

The Influence of Physical Exercise on College Students' Ego Effect, Psychological Resilience and Negative Emotions: A Descriptive, Cross-Sectional Study

Jian Li (✉ ljjiantiyu@sust.edu.cn)

Shaanxi University of Science and Technology

Mei-yue Li

Xi'an Medical University

Chong Zhang

Xi'an Physical Education University

Research Article

Keywords: ego effect, psychological resilience, physical exercise, college students, negative emotions

Posted Date: June 14th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-561130/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Background

At present, college students' mental health problem has drawn a wide attention. The aim of this study was to explore the influence of physical exercise on college students' ego effect, psychological resilience and negative emotions.

Methods

A cross-sectional study was conducted with a targeted sample of 1500 college students and above who were 1–3 undergraduate students. The participants were randomly selected. Data were collected using a paper-based questionnaire. One-way ANOVA and chi-square test were used for statistical analysis.

Result

College students' physical exercise can positively predict ego effect and psychological resilience (personal strength), and negatively predict negative emotions. College students' ego effect and psychological resilience (personal strength) can negatively predict their negative emotions. The mediating effects between physical exercise and negative emotions accounted for 26.78% and 31.7% of the total effects. Family support dimension plays a significant negative regulatory role between physical exercise and negative emotion, while the interaction between interpersonal assistance and physical exercise is not significant, which can not regulate the relationship between physical exercise and negative emotion.

Conclusion

Ego effect and psychological resilience (personal strength) play an important role in the process of improving negative emotions in college students' physical exercise, and family support dimension in psychological resilience (power of support). Negative regulation of the effect of physical exercise on negative emotions. It is further confirmed that ego effect and psychological resilience have intermediary effect and regulatory effect between physical exercise and negative emotion. It is recommended that college students: choose interesting, challenging and able to adhere to the completion of sports, 3 times a week should be high-intensity physical exercise. It is not only conducive to relieving bad emotions, improving interpersonal communication, improving ego effect and psychological resilience, but also can actively promote and maintain the physical health of college students.

Background

The mental health of college students has risen to health problems, and negative emotions often occur in daily life, such as depression, anxiety, stress and so on. It is true that these negative emotions can indeed mobilize people's subjective initiative in real life and help to solve or realize the actual needs of specific aspects. However, negative emotions also have two characteristics. Excessive negative emotions belong to psychological disorders or psychological diseases, which seriously interfere with the normal life, work and study of life individuals, and should be included in the scope of prevention and treatment.

How do negative emotions occur and gradually evolve into health problems? This is because people's self-consciousness must use abstract methods to transform object things into illusory images and then use them. The objective environment changes with time, but the psychological image stays in people's cognition for a long time and is closely combined with self-consciousness, which makes a certain emotion fall into it and break away from real life. Unable to freely change the role of life, so evolved into a health problem, disease occurred.

At present, there is no systematic statistical analysis of the quantitative study of physical exercise and negative emotional effects of college students at home and abroad. Through the review of relevant literature and theory, physical exercise is aimed at pleasing body and mind, promoting physical health, and taking physical activity as the carrier, with a certain intensity, frequency and time of physical activity. Empirical studies have shown that regular and moderate physical exercise can improve and treat depression, anxiety and stress^[1–2], it can effectively reduce the adverse effects of negative emotions of college students.

Relevant empirical studies suggest that ego effect and psychological resilience may be important mediating variables between physical exercise and negative emotions. Ego effect refers to an individual's self-belief in performing an action to achieve a special purpose. The theory of ego effect holds that behavior is determined by ego effect and expectation of results. People with strong sense of ego effect can show higher self-confidence and stronger execution. Physical exercise as a behavior will interact with ego effect and produce positive changes. Empirical research shows that college students who actively participate in physical exercise can significantly improve their ego effect^[3]. Second, adolescents' sense of ego effect also plays an important role in regulating negative emotions. Studies have shown that ego effect negatively predicts negative emotions^[4]. Therefore, the study assumes that ego effect is an important "bridge".

