



OPEN Physical exercise moderates the mediating effect of depression between physical and psychological abuse in childhood and social network addiction in college students

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Physical and psychological abuse (physical-psychological abuse) can easily cause individual's future social network sites addiction (SNSA), and the psychological and behavioral mechanisms between the two need to be further explored. This study took physical-psychological abuse as the independent variable, SNSA as dependent variable to explore the relationship between the two and the intermediary variable adjustment. In March 2024, a cross-sectional survey was conducted in universities of seven provincial administrative units in China, and a total of 1484 (804 males; 680 females) valid data were collected. Data on physical-psychological abuse, SNSA, depression and physical exercise were collected. These variables were subsequently correlated and a moderated mediation model was constructed. The results showed that the physical-psychological abuse positively predicted SNSA in college students, and mediated through the depression. In addition, the predictive effect between physical-psychological abuse and depression in college students could be moderated by physical exercise. This study further explored the association between physical-psychological abuse and SNSA in college students, considering the mediating effect of depression and the moderating effect of physical exercise. The results suggest that college students who have experienced physical-psychological abuse should pay attention to the use of social network sites, and can alleviate the negative results caused by physical-psychological abuse through active physical exercise.

Keywords Physical abuse, Psychological abuse, Social network sites addiction, Depression, Physical exercise

Childhood abuse refers to mistreatment and neglect experienced by individuals before adulthood (<18 years old), typically encompassing physical abuse, psychological (emotional) abuse, sexual abuse, and neglect¹. The prevalence of childhood abuse in China is notably high, with overall rates reported to be as high as 64.7%², and rates for physical-psychological abuse reaching up to 40%^{3,4}, with recent reports among Chinese college students indicating rates of around 20%⁵. Childhood abuse can lead to severe long-term consequences for individuals, including anxiety^{6,7}, depression^{6–11}, low self-esteem⁹, academic difficulties^{6,9}, substance abuse^{7,8}, suicidal behavior^{5,8,9}, social difficulties⁹, and internet addiction^{5,12}. Furthermore, active psychological abuse appears to be more strongly associated with increased odds of various mental disorders compared to passive psychological neglect⁷. Unlike other forms of abuse, physical abuse not only affects the victims directly but also has significant negative effects on witnesses¹³. Such direct negative handling of young individuals' physical and psychological well-being seems to be considered a normative parenting approach in the Chinese context¹⁴. Given the severe consequences of childhood abuse and its high prevalence in the Chinese context, this study aims to discuss the serious outcomes of physical and psychological abuse (physical-psychological abuse) on Chinese college students.

Physical-psychological abuse can lead to severe psychological disorders and a lack of support^{15–17}, which in turn may predispose individuals to addictive behaviors^{18,19}. Meanwhile, Chinese university students enjoy

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flexible time arrangements^{20,21}, and social media and networks are highly prevalent among this group²², making social networks a preferred avenue for emotionally regulating those who have experienced physical-psychological abuse^{23–25}. However, this coping mechanism is not without its risks, as it can lead to social network sites addiction (SNSA)²⁶. SNSA refers to an individual's behavior of excessive dependence, compulsive use and withdrawal reaction on social networks^{27–29}. According to the general strain theory³⁰, experiences of victimization, including physical-psychological abuse, induce various negative emotions in individuals, prompting addiction as a means of escape³¹. Studies have found a significant positive correlation between emotional abuse and SNSA among college students, and psychological abuse significantly predicts SNSA^{32,33}. There is also a significant positive correlation between physical-psychological abuse and adult SNSA³⁴. Based on this review, this study hypothesizes that physical-psychological abuse significantly predicts SNSA among college students.

The relationship between physical-psychological abuse and SNSA among college students may be mediated by depression. Because abuse is perceived as a “toxic” stressor for individuals³⁵, it can disrupt development and brain structure^{36,37}, disturb the hypothalamic–pituitary–adrenal axis homeostasis^{38–40}, and consequently lead to severe depression^{41–43}. Positive childhood experiences were significantly negatively correlated with depression⁴⁴. Studies have shown a strong association between physical-psychological abuse and depression^{32,45,46}, with predictive effects noted^{6,32}. Moreover, due to real-life distress, individuals may increasingly turn to the internet as an escape mechanism, aligning with the compensatory internet use theory⁴⁷ and the self-medication hypothesis⁴⁸. Research indicates a significant positive correlation between depression and SNSA among college students^{32,49–52}, and suggesting a potential bidirectional predictive effect between the two⁵³. Building on this review, this study hypothesizes that physical-psychological abuse significantly predicts depression among college students, and depression significantly predicts SNSA. In other words, depression mediates between physical-psychological abuse and SNSA among college students.

