



Physical activity and subjective well-being: A chain mediating model

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Physical activity plays an important role in enhancing individual subjective well-being, but the mechanism underlying this effect is still under investigation. This study constructed a chain mediation model to explore the relationship between physical activity and subjective well-being among college students, incorporating the mediating effects of general self-efficacy and self-esteem. We recruited a sample of 1,184 Chinese college students, who completed four scales. Physical activity had a significant positive correlation with subjective well-being. Further, the direct effect of physical activity on subjective well-being was significant, and general self-efficacy and self-esteem had both independent and chain mediating effects on this relationship. Our results provide a theoretical basis and practical reference for improving the subjective well-being of college students.

Keywords

physical activity, general self-efficacy, self-esteem, subjective well-being, college students

Article Highlights

- Physical activity was found to be positively correlated with subjective well-being.
- General self-efficacy and self-esteem had independent mediating effects on the relationship between physical activity and subjective well-being.
- General self-efficacy and self-esteem acted as chain mediators of the relationship between physical activity and subjective well-being.

Subjective well-being is an individual's overall assessment of their quality of life based on self-imposed criteria (Diener, 1984). Strong subjective well-being not only reduces the problem behavior of college students but also improves their academic achievement and self-evaluation level (Ayyash-Abdo & Sánchez-Ruiz, 2012; Qin et al., 2023), thus promoting their mental health. In recent years college students have been facing more competition in terms of academic, employment, and social adaptation, leading to a decline in their subjective well-being and an increase in various psychological problems (Graupensperger et al., 2020), which has aroused concern for education providers. Therefore, it is of great practical significance to explore ways to effectively improve the subjective well-being of college students to promote their mental health.

Physical activity is any activity that generates energy through the movement of skeletal muscles (Xu, 2014). Physical activity participation has been found to lead to improvement in individuals' subjective well-being (You & Shin, 2017) and to be positively associated with mental health and well-being among college students (Herbert, 2022), whereas sedentary behavior has been found to be negatively related to the quality of life of college students (Nowak et al., 2019). The longer the sedentary time, the lower the subjective well-being (Panza et al., 2019). Thus, we proposed the following hypothesis:

Hypothesis 1: Physical activity will be positively related to the subjective well-being of college students.

General self-efficacy is an individual's level of self-confidence in coping with various life challenges or facing new situations (Schwarzer, 1997). Physical activity can effectively improve general self-efficacy and alleviate negative emotions (Schwarzer & Renner, 2000). Yu et al. (2022) found that physical exercise was positively correlated with college students' general self-efficacy and self-control ability, and X. Wang et al. (2021) reported a significant link between general self-efficacy and subjective well-being. General self-efficacy has been found to be beneficial in promoting higher self-concept, life satisfaction, and positive emotions (Caprara et al., 2006). K. Wang et al. (2022) found a significant positive correlation between the general self-efficacy and subjective well-being of college students, and, further, observed that general self-efficacy partially mediated the relationship between physical activity and subjective well-being. Therefore, we proposed the following hypothesis:

Hypothesis 2: General self-efficacy will mediate the relationship between physical activity and subjective well-being in college students.

Self-esteem is an individual's evaluation of their sense of value and importance (Brissett, 1972). Regular participation in physical exercise can improve self-efficacy, self-esteem, and body awareness levels in young adults (Tikac et al., 2022). Zamani Sani et al. (2016) reporting finding that physical activity was directly and indirectly related to self-esteem, and Diener (1984) found a close relationship between self-esteem and subjective well-being. Rosenberg et al. (1995) found that self-esteem was positively correlated with happiness and life satisfaction, and negatively correlated with negative emotion. Staats et al. (1995) observed that self-esteem contributed significantly to two indicators of college students' subjective well-being: satisfaction and happiness. Physical exercise can also improve self-esteem and subjective well-being among college students (Shang et al., 2021). Furthermore, a previous study found that self-esteem played a mediating role in the relationship between physical activity and subjective well-being (Liao et al., 2023). Thus, we investigated the independent mediating and chain mediating roles of general self-efficacy and self-esteem between physical activity and subjective well-being, putting forward the following hypothesis:

Hypothesis 3: Self-esteem will mediate the relationship between physical activity and subjective well-being among college students.