Psychological resilience is a dynamic psychological process^[5]. Hu Yueqin and others through analysis and verification^[5], psychological resilience is divided into two main factors: human (goal focus, emotional control, positive cognition) and support (family support, interpersonal assistance), respectively. By comparing with the emotional regulation model proposed by Dodge etc^[6], the author found that the internal regulation and external regulation of the model are basically consistent with the individual force factors and the supporting force factors in psychological resilience. Therefore, the author believes that psychological resilience plays a key role in internal and external regulation of emotion. Empirical research also shows that physical exercise helps to regulate students' attention orientation, emotional level and improve their ability to solve problems^[7].

The study also found that there were differences in negative emotions between college students with the same physical exercise, which indicated that physical exercise and negative emotions were regulated by some variables. In view of the high correlation between psychological resilience and negative emotion of college students. The hypothesis is that psychological resilience can significantly regulate physical exercise and negative emotion of college students.

To sum up, the current research on negative emotions of college students mainly focuses on psychological aspects, and few scholars discuss the relationship between negative emotions self, my sense of efficacy and psychological resilience, physical exercise. Therefore, this study takes physical exercise as a leading factor and discusses the influence of negative emotion on college students from the perspective of ego effect and psychological resilience. In this study, the following hypotheses are put forward: the negative emotions of college students are not only directly affected by physical exercise, but also affected by the mediation and regulation of ego effect and psychological resilience. In order to strengthen the physique of college students to provide an important empirical basis.

Methods

Research subjects

Using stratified cluster sampling, In September 2020, 3 colleges and universities in Shaanxi Province selected 1-3 undergraduate students as the mother group, to ensure the sample selection is representative, Stratified by discipline, Then random sampling, to finalize a questionnaire survey of eight undergraduate students, A total of 1500 people. The questionnaire was conducted in two sessions, the interval is 2 weeks. Eventually, Checked out 88 invalid questionnaires, the effective sample size of this study is 1412, the effective rate of the sample was 94.13. Among them, 52.9 per cent are from towns, 47.1 per cent from rural areas; Arts students accounted for 41.3 per cent, 58.7 percent of science students; 46.8% female, 53.2 percent were boys.

Research tools

Negative emotional scale

The Self rating Depression Anxiety Stress Scale compiled by Lovibond et al, revised by Andony et al and translated by Yuan xinqun was used for measurement. The scores were quantified from three dimensions of depression, anxiety and stress. Likert 4-point scoring system was used, and the score was 0-3. The higher the score of the scale, the higher the level of negative emotion. In this study, the internal consistency coefficient of each dimension of the scale ranged from 0.861 to 0.896

Ego effect scale

The general Ego effect scale compiled by Sehwarzer and revised by Wang caikang was used take measurements. The scale consists of 10 questions. The Likert 4 score is 1-4 points, and the higher the score is, the higher the sense of ego effect is. In this study, the internal consistency coefficient of the scale was 0.886

Resilience scale

The Adolescent Resilience Scale was developed by Hu Yueqin et al. There are 21 items in 5 dimensions of the scale, involving personal factors and support factors. The Likert 4-point scoring system was used, and the score was 1-4. The higher the score, the better the psychological resilience. In this study, the internal consistency coefficient of the three dimensions of the scale ranged from 0.721 to 0.793.

Physical exercise rating scale

The physical exercise rating scale revised by Hu Deqing was used for measurement. It mainly involves three dimensions of exercise intensity, duration and frequency. The Likert 5-point scoring system is adopted, and the corresponding score is 1-5. The higher the score is, the greater the amount of physical exercise is. The score of the amount of physical exercise = exercise intensity \times Exercise time score - 1). In this study, the test-retest reliability of the scale was 0.86.

Mathematical statistics methods

Data are processed and analyzed by spss22.0 and AMOS20.0 software. At the same time, after data collection, the Harman single factor test method is used to verify the serious common method deviation. The results show that there are 5 common factors with characteristic roots greater than 1, and the interpretation of variation of the first common factor is only 21.33, less than the critical value standard of 40%, so there is no serious common method deviation problem in this study.

Ethical approval and consent

The study conducted is in accordance with Declaration of Helsinki guidelines. When selecting experimental subjects, the significance and risk of participating in exercise intervention experiment were explained in detail to them. The experimental subjects were required to fill in the personal information form and informed consent form first, and those suffering from various diseases were excluded. All subjects volunteered to participate in the experiment and ensured good physical condition before the test. No sports injuries occurred during the experiment. This experiment was approved by the Ethics Committee of the Sports Department of Shaanxi University of Science and Technology.

