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The mediating effect of social adaptation and the moderating effect of prosocial behavior on the relationship between physical activity and psychological capital

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This study aims to explore the relationship between physical activity, social adaptation, pro-social behavior, and psychological capital, and to examine the mediating role of social adaptation in the influence of physical activity on psychological capital and the moderating role of pro-social behavior on this mediating effect. In this study, a cross-sectional study design was used to conduct a questionnaire survey on 415 students from a 211 university in Ningxia, and their physical activity, psychological capital, social adaptation and prosocial data were collected during the break. In addition, this study conducted Harman single factor test, independent sample t test, descriptive statistics, correlation analysis, and moderated mediating effect model analysis on the data. Physical activity was positively correlated with psychological capital, social adaptation and prosocial behavior. Social adaptation plays a mediating role in the influence of physical activity on psychological capital, and prosocial behavior has a moderating effect on this mediating process (the moderating effect value is -0.018). When prosocial behavior is at a low level, there is significant mediation of physical activity on psychological capital through social adaptation, but when prosocial behavior is a high level, mediation is not significant. Physical exercise helps to improve the psychological capital of college students, and social adaptation plays an intermediary role in this process; at the same time, it should be noted that prosocial behavior has a moderating effect on the mediating process. This suggests that we should fully consider the impact of prosocial behavior when formulating relevant interventions.

Keywords College students, Physical activity, Psychological capital, Social adaptability, Pro-social behavior, Moderating effects

Nowadays, the intensity of social competition is increasing, and college students are facing multiple pressures such as academics¹, employment², socialization³, etc., and their mental health problems are becoming more and more serious. According to the China National Mental Health Development Report, more and more college students are facing different degrees of psychological distress. From the perspective of positive psychology, the positive psychological characteristics of an individual can effectively alleviate psychological pressure and prevent the negative impact of the external environment on the individual⁴. As a core psychological resource, psychological capital consists of four components: self-efficacy, resilience, hope, and optimism, which are related to positive emotions and can lead people to produce positive behaviors^{5,6}. Psychological capital can help individuals mobilize positive psychological resource reserves to alleviate or eliminate the worries and pains caused by unfavorable external environments⁷.

Physical activity, as a no-cost and effective intervention to improve the physical and mental health of college students, can reduce stress, improve mood, and enhance cognitive function⁸. The accumulation of

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psychological capital is strongly correlated with the level of participation in physical activity, and studies have shown that psychological capital is plastic and stable⁹. Physical activity is closely related to multiple dimensions of psychological capital. Regular exercise enhances self-efficacy¹⁰ and self-confidence¹¹, fosters optimism and mental resilience¹², and sustained physical activity interventions increase and stabilize levels of psychological capital. However, despite the many benefits of physical activity, many college students face the serious problem of physical inactivity. According to survey data, nearly one-third of adults and four-fifths of adolescents worldwide are physically inactive¹³.

Social adaptability refers to how well an individual adapts to the environment¹⁴. On the other hand, the level of social adaptation reflects an individual's social and psychological maturity, and college students are at an essential stage of psychological maturity in their lives. Insufficient social adaptability will cause alienation and social sensitivity disorder and affect the healthy development of the human body and mind¹⁵. Many psychological problems of college students stem from maladaptation, and maladaptation produces negative emotions¹⁶, such as anxiety and depression. High levels of psychological capital can counteract depression, anxiety, and other negative emotional distress and enhance social adjustment, protecting or improving physical and mental health¹⁷. Similarly, there is a significant causal association between physical activity and social adjustment, and research has confirmed that actively engaging adolescents in physical activity is efficacious in improving their social skills and social adjustment¹⁸.

