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RESEARCH ARTICLE

The influence of Taijiquan exercise on the subjective well-being of college students: Mediator and regulatory effects

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ABSTRACT

Objective: To explore the influence of Taijiquan exercise on students' subjective well-being and its internal mechanism, and to investigate the role of basic psychological needs as a mediating factor and psychological resilience as a moderating factor. **Methods:** In this study, 810 students from three different schools were surveyed by Taijiquan exercise scale, subjective well-being scale, basic psychological needs scale and mental resilience scale. Subsequently, SPSS27.0 software is used to analyze and process the collected data in detail. In order to further reveal the mediating role of basic psychological needs between Taijiquan exercise and subjective well-being, we further used AMOS28.0 software to build a structural equation model, and adopted the Bootstrap mediation effect test method to analyze the path relationship between variables in detail. **Results:** There were significant pairwise correlations among Taijiquan exercise, subjective well-being, basic psychological needs and psychological resilience. The direct effect analysis showed that Taijiquan exercise had a significant direct effect on the subjective well-being of college students ($\beta = 0.420$, $P < 0.001$). The mediating effect analysis showed that basic psychological need played a partial mediating role in the influence of Taijiquan on the subjective well-being of college students, and its effect size was 0.237, 95% confidence interval was [0.022,0.252]. Meanwhile, mental resilience played a moderating role in this process ($\beta = 0.166$, $P < 0.001$). **Conclusion:** Taijiquan exercise can not only directly improve students' subjective well-being, but also indirectly affect students' subjective well-being through the mediating effect of basic psychological needs and the regulating effect of psychological resilience.

Keywords: college students; subjective well-being; Tai Chi exercise; basic psychological needs; mental resilience

As Tai Chi is increasingly favored by the public, it has gradually become one of the important ways for people to pursue health and fitness. Many universities have also incorporated Tai Chi into the physical education curriculum system, providing opportunities for college students to learn and practice Tai Chi on campus[1]. With the increasing number of college students taking Taijiquan courses, the positive effects of Taijiquan on college students' physical health have gradually surfaced[2]. Today, with the rapid development of society, people have an increasingly strong demand for health, cultural heritage and physical and mental harmony, and Tai Chi just fits in with these diversified pursuits. Therefore, it is of great significance to explore college students' cognitive level of Taijiquan and the current development status of Taijiquan in colleges and universities to deeply understand students' cognitive level, learning needs and actual

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participation in Taijiquan[3]. This will provide strong support for scientific planning of Tai Chi project development strategy, optimization of curriculum and improvement of service quality, aiming at providing students with a more adaptable Tai Chi learning experience.

In recent years, how physical exercise affects subjective well-being has become a topic widely discussed by scholars at home and abroad. A study of high school students conducted by scholar Chen Zuosong revealed that those who actively participated in physical exercise reported greater subjective well-being than those who did not exercise enough. The reason may be attributed to the potential effect of sports on the quality of life and emotional state of high school students. At the same time, sports may further promote the improvement of their subjective well-being through shaping self-esteem and personality traits[4]. Secondly, the research of foreign scholar Zhang has deeply discussed the internal relationship between sports and undergraduates' happiness, and pointed out that there is a dose-dependent relationship between individual subjective happiness and exercise intensity[5]. Scholar Zhang Yunbang's survey results on college teachers show that those who have the habit of physical exercise are significantly better than those who lack the habit of physical exercise in terms of subjective well-being, which further confirms the positive predictive effect of physical exercise on subjective well-being [6]. The research of scholar Jiang Huizhen emphasized the positive impact of physical exercise on subjective well-being through emotional experience, a key factor, and pointed out that the length of exercise time has a significant impact on the happiness experience of college teachers[7]. Through comprehensive analysis, Buecker found that physical activity is significantly correlated with multiple aspects of the emotional dimension, and physical exercise can improve participants' subjective well-being by regulating these emotional factors[8]. In the study of specific exercise forms, Taijiquan exercise has a positive effect on the happiness of middle-aged and elderly people, and this effect is more prominent in middle-aged and elderly women, especially the improvement of happiness of elderly women[9]. Scholar Mei Song also pointed out that compared with students who did not do Tai Chi or other physical exercises, college students who participated in Tai Chi showed a higher advantage in the level of happiness[10]. Similarly, scholar Caldwell, through a 15-week intervention study of Tai chi exercise program, found that tai chi exercise can significantly improve college students' positive emotions, sleep quality and subjective well-being[11]. In summary, although there are differences in object selection, exercise forms and research methods, all studies have reached the conclusion that physical exercise is positively correlated with subjective well-being. Therefore, this paper proposes hypothesis H1: Taijiquan exercise can positively predict the subjective well-being of college students.