Results

Ego effect, Psychology Resilience and Physical Exercise on Negative Emotion of College Students

For testing the direct effects of ego effect, psychological resilience and physical exercise on negative emotions of college students, the Pearson correlation analysis of the four variables was carried out.

Table 1 shows that there is a very significant correlation between physical exercise and the five dimensions of depression, anxiety, stress, ego effect, psychological resilience ($P < 0.01$); there is a very significant correlation between ego effect and depression, anxiety, stress ($P < 0.01$); the five dimensions of psychological resilience have a very significant correlation with depression, anxiety, stress ($P < 0.01$).

The author also tests the mean values of the three variables in negative emotions. results showed (table 2) that the negative emotional symptoms of college students decreased with the increase of physical exercise, and the levels of depression, anxiety and stress in the middle exercise group and the large exercise group were significantly lower than those in the small exercise group ($P < 0.01$).

Regression Analysis of ego effect, Mental Resilience, Physical Exercise and Negative Emotion of College Students

Table 3 shows that ego effect and psychological resilience (personal ability) have a very significant predictive effect on negative emotions. The predictive power of ego effect to stress > anxiety > depression, psychological resilience (personal ability) to depression > stress and anxiety. Specifically, in predicting depression, emotional control > goal focus > positive cognition; in predicting stress, emotional control > positive cognition > goal focus.

Physical exercise can significantly predict negative emotions. Table 3 shows that the ability to predict stress > anxiety > depression. At the same time, physical exercise can also significantly predict ego effect and psychological resilience (personal ability).

The mediating effect of ego effect and psychological resilience between physical exercise and negative emotion

Standard procedure for testing intermediary effects. By centralizing the data of physical exercise, negative emotion, ego effect and psychological resilience (personal ability) in spss, the mediating effects of ego effect and psychological resilience (personal ability) on negative emotion in physical exercise were investigated. The first step is to test the total effect of independent variable and dependent variable C, if significant, the second step is to test the path coefficient of independent variable to intermediary variable a as well as independent variable and intermediary variable. If the path coefficient b and c, of the dependent variable are significant, the intermediary variable has partial mediation effect.

As shown in table 4, The regression coefficients of ego effect, psychological resilience (personal ability) and physical exercise were significant. Therefore, ego effect and psychological resilience (personal ability) play a part role in mediating negative emotions in physical exercise. The mediating effect of ego effect between physical exercise and negative emotion was 26.78% [$\beta = (0.471 \times 0.224) / 0.319 \approx 0.2678$]; The mediating effect of psychological resilience (personal ability) between physical exercise and negative emotion was 31.33% [$\beta = (0.387 \times 0.319) / 0.394 \approx 0.3133$].

For further verification of the hypothesis, the AMOS20.0 is used to analyze the fitting degree of the hypothesis model. Because the sense of ego effect is a single dimension scale and there are many problems, the problems in the scale are divided into two packages, each package is 5 questions, which is used as the observation index. Taking physical exercise as independent variable, negative emotion as dependent variable, ego effect and psychological resilience as intermediary variables, the intermediary effect model was established. As shown in Figure 1, the standardized coefficient shows: $\chi^2 = 125.424$, $df = 3$, 216 , $CFI = 0.953$, $NFI = 0.941$, $RFI = 0.934$, $IFI = 0.922$, $AGFI = 0.917$, $RMSEA = 0.065$. According to Wu Minglong A point of view, in the SEM, $\chi^2 / df \leq 5.00$, $RMSEA \leq 0.08$, $CFI, NFI, RFI, IFI, AGFI \leq 0.90$, indicating model adaptation. Therefore, all the indexes in this study model meet the adaptation standard and the fitting degree is correct.

Physical exercise \rightarrow negative emotions ($\beta = -0.17$, $P \beta = 0.001$), ego effect ($\beta = 0.47$, $P \beta = 0.001$), ego effect ($\beta = -0.22$, $P \beta = 0.001$), psychological resilience \rightarrow negative emotions ($\beta = -0.32$, $P \beta = 0.001$) were significant, indicating the mediating effect of ego effect and psychological resilience between physical exercise and negative emotion, which verified the hypothesis.

