Psychology Research and Behavior Management Dovepress

Open Access Full Text Article ORIGINAL RESEARCH

The Role of Self-Esteem and Depression in the Relationship Between Physical Activity and Academic Procrastination Among Chinese Undergraduate Students: A Serial Mediation Model

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Purpose: Physical activity has been found to be negatively correlated with academic procrastination. However, the potential mediating variables in this relationship are not well understood. This study aimed to explore the mediating effects of self-esteem and depression in the relationship between physical activity and academic procrastination among Chinese undergraduate students.

Patients and Methods: A total of 1233 Chinese undergraduate students participated in the study. The unidimensionality of the self-esteem, depression, and academic procrastination was examined using Confirmatory Factor Analysis (CFA). Serial mediation analysis was conducted using SPSS 25.0 macro-PROCESS 3.3 to examine whether self-esteem and depression jointly mediated the relationship between physical activity and academic procrastination.

Results: Self-esteem, depression, and academic procrastination displayed a good-fit to the one-factor model. The results indicated that physical activity indirectly impact academic procrastination through three pathways: (1) self-esteem (β=−0.011, Boots 95% CI [−0.021, −0.001]), which accounted for of 12.09% of the total effect, (2) depression (β=−0.022, Boots 95% CI [−0.036, −0.009]), which accounted for 24.18% of the total effect, and (3) self-esteem and depression (β=−0.006, Boots 95% CI [−0.011, −0.002]), which accounted for 6.59% of the total effect. The total mediating effect was 42.86%.

Conclusion: These findings suggest that self-esteem and depression playing a mediating role in the relationship between physical activity and academic procrastination, respectively. Moreover, self-esteem and depression co-mediate this relationship through a serial pathway.

Plain Language Summary: This study explores the connection between physical activity and the tendency of undergraduate students in China to delay their academic tasks. Researchers were particularly interested in how feelings of self-worth (self-esteem) and mood (depression) might influence this relationship. We found that students who are more active physically tend to procrastinate less on their study. This effect is partly because physical activity boosts their self-esteem and reduces feelings of depression. Both these factors, individually and together, help explain why active students are more likely to tackle their academic tasks promptly. Basically, being physically active not only helps students feel better about themselves and less depressed but also encourages them to be more diligent with their studies.

Keywords: physical activity, self-esteem, depression, academic procrastination

Received: 10 May 2024
Accepted: 21 October 2024
Published: 28 October 2024

Introduction

Academic procrastination is a common issue among undergraduate students, characterized by the tendency to delay starting or completing academic tasks despite recognizing the potential negative consequences.[1] Research shows that 74.1% of undergraduate students engage in this behavior,[2] which is linked to poor academic performance and various mental health conditions.[3,4] Given these harmful effects, researchers have identified factors that may influence academic procrastination, with physical activity emerging as a promising factor due to its negative correlation with procrastination.[5–8] While some studies have examined the indirect effects of physical activity on academic procrastination via mediators such as self-efficacy and self-control,[9,10] additional variables remain to be examined. Two potential mediators are self-esteem and depression. Previous research has shown that low levels of physical activity correlate with low self-esteem,[11] while engagement in physical activity can enhance feelings of competence and satisfaction, thereby improving self-esteem.[12] Furthermore, according to the vulnerability model of low self-esteem and depression,[13] individuals with low self-esteem are at greater risk for depression, which may lead to procrastination as a means of protecting their self-worth.[14] Depression itself is positively correlated with academic procrastination,[15] as students experiencing high levels of depression may develop negative self-perceptions that hinder their ability to complete academic responsibilities.[15] Consequently, this study seeks to explore the potential mediating roles of self-esteem and depression in the relationship between physical activity and academic procrastination among Chinese undergraduate students.

Self-esteem refers to an individual's overall assessment of personal worth or abilities. Researchers have shown that physical activity can improve self-esteem,[12,16] which is consistent with the skill-development hypothesis.[17] Evidence indicates a significant link between self-esteem and procrastination,[18] suggesting that lower self-esteem leads to decreased motivation for academic tasks.[15] Furthermore, Self-esteem is considered a predictor of academic procrastination.[2,19] According to the Temporal Motivational Theory (TMT), individuals with low self-esteem are more sensitive to threats, which can trigger stronger negative emotions when confronting academic tasks. This emotional response may lead to procrastination as a way to avoid these feelings and protect self-esteem.[20] Studies have shown a negative correlation between self-esteem and procrastination among college students.[21,22] These findings proved that physical activity influences self-esteem, which in turn is linked to academic procrastination. Therefore, it is hypothesized that self-esteem mediates the relationship between academic procrastination and physical activity.

