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Research Article

Physical Fitness Self-Efficacy Influences College Students' Subjective Well-Being Through the Mediating Role of Physical Activity and the Moderating Effect of Gender

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Abstract

Amid growing concerns about mental health issues in higher education, understanding determinants of college students' subjective well-being has become crucial. While existing research establishes connections between psychological factors and well-being, the specific mechanisms linking physical fitness perceptions with mental health outcomes remain underexplored. This study explores the influence of physical fitness self-efficacy on college students' subjective well-being, highlighting the mediating role of physical activity and the moderating effect of gender. Using the "Physical Fitness Self-Efficacy Scale," "Physical Activity Level Scale" (PARS-3), and "Subjective Well-Being Questionnaire," data were collected from 455 students (Age 19.13±1.32) in Yunnan Province, China, and analyzed using SPSS 27.0 and Process 4.2. Results showed significant gender differences in physical fitness self-efficacy, physical activity, and subjective well-being, with physical activity mediating 20.86% of the effect (The results support that physical activity plays a partial mediating role between physical fitness self-efficacy and subjective well-being). Notably, gender moderated this relationship, as the study found that physical fitness self-efficacy and physical activity predict subjective well-being in both male (ΔR^2 = 11.40%, mediating effect 11.93%) and female university students (ΔR^2 = 14.40%, mediating effect 23.66%), with exercise behavior showing a stronger mediating role in females. These findings extend social cognitive theory by demonstrating gender-specific pathways through which physical self-perceptions translate into well-being outcomes. And the study suggests the importance of promoting physical fitness self-efficacy and physical activity to enhance college students' subjective well-being, with gender-specific intervention strategies recommended.

Keywords

Physical Fitness Self-efficacy, Subjective Well-being, Physical Activity, Mediating Role, Gender Differences, Moderating Effect

1. Introduction

Subjective well-being, generally understood as an individual's comprehensive appraisal of their life events, physical and mental states, and environment, is a significant metric of mental health and overall quality of life [1-3]. This all-encompassing concept includes life satisfaction, emotional experiences, and self-evaluation, and various factors such as individual perceptions, values, social environment, and personal experiences also mold it [4, 5]. People recognize sub-

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jective well-being as a deeply personal cognitive and emotional response. It has intimate links with elements like emotional stability, mental health, strong interpersonal relationships, and life satisfaction. A decline in subjective well-being can potentially trigger adverse psychological and physical health outcomes [3, 6]. Therefore, understanding the foundations of subjective well-being and its influencing factors is vital for enhancing individual happiness levels [7].

Among the factors influencing subjective well-being, physical fitness self-efficacy stands out as a potential contributor. Physical fitness self-efficacy refers to an individual's belief—based on their self-assessment of their physical condition—that they can overcome physical challenges and achieve health-related goals [8-10]. This belief reflects confidence in one's capacity to surmount obstacles and improve suboptimal physical conditions through personal effort. Existing research suggests a significant correlation between physical fitness self-efficacy and health cognitions and behaviors [8, 9]. The theory of self-efficacy further supports that individuals with high physical fitness self-efficacy tend to have a firm belief in their ability to maintain health and conquer physical challenges [11, 12], which may enhance their subjective well-being.

Furthermore, physical fitness self-efficacy may positively influence the level of physical activity among college students. Studies have shown that self-efficacy can promote physical activity in adolescents and young adults [19-21]. For instance, Yiming et al. demonstrated that self-efficacy could enhance physical activity among teenagers [18], while Wang Yuxiu and colleagues found a positive correlation between physical fitness self-efficacy and participation in physical activity among college students [10]. Drawing from self-efficacy theory and existing research, students with high physical fitness self-efficacy may exhibit a greater inclination toward physical activity.

A wealth of research supports the notion that physical activity positively affects subjective well-being [22, 23]. Meta-analyses have concluded that physical activity can enhance subjective well-being across different contexts and populations [24-26]. For example, a meta-analysis by Wang et al. found that physical activity improves subjective well-being regardless of activity patterns or measurement methods [24]. Therefore, we propose that physical activity could positively influence the subjective well-being of college students.