General self-efficacy is an important factor affecting self-esteem (Chen et al., 2004), and self-esteem consists of two components: (a) self-competence and (b) self-acceptance or self-love (AlHarbi, 2022). *Self-competence* refers to having a basic sense of confidence in the face of life's challenges, and it is very close to the concept of general self-efficacy. Self-efficacy has been found to be positively correlated with self-esteem (Lane et al., 2004; McKenzie, 1999). Lightsey et al. (2006) further found that general self-efficacy may play a role in promoting the development of self-esteem. Therefore, changes in general self-efficacy can temporally precede changes in self-esteem. However, whether general self-efficacy and self-esteem play a chain mediating role in the relationship between physical activity and subjective well-being is yet to be investigated. Therefore, we proposed the following hypothesis:

Hypothesis 4: General self-efficacy and self-esteem will play a chain mediating role in the relationship between physical activity and subjective well-being.

Method

Participants and Procedure

We conducted a cross-sectional survey, using convenience sampling to recruit participants from five universities in Guangdong Province, China. Of 1,265 questionnaires we distributed, 1,184 were returned, representing a valid recovery rate of 93.6%. There were 602 men and 582 women. Respondents' ages ranged from 18 to 24 years ($M = 20.10$, $SD = 1.14$).

The study followed the guidelines of the Declaration of Helsinki and was reviewed by the Ethics Committee of Zhaoqing College (2023-01026-01). All participants signed an informed consent form. We emphasized to them the principles of voluntary participation, information confidentiality, and anonymity.

Measures

Physical Activity

We measured physical activity using a Chinese translation (Liang & Liu, 1994) of the Physical Activity Rating Scale (Hashimoto, 1990), which comprises three items assessing three dimensions: intensity, time, and frequency. Each aspect is rated on a 5-point Likert scale. Intensity is rated from 1 = *light exercise* to 5 = *intense, sustained exercise*. Time is rated from 1 = *under 10 minutes* to 5 = *more than 60 minutes*. Frequency is rated from 1 = *less than once a month* to 5 = *once or twice a week*. The level of physical activity is calculated as intensity \times (time - 1) \times frequency. A score of less than 20 indicates a low level of physical activity, between 20 and 42 indicates a moderate level, and above 43 indicates a high level. Cronbach's alpha coefficient in this study was .75.

General Self-Efficacy

We assessed general self-efficacy with the General Self-Efficacy Scale developed by Schwarzer et al. (1997) and revised into Chinese by C. K. Wang et al. (2001). The scale consists of 10 items (e.g., "I can always solve problems if I try my best") rated on a 4-point Likert scale ranging from 1 = *strongly disagree* to 4 = *strongly agree*. The higher the score, the higher the self-efficacy. Cronbach's alpha coefficient in this study was .92.

Self-Esteem

We measured self-esteem using the Rosenberg Self-Esteem Scale, which was developed by Rosenberg (1965) and revised into Chinese by X. D. Wang et al. (1999). The scale consists of 10 items, six of which are forward scored (e.g., "I feel I have many good qualities") and four of which are reverse scored (e.g., "I often think I'm worthless"). Items are rated on a 4-point Likert scale ranging from 1 = *not at all consistent* to 4 = *very consistent*. The higher the score, the higher the level of self-esteem. Cronbach's alpha coefficient in this study was .90.

Subjective Well-Being

We measured subjective well-being using the Index of Well-Being (Campbell et al., 1976), which was revised into Chinese by X. D. Wang et al. (1999). This scale comprises nine items divided across two dimensions: an overall affective index (eight items, e.g., "boredom, misery, and loneliness") and life satisfaction (one item: "How satisfied or dissatisfied are you with your life in general?"). The overall well-being index is calculated as the average affective index + average life satisfaction index \times 1.1. A higher index represents greater subjective well-being. Cronbach's alpha coefficient in this study was .94.

Data Analysis

We used Amos 26.0 to conduct a confirmatory factor analysis. Descriptive statistics and Pearson correlation coefficients were calculated using SPSS 26.0. We conducted mediation modeling tests using Model 6 of the PROCESS macro for SPSS, and tested the mediation effects using the bootstrapping method.

Results

Common Method Bias Test

We checked for common method bias using Harman's single-factor test. The first factor explained 20.61% of the variance, which is less than the critical value of 40%; thus, common method bias was not a serious concern in this study.

Descriptive Statistics and Correlation Analysis

Table 1 shows there were significant correlations between physical activity, general self-efficacy, self-esteem, and subjective well-being. Physical activity was positively correlated with general self-efficacy, self-esteem, and subjective

well-being. Both general self-efficacy and self-esteem were positively correlated with subjective well-being. General self-efficacy was positively correlated with self-esteem.