Depression is a common mental disorder that inversely relates to physical activity,[23–26] indicating that physical activity can alleviate depressive symptoms. Moreover, depression is closely related to academic procrastination,[15,27,28] making it difficult for affected students to complete tasks efficiently.[14] Therefore, it is reasonable to consider depression as a plausible mediator of the relationship between academic procrastination and physical activity. Evidence also shows that self-esteem predicts depression.[29,30] Individuals with low self-esteem are more likely to experience sadness and loneliness. Some studies indicate that self-esteem can mediate the relationship between physical activity and depression,[31,32] implying that enhancing self-esteem may be one mechanism through which physical activity improves mental health. Given that both self-esteem and depression correlate with procrastination,[18] they may play a serial mediating role in the relationship between physical activity and academic procrastination. Prior research also highlights that self-esteem mediates the connection between depression and procrastination, particularly among individuals influenced by dysfunctional attitudes such as perfectionism.[15]

In summary, this study aims to investigate how self-esteem and depression mediate the relationship between physical activity and academic procrastination among Chinese undergraduate students, as shown by three proposed hypotheses and a developed model (see Figure 1).

Hypothesis 1: Self-esteem plays a mediating role in the relationship between physical activity and academic procrastination.

Hypothesis 2: Depression is a mediator of the relationship between physical activity and academic procrastination.

Hypothesis 3: Self-esteem and depression act as serial mediators in the relationship between physical activity and academic procrastination. The order of pathway is physical activity → self-esteem → depression → academic procrastination.

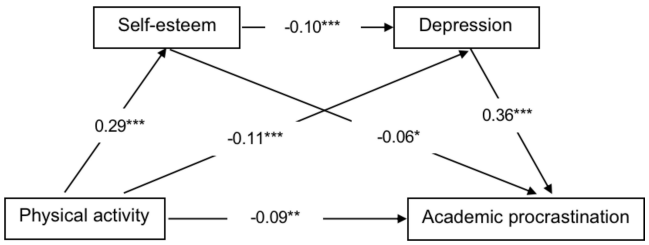

Figure 1 Serial mediation model of physical activity and academic procrastination through self-esteem and depression as serial mediators.
Notes: *p < 0.05, **p < 0.01, ***p < 0.001.

Materials and Methods

Participants and Ethics Statement

A total of 1233 full-time undergraduate students (17–22 years old) from two universities in Jiangsu Province and Zhejiang Province (China) were recruited using a convenient sampling strategy. A cross-sectional study requires a large number of subjects, so this study collected more than 1000 samples without calculating the sample size.

Before the investigation, all participants completed an informed consent process. For participants under 18 years of age, consent was obtained from their legal guardians. This study complies with the Declaration of Helsinki and was approved by the Ethics Committee of Zhejiang Normal University (ZSRT2019045).

Measures

Physical Activity

The Physical Activity Rating Scale-3 (PARS-3), which was revised by Liang,[33] was used to assess the physical activity levels of the participants. The PARS-3 scale is a reliable tool for measuring physical activity that has been previously validated, with a retest reliability of 0.82.[33] The PARS-3 has been widely used in the field of physical activity, especially among Chinese undergraduate students.[34–36] It consists of 3 self-reported items that evaluate physical activity intensity, duration, and frequency. Participants rated each item on a 5-point Likert scale, with scores ranging from 1 to 5. For instance, the question regarding physical activity frequency asked, "How often do you engage in physical activity each month/week?" The answer choices were: less than once a month (1 point), 2 to 3 times a month (2 points), 1 to 2 times a week (3 points), 3 to 5 times a week (4 points), and daily (5 points). The total physical activity score is calculated using the following formula: Physical Activity Score = Physical Activity Intensity Score × (Physical Activity Duration Score - 1) × Physical Activity Frequency Score. Scores range from 0 to 100 points. Physical activity levels are classified as low (≤19 points), moderate (20 to 42 points), and high (≥43 points).

Academic Procrastination

The 26-item Academic Procrastination Questionnaire for College Students (APC), which was revised by Han,[37] was used to assess academic procrastination. The APC focuses on three key areas: completing assignments, studying for exams, and independent learning. It has been validated in previous study, showing good reliability and validity.[37] The questionnaire consists of 26 items and uses a 5-point Likert scale, where responses range from "never" (1) to "always" (5). A higher score indicates a greater level of procrastination. Representative items include statements such as, 'I cannot finish my homework in time', 'Even though I know when the exam is, I rarely prepare in advance', and 'I cannot complete my self-set study goals and tasks on time'.