Modulating effects of psychological resilience

Standard procedure for testing regulatory effects. By means of SPSS20.0, the family support and interpersonal cooperation dimensions in physical exercise, negative emotion, psychological humanity were treated centrally. The first step is to do the regression of dependent variables to independent variables and regulatory variables, and the second step is to do the regression of dependent variables to independent variables, regulatory variables and interaction items between independent variables and regulatory variables. If the interaction items are significant, it indicates that the regulatory variables have regulatory effects. As shown in Table 5, family support (ΔR) in physical exercise and psychological resilience² = 0.005, $F = 0.041$ R of interaction items² The change amount reaches a significant level, indicating that there is a regulatory effect. But the interaction between interpersonal assistance and physical exercise is not significant (ΔR) Annex² = 0.002, $F = 0.218$ Therefore, interpersonal assistance in psychological resilience (support) does not show the relationship between the negative emotions of physical exercise. At the same time, for each increase in family support, the slope of physical exercise to negative emotions increases by 0.075 standard deviations.

Discussion

According to the relevant research results^[7], it is speculated that its physiological mechanism may promote the production and release of endorphins β -human body, reduce activities such as adrenaline and cortisol, and then stimulate cognitive thinking and emotional cognition, thus reducing negative

emotions such as depression, anxiety and stress in college students. It is also suggested that the duration, intensity and frequency of physical exercise are the key indexes to influence the effect of negative emotion intervention. Studies have shown that aerobic exercise of moderate to higher intensity three or more times a week is associated with depression^[8], anxiety^[9] and stress responses^[10]. The effect of intervention was more significant. The results show that college students' participation in physical exercise can positively predict their negative emotional level, which is consistent with the previous research results^[11]. The study focuses on the relationship between physical exercise and negative emotion of college students, and finds that the negative emotion level of middle and high exercise students is low. This further confirms the view^[12] that long-term regular moderate and high intensity aerobic exercise has a more positive effect on negative emotions. It is suggested that college students should pay special attention to the duration, intensity and frequency of exercise^[13], that is, the long-term regular medium and high intensity aerobic exercise can have a more significant effect on the negative emotions of college students.

This study further confirmed that physical exercise can not only directly improve the negative emotional level of college students, but also indirectly improve their negative emotional level by improving their ego effect. That is to verify the establishment of the intermediary role between physical exercise and negative emotion of college students, which suggests that college students' ego effect is the intermediary variable that physical exercise affects negative emotion. Studies have shown that ego effect is the most closely related variable in physical exercise behavior^[14]. Whether it's a single strenuous physical exercise or a long-term exercise intervention can have a positive effect on ego effect^[15]. Secondly, ego effect can also affect people's emotions and thinking patterns. People with a strong sense of ego effect tend to be more active and self-confident in dealing with different difficulties or challenges, while their sense of control and ability increases during the implementation of the challenge, thus preventing and reducing the generation of negative emotions. It is suggested that ego effect is an important bridge between physical exercise and mental health. Physical exercise behavior of college students can not only actively prevent the occurrence of negative emotions. It can also improve the ego effect of college students and achieve the purpose of improving mental health.

This study confirmed the mediating and regulating role of psychological resilience between physical exercise and negative emotions of college students. The results show that psychological resilience (personal ability) plays a part intermediary role between physical exercise and negative emotion of college students. That is, physical exercise can actively predict college students' psychological resilience (personal ability) and play a regulatory role in the process of improving college students' negative emotions, which verifies the hypothesis. The results also show that the influence of physical exercise on negative emotions of college students is also regulated by the variables of family support dimension in psychological resilience (family strength). The results show that physical exercise is also affected by negative emotions of college students^[16]. According to the dynamic model of psychological resilience^[17]. The potential power to promote individual psychological resilience involves family, school and peer groups. Therefore, the higher the degree of family and peer support, the stronger the psychological resilience of college students, the lower the negative emotional level, and the weakening of the effect of physical exercise relative to negative emotions. However, this study also found that the interpersonal assistance dimension did not significantly regulate physical exercise and negative emotions of college students^[18]. This may be related to the decline of college students' real interpersonal skills^[19], Network virtual communication increased^[20], and so on. The results show that college students' psychological resilience plays an important role in mediating and regulating physical exercise and negative emotion. On the one hand, physical exercise can improve the psychological resilience (personal ability) of college students, thus reducing the negative emotional level of college students, suggesting that we should strengthen the cultivation of psychological resilience (personal ability) in daily physical education and group activities inside and outside the school. It can improve psychological resilience through family support and realize the influence on negative emotion of college students. But this path will weaken the intervention effect of physical exercise on negative emotion of college students.