Self-determination theory (SDT) states that humans have three basic psychological needs: autonomy, competence, and connection. Tai Chi exercise can just meet these basic psychological needs. In the academic field of exploring physical exercise motivation, Self-DeterminationTheory (SDT) has been widely adopted to explain and predict individual physical exercise behavior, and this applied research direction has attracted the attention of many scholars[12]. As self-determination theory under the framework of a core component of the basic psychological needs theory (BasicPsychologicalNeedsTheory BPNT) occupies a pivotal position. The theory asserts that individual growth and development depend on the satisfaction of three basic psychological needs: autonomy, competence, and relationships. These three elements are regarded as indispensable elements to nourish individual growth, and the absence of any of them may hinder the normal survival and progress of individuals[13]. In other words, only when these three basic psychological needs are fully satisfied can individuals achieve optimal performance and development in activities such as tai chi exercise. At present, the relevant researches in the field of sports at home and abroad are in the stage of continuous deepening. Although the research on the relationship between physical exercise, subjective well-being and basic psychological needs has been paid more and more attention, the literature on in-depth

discussion of these three as a whole is still insufficient compared with the research on the pduo relationship. The study of foreign scholar Ihsan pointed out that basic psychological needs have a positive effect on self-efficacy, which can further affect individual exercise habits[14]. Foreign scholar Jaakkola et al. found that meeting basic psychological needs can directly predict individuals' motivation to participate in sports and extracurricular sports[15]. Taijiquan exercise can significantly improve the subjective well-being of college students. On the one hand, Tai Chi exercises improve the physical health condition, enhance the individual's physiological function and physical quality, thus enhancing their sense of control over life and self-confidence; On the other hand, by satisfying the basic psychological needs of college students, Tai Chi exercises improve their mental toughness and ability to cope with pressure, and thus enhance their subjective well-being. The mediating effect of basic psychological needs has been confirmed by a large number of studies. For example, Li Qinghua's research results reveal that the satisfaction of basic psychological needs has a positive predictive effect on individual psychological well-being and subjective well-being, while it is negatively correlated with unhappiness. This conclusion has also been verified in the sample of high school students, that is, the satisfaction of autonomy, relationship and ability needs is significantly positively correlated with subjective well-being and psychological well-being[16]. In addition, scholar Lv Guoqing further pointed out in his research that meaning happiness tendency can not only directly predict happiness, but also indirectly affect happiness through the double mediating effect of prosocial behavior and basic psychological needs satisfaction[17]. Finally, through the use of the theoretical framework of basic psychological needs, the in-depth analysis of the relationship between college students' physical exercise and subjective well-being can not only fill the gap in the existing research, but also provide more abundant and in-depth theoretical support and practical guidance for the complex correlation between the three. Therefore, hypothesis H2 is proposed in this paper: Taijiquan exercise has a positive impact on college students' subjective well-being through the mediating role of basic psychological needs.