Self-Esteem

The Rosenberg Self-esteem Scale (RSES),[38] a validated 10-item scale with positive and negative statements was used to assess global self-esteem using a Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). The Chinese version of the RSES demonstrated good reliability and validity,[39] Example question: "I feel that I have good qualities." Higher scores indicate higher levels of self-esteem.

Depression

Depression was assessed by the Patient Health Questionnaire (PHQ-9),[40] a valid and reliable tool for screening depressive symptoms in its Chinese version.[41] Participants indicated the frequency of experiencing nine depression-related symptoms in the past two weeks, such as feeling down, depressed, or hopeless, using a 4-point scale ranging from 1 (not at all) to 4 (almost every day).

Data Analysis

The data in this study were analyzed using SPSS Version 25.0. Confirmatory factor analysis (CFA) was performed to assess the adequacy of the measurement model, including the three latent variables (ie, self-esteem, depression, and academic procrastination). In assessing the goodness-of-fit for the measurement, multiple statistics were employed, such as Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Incremental Fit Index (IFI), using values of above 0.90 as a cutoff for a good model fit, and Root Mean Square Error of Approximation (RMSEA) with a cutoff of 0.08 or less indicating a good model fit. A hierarchical regression analysis was used to test the predictive level of each variable (physical activity, self-esteem, and depression) on the dependent variable (academic procrastination). Hayes (2013)'s SPSS macro-PROCESS 3.3 (model 6) with a 95% percentile confidence interval (CI) based on 5000 bootstrap samples was used to examine the indirect effects of physical activity and academic procrastination through self-esteem and depression. The indirect effect is considered statistically significant if the CI does not include zero.

Results

Characteristics of Participants

A total of 1233 Participants were aged 17–22 years old (Mean=19.22, SD=0.98), including 941 females and 292 males. The sample consisted of 484 freshmen (39.30%), 575 sophomores (46.60%), and 174 juniors (14.10%).

CFA Results

The CFA results indicated that the fit of the models for self-esteem, depression, and academic procrastination was good, with CFI, TLI, and IFI all above 0.90, and RMSEA values all below 0.08. Detailed results are presented in Table 1.

Regression Analysis Results

Table 2 shows the results of the regression analysis.

Step 1: Physical activity significantly predicted self-esteem ($\beta=0.29$, $p<0.001$), indicating that higher levels of physical activity were correlated with higher levels of self-esteem.

Step 2: Both physical activity and self-esteem significantly predicted depression ($\beta=-0.11$, $p<0.001$; $\beta=-0.10$, $p<0.001$, respectively). Higher levels of both factors were linked to lower levels of depressive symptoms.

Step 3: All three variables significantly predicted academic procrastination. Physical activity ($\beta=-0.09$, $p<0.01$) and self-esteem ($\beta=-0.06$, $p<0.05$) negatively correlated with academic procrastination, while depression ($\beta=0.36$, $p<0.001$) positively correlated with academic procrastination.

Table 1 Results of Confirmatory Factor Analysis

Variables	χ^2/df	CFI	TLI	IFI	RMSEA
Self-esteem	1.639	0.987	0.968	0.987	0.047
Depression	1.753	0.997	0.992	0.997	0.025
Academic procrastination	2.727	0.986	0.975	0.986	0.037

Abbreviations: χ^2/df, Chi-squared divided by degrees of freedom; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; IFI, Incremental Fit Index; RMSEA, Root Mean Square Error of Approximation.

Table 2 Results of Regression Analysis

Regression Equation		Fitting Indices		Regression Coefficient	
Outcome Variables	**Predictor Variables**	**R^2**	**F**	**β**	**t**
Self-esteem		0.08	112.80***		
	Physical activity			0.29	10.62***
Depression		0.03	17.38***		
	Physical activity			−0.11	−3.60***
	Self-esteem			−0.10	−3.42***
Academic procrastination		0.16	75.68***		
	Physical activity			−0.09	−3.21**
	Self-esteem			−0.06	−2.20*
	Depression			0.36	13.42***

Notes: *p < 0.05, **p < 0.01, ***p < 0.001.

Mediation Analysis Results

Table 3 presents findings on the serial mediation analysis aimed to examine the indirect effects of physical activity on academic procrastination through self-esteem and depression.