As a core indicator of individual social development, pro-social behavior is voluntary behavior that benefits others¹⁹. Participating in pro-social behavior can not only make individuals feel the fulfillment of self-worth and achievement but also enhance self-confidence and self-esteem, as well as effectively alleviate negative emotions such as anxiety and depression through positive emotional feedback to build a solid line of defense for mental health. Research has shown that pro-social behavior is of great practical significance for the social adaptation of individuals and the development of society as a whole²⁰. Numerous studies have shown a significant correlation between physical activity and the development of mental health and pro-social behaviors^{21,22} and that individuals with higher levels of physical activity are more likely to display pro-social behaviors such as sharing and helping others in their daily behaviors^{23,24}. College students who actively participate in prosocial behavior may be more likely to gain recognition and support from others, thereby enhancing their self-confidence, optimism and coping ability, which are important components of psychological capital^{25,26}. For example, a survey of medical students found that individuals with higher moral identity also have higher levels of psychological capital, which in turn is related to higher levels of prosocial behavior²⁷. Physical activity itself may promote social adaptation, but participants in prosocial behavior may be more likely to build deeper social relationships and thus gain stronger social support. This social support in turn enhances psychological capital, as feeling cared for and supported is a key factor in improving resilience²⁸. In addition, based on Self - Determination Theory²⁹, prosocial behavior can satisfy individuals' psychological need for "relatedness" during physical activities. For college students, when they perceive social support such as mutual encouragement from classmates in fitness - related physical activity scenarios, their intrinsic motivation to participate in physical activities will be strengthened. And this strengthened intrinsic motivation is conducive to promoting the development of their social adaptability, such as enhancing communication skills and alleviating social anxiety.

Although previous studies have explored physical activity, psychological capital, social adaptation, and pro-social behavior among college students, there are still research gaps. Most studies have only analyzed the relationship between physical activity and psychological capital, or physical activity and social adaptation and pro-social behavior in isolation, and lacked the exploration of the comprehensive mechanism of multivariate interaction. Based on the above background, the purpose of this paper is to explore the effect of physical activity on the psychological capital of college students, analyze the mediating effect of social adaptation, and the moderating role of pro-social behavior. Therefore, Model 7 based on PROCESS, we designed a mediation model with moderation (see Fig. 1) and proposed four hypotheses:

H1 There is a significant positive effect of physical activity on psychological capital among college students;

H2 Physical activity is a significant positive predictor of social adaptation;

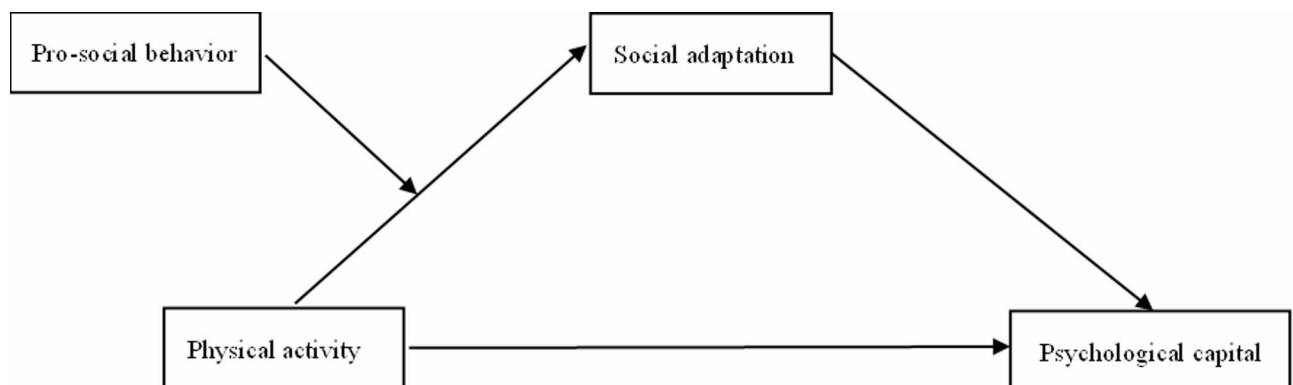


Fig. 1. Conceptual hypothesis model.

H3 Social adaptability mediates the relationship between physical activity and psychological capital among college students;

H4 In the mediation model, prosocial behavior moderates the relationship between college students' physical activity and social adaptation.