Conclusion

This study verified the influence of physical exercise on College Students' negative emotions and its function: ego effect and psychological resilience (personal strength) play an important role in the process of improving negative emotions. Psychological resilience (power of support) in the family support dimension, negative regulation of physical exercise on negative emotions. It is further confirmed that self-efficacy and psychological resilience have intermediary effect and regulatory effect between physical exercise and negative emotion. And suggest to college students: choose interesting, challenging and you can adhere to the completion of sports, should be three times a week high-intensity physical exercise. It is not only conducive to relieving bad emotions, improving interpersonal communication, improving ego effect and psychological resilience, but also can actively promote and maintain the physical health of college students.

Declarations

Acknowledgements

We thank the undergraduate students who took part in the study.

Authors' contributions

LJ collected the literature and determined the analysis framework, analyzed the data, and wrote the paper. LMY and ZC managed data collection and cleaning. All authors reviewed and approved the final draft.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This research was approved by the Ethics Committee of the Sports Department of Shaanxi University of Science and Technology. All students invited to participate were voluntary accepted to take part in the study after signing written informed consent.

Funding

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Jo G, Rossow-Kimball B, Lee Y. Effects of 12-week combined exercise program on self-efficacy, physical activity level, and health related physical fitness of adults with intellectual disability. *J Exerc Rehabil.* 2018 Apr 26;14(2):175–182. doi: 10.12965/jer.1835194.597.
2. De Castella K, Platow MJ, Tamir M, Gross JJ. Beliefs about emotion: implications for avoidance-based emotion regulation and psychological health. *Cogn Emot.* 2018 Jun;32(4):773–795. doi: 10.1080/02699931.2017.1353485. Epub 2017 Jul 24. PMID: 28737108.
3. Lamis DA, Ballard ED, May AM, Dvorak RD. Depressive Symptoms and Suicidal Ideation in College Students: The Mediating and Moderating Roles of Hopelessness, Alcohol Problems, and Social Support. *J Clin Psychol.* 2016 Sep;72(9):919–32. doi: 10.1002/jclp.22295. Epub 2016 Mar 23.
4. Straszewski T, Siegel JT. Positive Emotion Infusions: Can Savoring Increase Help-Seeking Intentions among People with Depression? *Appl Psychol Health Well Being.* 2018 Mar;10(1):171–190. doi: 10.1111/aphw.12122.
5. Sin NL, Almeida DM, Crain TL, Kossek EE, Berkman LF, Buxton OM. Bidirectional, Temporal Associations of Sleep with Positive Events, Affect, and Stressors in Daily Life Across a Week. *Ann Behav Med.* 2017 Jun;51(3):402–415. doi: 10.1007/s12160-016-9864-y.
6. Gutmann B, Zimmer P, Hülsdünker T, Lefebvre J, Binnebösel S, Oberste M, Bloch W, Strüder HK, Mierau A. The effects of exercise intensity and post-exercise recovery time on cortical activation as revealed by EEG alpha peak frequency. *Neurosci Lett.* 2018 Mar 6;668:159–163. doi: 10.1016/j.neulet.2018.01.007.