Previous studies mainly focused on the factors related to psychological resilience and their effects, but there were relatively few studies on psychological resilience itself. At home and abroad, some scholars and experts have begun to explore the relationship between physical exercise and mental resilience in some projects in the field of physical education. Scholar Zhou Yang et al. selected 250 elderly people in Zhengzhou as research objects to improve their mental resilience through physical exercise, and the results showed that the elderly with a higher level of mental resilience had relatively higher physical fitness and subjective well-being. The elderly who regularly participate in physical exercise show better state of mind and body, and they are more confident to face and deal with setbacks and difficulties in life[18]. This finding is consistent with the research results of scholars Mazo et al.[19]. Tai Chi has attracted a growing audience in recent years. Studies have shown that Taijiquan is closely related to mental resilience. Scholars Kohn et al. conducted 12 weeks of Tai chi fusion resistance training on the samples, and the results showed that this training method could improve the psychological resilience of the samples, indicating that there was a positive correlation between Tai chi fusion resistance training and psychological resilience [20]. Taijiquan not only enhances the mental resilience of normal people, but also has a significant impact on special groups. During the COVID-19 epidemic, Xu Xia et al. conducted a survey of tai chi exercise among patients in makeshift hospitals, and found that this exercise can effectively relieve the psychological pressure of patients with COVID-19, and has a positive effect on the enhancement of mental resilience. Patients with higher mental resilience will more actively cooperate with treatment, and their physical condition will gradually recover[21]. Before that, scholar Wu Yonghui et al. also used Tai chi to improve the psychological resilience of patients with coronary heart disease[22]. However, the research results of scholar Li Xiaobing et al. showed that tai chi exercise could not significantly enhance the internal psychological ability to resist pressure and

the physical adaptability reflected by heart rate variability (HRV), but it could improve the perseverance and pain tolerance of college students in practice[23]. At present, the research results for different populations and different interventions are different, therefore, it is necessary to develop more scientific, standardized and systematic tai chi intervention measures, and conduct in-depth research on different populations. At the same time, at the psychological level, the level of individual psychological resilience also plays a key role in regulating. Psychologists have pointed out that psychological resilience refers to the ability of an individual to take positive strategies to quickly reduce pressure and restore the original state when encountering adversity, disaster or setback[24]. Studies have confirmed that mental resilience is an important defense mechanism against psychological disorders such as depression and anxiety[25]. Individuals with high psychological resilience show stronger adaptability in the face of stressful environments[26]. The improvement of mental resilience is directly related to the improvement of individual mental health and the increase of subjective well-being index[27]. Therefore, this paper proposes hypothesis H3: Psychological resilience positively regulates the relationship between Taijiquan exercise and subjective well-being.

To sum up, there may be a close relationship between Tai chi exercise, subjective well-being, basic psychological needs and psychological resilience. This study constructed a theoretical model containing mediating variables and moderating variables, aiming to deeply explore the mediating role of basic psychological needs between Taijiquan exercise and college students' perception of happiness, and examine the moderating effect of mental toughness, so as to provide theoretical support for the application of Taijiquan exercise in the intervention of college students' mental health.

1. Research objects and methods

1.1. Research objects

The survey objects of this study were mainly selected from Guangxi University of Traditional Chinese Medicine, Thailand Gale University, Yulin Normal College students who took Taijiquan courses as the survey objects, a total of 850 people. The questionnaire was distributed in the form of questionnaire star, and the corresponding data were obtained. There were 850 questionnaires in this survey. According to the screening principle, some invalid questionnaires were deleted, and the valid questionnaires were statistically recovered. A total of 810 valid questionnaires were obtained, with a recovery rate of 95%.