Participants and methodology

Participants

In April 2025, a cross-sectional survey was conducted in 211 universities in Ningxia Hui Autonomous Region using a combination of online (questionnaire star) and offline (public physical education classroom) methods, all procedures followed the Declaration of Helsinki's Ethical Principles for Medical Research Involving Human Subjects and other applicable laws, rules, and ethical codes; 132 copies were collected online, and a total of 290 copies were distributed offline, and 290 copies were recovered, with a 100% recovery rate. The content of the questionnaire includes questions related to demographic basic information, physical activity, psychological capital, prosocial behavior, and social adaptation. In addition, the study followed the STROBE checklist for cross-sectional studies. A total of 422 participants completed the questionnaire. Then we processed the recovered questionnaires to (1) exclude samples with missing values in the responses and (2) remove responses with straightlining, such as all responses to a question are almost the same or show a simple increasing or decreasing sequence, and (3) remove irregularly fast completion, e.g. replies less than 90s; Finally, 7 samples were excluded and 415 samples were included, with an effective rate of 98.34%. The final sample size included 129 males (31.1%) and 286 females (68.9%), including 238 Han (57.3%) and 177 ethnic minorities (42.7%). The mean age of participants was 19.70 ± 1.588 years.

Measuring tools

Physical activity rating scale (PARS-3)

This study adopted the PARS –3 scale revised by Liang Deqing³⁰. This scale consists of three assessment indicators, namely exercise duration, exercise intensity, and exercise frequency. Each indicator is divided into five levels. For exercise intensity and exercise frequency, levels 1–5 correspond to scores of 1–5 respectively. For exercise duration, levels 1–5 correspond to scores of 0–4 respectively. with a maximum score of 100 and a minimum score of 0. Assessment criteria: low exercise ≤ 19 points; moderate exercise $19 < \text{score} < 43$ points; ≥ 43 points indicates high exercise, with higher scores indicating more physical activity. The Kaiser-Meyer-Olkin value of the scale in this study was 0.609, and the Cronbach's alpha coefficient of the scale in this study was 0.631.

Positive psychological capital scale (PPQ)

The Positive Mental Capital Scale prepared by Zhang Kuo et al.³¹ was used, which includes four dimensions: self-efficacy, resilience, hope, and optimism. For statistical convenience, the Likert 5-point scale was used in this study, ranging from 1 (not at all compliant) to 5 (fully compliant), working with a total of 26 questions, five of which were reverse scored (questions 8, 10, 12, 14, and 25). Higher total scores indicate higher individual psychological capital. The Kaiser-Meyer-Olkin value of the scale in this study was 0.925, and the Cronbach's alpha coefficient was 0.877.

Diagnostic scale for social adaptability

In this study, we used the Social Adaptability Diagnostic Scale developed by Jung Il-chang³². It consists of 20 questions, with single-numbered questions scored A=–2, B=0, C=2, and double-numbered questions scored A=2, B=0, C=–2 (Where A represents yes, B represents no certainty, and C represents no). The higher the total score, the better the social adaptability, and vice versa. The Kaiser-Meyer-Olkin value of the scale in this study was 0.773, and the Cronbach's alpha coefficient for this scale in this study was 0.762.

Prosocial tendencies scale (PTM)

The pro-social tendency scale (PTM)³³ developed by Kou et al. was used in the study, which consists of 23 questions and is a 5-point Likert scale, with one standing for “not very much like me” and five standing for “very much like me,” and contains six dimensions: emotionality, dependence, altruism, openness, anonymity, and urgency, and the higher the total score, Individuals have a higher tendency of prosocial behavior. The Kaiser-Meyer-Olkin value of the scale in this study was 0.918, and the Cronbach's alpha coefficient for this scale in this study was 0.902.

Data analysis

In the data processing stage of this study, through systematic screening and standardization, firstly, the raw data were strictly screened to eliminate the samples with too high a proportion of missing values, apparent logical contradictions, and invalid responses, and secondly, we used the SPSS version 27 software to carry out Harman's one-way test, the independent samples t-test, the standard distribution test, the descriptive statistical analysis, the Pearson's correlation analysis, and the test of mediated effect with moderated mediated effects test. To analyze the moderated mediating effect, we first used Model 4 of the PROCESS 4.1 plugin in SPSS to test the independent mediating effect, and then, on this basis, adopted Model 7 to test the moderated mediating effect. We standardized all variables and conducted a simple slope analysis to test for all potentially significant interaction effects. In order to improve the accuracy of the analysis, the bias-corrected percentile Bootstrap method was used to select the sampling amount to 5000, and the model was further tested under the 95% confidence interval. The significance of moderating effects was determined by whether the 95% CI contained zero; if the 95% CI did not, the corresponding effect was considered significant.