Based on the literature, there is reason to believe that physical fitness self-efficacy may not only directly influence subjective well-being but also do so indirectly through physical activity. Previous studies have shown that other forms of self-efficacy positively impact subjective well-being [14-17]. For instance, Chamani et al. identified that occupational self-efficacy enhances teachers' sense of well-being [16], and Céspedes found a positive correlation between general self-efficacy and subjective well-being among teenagers [17]. Thus, it is reasonable to hypothesize that physical fitness self-efficacy may be a positive predictor of subjective well-being among college students, potentially mediated by physical activity.

Despite advancements in subjective well-being research, there is a lack of studies explicitly focused on the college student population in Yunnan Province, China—a region renowned for its unique geographical and cultural environment, with multiple ethnic groups coexisting and integrating [13]. The influence of this multicultural background on the relationships among physical fitness self-efficacy, physical activity, and subjective well-being remains uncertain. Additionally, physical activity levels and their effects on subjective well-being may vary by gender, suggesting that gender might moderate these relationships [27].

Purpose of the Study

This study aims to examine the current state of subjective well-being among college students in Yunnan Province and explore the relationships among physical fitness self-efficacy, physical activity, and subjective well-being. Specifically, we propose the following hypotheses:

1) Physical fitness self-efficacy positively predicts subjective well-being.
2) Physical fitness self-efficacy positively influences physical activity levels.
3) Physical activity positively predicts subjective well-being.
4) Physical activity mediates the relationship between physical fitness self-efficacy and subjective well-being.
5) Gender moderates the mediation model, affecting the strength of the relationships among these variables.

By investigating these hypotheses, we hope to provide a theoretical foundation for developing intervention strategies tailored to enhance the happiness and mental health of college students in Yunnan Province.

2. Methods

2.1. Population and Sample

After obtaining approval from the Ethics Committee of Kunming Medical College (IRB: KMMU2023MEC161), the study was performed in accordance with relevant guidelines and regulations. Students from 5 higher education institutions in Yunnan Province, representing a broad spectrum of academic disciplines, were randomly selected as participants. The array of disciplines mirrored the diverse academic interests of college students in the province, including ethnic studies, medical studies, agricultural studies, engineering, and arts. We used G*Power to calculate the sample size, setting it as a linear bivariate regression, two tails, with a medium effect size and a power of 0.8 [28]. We found that a sample size exceeding 343 participants is sufficient to meet the statistical analysis requirements of this study.

The study began with the random selection of 480 students from the five participating higher education institutions in Yunnan Province. We used a simple random sampling method

based on enrollment lists provided by the institutions, ensuring each student had an equal chance of being selected. We obtained informed consent from all participants or their parents. For participants under the age of 18, parental consent was obtained prior to participation. We implemented rigorous quality control measures during the data collection process. We meticulously identified and excluded invalid entries, such as incomplete questionnaires and inattentive responses, from the analysis. As a result, the final statistical analysis incorporated data from 455 valid responses (Age 19.13±1.32), yielding an effectiveness rate of 94.79%. This rate reflects this study's rigorous data collection and validation process.

2.2. Instruments

This study utilizes the "Physical Fitness Health Self-Efficacy Questionnaire" as its primary measurement tool. In this study, we define physical fitness self-efficacy as an individual's confidence in overcoming barriers to exercise after assessing their physical fitness [8, 10]. More specifically, it relates to their belief in their ability to improve suboptimal physical conditions through personal efforts. The questionnaire consists of four items, each rated on a 5-point Likert scale. An illustrative item is, "Given poor physical health conditions, I can surmount obstacles like weather and environment to maintain regular exercise." This item exemplifies the type of self-efficacy belief the questionnaire seeks to measure. Factor analysis of the four items in the "Physical Fitness Health Self-Efficacy Questionnaire" yielded a single factor with an eigenvalue above 1, explaining 60.53% of the total variance. The Kaiser-Meyer-Olkin measure was 0.75, $p < 0.001$, indicating adequate sample adequacy for the factor analysis. Furthermore, the internal consistency reliability of the questionnaire was satisfactory, with a Cronbach's alpha of 0.76.