1.2. Measuring tools

1.2.1. Physical exercise scale

In this study, we will adopt the Physical Activity Rating Scale (PARS-3) improved by Liang Deqing et al.[28] from Wuhan Institute of Physical Education, which is designed to evaluate the amount of Tai chi exercise activities of college students. Specifically, the scale takes into account the intensity of college students' participation in sports activities, the duration of a single exercise and the frequency of exercise, uses a scoring mechanism to measure the amount of physical exercise, and evaluates the level of physical exercise according to a specific formula. The calculation formula is: physical exercise score = activity intensity × (duration -1) × frequency. Length, intensity and frequency are divided into five levels, with each level assigned a score of 1 to 5. The score range for the amount of physical activity ranges from 0 to 100 points. In addition, according to the score range, the amount of physical activity is further divided into: high activity corresponds to ≤19 points; Moderate activity corresponded to scores between 20 and 42; Low activity corresponds to a score of ≥43 points. In this study, Cronbach's salpha coefficient was 0.819, indicating good reliability. At present, this scale is mainly used for the assessment of physical activity of college students and other groups.

1.2.2. Subjective well-being index scale

The well-being assessment tool, IndexofWell-Being (IWB), designed by Campbell et al.[29] in 1976, was adopted. The scale covers two aspects: overall emotional status and life satisfaction. Specifically, the first eight items were used to assess overall emotional well-being, each weighing equally; The last category, which focuses on life satisfaction, has a slightly higher weight of 1.1 times. This scale adopts a seven-level scoring system, with the total score ranging from 2.1 points to 14.7 points, and the increase of scores means that the subjective well-being of individuals is enhanced correspondingly. After this verification, the internal consistency coefficient (Klonbach coefficient) of the scale is as high as 0.954, which further confirms its high reliability.

1.2.3. Basic psychological needs Scale

This scale, revised by Liu Junsheng et al.[30] in 2013, contains 19 assessment items and is carefully divided into three sections: Independent demand plate (2, 4, 8, 11, 13, 17, total 6 questions), ability demand plate (3, 7, 9, 12, 15, 18, total 6 questions) and ownership demand plate (1, 5, 6, 10, 14, 16, 19, total 7 questions). The scale adopts a five-level scoring system and has 9 reverse scoring items (question numbers 2, 3, 6, 9, 13, 14, 16, 17, 18, respectively). In general, the higher a subject's score, the higher their level of satisfaction of basic psychological needs. In this study, the internal consistency reliability (Cronbach's salpha value) of this scale is as high as 0.952, which is widely used in the assessment of basic psychological needs of students and other groups.

1.2.4. Psychological resilience scale

The Resiliency Scale (CD-RISC) developed by Connor and Davidson[31] is adopted in this paper, and the Resiliency Scale (CD-RISC) is adjusted by Xiao Nan, Zhang Jiaxin and other scholars. The scale focuses on three core aspects: resilience, sense of strength and optimism. Specifically, the optimism section covers four items (items 2, 3, 4, 6); The sense of strength section contains 8 items, namely items 1, 5, 7, 8, 9, 10, 24, 25; The resilience section consists of 13 items, items 11 to 23, and the total scale contains 25 items. This scale follows the Likert five-level scoring principle, and the increasing score means the higher the level of mental toughness of an individual. In this study, the internal consistency reliability (Cronbach's salpha value) of this scale was as high as 0.963, and it has been widely used in the assessment of mental toughness of college students and other groups.

1.3. Common method deviation test

In this study, Harman single factor test was used to test the common method bias. The results show that a total of 8 factors have characteristic roots greater than 1, and the first factor explains the cumulative variation of 39.209%. As long as it is below the critical value of 40%, there is no serious common method bias problem.

2. Research results

2.1. Correlation coefficients of each variable

Table 1. Correlation coefficient matrix of each variable.