	Male (N=129)	Female (N=286)	P-value	t	Skewness	Kurtosis
Physical activity	28.50 (23.314)	17.22 (17.462)	<0.001	4.909	1.669	2.753
Social Adaptation	11.77 (12.808)	11.14 (13.243)	0.955	0.451	0.829	0.158
Psychological capital	84.54 (16.013)	84.28 (14.148)	0.117	0.168	-0.149	1.373
Pro-social behavior	74.59 (12.168)	74.56 (12.320)	0.832	0.023	0.223	1.470

Table 1. Independent samples t-test and normality test.

	M	SD	Physical activity	Social Adaptation	Psychological capital	Pro-social behavior
Physical activity	20.73	20.132	1			
Social Adaptation	11.33	13.097	0.155 **			
Psychological capital	84.36	14.735	0.210**	0.199**		
Pro-social behavior	74.57	12.258	0.203**	0.188 **	0.364**	1

Table 2. Descriptive statistics and correlation analysis between study variables (N=415). Note: * $p < 0.05$, ** $p < 0.01$.

Results

Common method bias test and normality test

The Harman one-way test was used to assess possible standard method bias. Exploratory factor analysis produced 17 factors with eigenvalues greater than 1, the first of which explained 16.505% of the variance. This value is well below the critical value of 40%, so it can be judged that the results were not seriously affected by common method bias.

Table 1 demonstrates the performance of different genders regarding physical activity, social adaptation, psychological capital, and pro-social behavior scores, as well as the skewness and kurtosis indicators of each variable. The independent samples t-test results showed that boys’ physical activity levels were significantly higher than girls’ ($p < 0.001$). At the same time, there was no significant difference between boys and girls on the scores of social adaptation, psychological capital, and pro-social behavior. The skewness and kurtosis indicators show that the absolute value of skewness is less than 3 and the absolute value of kurtosis is less than 10, so it can be assumed that the data conform to normal distribution.

Descriptive statistics and correlation analysis

Descriptive statistics and Pearson’s correlation analysis showed that physical activity was significantly and positively correlated with social adaptation ($r = 0.155, p < 0.01$), psychological capital ($r = 0.210, p < 0.01$), and pro-social behavior ($r = 0.203, p < 0.01$), this indicates that the higher the frequency or intensity of college students’ participation in physical activities, the better their social adaptation ability, psychological capital level and prosocial behavior performance tend to be ; that social adaptation was significantly and positively correlated with psychological capital ($r = 0.199, p < 0.01$) and pro-social behavior ($r = 0.188, p < 0.01$) were significantly positively correlated, it indicates that college students with stronger social adaptation ability generally have a higher level of psychological capital and are more inclined to exhibit prosocial behaviors. Psychological capital was significantly positively correlated with pro-social behavior ($r = 0.364, p < 0.01$), it suggests a closer positive correlation between the two, meaning that college students with richer psychological capital may exhibit more prominent prosocial behaviors, and vice versa. See Table 2.

Moderated mediation model analysis

Analysis of the independent mediating effect of social adaptation

All variables in this study were standardized, and mediation effect analysis was conducted using Model 4 of the PROCESS 4.1 plugin in IBM SPSS 27 to explore the mediating role of social adaptation. The model in this study took physical activity as the independent variable, social adaptability as the mediating variable, and psychological capital as the dependent variable, while incorporating gender, age, and ethnicity as control variables into the model. To improve the accuracy of the analysis, the bias-corrected percentile Bootstrap method was adopted, with a sampling size of 5000 selected for further testing of the model under a 95% confidence interval. The results showed that physical activity significantly and positively predicted social adaptation ($\beta = 0.177, p < 0.01$) and psychological capital ($\beta = 0.224, p < 0.01$), and social adaptation significantly and positively predicted psychological capital ($\beta = 0.155, p < 0.01$). The indirect effect value of physical activity on psychological capital through social adaptation was 0.027 (95% CI [0.010, 0.052]), indicating that the independent mediating effect of social adaptation was significant, and Hypothesis H3 was supported.