In this study, we employ the "Physical Activity Rating Scale" (PARS-3) to quantify physical activity [29]. We conceive physical activity as health-focused exertion, typically measuring it in terms of the intensity, frequency, and duration of sports activities engagement. We compute the volume of physical exercise using the following formula: Intensity × (Time-1) × Frequency. This formula encapsulates the critical dimensions of physical activity as conceived in this study. The factor analysis conducted on the three items of PARS-3 extracted a single factor with an eigenvalue exceeding 1, explaining 54.68% of the total variance. This result suggests that these three items coherently measure a common underlying concept, physical activity, as defined for this study. The Kaiser-Meyer-Olkin measure amounted to 0.61, $p < 0.001$, indicating adequate sampling adequacy for the factor analysis. Additionally, the internal consistency reliability of the scale was found to be satisfactory, with a Cronbach's alpha of 0.71, thus ensuring the reliability of the PARS-3 in this study.

This study utilized the "Subjective Well-being Questionnaire" with a 5-point Likert scale to measure subjective well-being [2, 30]. Since the original questionnaire was developed for high school students, we conducted both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to validate its applicability and factor structure among university students. Data collection occurred in two stages. The first stage involved 120 online questionnaires at Kunming Medical University, with 109 valid responses (90.83% valid rate). Exploratory factor analysis revealed a total explained variance of 65.64%, with a KMO measure of 0.94 and a significant Bartlett's test ($p<0.001$). The second stage collected 100 questionnaires at Yunnan Minzu University, resulting in 91 valid responses (91% valid rate). We conducted a confirmatory factor analysis (CFA) using maximum likelihood estimation in AMOS 25.0. Confirmatory factor analysis led to the removal of the physical satisfaction dimension due to its negligible contribution (0.03). The revised questionnaire includes four dimensions: positive emotions, negative emotions, life satisfaction, and learning satisfaction, with 28 items in total. The model fit indices were satisfactory: chi-square = 1243.30, df = 346, chi-square/df = 3.59, $p< 0.001$, GFI = 0.85, AGFI = 0.82, CFI = 0.91, RMSEA = 0.07, these indices meet the conventional criteria for acceptable model fit, where GFI and AGFI values above 0.80, CFI above 0.90, and RMSEA below 0.08 indicate a good fit [31]. The refined questionnaire demonstrated high reliability with a Cronbach's α of 0.93, indicating strong internal consistency and suitability for measuring subjective well-being.

2.3. Procedure

We uploaded the questionnaire to 'Questionnaire Star' and circulated it online to collect data on physical fitness self-efficacy, physical activity, and subjective well-being. The data were imported into SPSS 27.0 for preprocessing, including data cleaning, outlier detection, handling missing values, and testing reliability and validity. Descriptive statistical analysis summarized the sample characteristics, while correlation analysis assessed the relationships between variables. Linear regression analysis was conducted to identify the most significant predictors. Finally, Hayes' mediation effect model (Process 4.2) was used to evaluate the study's hypothesis and understand the interrelationships among variables.

3. Results

We divided the research findings into four distinct sections. The first section provides a demographic analysis of physical fitness self-efficacy, physical activity and subjective well-being, offering a snapshot of the sample's characteristics. The second section reveals the results of the correlation analysis between physical activity and subjective well-being. This analysis helps us understand the degree of association between these two variables. The third section communicates the outcomes of the regression analysis between physical

activity and subjective well-being. This part elaborates on the predictive power of physical activity on subjective well-being. Lastly, the fourth section examines the mediation effect of physical activity on the relationship between physical fitness self-efficacy and subjective well-being. This final part provides a more nuanced understanding of the interrelationships among these variables.

Consistent with suggestions from previous studies, researchers recognize that using self-report measures for data collection might lead to common method bias. In this research, to address this concern related to the three constructs—physical fitness self-efficacy, physical activity, and subjective well-being—we utilized Harman's single-factor test for validation. The results revealed an explanatory variance of 12.56% for the first factor. This percentage is below the critical 40% threshold, indicating that common method bias isn't a significant issue in our data [32].

3.1. Demographic Analysis of Physical Fitness Self-efficacy, Physical Activity, and Subjective Well-being

To investigate gender differences in physical fitness self-efficacy, physical activity, and subjective well-being, we carried out separate independent sample t-tests. As shown in Table 1, where the effect sizes (Cohen's d) calculated for gender differences in physical activity, physical fitness self-efficacy, and subjective well-being were 1.00, 0.59, and 0.33, respectively.

