

The Effect of Physical Activity on Life Satisfaction in University Students: The Mediation of Loneliness

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Abstract

Original Research Article

Objective: To explore the relationship between loneliness and the life satisfaction of college students in the context of physical exercise. **Methods:** A questionnaire survey was conducted among 600 college students on campus, and the data were analyzed using SPSS 26.0 and Process 4.0. **Results:** 1) The loneliness and life satisfaction of college students were significantly correlated at different levels of physical exercise. 2) Physical exercise had a significant positive effect on the life satisfaction of college students ($\beta = 0.61, p < 0.01$); physical exercise could influence the life satisfaction of college students through the indirect path of loneliness, with an indirect effect path value of 0.1 (physical exercise \rightarrow loneliness \rightarrow life satisfaction), accounting for 26.32% of the total effect. **Conclusion:** Physical exercise has a direct impact on the life satisfaction of college students and can also indirectly affect it through loneliness.

Keywords: Loneliness, Life Satisfaction, Physical Exercise, College Students, Mental Health.

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1. INTRODUCTION

College students are in a crucial stage of transition from school to society, facing multiple pressures from studies, employment, etc., and often experience negative emotions such as depression and anxiety, which seriously affect their life satisfaction 1. The "Special Action Plan for Comprehensively Strengthening and Improving Students' Mental Health Work in the New Era (2023-2025)" released by the Ministry of Education in 2023 pointed out that physical exercise should be used to strengthen the mind, fully leveraging its role in regulating and relieving stress, while allowing students to enjoy the fun of sports and develop a sound personality 2. Physical exercise, as an effective way to enhance physical fitness and improve negative emotions, has been highly recognized by the state and society in promoting positive emotional experiences among college students 3. Currently, research indicates that individuals with high life satisfaction can obtain more positive emotional experiences in daily life, thereby improving the mental health status of college students 4 5. Therefore, it is particularly important to explore the mechanism of the effect of physical exercise on the life satisfaction of college students.

2. LITERATURE REVIEW

The principal contradiction in our country has transformed into "the contradiction between the people's ever-growing needs for a better life and unbalanced and inadequate development", which indicates that the social life demands of the people are also on the rise. With the rapid changes in social development and the increasingly better life in the new era, college students, who are in a semi-socialized state between society and school, are also experiencing continuous changes in their quality of life demands. Life satisfaction is the cognitive component of subjective well-being. As a positive emotional experience, it can help college students eliminate negative emotions 6. At the same time, life satisfaction is a comprehensive evaluation of an individual's current quality of life and can reflect whether the person being tested is satisfied with their current living conditions, thereby predicting the current state of their mental health. Therefore, this standard can be used to understand and explore the current living situation of college students, care about their life experiences, which is indispensable for their physical and mental health development.

Currently, life satisfaction has become a focal point of research in the field of psychology. According to Self-Determination Theory, physical exercise can

bring about many positive psychological responses such as pleasure, relaxation, and happiness, which can provide individuals with a sense of fulfillment and thereby enhance their life satisfaction 7. Numerous studies have shown a positive correlation between physical exercise and life satisfaction 8, furthermore, empirical research has confirmed that physical exercise has a predictive effect on life satisfaction 9. According to Xie Lihong's (2009) research, a questionnaire survey of students from seven universities in Jiangxi revealed significant gender differences in life satisfaction among college students. Additionally, the study used sports dance as an intervention method, and after eight weeks of practice, the students' life satisfaction levels significantly improved 10. Niu Zhining's (2009) experimental study found that Tai Chi practice can enhance college students' life satisfaction, and the impact of Tai Chi on life satisfaction varies by gender and grade level 11. Liu Ling's (2012) 12, research found a strong positive correlation between the amount of physical exercise and college students' life satisfaction, with higher levels of physical exercise associated with higher levels of life satisfaction. Li, C., & Wu, S. (2012) 13, explored the impact of physical activity on the mental health and life satisfaction of high school students and proposed methods for designing and implementing physical activity intervention programs. In summary, life satisfaction is an individual's subjective evaluation of their own life, and physical exercise, as an effective means of emotional regulation, can effectively promote the improvement of college students' life satisfaction. Based on this, the study proposes hypothesis H1: College students' physical exercise can significantly predict their life satisfaction.