Analysis of the moderating effect of prosocial behavior

On the basis of the above, we used Model 7 of the PROCESS 4.1 plugin to conduct a moderated mediation effect analysis to explore the moderating role of prosocial behavior. Prosocial behavior was included in the model as a moderating variable for analysis. Table 3; Fig. 2 fully present the results of the moderating effect, at the same time, Fig. 3 clearly shows this adjustment trend. Physical activity significantly and positively predicted social

Model Component	Effect Size	SE	95% CI
Direct effect	0.224	0.048	0.125~0.3219
M-1SD	0.047	0.018	0.018~0.087
M	0.029	0.012	0.010~0.055
M + 1SD	0.011	0.009	-0.005~0.031
Indirect effect	-0.018	0.008	-0.037~-0.005
PA→SA→PC	0.027	0.011	0.010~0.052

Table 3. Moderating effects of pro-social behaviors in the impact of physical activity on psychological capital among college students. Note: M-1SD: low pro-social behavior; M + 1SD: high pro-social behavior; PA: physical activity ; SA: social adaptation; PC: psychological capital

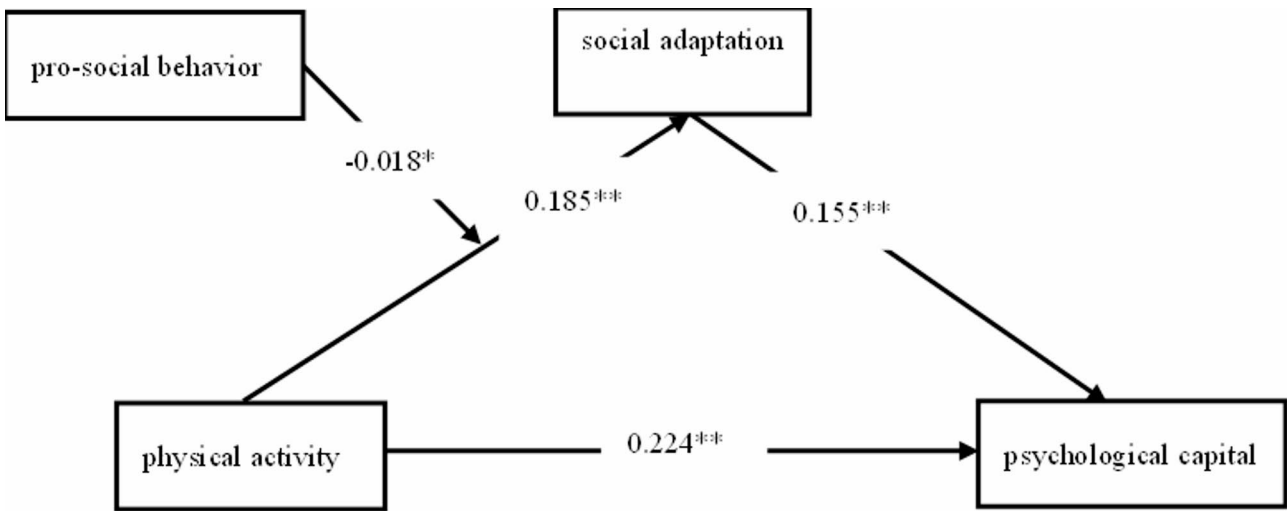


Fig. 2. Moderating model of pro-social behavior in the effect of physical activity on psychological capital in college students. * $p < 0.05$, ** $p < 0.01$.

adaptation ($\beta = 0.185, p < 0.01$) and psychological capital ($\beta = 0.224, p < 0.01$); social adaptation significantly and positively predicted psychological capital ($\beta = 0.155, p < 0.01$); and prosocial behavior significantly moderated the indirect effect of physical activity on psychological capital through social adaptation (Index = -0.018 , 95% CI [$-0.037, -0.005$]). When individuals were at a low level of prosocial behavior, the mediating effect was significant with an effect value of 0.047 (95% CI = $0.018, 0.087$). In contrast, when individuals were at a high level of prosocial behavior, the mediating effect was insignificant with an effect value of 0.011 (95% CI = $-0.005, 0.031$).