	1	2	3	4	5	6	7	8	9	10	11
Exercise intensity	1										
Exercise time	0.609**	1									
Exercise frequency	0.565**	0.636**	1								

Emotional experience	0.312**	0.319**	0.194**	1							
Life satisfaction	0.337**	0.334**	0.241**	0.784**	1						
autonomy	0.437**	0.431**	0.393**	0.332**	0.381**	1					
competence	0.338**	0.400**	0.444**	0.207**	0.276**	0.570**	1				
belongingness	0.339**	0.369**	0.363**	0.373**	0.413**	0.491**	0.546**	1			
optimism	0.348**	0.370**	0.435**	0.175**	0.210**	0.468**	0.497**	0.464**	1		
strength	0.292**	0.328**	0.348**	0.192**	0.200**	0.417**	0.460**	0.427**	0.495**	1	
tenacity	0.398**	0.419**	0.389**	0.383**	0.355**	0.550**	0.467**	0.451**	0.551**	0.507**	1

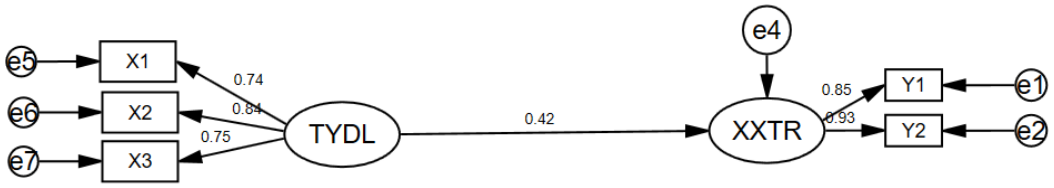
Table 1. (*Continued*)

Note: ** represents p<0.05, ** represents p<0.01, *** represents p<0.001.*

The correlation analysis of the average scores of each variable shows that Taijiquan exercise has a significant positive correlation with subjective well-being. There is a significant positive correlation between Taijiquan exercise and basic psychological needs. There is a significant positive correlation between basic psychological needs and subjective well-being. There is a significant positive correlation between Taijiquan exercise and mental resilience. There is a significant positive correlation between psychological resilience and subjective well-being.

2.2. Direct effect analysis

With the help of AMOS28.0 software, the direct influence model of Taijiquan exercise on subjective well-being is constructed. After the correlation relationship and residual setting, the corresponding results are obtained, as shown in the following figure:



Notes: *TYDL (physical exercise), XXTR (Subjective well-being), X1 (intensity), X2 (time), X3 (frequency),Y1 (Emotional experience), Y2 (Life satisfaction) ,e(error term).*

Figure 1. Model of the direct influence of Tai Chi exercise on subjective well-being.

After constructing the direct effect model, the model was tested, as shown in the table below:

Table 2. Structural equation model fitting index.

Adaptation index	χ2/df	RMSEA	NFI	IFI	TLI	CFI	RFI
Actual value	3.545	0.056	0.975	0.968	0.982	0.977	0.982

According to the data provided in **Table 2**, the specific value of χ2 is 3.545, and that of RMSEA (approximate root mean square error) is 0.056. According to the established criteria, a value of RMSEA below 0.1 is considered to meet the requirements. In addition, a number of fit indicators such as RFI (relative fit index), NFI (normative fit index), TLI (Tuck-Lewis index), IFI (incremental fit index) and CFI (Comparative fit index) have values in excess of 0.9. These results show that the model exhibits good fit and adaptability.

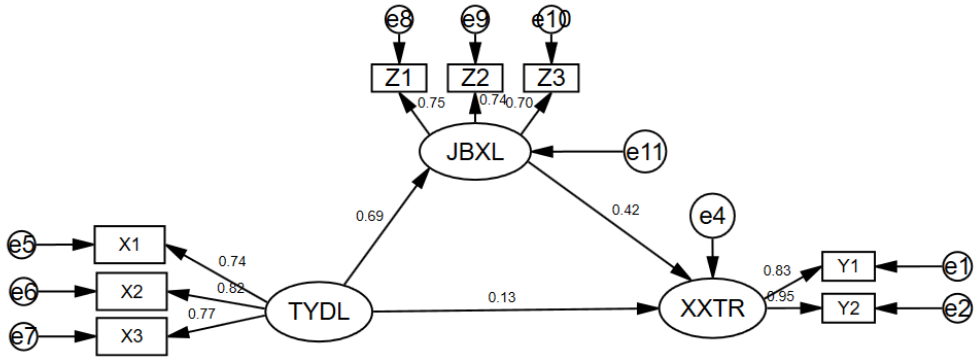
Table 3. Direct effect path coefficient estimation table.