7. Scali J, Gandubert C, Ritchie K, Soulier M, Ancelin ML, Chaudieu I. Measuring resilience in adult women using the 10-items Connor-Davidson Resilience Scale (CD-RISC). Role of trauma exposure and anxiety disorders. *PLoS One.* 2012;7(6):e39879. doi: 10.1371/journal.pone.0039879. Epub 2012 Jun 29. PMID: 22768152; PMCID: PMC3387225.
8. Xu Z, Zhu R, Shen C, Zhang B, Gao Q, Xu Y, Wang W. Selecting pure-emotion materials from the International Affective Picture System (IAPS) by Chinese university students: A study based on intensity-ratings only. *Heliyon.* 2017 Aug 30;3(8):e00389. doi: 10.1016/j.heliyon.2017.e00389.
9. von der Embse N, Jester D, Roy D, Post J. Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *J Affect Disord.* 2018 Feb;227:483–493. doi: 10.1016/j.jad.2017.11.048.
10. Miler JA, Meron D, Baldwin DS, Garner M. The Effect of Prefrontal Transcranial Direct Current Stimulation on Attention Network Function in Healthy Volunteers. *Neuromodulation.* 2018 Jun;21(4):355–361. doi: 10.1111/ner.12629. Epub 2017 Jul 17. PMID: 28714563.
11. Valois RF, Zullig KJ, Revels AA. Aggressive and Violent Behavior and Emotional Self-Efficacy: Is There a Relationship for Adolescents? *J Sch Health.* 2017 Apr;87(4):269–277. doi: 10.1111/josh.12493. PMID: 28260243.
12. Jenkins LN, Fredrick SS, Nickerson A. The assessment of bystander intervention in bullying: Examining measurement invariance across gender. *J Sch Psychol.* 2018 Aug;69:73–83. doi: 10.1016/j.jsp.2018.05.008.
13. Banzon-Librojo LA, Garabiles MR, Alampay LP. Relations between harsh discipline from teachers, perceived teacher support, and bullying victimization among high school students. *J Adolesc.* 2017 Jun;57:18–22. doi: 10.1016/j.adolescence.2017.03.001.
14. Pouwels JL, Lansu TA, Cillessen AH. Participant roles of bullying in adolescence: Status characteristics, social behavior, and assignment criteria. *Aggress Behav.* 2016 May-Jun;42(3):239–53. doi: 10.1002/ab.21614.
15. Mogg K, Bradley BP. Anxiety and Threat-Related Attention: Cognitive-Motivational Framework and Treatment. *Trends Cogn Sci.* 2018 Mar;22(3):225–240. doi: 10.1016/j.tics.2018.01.001.
16. Lee SY. Media coverage of celebrity suicide caused by depression and increase in the number of people who seek depression treatment. *Psychiatry Res.* 2019 Jan;271:598–603. doi: 10.1016/j.psychres.2018.12.055.
17. Dryman MT, Heimberg RG. Emotion regulation in social anxiety and depression: a systematic review of expressive suppression and cognitive reappraisal. *Clin Psychol Rev.* 2018 Nov;65:17–42. doi: 10.1016/j.cpr.2018.07.004.
18. Greitemeyer T, Sagioglou C. Increasing wealth inequality may increase interpersonal hostility: The relationship between personal relative deprivation and aggression. *J Soc Psychol.* 2017;157(6):766–776. doi: 10.1080/00224545.2017.1288078.

19. Lopez RB, Denny BT, Fagundes CP. Neural mechanisms of emotion regulation and their role in endocrine and immune functioning: A review with implications for treatment of affective disorders. *Neurosci Biobehav Rev.* 2018 Dec;95:508–514. doi: 10.1016/j.neubiorev.2018.10.019.
20. Dunlop BW, Cole SP, Nemeroff CB, Mayberg HS, Craighead WE. Differential change on depressive symptom factors with antidepressant medication and cognitive behavior therapy for major depressive disorder. *J Affect Disord.* 2018 Mar 15;229:111–119. doi: 10.1016/j.jad.2017.12.035.