Furthermore, the predictive effect of physical-psychological abuse on depression among college students can be moderated by certain psychological and behavioral patterns, such as physical exercise. Physical exercise is typically defined as any bodily movement that results in energy expenditure by skeletal muscles⁵⁴. According to the stress-buffering model⁵⁵, physical-psychological abuse constitutes a stressful event for individuals, and physical exercise, as a clean and readily accessible lifestyle factor, can buffer some of the negative outcomes associated with stress. Research shows that physical exercise stimulates the hypothalamic–pituitary–adrenal axis stability, regulates cortisol release^{56,57}, promotes brain plasticity and neural adaptation^{58–61}, enhances interpersonal relationships⁶², and increases social capital⁶³, thereby alleviating depression^{49,64}. Studies have consistently found a significant negative relationship between physical exercise and depression, with physical exercise significantly negatively predicting depression^{49,65,66}. Based on these findings, this study hypothesizes that physical exercise significantly moderates the relationship between physical-psychological abuse and depression among college students.

In summary, this study uses physical-psychological abuse as the independent variable, SNSA as the dependent variable, depression as the mediator variable, and physical exercise as the moderating variable to construct a moderated mediation model. It aims to further elucidate the underlying psychological and behavioral mechanisms between physical-psychological abuse and SNSA among college students. The proposed model diagram is depicted in Fig. 1.

Methods

Participants and procedure

A cross-sectional survey was conducted in March 2024 among college students from 7 provincial administrative units in China. Participants were recruited at the class level and provided with explanations by survey personnel prior to participation. These explanations covered the survey's purpose, confidentiality measures, data usage, and the voluntary nature of participation with the right to withdraw at any time. Informed consent was obtained electronically at the beginning of the survey; refusal to consent redirected participants away from the survey. Participation was anonymous and voluntary, and completing the survey took approximately 20 min. Ethical

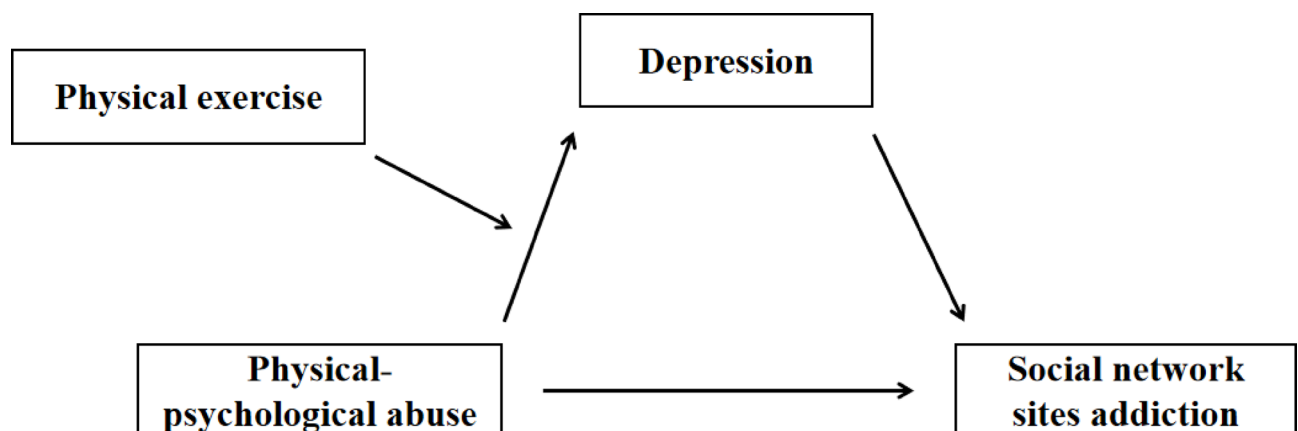


Fig. 1. Hypothesis model diagram.

approval was obtained from the institutional medical ethics committee before commencement. A total of 1787 students participated initially, with 1484 (804 males, 680 females) providing valid data.

Tools

Physical-psychological abuse

The International Adverse Childhood Experiences Abuse Short Form (ACE-ASF) was utilized to assess levels of physical and psychological abuse experienced before age 18^{67,68}. This study employed 4 items from the physical-psychological abuse section, rated on a scale of 0 (never) to 1 (ever). Scores range from 0 to 4. This tool has been used in previous studies³⁴. The Cronbach's α of the sample in this study was 0.816.