Table 1. *Summary of gender difference analysis of physical activity, physical fitness self-efficacy, and subjective well-being.*

	Gender	M	SD	*t*	*p*	95% confidence interval		Cohen's *d*
						LLCI	ULCI	
PA	M	25.70	21.24	11.24	0.00	13.44	19.14	1.00
	F	9.41	9.21					
PFSE	M	11.95	2.99	6.22	0.00	1.15	2.20	0.59
	F	10.27	2.67					
SWB	M	96.12	14.30	3.46	0.00	2.05	7.46	0.33
	F	91.36	14.33					

Notes: PA = physical activity; PFSE = physical fitness self-efficacy; SWB = subjective well-being; M = male; F = female. 'M' stands for the mean and 'SD' denotes the standard deviation. The 'LLCI' represents the lower limit of the 95% confidence interval, while the 'ULCI' refers to the upper limit of the 95% confidence.

3.2. Correlation Analysis of Physical Fitness Self-efficacy, Physical Activity, and Subjective Well-being

In order to explore the correlation between physical activity, physical fitness self-efficacy, subjective well-being, and their respective dimensions, we conducted a Pearson correlation analysis. We outline the results of this analysis in Table 2.

Table 2. *Summary of correlation analysis of concepts and dimensions of physical activity, physical fitness self-efficacy, and subjective well-being.*

	1	2	3	4	5	6	7	8	9	10
1. Intensity	1.00									
2. Time	.41**	1.00								
3. Frequency	.27**	.27**	1.00							
4. PA	.77**	.71**	.49**	1.00						
5. PFSE	.32**	.21**	.24**	.35**	1.00					

	1	2	3	4	5	6	7	8	9	10
6. SWB	.21**	.31**	.25**	.29**	.33**	1.00				
7. NE	.14**	.21**	.20**	.22**	.15**	.76**	1.00			
8. Life S	.15**	.27**	.10*	.10**	.31**	.65**	.16**	1.00		
9. Learn S	.18**	.25**	.20**	.22**	.31**	.70**	.21**	.60**	1.00	
10. PE	.16**	.23**	.21**	.22**	.32**	.82**	.40**	.56**	.63**	1.00

Notes: *indicates p＜0.05，**indicates p＜0.01. PA = physical activity; PFSE = physical fitness self-efficacy; SWB = subjective well-being; NE = negative emotions; Life S = life satisfaction; Learn S = learning satisfaction; PE = positive emotions.

3.3. Regression Analysis of Physical Fitness Self-efficacy and Physical Activity on Subjective Well-being

We conducted linear regression analyses to assess the predictive impact of physical fitness self-efficacy and physical activity on subjective well-being. Physical fitness self-efficacy and physical activity served as independent variables, while subjective well-being was the dependent variable. The results, presented in Table 3, indicate that both physical fitness self-efficacy and physical activity significantly predict subjective well-being. Adding physical activity to the model significantly increased the explained variance in subjective well-being (R^2 change = 13.80%, indicating that physical fitness self-efficacy and physical activity explained 13.80% of the variance in subjective well-being), suggesting that physical activity contributes additional explanatory power beyond physical fitness self-efficacy. The effect sizes ranged from medium to large, indicating meaningful relationships.

Table 3. *Summary of Regression Analysis of Physical fitness self-efficacy and Physical activity on Subjective Well-being.*

IndV	DV	R^2	R^2 change	Coeff	se	β	*t*	p	LLCI	ULCI
PFSE	SWB	10.80%	10.60%	1.63	0.22	0.33	7.41	***	1.20	2.07
PFSE	PA	12.10%	11.90%	2.04	0.26	0.35	7.91	***	1.53	2.54
PA	SWB	8.20%	8.00%	0.24	0.04	0.29	6.34	***	0.17	0.32
PFSE	SWB	14.10%	13.80%	1.30	0.23	0.26	5.61	***	0.84	1.75
PS				0.17	0.04	0.20	4.19	***	0.09	0.24

Notes: ***indicates p＜ 0.001. IndV = independent variable; DV = dependent variable; PA = physical activity; PFSE = physical fitness self-efficacy; SWB = subjective well-being. R^2 (R-squared) represents the coefficient of determination for each regression model. R^2 change represents the change in R^2 when a new predictor is added to the regression model. 'Coeff' symbolizes the unstandardized effect. Furthermore, 'se' signifies standard error, 'β' indicates the standardized effect, 't' represents the difference, and 'p' discloses the level of statistical significance. The effect size is categorized as small (0.01≤ R2 ≤0.06), medium (0.06＜ R2 ≤0.14), or large (0.14＜ R2), as applicable [33].