Tables

Table 1 Data analysis of mean, standard deviation and correlation of variables

| Variable | M | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------------------|-------|-------|---------------------|---------------------|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Physical exercise | 15.61 | 17.66 | | | | | | | | | |
| Depression | 6.47 | 5.47 | 0.347 [□] | 0.892 | | | | | | | |
| Anxiety | 8.54 | 5.92 | -0.340 [□] | -0.785 [□] | 0.871 | | | | | | |
| Pressure | 8.71 | 6.19 | -0.385 [□] | -0.821 [□] | -0.823 [□] | 0.882 | | | | | |
| Self-efficacy | 26.66 | 5.85 | 0.413 [□] | -0.327 [□] | -0.333 [□] | -0.369 [□] | 0.892 | | | | |
| Target focus | 16.68 | 3.76 | 0.286 [□] | 0.367 [□] | -0.308 [□] | -0.278 [□] | 0.244 [□] | 0.714 | | | |
| Emotional control | 20.51 | 3.99 | 0.277 [□] | -0.429 [□] | -0.387 [□] | -0.447 [□] | 0.313 [□] | 0.297 [□] | 0.752 | | |
| Positive awareness | 14.44 | 3.45 | 0.231 [□] | -0.320 [□] | -0.238 [□] | -0.278 [□] | 0.186 [□] | 0.658 [□] | 0.258 [□] | 0.768 | |
| Family support | 21.56 | 4.12 | 0.255 [□] | -0.493 [□] | -0.391 [□] | -0.419 [□] | 0.204 [□] | 0.475 [□] | 0.268 [□] | 0.502 [□] | 0.750 |
| Interpersonal assistance | 19.57 | 4.48 | 0.217 [□] | -0.379 [□] | -0.285 [□] | -0.301 [□] | 0.191 [□] | 0.197 [□] | 0.404 [□] | 0.261 [□] | 0.400 [□] |

[□]P<0.001

Table 2 Variance analysis results of the effect of physical exercise on negative emotion of college students

| Variable | Small exercise | Medium exercise | Large amount of exercise | F | P |
|------------|----------------|-----------------|--------------------------|--------|--------|
| Depression | 7.37±5.16 | 4.72±4.58 | 4.91±3.78 | 26.347 | <0.001 |
| Anxiety | 9.32±7.01 | 5.81±5.62 | 6.14±4.45 | 31.637 | <0.001 |
| Pressure | 9.64±7.88 | 6.03±5.17 | 5.13±4.89 | 37.658 | <0.001 |

Table 3 Results of regression analysis of ego effect, psychological resilience (personal ability), physical exercise and negative emotion of college students

| Variable | Depression | | | Anxiety | | | Pressure | | | ego effect | | | psychological resili (Personal strength) | |
|--------------------------|------------|----------------------|----------------|---------|---------------------|----------------|----------|------------------------|----------------|------------|---------------------|----------------|------------------------------------------|---------------------|
| | β | t | R ² | β | t | R ² | β | t | R ² | β | t | R ² | β | t |
| Physical exercise | -0.336 | -9.588 [□] | 0.134 | -0.355 | -9.264 [□] | 0.126 | -0.403 | -10.733 [□] | 0.162 | 0.471 | 13.010 [□] | 0.222 | 0.387 | 10.225 [□] |
| Self-efficacy | -0.327 | -8.426 [□] | 0.107 | -0.333 | -8.603 [□] | 0.111 | -0.369 | -9.683 [□] | 0.136 | | | | | |
| Psychological resilience | -0.434 | -11.784 [□] | 0.189 | -0.366 | -9.613 [□] | 0.135 | -0.405 | -10.10787 [□] | 0.164 | | | | | |
| Target focus | -0.281 | -7.095 [□] | 0.078 | -0.221 | -5.494 [□] | 0.048 | -0.213 | -5.332 [□] | 0.046 | | | | | |
| Emotional control | -0.383 | -10.098 [□] | 0.147 | -0.361 | -9.443 [□] | 0.131 | -0.414 | -11.065 [□] | 0.171 | | | | | |
| Positive awareness | -0.258 | -6.472 [□] | 0.067 | -0.189 | -4.688 [□] | 0.036 | -0.222 | -5.565 [□] | 0.050 | | | | | |

[□]P <0.001

Table 4 Results of Stepwise Stratified Regression Analysis of ego effect and Mental Resilience