Table 1. Descriptive Statistics and Correlation Analysis Among Variables

Variable	<i>M</i>	<i>SD</i>	1	2	3	4
1. Physical activity	28.211	26.136	1			
2. General self-efficacy	25.761	6.488	.402**	1		
3. Self-esteem	26.454	8.156	.289**	.416**	1	
4. Subjective well-being	43.176	11.395	.297**	.361**	.380**	1

Note. *N* = 1,184.

** *p* < .01 (two-tailed).

Mediating Effects Test

The results of mediating effects testing are shown in Table 2. First, the direct effect of physical activity on subjective well-being was 0.063, 95% confidence interval (CI) [0.090, 0.169], which indicates that physical activity had a significant effect on subjective well-being, supporting Hypothesis 1. Second, the indirect effect of physical activity → general self-efficacy → subjective well-being was 0.034, 95% CI [0.015, 0.059], indicating that the mediating effect of general self-efficacy between physical activity and subjective well-being was significant, supporting Hypothesis 2. Third, the indirect effect size of physical activity → self-esteem → subjective well-being was 0.016, 95% CI [0.005, 0.029], indicating that self-esteem had a significant mediating effect between physical activity and subjective well-being, supporting Hypothesis 3. Last, the indirect effect size of physical activity → general self-efficacy → self-esteem → subjective well-being was 0.016, 95% CI [0.009, 0.026], indicating that general self-efficacy and self-esteem had a significant chain mediating effect between physical activity and subjective well-being. Thus, Hypothesis 4 was supported. The independent and chain mediating effects of general self-efficacy and self-esteem between physical activity and subjective well-being are shown in Figure 1.

Table 2. Mediating Effects Analysis

		Effect	Boot <i>SE</i>	95% CI		Mediation effect to total effect ratio (%)
				<i>LL</i>	<i>UL</i>	
Total effect	Physical activity → Subjective well-being	0.129	0.020	0.090	0.169	
Direct effect	Physical activity → Subjective well-being	0.063	0.020	0.023	0.101	48.4
Indirect effect	Total indirect effect	0.067	0.014	0.041	0.097	51.6
	Physical activity → General self-efficacy → Subjective well-being	0.034	0.011	0.015	0.059	26.6
	Physical activity → Self-esteem → Subjective well-being	0.016	0.006	0.005	0.029	12.6
	Physical activity → General self-efficacy → Self-esteem → Subjective well-being	0.016	0.005	0.009	0.026	12.4

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

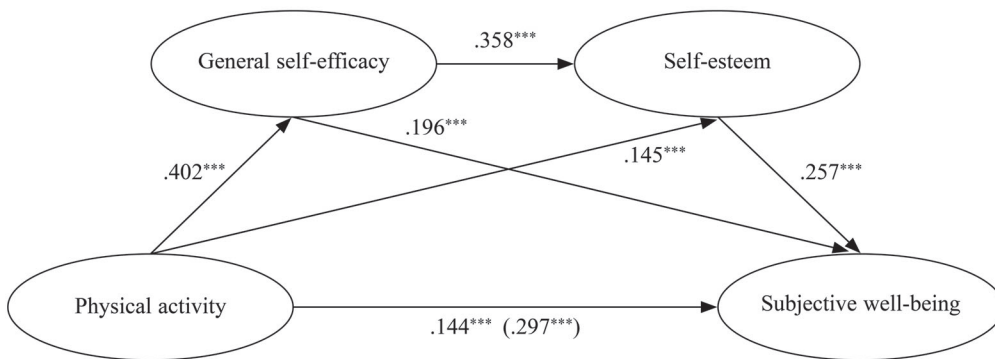


Figure 1. *Chain Mediation Model of General Self-Efficacy and Self-Esteem in the Relationship Between Physical Activity and Subjective Well-Being*

Note. Values are standardized coefficients tested by stepwise regression.

*** $p < .001$.

Discussion

Physical Activity and Subjective Well-Being

This study found a significant positive correlation between physical activity and subjective well-being among college students. Physical activities with different intensities and durations have different effects on subjective well-being (Wicker & Frick, 2015). For example, aerobic exercises of low to moderate intensity have been found to have positive effects on the subjective well-being of college students (Herbert, 2022). Neuroscience research has found that changes in certain regions of the brain induced by physical activity may influence individuals' feelings of well-being, and that the prefrontal cortex and hippocampus show more activation than other areas of the brain (Erickson et al., 2013). Furthermore, the mechanism of physical activity affecting subjective well-being may be reflected in a variety of neurotransmitters and biochemical indicators. Physical activity activates endogenous cannabinoids (Matei et al., 2023), which can mediate some of the effects that physical activity triggers throughout the body (Tantimonaco et al., 2014), alleviating pain, increasing euphoria levels, and generating an intense sense of well-being. Therefore, college students, as emerging adults, should be encouraged to participate in physical activity to improve their subjective well-being.