3.4. Test of the Mediating Effect of Physical Activity Between Physical Fitness Self-efficacy and Subjective Well-being

To test the hypothesis that physical activity serves as a mediator between physical fitness self-efficacy and subjective well-being, we employed PROCESS version 4.2 (Model 4) with physical fitness self-efficacy as the independent variable, physical activity as the mediator, and subjective well-being as the dependent variable. We utilized the bootstrap procedure with 5,000 samples. We present the results in Table 4. These findings support the hypothesis that physical activity partially mediates the relationship between physical fitness self-efficacy and subjective well-being (indirect effect = 0.34, 95% CI [0.19, 0.50]).

Table 4. Summary of Summary of Total, Direct, and Indirect Effects of Physical Fitness Self-Efficacy on Subjective Well-Being Mediated by Physical Activity.

X on Y	effect	se	t	p	LLCI	ULCI	BootSE	BootLLCI	BootULCI	Effect (ab/c)
total	1.63	0.22	7.41	***	1.20	2.07				
direct	1.30	0.23	5.61	***	0.84	1.75				
*Indirect effect	0.34						0.08	0.19	0.50	20.62%

Notes: ***indicates p＜0.001. se = Standard Error; LLCI = Lower Level of the Confidence Interval; ULCI = Upper Level of the Confidence Interval; Bootse = Bootstrapped Standard Error; BootLLCI and BootULCI = Bootstrapped 95% Confidence Intervals; Effect (ab/c) = Proportion of the total effect mediated. *Indirect effect through the mediator: physical activity.

We created a standardized path diagram to illustrate the relationships among physical activity, physical fitness self-efficacy, and subjective well-being. This diagram visualizes the mediating role of physical activity in the influence of physical fitness self-efficacy on subjective well-being. We display the results in Figure 1. Here, the symbol 'c' represents the total effect of physical fitness self-efficacy on subjective well-being. The symbol 'a' denotes the path from physical fitness self-efficacy to physical activity, 'b' indicates the path from physical activity to subjective well-being, and 'c" corresponds to the direct effect of physical fitness self-efficacy on subjective well-being.

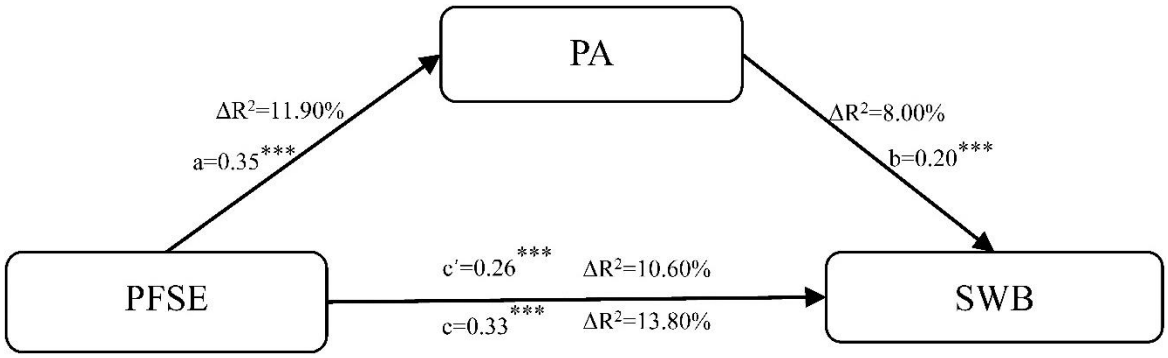

Figure 1. Standardized Path Diagram of the Mediating Model of Physical activity in the Impact of Physical fitness self-efficacy on Subjective Well-being.

3.5. Test of the Moderating Effect of Gender in Model

Considering gender differences in physical fitness self-efficacy, physical activity, and subjective well-being, according to Hayes' suggestions [27], the study used the mediation hypothesis testing method to examine the mediation model effect separately for male and female university students. The findings revealed that for cases of male university students, the predictive effect of physical fitness self-efficacy and physical activity on subjective well-being was ΔR^2 = 11.40%, with a total effect of physical efficacy on subjective well-being of 1.57 (CI = 0.90, 2.24), a direct effect of 1.38 (CI = 0.68, 2.08), and a mediating effect of exercise behavior of 0.19 (BootCI = 0.02, 0.40), making up 11.93% of the mediating effect. For cases of female university students, the predictive effect of physical fitness self-efficacy and physical activity on subjective well-being was ΔR^2 = 14.40%, with a total effect of physical efficacy on subjective well-being of 1.50 (CI = 0.89, 2.11), a direct effect of 1.15 (CI = 0.54, 1.75), and a mediating effect of exercise behavior of 0.36 (BootCI = 0.13, 0.62), making up 23.66% of the mediating effect. The results support the moderating role of gender, showing higher impact effects in the female model than in the male model.