Loneliness refers to the subjective experience of feeling isolated or lacking interpersonal contact, which leads to unpleasant or painful emotions. Research on the age-related trends of loneliness has found that it follows a non-linear U-shaped distribution, with the highest levels of loneliness observed in individuals under the age of 25 and over the age of 65 14. College students, as a unique social group, exhibit specific stage characteristics in their experience of loneliness during this period. As a negative emotional experience, loneliness can easily lead to a decline in an individual's evaluation of life, thereby exerting numerous adverse effects on their physical and mental health. Elderly individuals who experience prolonged loneliness are more prone to increased rates of cardiovascular diseases, reduced life satisfaction, higher

risks of depression, increased suicidal tendencies, and cognitive decline 15.

Physical exercise is an effective way to regulate psychological emotions, and individuals who regularly engage in physical activity can maintain a healthy mental state. Currently, numerous studies have confirmed that long-term physical exercise can have a positive impact on emotions, thereby effectively preventing the onset of psychological disorders. The role of physical exercise in alleviating loneliness has also been supported by various studies. For example, Zhong Weitan *et al.*, found that physical exercise can improve college students' experience of loneliness through social self-efficacy 16. Han Chaoyi *et al.*, discovered that elderly individuals who regularly participate in physical exercise exhibit lower levels of loneliness 17. Wang Shiyang, through a physical exercise intervention for left-behind children, observed an improvement in their feelings of loneliness 18. In addition to physical exercise, life satisfaction is also associated with loneliness. Ye Tingting *et al.*, demonstrated a significant correlation between loneliness and life satisfaction among the elderly, indicating that as loneliness increases, life satisfaction decreases. Furthermore, less social interaction is associated with lower life satisfaction 19. Ye Xiaoyun *et al.*, confirmed that when college students experience weaker feelings of loneliness, their life satisfaction is correspondingly higher 20. Qu Xiaoyuan *et al.*, found a negative relationship between loneliness and life satisfaction among adolescents, with psychological resilience moderating the negative impact of loneliness on life satisfaction 21. Based on the above findings, this study hypothesizes that physical exercise, as an important form of social activity, can promote interaction between college students and other members of society, help them achieve a sense of self-worth in life, enhance their social integration, and thereby improve their overall life satisfaction. The environmental information gained through physical exercise also fulfills college students' social and emotional needs, alleviating their feelings of loneliness. On this basis, this study proposes hypothesis H2: Physical exercise can influence college students' life satisfaction through the mediating role of loneliness.

In summary, to better explore the underlying mechanisms between college students' physical exercise and life satisfaction, this study constructs a theoretical model illustrating the impact mechanism of physical exercise on life satisfaction. The model is shown in Figure 1.

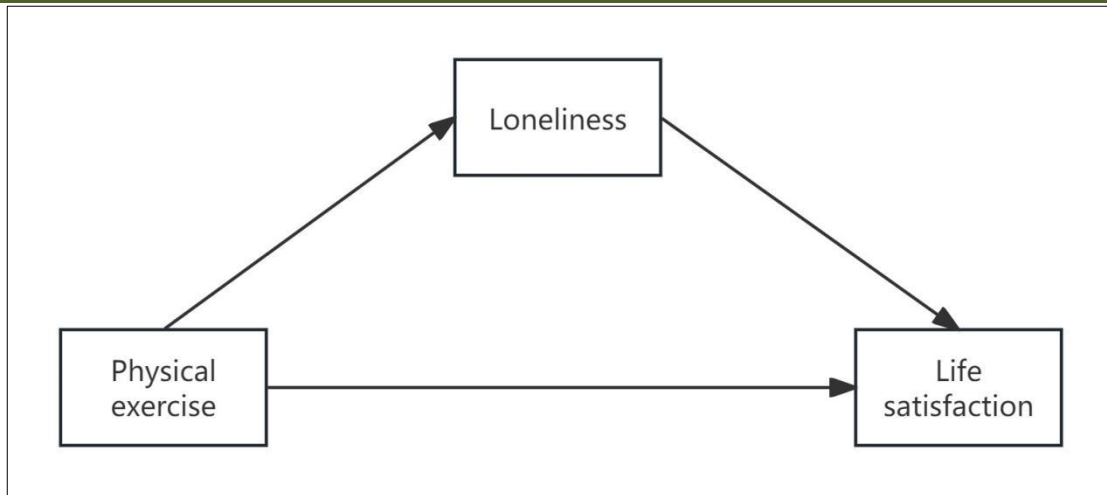


Figure 1: The Mediation Effect Model of Loneliness

3. METHODS

3.1. Participants

This study adopted a convenience sampling principle and utilized a random sampling method to select college students from three universities in Zhejiang Province as the research subjects. The primary test administrator provided detailed instructions on how to complete the questionnaire and distributed paper-based questionnaires to the students, who were asked to fill them out independently and carefully based on the instructions and their actual circumstances. To eliminate irrelevant distractions and help participants understand the meaning of the questionnaire items, researchers accompanied them throughout the entire questionnaire completion process. Participants took approximately 20 minutes to complete the questionnaire, which was collected immediately after completion. A total of 600 individuals were surveyed. After excluding samples with missing values for key variables, 489 individuals were included in the final analysis.