Social network site addiction (SNSA)

Social Network Site Addiction was measured using the Wei Qi revised Social Network Site Addiction Scale⁶⁹. The scale consists of 8 items, each of which is scored on a 5-point Likert scale, ranging from 1 (completely inconsistent) to 5 (completely consistent). The total score ranges from 8 to 40 points. The SNSA level of individuals was evaluated by the total score, and the higher the total score, the deeper the SNSA level. The Cronbach's α of the sample in this study was 0.901.

Depression

Depressive symptoms were assessed using the depression subscale of the Depression Anxiety Stress Scale revised by Gong et al.⁷⁰. The subscale consists of 7 items, each of which is scored on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree), with a total score ranging from 7 to 28. Total score is used to evaluate individuals levels of depression, the higher the score represents the higher the degree of depression. The Cronbach's α of this study was 0.900.

Physical exercise

Physical exercise levels were assessed with a single item: "During the past 7 days, on how many days did you exercise or engage in physical exercise for at least 20 min that made you sweat or breathe hard?"⁷¹. This measure has been validated and used in previous research⁷²⁻⁷⁴.

Statistical analysis

Statistical analyses were performed using SPSS 26.0. Variables of interest were standardized prior to analysis. First, common method bias was assessed using Harman's single-factor test, with a threshold of less than 40% indicating no significant bias⁷⁵. Descriptive statistics and correlations were computed for demographic variables and main study variables. To test hypotheses, PROCESS macro (model 4 and model 7) in SPSS was used to analyze the relationship between childhood physical-psychological abuse and SNSA among college students, as well as the moderating and mediating effects of depression and physical exercise⁷⁶. Bootstrap resampling with 5000 iterations was employed to enhance the robustness of the models and provide 95% confidence intervals⁷⁷. If 95% CI does not include 0, the relationship is significant. Gender was included as a covariate in the analyses.

Results

Common method bias test

The common method bias test in this study revealed two eigenvalues greater than 1. The first factor accounted for 32.795% of the total variance, which is below the threshold of 40%. This indicates that there is no significant risk of common method bias in this research.

Correlation analysis

Results presented in Table 1 indicate that physical-psychological abuse is significantly positively correlated with SNSA ($r=0.148, p<0.001$) and depression ($r=0.256, p<0.001$). Depression is significantly positively correlated with SNSA ($r=0.475, p<0.001$) and significantly negatively associated with physical exercise ($r=-0.093, p<0.001$).

Mediation test

Tables 2 and Fig. 2 show that physical-psychological abuse has a significant direct predictive effect on college students' SNSA ($\beta=0.168, p<0.001$). Even after introducing the mediating variable, the predictive effect of physical-psychological abuse on college students' SNSA remains significant ($\beta=0.048, p<0.05$). Additionally, physical-psychological abuse significantly predicts college students' depression ($\beta=0.258, p<0.001$), and depression significantly predicts college students' SNSA ($\beta=0.465, p<0.001$).

Variables	1	2	3	4	5
1 Gender	–				
2 Physical-psychological abuse	– 0.098***	–			
3 SNSA	0.181***	0.148***	–		
4 Depression	– 0.008	0.256***	0.475***	–	
5 Physical exercise	– 0.092***	– 0.039	– 0.049	– 0.093***	–

Table 1. Correlation analysis. *** $p<0.001$.

Variables	SNSA			Depression			SNSA		
	β	SE	t	β	SE	t	β	SE	t
Gender	0.198	0.025	7.805***	0.018	0.025	0.693	0.189	0.022	8.441***
Physical-psychological abuse	0.168	0.025	6.623***	0.258	0.025	10.220***	0.048	0.023	2.060*
Depression							0.465	0.023	20.105***
R ²	0.061			0.066			0.262		
F	47.775***			52.269***			175.265***		

Table 2. Tests the mediation model. * $p < 0.05$; *** $p < 0.001$.