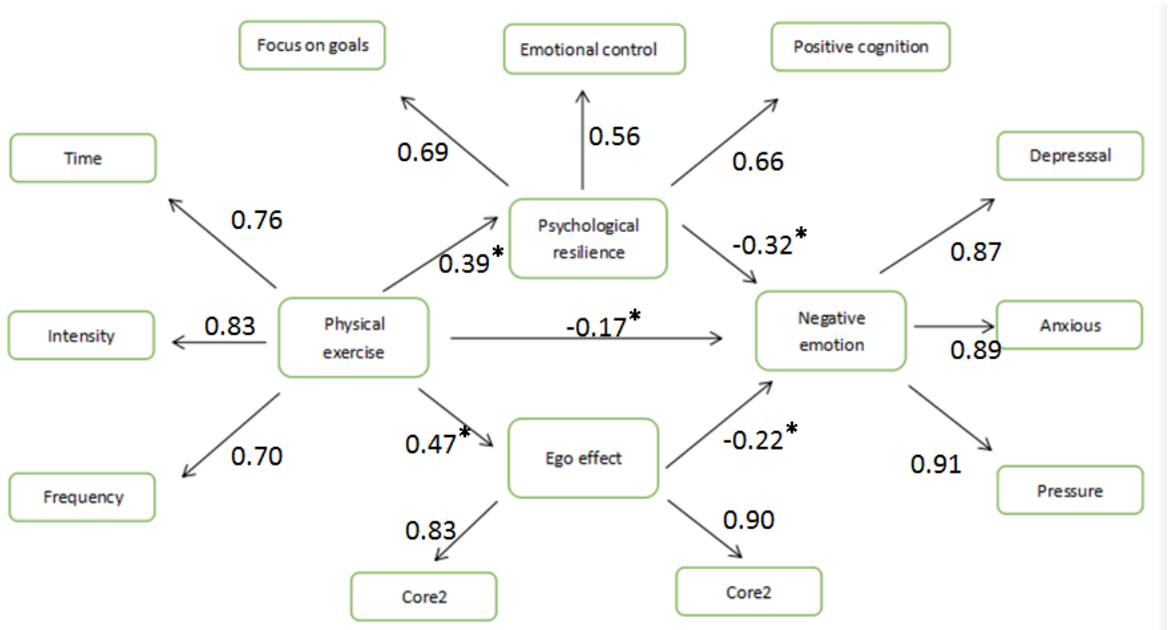
| Model | Steps | Standardized equations | SE | t |
|---------------------------------------------|-------|------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------|
| ego effect | 1 | Negative emotions =-0.393×Physical exercise | 0.038 | -10.436 [□] |
| | 2 | ego effect =0.471× Physical exercise | 0.036 | 13.010 [□] |
| | 3 | Negative emotional =-0.224× ego effect -0.288× physical exercise | 0.042 0.042 | -5.369 [□] -6.891 |
| Psychological resilience (personal ability) | 1 | Negative emotions =-0.393× physical exercise | 0.038 | -10.436 [□] |
| | 2 | Psychological resilience (personal ability)=0.387× physical exercise | 0.038 | 10.225 [□] |
| | 3 | Negative emotional =-0.394× Psychological resilience (personal ability) -0.270× physical exercise | 0.039 0.039 | -8.211 [□] -6.970 [□] |

[□]P <0.001

Table 5 Results of Psychological Resilience (Support) Regulation Effect Test

| Model | β | SE | t | Sig | R2 | ΔR2 | F |
|----------------------------------|--------|-------|---------|-------|-------|-------|-------|
| Constants | -0.907 | 0.034 | 0.000 | 1.000 | | | |
| Family support | -0.291 | 0.036 | -8.097 | 0.000 | | | |
| Constants | -0.384 | 0.036 | -10.755 | 0.000 | 0.293 | | 0.000 |
| Physical exercise | -0.020 | 0.037 | -0.563 | 0.574 | | | |
| Family support | -0.383 | 0.036 | -10.620 | 0.000 | | | |
| Exercise × Family Support | 0.076 | 0.038 | 2.044 | 0.041 | 0.298 | 0.005 | 0.041 |
| Constants | -0.072 | 0.036 | 0.000 | 1.000 | | | |
| Physical exercise | -0.335 | 0.038 | -8.952 | 0.000 | | | |
| Interpersonal assistance | -0.244 | 0.038 | -6.462 | 0.000 | 0.211 | | 0.000 |
| Negative emotional constants | -0.009 | 0.037 | -0.255 | 0.799 | | | |
| Physical exercise | -0.347 | 0.039 | -8.989 | 0.000 | | | |
| Interpersonal assistance | -0.248 | 0.038 | -6.573 | 0.000 | | | |
| Exercise × Interpersonal Support | 0.040 | 0.033 | 1.233 | 0.217 | 0.213 | 0.002 | 0.217 |

Figures



*P<0.001

Figure 1
 Mediating models of my efficacy, psychological resilience, physical exercise and negative emotions