Direct Effect

The direct effect of physical activity on academic procrastination was significant (β=−0.052, Boots 95% CI [−0.085, −0.023], p<0.01).

Total Indirect Effect

The total indirect effect of physical activity on academic procrastination through self-esteem and depression was −0.039 (Boots 95% CI [−0.055, −0.024], p<0.001).

Indirect Effects

Through self-esteem: −0.011 (Boots 95% CI [−0.021, −0.001], p<0.001), accounting for 12.09% of the total effect.
Through depression: −0.022 (Boots 95% CI [−0.036, −0.009], p<0.001), accounting for 24.18% of the total effect.
Serial mediation (Self-esteem → Depression): −0.006 (Boots 95% CI [−0.011, −0.002], p<0.001), accounting for 6.59% of the total effect.

Overall, the total mediating effect of physical activity on academic procrastination through both self-esteem and depression was 42.86%.

These findings suggest that both self-esteem and depression partially mediate the relationship between physical activity and academic procrastination. Specifically, increased physical activity is related to higher levels of self-esteem and lower levels of depression, which may reduce the academic procrastination likelihood.

Table 3 Total, Direct, and Indirect Effects of Physical Activity (X) on Academic Procrastination (Y) Through Self-Esteem (M1) and Depression (M2) (N=1223)

Effect	Point Estimate	SE	Boots 95% CI		t	p
			Lower	Upper		
Total effects	−0.091	0.016	−0.123	−0.060	−5.46	<0.001
Direct effect	−0.052	0.016	−0.085	−0.023	−3.21	<0.01
Total indirect effects	−0.039	0.008	−0.055	−0.024		
X→M1→Y	−0.011	0.005	−0.021	−0.001		
X→M2→Y	−0.022	0.007	−0.036	−0.009		
X→M1→ M2→Y	−0.006	0.002	−0.011	−0.002		

Notes: X, physical activity; M1, self-esteem; Y, academic procrastination; M2, depression.

Discussion

Core Findings

This study investigated the impact of physical activity on academic procrastination among undergraduate students focusing on the mediating roles of self-esteem and depression. Our results demonstrated that both self-esteem and depression serves as mediators in the relationship between physical activity and academic procrastination through a serial pathway. Our findings support the three indirect effects that we hypothesized: (1) physical activity → self-esteem → academic procrastination, (2) physical activity → depression → academic procrastination, and (3) physical activity → self-esteem → depression → academic procrastination. The total mediating effect was 42.86%, proving that our mediators were crucial in explaining the link between physical activity and academic procrastination.

Specifically, our findings revealed that self-esteem played a mediating role in the relationship between physical activity and academic procrastination. Thus, hypothesis H1 was supported: undergraduates who were physically inactive were more likely to experience academic procrastination through low self-esteem. Undergraduate students with low self-esteem often have a lower sense of task intention and efficacy, and are more susceptible to procrastination.[15] The positive impact of physical activity on self-esteem was consistent with previous evidences[12,16] and the skill-development hypothesis.[17] The skill-development hypothesis suggests that experiencing success and receiving rewards makes people feel better about themselves and strengthens their perceived competence. Regarding physical activity, the skill-development hypothesis suggests that enhancements in physical fitness or motor skill that arise by participating in physical activity trigger the increase in self-esteem. Self-esteem is considered to be an inherent outcome of successful mastery of motor skills. Therefore, it is highly recommended that undergraduate students participate in physical activity regularly to improve their level of self-esteem, thereby reducing their academic procrastination behavior.

Additionally, our study confirmed that depression substantially mediated the link between physical activity and academic procrastination. Therefore, hypothesis H2 was validated. Individuals with high levels of physical activity were less likely to suffer from depression, consistent with previous findings.[24,25] This finding can be explained based on the distraction hypothesis: physical activity may relieve depressive emotions by distracting individuals from depressive thoughts.[42] Moreover, the reason by which depression may trigger academic procrastination could be partially clarified by the symptoms of depressive disorders.[43] Individuals who experience high levels of depression may have negative views towards themselves, their lives, and their futures. This negative assessment can result in individuals negatively assessing their academic lives as well. In addition, individuals experiencing symptoms of depression, such as depressed mood, fatigue difficulty concentrating, and reduced interest in activities, may display procrastination behavior and be unable to complete academic duties on time.[15] The present study revealed that physically inactive undergraduates were more likely to be depressed, which could result in academic procrastination.