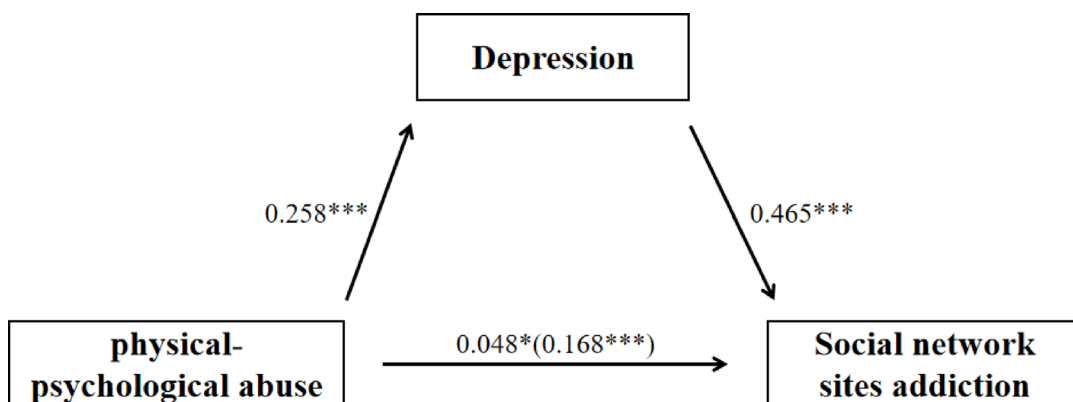


Fig. 2. Tests the mediation (* $p < 0.05$; *** $p < 0.001$).

	Depression			SNSA		
	β	SE	t	β	SE	t
Gender	0.010	0.025	0.395	0.189	0.022	8.441***
Physical-psychological abuse (A)	0.251	0.025	9.9987***	0.048	0.023	2.060*
Physical exercise (B)	-0.078	0.025	-3.105**	0.465	0.023	20.105***
A × B	-0.053	0.024	-2.234*			
Depression						
R ²	0.076			0.262		
F	30.303***			175.265***		

Table 3. Moderation and mediation analysis. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Moderated mediation testing

Results in Table 3 demonstrate that after incorporating the moderating variable of physical exercise, the positive predictive effect of physical-psychological abuse on college students' depression remains significant ($\beta = 0.251$, $p < 0.001$). Furthermore, physical exercise significantly negatively predicts college students' depression ($\beta = -0.078$, $p < 0.01$). Concurrently, the interaction term between physical-psychological abuse and physical exercise significantly negatively predicts college students' depression ($\beta = -0.053$, $p < 0.05$) (see Figs. 3 and 4).

Discussion

The findings of this study indicate that physical-psychological abuse significantly predicts SNSA among college students, with depression serving as a mediating factor, and physical exercise acting as a moderator between physical-psychological abuse and depression in college students. These results further elucidate the psychological and behavioral mechanisms underlying the relationship between physical-psychological abuse and SNSA among college students and explore the protective and risk factors associated with this relationship, providing a theoretical reference for future research.

Physical-psychological abuse and SNSA

The results show that physical-psychological abuse is a significant positive predictor of SNSA among college students. Influenced by traditional Confucian culture, within the Chinese cultural context, parents or teachers seem to be endowed with a "power" to educate children through scolding and physical punishment¹⁴. Such behavior can be detrimental to children, especially when parents do not control the extent of punishment or

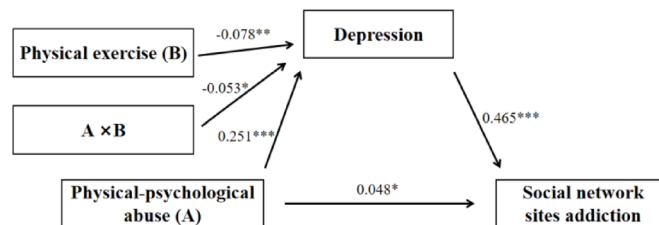


Fig. 3. Moderated Mediation model (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

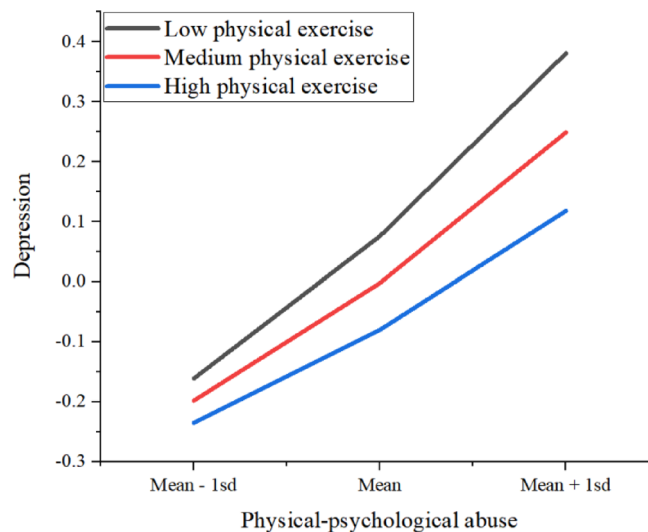


Fig. 4. Simple slope diagram.