Independent Mediating Effect of General Self-Efficacy

This study found that general self-efficacy mediated the relationship between physical activity and subjective well-being. First, physical activity and general self-efficacy showed a positive correlation, which is consistent with the results of other studies (K. Wang et al., 2022). Xie (2012) found that physical activity was significantly and positively correlated with general self-efficacy, and had a positive predictive effect on general self-efficacy. C. Q. Li et al. (2022) further revealed that physical activity significantly predicted higher levels of general self-efficacy in their sample. By participating in physical activity, college students can improve their self-control ability and be recognized by their peers, thus enhancing their sense of accomplishment and general self-efficacy.

Second, this study found that general self-efficacy was positively associated with subjective well-being. This aligns with previous research showing that general self-efficacy directly affects the subjective well-being of college students (K. Wang et al., 2022). Social learning theory states that when individuals face changes in their social environment, general self-efficacy will enable them to show a positive attitude in life, thus promoting their subjective well-being (Bandura & Walters, 1977). In conclusion, we have identified general self-efficacy as an important mediating variable between physical activity and subjective well-being. Therefore, physical activity can more effectively improve college students' subjective well-being by enhancing their general self-efficacy.

Independent Mediating Effect of Self-Esteem

This study found that self-esteem mediated the relationship between physical activity and subjective well-being, which aligns with the findings of Liao et al. (2023). First, physical activity showed a positive correlation with the self-esteem of college students. Regular physical activity can improve the general self-efficacy and self-esteem of young adults (Tikac et al., 2022). Zurita-Ortega et al. (2017) found that self-esteem was associated with physical condition, body mass index, and level of physical activity. Du et al. (2022) further revealed that moderate-intensity physical activity improved the self-esteem of college students. In contrast, low self-esteem has been linked to sedentary behavior (Hoare et al., 2016).

Second, self-esteem was found to be positively related to college students' subjective well-being, which is consistent with previous research (G. M. Li, 2023). High self-esteem has been reported to be positively correlated with high subjective well-being. Individuals with high (vs. low) self-esteem are more confident when faced with failure and cope better with various problems, resulting in higher subjective well-being (Baumeister et al., 2003). In contrast, low self-esteem and low subjective well-being are intrinsically linked. When faced with failure, people with low self-esteem feel worse about themselves and face more intense emotional distress than do people with high self-esteem (Dutton & Brown, 1997).

Chain Mediation Effect of General Self-Efficacy and Self-Esteem

Consistent with previous research (Bhatt & Bahadur, 2018; Lightsey et al., 2006), this study found that general self-efficacy was positively related to self-esteem. College students with high general self-efficacy are usually more confident in their abilities, while the opposite is true for those with low general self-efficacy. This directly affects their level of self-esteem. First, physical activity can regulate the way individuals respond to pressure and negative events, and improve general self-efficacy. Second, higher general self-efficacy facilitates competence, confidence, and self-esteem. Thus, general self-efficacy may play a role in the development of self-esteem (Lightsey et al., 2006). Further, individuals with high self-esteem view themselves in a positive light, cope better with various problems, and thus have higher subjective well-being. Therefore, we should encourage college students to actively engage in physical activities and emphasize increasing their general self-efficacy and self-esteem in order to improve their subjective well-being.

Practical Implications

Our findings regarding the effect of physical activity on the subjective well-being of college students have important implications for improving their subjective well-being and promoting their mental health. College students should be encouraged to regularly participate in physical activities, which is conducive to enhancing their self-efficacy and self-esteem. This will help to further improve their subjective well-being.

Limitations and Future Research Directions

First, the study data were derived from a questionnaire, which may have affected the accuracy and reliability of the results. Future studies could use more objective measurement methods to improve the research paradigm and methodology. Second, we utilized a cross-sectional research design that does not allow for the inference of causal relationships between variables. Future researchers could conduct longitudinal follow-up or experimental intervention studies to establish causality. Third, we examined only two mediating variables: general self-efficacy and self-esteem. Future research could focus on other potential mediating variables, such as perceived social support, peer relationships, and emotion regulation ability.

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The data that support the findings of this study are available on request from the corresponding author.

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