Finally, to clearly display the moderation effect of gender, the study separately drew standardized path diagrams of the mediation model for the effect of physical fitness self-efficacy on subjective well-being through physical activity in male and female university students, with results shown in Figure 2.

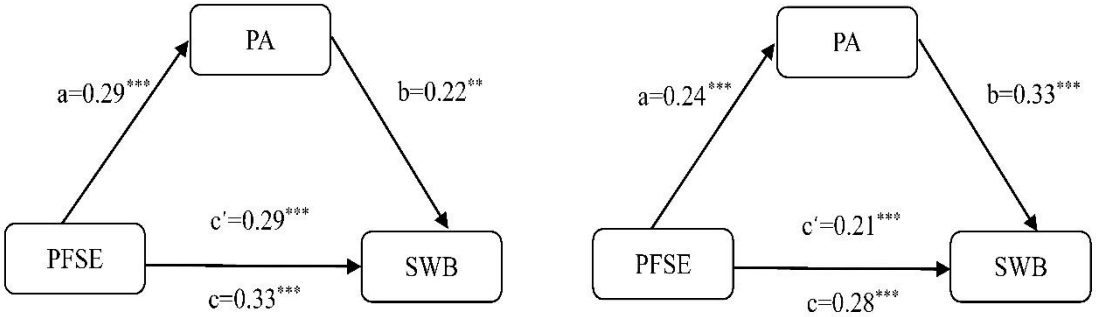

Figure 2. *Standardized path diagram of the mediation model for the effect of physical fitness self-efficacy on subjective well-being through exercise behavior in male (left) and female (right) university students.*

Finally, to demonstrate the moderating effect of gender, we plotted the interaction effect of gender (see Figure 3). As shown in Figure 3, gender moderates the relationships among physical fitness self-efficacy (PFSE), physical activity (PA), and subjective well-being (SWB). The results indicate that gender influences the strength of the paths between these variables. Among male students, PFSE has a stronger effect on PA, while among female students, PA has a more significant impact on SWB. Additionally, the direct effect of PFSE on SWB is stronger in males. These findings suggest that gender plays a significant moderating role in the influence of physical activity as a mediator on well-being.