Discussion

This study further explored the relationship between physical activity and psychological capital by constructing the mediating effect of social adaptation and the moderating effect model of prosocial behavior. The results show that physical activity is positively correlated with psychological capital, and social adaptation mediates the relationship between physical activity and psychological capital, and prosocial behavior plays a regulatory role in it. Compared with high-level prosocial behavior, physical activity has a stronger effect on psychological capital through social adaptation under low-level prosocial behavior. Therefore, in the process of improving college students' psychological capital, in addition to paying attention to the mediating role of social adaptability, we should also pay attention to the moderating factor of prosocial behavior.

Associations between physical activity, social adaptation, and psychological capital

First, college students' physical activity positively relates to psychological capital and predicts psychological capital, and research hypothesis H1 is established. The results of this study are the same as those of previous studies^{34,35,50}, further affirming the positive effect of physical activity on improving psychological capital. Meanwhile, this study also proved a significant positive correlation between physical activity and social adaptation, which supports research hypothesis H2. The comprehensive analysis shows a significant positive correlation between all three, i.e., higher psychological capital is associated with higher physical or social adaptation. According to the social interaction theory³⁶, participating in physical activities allows individuals to interact with others. Those who regularly participate in physical activities are more likely to come into contact with people of different backgrounds and personalities during exercise, which helps expand their social circle and enhance their adaptability to different social roles and relationships.