3.2 Instruments

The questionnaire consists of three parts. First, we stated that the survey is conducted voluntarily and anonymously. The answers to the questionnaire are provided solely to the researchers and will not be used for commercial or any other purposes.

The Physical Exercise Level Questionnaire (PARS-3) compiled by Japanese scholar Hashimoto Kumiong, translated and revised by Liang Deqing and others, was used to measure the sports situation of different groups of people. The questionnaire measured sports from the intensity, time and three directions of sports. Among them, each direction is divided into 5 grades from low to high, which are recorded as 1-5 points. Through the conversion of intensity, time and, the amount of exercise containing basic sports elements is obtained. Exercise amount = intensity * (time-1) *, 100 is the score, 0 is the lowest score, according to the theory of motor activity grades, ≤ 19 is recorded as small

exercise amount, 20-42 is recorded as medium exercise amount, and ≥ 42 is recorded as large exercise amount. The scale had a high test-retest reliability with a correlation coefficient $r = 0.89$. The correlation among the three dimensions of exercise, exercise time and exercise intensity was significant ($P < 0.01$), and the absolute value of the correlation coefficient was less than 0.5, and all of them were less than the square root of the corresponding mean variance extraction value AVE, which means that there was a certain correlation among the dimensions, and at the same time, there was a certain degree of discrimination. The discriminative validity of this scale.

The UCLA loneliness scale (ULS-8) compiled by HAYS and others has 8 items in total, of which 6 "loneliness" are positive items, and 2 "non-loneliness" are reverse items. Each item is scored by Likert 4-level scoring method. 1 to 4 points are never, rarely, sometimes, and always. The non-loneliness item adopts reverse scoring. The score range of the scale is 8 to 32 points. The higher the score, the higher the degree of loneliness. The loneliness scale has a good fit ($\chi^2/df = 0.987$, CFI = 1.000, TLI = 1.000, RMSEA = 0.000, SRMR = 0.022). In this study, the Cronbach's α coefficient of the scale is 0.801, which has good reliability and validity. The Satisfaction with Life Scale (SWLS) was compiled by Pavot *et al.*, translated and revised by Dr. Mankak Yuen. The scale consisted of 5 items, and the subjects' feelings, reactions and approval were used as evaluation indicators. Using the 7-point scale evaluation method ("1 = very inconsistent" to "7 = very consistent"), the scores of all items were summed up as a total score. The higher the score, the higher the life satisfaction. Life satisfaction scale ($\chi^2/df = 1.376$, CFI = 0.981, TLI = 0.975, RMSEA = 0.028, SRMR = 0.032), in this study, the Cronbach's alpha coefficient of this scale is 0.810, with good reliability and validity.

3.3 Statistical Analysis

The data of this study include: (1) descriptive, used to describe the general characteristics of the study population; (2) Bivariate correlation (t-test, f-test and Pearson's r) was used to test the relationship between sex and different levels of physical exercise and life satisfaction and loneliness; (3) To explore the mediating effect of loneliness on physical exercise and life satisfaction through mediating. SPSS (Armonk, NY: IBM Corp) software was used for descriptive data, bivariate and mediation, and Hayes SPSS Macro PROCESS Macro Program (Model 4) was used for mediation [43]. The sample number was set to 5,000 with a default confidence interval of 95%.

4. RESULTS

In this study, procedural measures such as anonymous measurements and reverse coding of certain items were implemented to control for common bias. The collected data were subjected to a Harman univariate test to test for common bias. The results of the exploratory factors without rotation showed 16 factors with eigenvalues greater than 1, with the largest factor accounting for 32.96% (less than 40%) of the variance. Therefore, there is no significant common bias in this study.

3.1 Gender Differences in Loneliness and Life Satisfaction of College Students

The independent sample t-test and one-way variance of SPSS 26.0 were applied to the questionnaire data. The results showed that there was no significant difference in the gender variables of loneliness and life satisfaction of college students ($p > 0.05$).