when children do not receive timely emotional guidance^{78–80}. Individuals who have experienced child abuse may feel a lack of support, unloved, and unwanted^{16,81}. To alleviate these negative emotions, those who have experienced physical-psychological abuse may use social network sites for emotional regulation, as these sites offer convenient and diverse social support^{82–84}. However, this can easily lead to SNSA²⁶. Studies have found a significant positive correlation between physical-psychological abuse and individual SNSA and that physical-psychological abuse significantly predicts SNSA^{32,85}. However, our study found that the direct predictive effect of physical-psychological abuse on college students' SNSA changed from 0.168 to 0.048, almost losing significance. This result has a similar finding to previous studies⁸⁶. That study found that anxiety fully mediated the relationship between physical-psychological abuse and college students' SNSA⁸⁶. Therefore, the finding in our study that the relationship between physical-psychological abuse and college students' SNSA is mediated by depression to a considerable extent should be given more attention.

Physical-psychological abuse, depression and SNSA

The study results indicate that depression has a partial mediating effect between physical-psychological abuse and Social Network Site Addiction (SNSA) among college students. This finding is crucial as it sheds light on the intricate interplay between adverse experiences and mental health issues in the context of young adults' online behaviors. The experience of physical-psychological abuse may act as a form of toxic stress for individuals^{35,37,87,88}, potentially leading them into a cycle of depressive despair⁸⁹. Consistent with prior research, our study shows that physical-psychological abuse significantly predicts individual depression^{46,90,91}. This aligns with broader findings that such abuse can have long-term detrimental effects on mental health, as seen in studies examining the link between childhood maltreatment and adult depression. Negative emotions, which can be triggered by experiences of abuse, are known to be conducive to the development of addictive behaviors^{92,93}. Our research adds to this body of knowledge by demonstrating a significant bidirectional predictive effect between depression and SNSA^{53,94}. This bidirectional relationship implies that not only does depression predispose individuals to higher levels of SNSA^{95,96}, but SNSA can also exacerbate depressive symptoms^{49,11}, creating a self-perpetuating cycle⁹⁷. This finding underscores the complexity of the relationship and the need for a multifaceted approach to address both issues.

Physical-psychological abuse, depression, physical exercise and SNSA

The study results indicate that physical exercise has a moderating effect between physical-psychological abuse and depression among college students. Although physical-psychological abuse is an immutable event from the

past, its relationship with depression is not always strong, possibly due to current behavioral patterns (physical exercise) that can alleviate the relationship between the two. Research has found that physical exercise is endowed with resilience⁹⁸, can promote mental health^{99,100}, regulate emotions from top to bottom, and the development of brain structure¹⁰¹. At the same time, meta-analysis results show that physical exercise promotes individual neuroplasticity, alleviates inflammation, regulates the endocrine system, and enhances psychosocial factors¹⁰², playing a positive role in alleviating depression and anxiety among college students¹⁰³. In addition, physical exercise can also alleviate individuals' anxiety^{73,104,105} and stress emotions¹⁰⁶, further reducing the levels of Social Network Site Addiction (SNSA)^{107–112}. Based on these results, the third hypothesis of this study is confirmed.

Limitations and recommendations

The advantage of this study is that it discusses the relationship between physical-psychological abuse and SNSA among college students through beneficial and risk factors, further enriching the internal psychology and behavior between physical-psychological abuse and SNSA. At the same time, this study also has some limitations. First, this study is based on cross-sectional data for discussion, and there are certain limitations in explaining the causal relationships between variables. Future longitudinal tracking or experimental research can further strengthen the explanation of these variables. Second, this study is based on surveys conducted within the Chinese cultural context, and its interpretation in cross-cultural research may need to be further strengthened. Finally, this study is based on retrospective and subjective surveys, and the objectivity of the data will be challenged. It is recommended that future research combine subjective and objective methods to strengthen the relationship between variables.

Conclusion

This study further explores the relationship between physical-psychological abuse and SNSA among college students, considering the mediating and moderating effects of depression and physical exercise. It is recommended that families and schools maintain a moderate rationality in the education of their children. At the same time, college students with experiences of physical-psychological abuse should pay attention to the way of emotional regulation to avoid falling into the “trap” of addictive behavior and actively strengthen physical exercise, which will help alleviate the negative impact of physical-psychological abuse.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due [our experimental team's policy] but are available from the corresponding author on reasonable request.

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Author contributions

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Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

The study was approved by the Biomedicine Ethics Committee of Jishou University before the initiation of the project (Grant number: JSDX-2024-0086). And informed consent was obtained from the participants before starting the program. We confirm that all the experiment is in accordance with the relevant guidelines and regulations such as the declaration of Helsinki.

Additional information

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