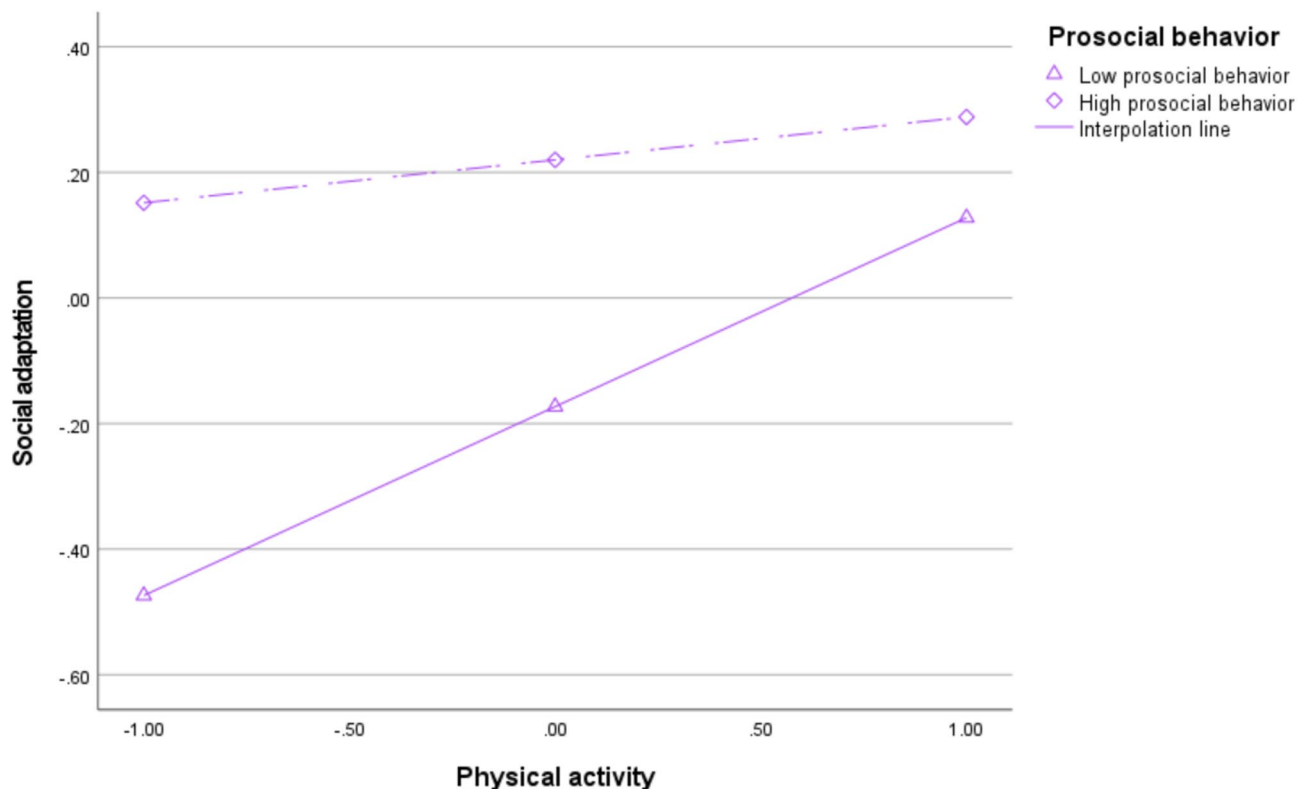


Fig. 3. Moderating trends of pro-social behaviors in the effects of physical activity on social adaptation.

In addition, self-determination theory²⁹ states that an individual's intrinsic motivation and psychological needs significantly impact the persistence of their behavior. Individuals with higher psychological capital are typically more self-driven and resilient, and they are more likely to view physical activity as a way to fulfill their health, growth, and socialization needs and thus actively engage in and persist in physical activity. Yuanhua Li (2020)³⁷ noted in his study that girls' physical activity levels and psychological capital were lower than boys', suggesting that girls need to increase their psychological capital by increasing their physical activity. In addition, for the duration and intensity of physical activity, sustained moderate-intensity physical activity has a good effect on the psychological capital level of college students³⁸.

Meanwhile, the social cognitive theory³⁹ well explains the association between the three, according to which college students in team sports, individuals learn to master social skills through observation and improve social adaptation, overcome sports challenges, enhance self-efficacy, and strengthen psychological capital. Meanwhile, good social adaptation attracts individuals to participate in physical activities, and higher psychological capital can sustain physical activities. The three form a dynamic closed loop, and any positive change in any link can trigger a chain reaction and promote the individual's overall development; conversely, it may fall into a vicious circle. Therefore, promoting individual development requires the synergistic enhancement of these three elements through encouraging physical activity, optimizing the social adaptive environment, and cultivating psychological capital to enhance individual physical and mental health and social functioning.

The mediating role of social adaptation

The independent mediation analysis showed that even without considering prosocial behavior, physical activity can still indirectly promote psychological capital by enhancing social adaptation, which confirms the stability of social adaptation as a core mediating variable. First, this study revealed a significant positive relationship between physical activity and social adaptation. Participation in physical activity can enhance an individual's social interaction, improve their coordination and communication skills in teamwork, and thus promote social adaptation⁴⁰. Second, the study showed that social adaptation significantly and positively predicted psychological capital. Good social adaptation helps individuals establish positive interpersonal relationships and obtain more social support, thus enhancing their psychological capital⁴¹. Chen H (2022)⁴² found that physical activity can ultimately reduce cell phone addictive behaviors by improving an individual's social adaptation, which in turn improves psychological capital. This implies that physical activity directly enhances an individual's psychological capital and has a longer-term and positive impact by improving their social adaptation⁴³.

In addition, other studies have shown that social adjustment mediates the relationship between different factors and psychological capital. For example, one study found that social support can influence the psychological capital of Chinese international students through social adaptation, helping them to better adapt to a new socio-cultural environment⁴⁴. Another study explored the effect of social capital on occupational adaptation and

found that psychological capital was mediating⁴⁵. Social adaptation is essential to mediating physical activity and psychological capital. By engaging in physical activity, individuals can improve their social adaptive capacity, which in turn enhances their psychological capital and ultimately promotes their physical and mental health⁴⁶.