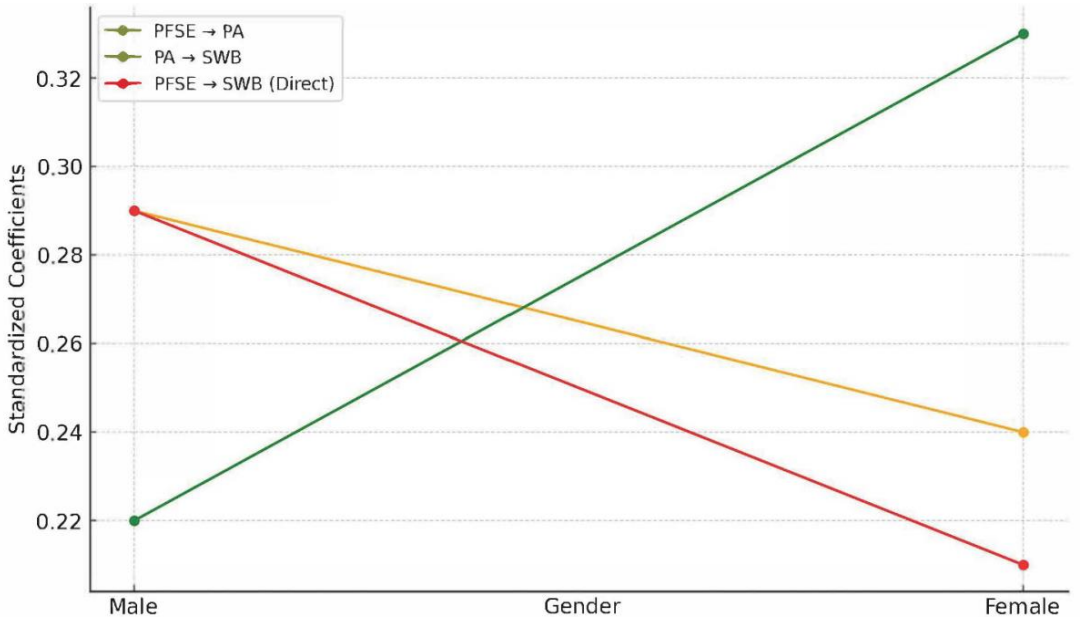

Figure 3. *Interaction Plot for Gender: PFSE, PA, SWB.*

4. Discussion

This study examined the impact of physical fitness self-efficacy on subjective well-being and the role of physical activity in this relationship. Our findings indicate that physical fitness self-efficacy accounts for 10.60% of the variance in subjective well-being. Including physical activity in the model increased the combined predictive power to 13.80%, with physical activity contributing 20.62% of the explained variance. Mediation analysis for male and female university students showed different effect sizes, with mediation effect proportions of 11.93% for males and 23.66% for females. These results suggest that physical activity partially mediates the relationship between physical fitness self-efficacy and subjective well-being, with gender moderating the effect.

Descriptive statistical analysis revealed significant gender differences in physical activity, physical fitness self-efficacy, and subjective well-being. Physical activity showed the largest gender difference (Cohen's d = 1.00), indicating a large effect size. Physical fitness self-efficacy had a moderate effect size (Cohen's d = 0.59), while subjective well-being showed a small effect size (Cohen's d = 0.33). Participants with higher physical fitness self-efficacy tended to have higher physical

activity and subjective well-being scores. Males significantly outperformed females in physical activity and physical fitness self-efficacy, both of which are practically significant. While males also scored higher in subjective well-being, the difference was minor. These gender differences in subjective well-being may be influenced by Yunnan's multi-ethnic and harmonious cultural environment [13], which promotes satisfaction across various dimensions, including societal and cultural roles, family, and academics.

Our study findings indicate that the influence of physical fitness self-efficacy on physical activity has a moderate effect size (β = 0.35, $p < 0.001$), with changes in physical fitness self-efficacy explaining 11.90% of the variations in physical activity. The participants' belief in their ability to overcome challenges and promote health, fostered during the physical assessment, enhanced their physical activity. Such an enhancement suggests that physical fitness self-efficacy has a predictive power on physical activity, which aligns with previous research. Specifically, individuals who perceive themselves as physically capable of exercising tend to increase their physical activity. Our findings align with previous research [18, 34, 35]. For example, a survey of 2341 teenagers revealed that self-efficacy has a moderate effect on physical activities, with an effect size of moderate magnitude ($\beta = 0.41$, $p < 0.001$) [35]. Therefore, when developing plans or interventions to encourage regular exercise, focusing on enhancing individuals' physical fitness self-efficacy could be beneficial. Strengthening their determination and confidence in maintaining exercise could be a critical factor.

The study also found that the predictive influence of physical activity on subjective well-being is quantified at 8.00%, reaching a moderate effect size. Such a statistic means that for each unit increase in physical activity, there is a corresponding 8-unit increase in subjective well-being. Physical activity accounted for 8.60% of the variance in subjective well-being. Conceptually, physical activity generates energy by stimulating muscle activity, enhancing the functionality of various organs, including the brain [36]. These enhancements could improve an individual's psychological state. Subjective well-being is a comprehensive psychological measure that assesses an individual's quality of life, encompassing elements such as cognition and emotions. Our findings are consistent with earlier research exploring the impact of physical activity on subjective well-being [37, 38]. For instance, a meta-analysis focused on physical activity, quality of life, and happiness found that physical activity enhances subjective well-being across various groups, including those with schizophrenia, Parkinson's, depression, and others [23]. Similarly, a meta-analysis by Buecker et al. on the relationship between physical activity and subjective well-being in healthy populations concluded that regardless of prior physical health levels or types of sports activities, physical activity significantly enhances subjective well-being [24].

