2002). During exercise, the brain releases chemicals such as endorphins, which can elevate mood and reduce anxiety and depression (Steinberg & Sykes, 1985), and thus may decrease the tendency toward OAB. Second, physical exercise can increase

exercise-related self-efficacy, which is significantly and negatively correlated with OAB (Ma et al., 2024). Individuals with high exercise self-efficacy are more likely to experience a sense of achievement and pleasure during exercise. This positive psychological state extends to their daily lives, leading them to view things more positively and reducing the likelihood of engaging in aggressive behaviors triggered by negative emotions (Ma et al., 2024). Third, physical exercise, especially activities that involve teamwork and social interaction, can cultivate an individual's social skills and empathy (Shi & Feng, 2022). The enhancement of these social skills may help individuals better understand the feelings and needs of others, thereby reducing OAB. Fourth, physical exercise may help individuals establish a positive self-image and identity (Kirkcaldy et al., 2002), which may reduce their need to seek recognition or express dissatisfaction through aggressive behavior. Last, physical exercise can improve an individual's inhibitory control and self-control, enhancing their ability to inhibit impulses and regulate emotions, thus reducing the likelihood of OAB.

Self-Control as a Mediator

We found that self-control mediated the relationship between physical exercise and OAB, supporting Hypothesis 2. These results are consistent with those from previous studies (L.-S. Chen et al., 2024; Y. Li et al., 2024; Z. Zhang et al., 2018), which found that physical exercise can reduce individuals' aggressive behavior by improving their self-control ability. Given the close relationship between OAB and traditional real-world aggressive behavior, we expected self-control to have a significant mediating effect in the relationship between physical exercise and OAB, and our results confirmed this.

In addition, a significant positive correlation between physical exercise and self-control has been reported in previous studies (Kinnunen et al., 2012; Zhong et al., 2021). When individuals engage in more physical exercise, these activities often require them to set goals, make plans, and persist in their execution, processes that promote the enhancement of self-control abilities. The relationship between self-control and aggressive behavior has also been supported by various studies (X. Chen, 2022; Denson et al., 2011; DeWall, Deckman, et al., 2011; DeWall, Finkel, & Denson, 2011). Self-control plays a role in inhibiting inappropriate actions, helping individuals resist temptation and avoid behaviors that may lead to negative consequences. Therefore, physical exercise may both directly reduce the occurrence of OAB and also indirectly reduce OAB by increasing self-control. This dual direct and indirect effect makes physical exercise an effective means of prevention and intervention to help reduce OAB.

Theoretical and Practical Implications

Through this study, a deeper understanding of the relationship between physical exercise and OAB among young people has been achieved, emphasizing the potential importance of self-control in reducing aggressive behaviors. This helps to further reveal the psychological and social mechanisms of OAB, providing new strategies for intervention. This study has implications for the formulation of subsequent public health policies and exercise intervention programs. First, public health policies should consider incorporating physical exercise as part of mental-health-promotion plans for young people, aiming to improve individuals' emotional stability and self-control capabilities, thereby reducing OAB. Second, researchers should design specific exercise intervention measures for individuals with weaker self-control abilities to enhance their self-control and emotional regulation capabilities. In addition, staff should establish evaluation mechanisms to regularly monitor the effectiveness of physical exercise programs and sports intervention projects, ensuring these measures can effectively reduce OAB, and making adjustments as needed. Third, the results highlight the importance of self-control in the online environment. Therefore, public health policies should include internet literacy education, that is, teaching adolescents how to act in a healthy and responsible manner in the online environment. Last, public health policy makers should collaborate with government sports and education departments, along with community organizations, to jointly develop and implement

comprehensive strategies to reduce OAB and promote the holistic development of adolescents. This will help to reduce OAB among young people and promote their mental health and social well-being.

Limitations and Future Research

This study has some limitations. First, we used a convenience sampling method to recruit college students, who may not fully represent all young people, potentially affecting the universality of the research results. In addition, the study may primarily reflect situations within specific cultural and geographical contexts, limiting its applicability to different cultural and geographical environments. Second, the data were collected via self-report and may be influenced by personal biases, social expectations, and inaccurate memories. Third, although the study showed significant correlations between physical exercise, self-control, and OAB, the cross-sectional research design limits the inference of causal relationships. Longitudinal studies are needed to determine the causal links between these variables. Final, there may be other uncontrolled variables in this study that affect the relationships between physical exercise, self-control, and OAB, such as individual mental health status, social support networks, or family environments. To overcome these limitations, future research could use more diverse samples, long-term follow-up studies, and more precise measurement tools. Moreover, research could explore the connection between different types of physical exercise and OAB, considering more individual differences and environmental factors.

Conclusion

This study conducted a survey to explore the relationship between physical exercise and OAB in young adults, as well as the potential mediating role of self-control. We found a significant negative correlation between physical exercise and OAB in college students, and self-control played a mediating role in this relationship. Promoting physical exercise among young adults may improve their self-control ability, thereby reducing their likelihood of engaging in OAB.

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