3.2 Overall Situation and Difference of Physical Exercise Amount of College Students

Through spss26.0 to describe the physical exercise characteristics of 489 college students in the questionnaire data, it is known that 302 college students have a small amount of exercise, accounting for 61.8%, 130 college students have a medium amount of exercise, accounting for 26.6%, and a large amount of exercise There are 57 college students, accounting for 11.7%. See Table 1 for details. Then the scores of loneliness and life satisfaction of college students with different amounts of physical exercise were compared. The results showed that the scores of loneliness and life satisfaction were statistically significant on the characteristics of different amounts of physical exercise ($p < 0.05$), and the scores of loneliness and life satisfaction were the lowest on the level of small exercise, the scores of loneliness and life satisfaction were in the middle on the level of medium exercise, and the scores of loneliness and life satisfaction were the lowest on the level of large exercise, which means that with the amount of physical exercise, The scores of college students' loneliness gradually increased, while the scores of life satisfaction gradually increased, and there were significant differences in scores. The detailed results are shown in Table 2.

Table 1: Descriptive statistics of physical exercise level of college students

Name	Grouping	Number of individuals	Percentage
Physical exercise level	Low level of physical exercise	302	61.8%
	Moderate level of physical exercise	130	26.6%
	High level of physical exercise	57	11.7%

Table 2: Comparison of loneliness and life satisfaction under different levels of physical exercise

Variables	Grouping	M	F	P
Loneliness	Low level	23.92±3.00	645.04	.00***
	Moderate level	15.93±3.39		
	High level	10.30±2.60		
Life satisfaction	Low level	14.60±4.52	510.79	.00***
	Moderate level	26.00±4.77		
	High level	30.79±2.55		

3.3 The Correlation between Physical Exercise, Life Satisfaction and Loneliness

Using spss26.0 software to correlate the three variables of college students' physical exercise, life satisfaction and loneliness, the results are as shown in Table 3, physical exercise is significantly negatively correlated with loneliness, and is significantly positively correlated with perceived social support, various

dimensions and life satisfaction; Perceived social support and its dimensions are positively correlated with life satisfaction; Perceived social support, various dimensions and life satisfaction were significantly negatively correlated with loneliness; It can be seen that the correlation of all variables is significant, which supports the construction of the measurement model versus the mediator effect model.

Table 3: Correlation between physical exercise, life satisfaction and loneliness

	Physical exercise	loneliness	life satisfaction
Physical exercise	1		
loneliness	-.880**	1	
life satisfaction	.844**	-.802**	1

3.4 Mediating Effect of Loneliness on Physical Exercise and Life Satisfaction of College Students

In order to further explore the relationship between the three variables, this study takes physical exercise score as the independent variable, loneliness score as the mediating variable, and life satisfaction score as the dependent variable. According to the hypothesis H2 proposed above, a mediating model is established: physical exercise-loneliness-life satisfaction (as shown in Figure 2); The PROCESS plug-in of SPSS

is used for the mediation effect, and the model 4 corresponding to the chain mediation model is selected, and the sampling is 5,000 times. The results are shown in Table 4. The results showed that after adding mediator variables, physical exercise significantly negatively predicted loneliness ($\beta = -0.88, p < 0.01$), and significantly positively predicted life satisfaction ($\beta = 0.61, p < 0.01$); Loneliness significantly negatively predicted life satisfaction ($\beta = -0.26, p < 0.01$).

Table 4: Mediated effect table

regression equation		Goodness of Fit			Regression weights and significance	
Dependent Variable	independent variable	R	R ²	F	β	t
loneliness	Physical exercise	.88	.77	1663.42	-.88	-40.79**
Life satisfaction	Physical exercise	.85	.73	650.07	.61	12.29**
	loneliness				-.26	5.32**