The mediation analysis of our study revealed that physical fitness self-efficacy and physical activity collectively predict 13.80% of subjective well-being. Of this, the indirect effect of physical activity accounted for 20.62%, indicating a partial mediating role. These findings suggest that physical fitness self-efficacy has both a direct and an indirect effect on subjective well-being, the latter through its influence on physical activity. According to the self-efficacy theory, physical fitness self-efficacy refers to an individual's belief in their ability to maintain and improve their health status [10, 34, 39]. Individuals with high physical fitness self-efficacy, who believe in their capacity to sustain and enhance their physical condition, are more likely to lead a healthier lifestyle, including regular exercise. Furthermore, physical fitness self-efficacy directly influences an individual's subjective well-being, as confidence and positive evaluations of one's health can increase life satisfaction. Physical activity can improve an individual's physical health, boost self-efficacy, and enhance subjective well-being. Therefore, in agreement with the self-efficacy theory, physical fitness self-efficacy increases subjective well-being both directly and indirectly by promoting physical activity. These findings underscore the importance of enhancing an individual's physical fitness self-efficacy and promoting physical activity in improving their subjective well-being.

Notably, the study's moderation analysis found differences in effect sizes between male and female university students in the model. Specifically, it revealed that physical fitness self-efficacy positively affects subjective well-being through physical activity in both groups, albeit with gender differences in effect size (mediation effect proportions of 11.93% for males and 23.66% for females). This implies that physical fitness self-efficacy and physical activity have a greater impact on subjective well-being in female students, with a more pronounced effect in female samples. According to self-efficacy theory, an individual's belief in their ability to perform a specific task, such as physical fitness self-efficacy, is a key predictor of behavioral change and mental health. In this study, physical fitness self-efficacy may act as an intrinsic self-belief, motivating individuals to engage in physical activity, thereby enhancing subjective well-being. This effect appears more pronounced in female university students, consistent with recent research indicating that women's self-efficacy in physical activities significantly impacts their subjective well-being [40-41]. Consequently, for both male and female university students, improving physical fitness self-efficacy and engaging in physical activity can enhance subjective well-being. Interestingly, intervention strategies may need to be gender-specific: for male university students, enhancing physical fitness self-efficacy may more directly improve well-being; for female students, promoting positive exercise behavior may be more crucial for well-being.

Research limitations

Initially, our study constructed a mediation model to evaluate the influence of physical activity on the relationship between physical fitness self-efficacy and subjective well-being. The analysis recognized physical fitness self-efficacy and physical activity as critical factors affecting subjective well-being.

However, the study does have certain limitations. Firstly, it should be noted that the generalizability of the study results may be limited due to the data being sourced solely from Yunnan Province. Future studies should consider validating the findings of this study in a broader geographical and cultural context to enhance their universality and applicability. Secondly, we based the study on findings from previous experimental research, and we deductively constructed a hypothetical model. We used a cross-sectional measurement approach for data collection, which limited our ability to monitor temporal variations in the variables. For example, variables such as students' physical fitness self-efficacy, physical activity, and subjective well-being could fluctuate due to changes in academic semesters, adjustments in course workload, and seasonal variations [42]. Future research might benefit from using longitudinal methods to validate the hypothetical model further. Additionally, our study found that physical activity partially mediates the effect of physical fitness self-efficacy on subjective well-being. Other potential mediating variables, such as individual motivation, goal setting, and self-regulation capabilities, might also need further exploration [4, 29, 43]. Future studies should investigate subjective well-being's determinants and underlying mechanisms [44, 45].

5. Conclusion

This study highlights the critical role of physical fitness self-efficacy and physical activity in promoting subjective well-being among university students. The findings demonstrate that physical activity partially mediates the relationship between physical fitness self-efficacy and subjective well-being, reinforcing the importance of health-promoting behaviors as mechanisms through which self-efficacy influences well-being. Additionally, the gender differences observed in the mediation model suggest the need for tailored interventions that cater to the unique needs of male and female students. Specifically, enhancing physical fitness self-efficacy may be more impactful for male students, while encouraging physical activity may have a stronger effect on well-being for female students. By integrating self-efficacy-building strategies and promoting regular physical activity, universities can play a crucial role in fostering students' overall mental health and well-being.

Abbreviations

PA	Physical Activity
PFSE	Physical Fitness Self-efficacy
SWB	Subjective Well-being
NE	Negative Emotions
Life S	Life Satisfaction
Learn S	Learning Satisfaction
PE	Positive Emotions

Acknowledgments

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Author Contributions

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Data Availability Statement

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

Conflicts of Interest

The authors declare no competing interests.

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