Finally, our study showed that the effect of physical activity on academic procrastination was sequentially mediated by self-esteem and depression. Thus, hypothesis H3 was supported. This initial finding suggests that by improving self-esteem, physical activity can reduce depressive symptoms, which might eventually lead to decreased risk of academic procrastination. Prior studies found that self-esteem mediated the relationship between physical activity and depression.[31] This can be explained by the Exercise and Self-Esteem Model;[44] increased self-esteem is vital for the effect of physical activity on emotional regulation. Moreover, depression, in turn, can have a significant impact on academic procrastination. It can lead to decreased motivation, difficulties in concentration and focus, and reduced energy levels, all of which can contribute to procrastination in academic tasks. Individuals with low self-esteem may be more prone to developing depression, which then leads to a higher tendency to engage in academic procrastination. Our study suggests that undergraduate students with higher levels of physical activity are less likely to experience academic procrastination through higher levels of self-esteem and lower levels of depression.

Practical Implications

This study is the first to explore the relationship between physical activity, self-esteem, depression, and academic procrastination among with undergraduate students. Our findings indicate that low self-esteem and depression are

correlated with increased academic procrastination, highlighting the need for effective interventions focused on physical activity and mental health education.

To address these challenges, institutions should prioritize developing structured physical activity programs that actively engage students in various fitness classes, team sports, and recreational activities that catering to diverse interests and skill levels. Ensuring that these programs are easily accessible will encourage broader participation.

Raising awareness about the mental health benefits of physical activity is another crucial step. Educational campaigns, including workshops and informational materials, can inform students of how regular exercise positively impacts their well-being and self-esteem while also helping to mitigate academic procrastination. Furthermore, integrating physical wellness and mental health components into academic curriculum, such as courses on stress management and healthy lifestyle choices, can allow students to value fitness alongside their studies.

Policymakers should consider these findings when designing comprehensive wellness policies that emphasize both mental health and physical activity in educational settings. By implementing these strategies, educational institutions can create an environment beneficial not only to academic success but also to overall student well-being.

Limitations

It is important to acknowledge some limitations of this study. The cross-sectional design limits our ability to establish causal relationships among variables, and makes it challenging to determine the temporal order of self-esteem and depression acting as mediators. Therefore, there is still a need for future longitudinal data to examine the sequential effects of mediation. Furthermore, relying solely on self-report questionnaires may introduce potential bias, such as retrospective self-report bias and social desirability bias which could affect the accuracy of the data. Lastly, the generalizability of the findings is limited due to the sample consisting primarily of Chinese undergraduate students, with a majority of female participants. Future studies should aim for more balanced gender representation and a diverse range of populations.

Conclusions

In conclusion, the present study provides evidence of the link between physical activity and academic procrastination. Physical activity was correlated with academic procrastination directly and indirectly. Specifically, physical activity alleviates academic procrastination via the mediating effects of high levels of self-esteem and low levels of depression, respectively, as well as the serial mediating effects of high levels of self-esteem and low levels of depression. These findings emphasize the significance of self-esteem and depression when exploring the link between physical activity and academic procrastination. Therefore, physical activity intervention or education programs aimed at decreasing academic procrastination could benefit from a multifaceted method therapeutically targeting the promotion of self-esteem and the reduction of depression. Future studies are needed to further understand the association between physical activity and academic procrastination.

Abbreviations

APC, Academic Procrastination Questionnaire for College Students; RSES, The Rosenberg Self-esteem Scale; PHQ-9, Patient Health Questionnaire; PARS-3, Physical Activity Rating Scale-3; TMT, temporal motivational theory; χ^2/df, Chi-squared divided by degrees of freedom; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; IFI, Incremental Fit Index; RMSEA, Root Mean Square Error of Approximation.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

This study complies with the Declaration of Helsinki and was approved by the Ethics Committee of Zhejiang Normal University (ZSRT2019045). Informed consent was obtained from all subjects involved in the study. For participants under 18 years of age, consent was obtained from their legal guardians.

Acknowledgments

We thank the instructors Lili Luo, Lei Ji, Xiaoping Jiang, Xi Chen, Guangjie Xin, Song Gu, Zhiyong Wang, Xiaofeng Li, and Xiaolong He for their assistance in data collection, and Leonard John Myers for assisting in proof-reading of the manuscript.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This study was funded by the National Social Science Foundation of China [Grant No. 19BTY079]; Youth Project of Science and Technology Research Program of Chongqing Education Commission of China [Grant No. KJQN202100531]; and Foundation of Chongqing Normal University [Grant No. 18XWB016].

Disclosure

The authors declare that they have no conflict of interest.

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