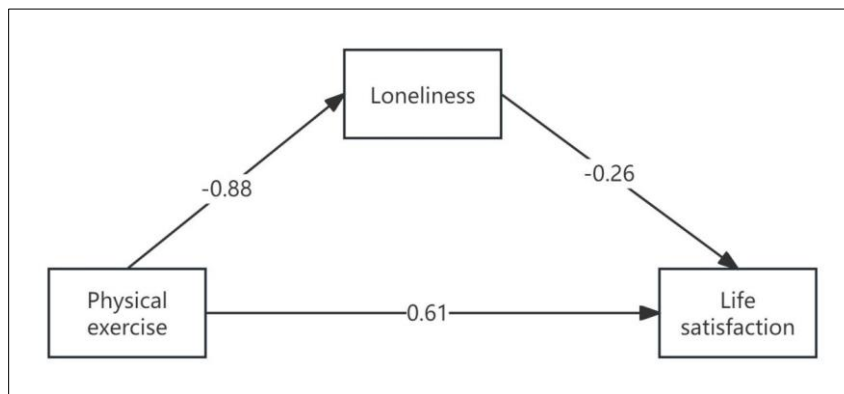


Fig. 2: Mediation effect model diagram

The Bootstrap test (Lee J.Y., 2023) used the range of confidence intervals to assess the significance of mediating effects [27]. In this study, physical exercise and loneliness of the two impact paths through the mediator of loneliness of 95% confidence interval does not contain 0. Therefore, the mediating effect is significant, which supports H1 and H2. In addition, the

direct effect remained significant after the inclusion of the mediating variable, indicating that this mediating variable plays a partial mediating role. The mediating effect through loneliness was 26.32%, and the direct effect of physical exercise on life satisfaction was 71.05%. The specific results are shown in Table 5.

Table 5: Mediation Path Effect Table

	Mediation Path	Effect size	LLCI	ULCI	Percentage
Direct effect		.27	.23	.32	
Mediating effect	loneliness	.10	.06	.14	26.32%
Total effect		.38	.36	.40	

5. DISCUSSION

5.1 Relationship between Physical Exercise and Life Satisfaction

The results show that physical exercise and life satisfaction of college students are significantly positive

correlation, indicating that physical exercise can significantly predict life satisfaction of college students. Assuming that H1 is verified, this conclusion has also been supported by relevant research. Such as the study that college students physical exercise can significantly improve their life satisfaction 22. Physical exercise, as a

social activity, can have an impact on the individual's society. According to the self-determination theory, physical exercise can meet the three needs of the individual. When doing physical exercise, the individual can feel a certain sense of belonging, enhance the individual's internal motivation, and promote the internalization of external motivation, thereby improving the individual's life satisfaction 23. Foreign studies have also shown that physical exercise can bring happiness and joy to individuals 24. Individuals who are in physical exercise will have more social opportunities, have more interactions with others, increase individual social needs, and create happiness 25. At the same time, physical exercise is also one of the means of emotional regulation. It can effectively help individuals improve bad emotions, let individuals vent their negative emotions in a timely and effective manner, enable individuals to be physically and mentally satisfied and happy, and improve their subjective evaluation of life satisfaction 26 27.

5.2 Mediating Role of Loneliness

The results of this study showed that loneliness and life satisfaction showed a significant negative correlation, indicating that loneliness can significantly and negatively predict college students' life satisfaction, and physical exercise can indirectly affect college students' life satisfaction through loneliness, which verified the hypothesis H2. Many studies have shown that loneliness has a negative effect on life satisfaction 28, and can affect life, leading to depression and many other physical and mental problems. Consistent with previous results, this study further demonstrates the association between life satisfaction and loneliness. Previous studies have shown that with the increase of loneliness, life satisfaction is significant. This study believes that the loneliness felt by oneself and the loneliness felt in social interaction are negatively correlated with life satisfaction. In this study, the reason for the formation of loneliness is mainly due to the lack of social relations. Many college students have no social channels in college and cannot meet their own social needs, which will lead to their own loneliness, which will affect the level of life satisfaction 29. In addition, most of the college students are in a poor financial situation, and they complete their studies while working and studying, resulting in lack of energy, lack of time to enjoy life and socialize, resulting in a strong sense of loneliness and low life satisfaction. As a social activity, physical exercise has the characteristics of economy and does not need to spend a lot of money, and physical exercise is also an effective means of emotional regulation, which can reduce students' pressure and adjust negative psychology 30. According to the theory of social cognition, physical exercise can effectively improve individual social interaction, make up for the lack of social relations of college students, and ease negative emotions, so that college students experience loneliness, and lonely experience can promote college students' positive emotional experience, thereby

improving their life satisfaction 31. Therefore, physical exercise can affect college students' loneliness and then affect college students' life satisfaction.

6. CONCLUSION

Physical exercise can significantly positively predict college students' life satisfaction, significantly negatively predict college students' loneliness. Loneliness has a mediating effect between physical exercise and life satisfaction of college students, and the mediating effect is significant.

The mediating effect model constructed in this study has a good fitting degree, which reveals the mechanism of physical exercise on life satisfaction to a certain extent. In order to better prevent the occurrence of loneliness of college students and improve their life satisfaction, college students should participate in more collective physical exercise activities and their social interaction.

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