The moderating role of pro-social behavior

In this study, a model was constructed using pro-social behavior as a moderating variable, which showed that pro-social behavior significantly moderated the process of physical activity mediating psychological capital through social adaptation and that this indirect pathway was significant in low pro-social behavior but not in high pro-social behavior, and that the research hypothesis H4 was valid. For this finding, on a psychological level, psychological exhaustion or saturation likely occurs when an individual's pro-social behaviors are overly frequent⁴⁷. For example, a college student who is overzealous in helping his classmates at the expense of his study and rest time may feel overwhelmed in the long run, interfering with the positive contribution that physical activity initially makes to psychological capital and affecting academic and psychological health. From the perspective of attention allocation, college students with high levels of pro-social behavior tend to focus more on paying attention to the needs of others and dealing with social relationships during their daily study and life⁴⁸. When participating in physical activities, their thoughts may still be occupied by such issues as “whether their classmates need help” and “whether the arrangement of club activities is appropriate,” making it difficult for them to focus all their energy on the exercise itself, thus reducing the psychological capital promotion effect of physical activities on psychological capital. This reduces the impact of physical activity on mental capital.

LUO X's findings suggest that gender moderates the relationship between physical activity and psychological capital⁴⁹. This indicates that, when exploring the complex relationship between physical activity, psychological capital, and related influencing factors, in addition to focusing on the moderating variable of pro-social behavior, the role of other potential factors, such as gender, should also be fully considered, to more comprehensively and in-depth understanding and grasping of the influencing mechanism of the psychological capital of college students, and to provide a more diversified and accurate direction for the subsequent relevant research and practical interventions.

Limitations and prospects of the study

This study has significant theoretical and practical significance at several levels. However, this study also has some limitations. First, the sample size mainly comes from college students in some colleges and universities, and there is a certain degree of concentration in terms of geography, subject specialization, and school level, which lacks a broad coverage of students in different regions and types of colleges and universities. Second, regarding variable measurement, the assessment of physical activity, social adaptation, pro-social behavior, and psychological capital primarily relied on self-reported scales. Thirdly, the cross-sectional research design adopted in this study involves measuring variables at a specific point in time with a one-time measurement. It is unable to capture the dynamic changes of variables over time, and thus it is difficult to determine the sequence in which these variables occur. Future research can be improved in the following ways: first, further expand the scope of sample selection to cover college students from different regions, levels, and disciplinary specialties, and even include groups of college students from other cultures. Second, a longitudinal design is used to explore the causal relationship between physical activity and psychological capital in depth. Finally, multiple measurement methods are combined to improve the accuracy and objectivity of variable measurement.

Conclusion

The present study confirms a significant positive correlation between physical activity, social adaptation, and psychological capital. Moreover, the study further found that social adaptation mediated the relationship between physical activity and psychological capital, while pro-social behavior played a significant moderating role in this mediating effect. These findings provide us with a deeper understanding of the benefits of physical activity for psychological capital while revealing the role of pro-social behavior. Based on these perceptions, the present study expects to provide a theoretical basis for relevant interventions. Given that the moderating effect is negligible at high levels of prosocial behavior, intervention measures should focus on contexts with low prosocial behavior. For example, carrying out characteristic courses or club activities that combine physical activities and prosocial elements in such contexts can promote social adaptation while optimizing the impact of prosocial behavior, contributing to the mental health and all-round development of college students.

Data availability

All data has been converted to specific scores and can be obtained from the following link: <https://github.com/nie-ship-it/PA-MENTAL/blob/0ab06f6b2a04a5f8d1c1abf3ec5501f3d26c340c/%E7%B8%B8%E8%B4%A8%E6%95%B0%E6%8D%AE.xlsx>.

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Author contributions

Xue Qiang, co-ordinate management, resource integration, funding, thesis writing and subsequent articles separately modified. Wang Tianci and Yuyang Nie designed the study, conducted the data analysis and interpretation. Jinchao Gao and Cong Liu organized the research process and conducted the literature search. Xishuai Wang and Xiansen Yao performed the literature screening and assisted in drafting the manuscript. Jiyu Zhang, Yanyue Li and Han Sun provided experimental and testing guidance and contributed to revising the manuscript. Tianci Wang contributed equally to this work with Xue Qiang and is considered a co-first author.

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Declarations

Ethical statement

This study has been approved by the Ethics Committee of the Department of Psychology, Beijing Normal University, and has obtained written informed consent from all subjects to ensure that they participate in this study on a voluntary basis.

Competing interests

The authors declare no competing interests.

Additional information

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