Path	Non-standardized coefficients	Standardization coefficient	S.E	t	p
Tai Chi exercise → Subjective well-being	0.623	0.378	0.066	9.396	0.000

As can be seen from the above table, the standardization coefficient is 0.623 ($p<0.001$), indicating that Taijiquan exercise has a significant positive impact on subjective well-being.

2.3. Intermediation effect test

In this study, we use structural equation model to analyze the relationship between variables. Specifically, we follow the mediation effect model testing method proposed by Wen Zhonglin[32] as a theoretical framework, and use Amos28.0, a professional software tool, to strictly test the preset mediation model. In the testing process, we adopted the bias correction percentile Bootstrap method and accurately calculated the 95% confidence interval through 5000 repeated sample extraction, thus successfully constructing the intermediary model. See **Figure 2** for a detailed construction of the model.



Notes: *TYDL (physical exercise), XXTR (Subjective well-being),JBXL (Basic psychological needs), X1 (intensity), X2 (time), X3 (frequency),Y1 (Emotional experience), Y2 (Life satisfaction)，Z1 (autonomy), Z2 (competence), Z3 (belongingness), e(error term).*

Figure 2. The mediation mechanism model of Tai Chi exercise on subjective well-being.

Table 4. Fitting index of structural equation model.

Adaptation index	χ2/df	RMSEA	NFI	IFI	TLI	CFI	RFI
Actual value	2.501	0.043	0.953	0.949	0.971	0.969	0.971

According to the data provided in **Table 4**, χ2/df has a value of 2.501 and RMSEA (root-mean-square error approximation) has a value of 0.043, which is below the threshold of 0.08. In addition, several fit indicators such as NFI (canonical fit Index), TLI (Tuck-Lewis Index), IFI (incremental fit Index), and CFI (Comparative fit Index) have values in excess of 0.9. These data show that the model has good fitting effect.

Table 5. Path coefficient estimation table.

Path	Non-standardized coefficients	Standardization coefficient	S.E	t	p
Tai Chi exercise → Basic psychological needs	0.574	0.685	0.041	13.821	0.000
Tai Chi exercise → Subjective well-being	0.237	0.147	0.095	2.507	0.012
Basic psychological needs → Subjective well-being	0.642	0.334	0.119	5.385	0.000

Note: **** stands for p<0.001*

According to **Table 5**, the standardization coefficient of the path "Tai Chi exercise → basic psychological needs" is 0.685 (p<0.001), indicating that Tai chi exercise has a significant positive impact on basic psychological needs. The standardized coefficient of the path "Tai Chi exercise → sense of well-being" was 0.147 (p<0.001), indicating that Tai Chi exercise had a significant positive impact on subjective well-being. The standardized coefficient of the path "basic psychological needs → subjective well-being" was 0.334 (p<0.001), indicating that basic psychological needs had a significant positive impact on subjective well-being.

Table 6. Tests the mediating effect of emotional regulation on self-efficacy.

path	point estimate	Product of coefficients		Boostrap 5000 times			
				Bias-Corrected 95%CI		Percentile95%CI	
		Standard error	Z value	floor	Upper limit	floor	Upper limit
The total effect of Taijiquan exercise on subjective well-being	0.376	0.068	10.924	0.294	0.436	0.305	0.448
Tai Chi exercise → Basic psychological needs → Indirect effects of subjective well-being	0.147	0.043	11.107	0.022	0.252	0.032	0.260
The direct effect of Taijiquan exercise on subjective well-being	0.229	0.069	4.861	0.150	0.303	0.153	0.448

As can be seen from **Table 6**, the direct effect value of Taiji exercise on subjective well-being is 0.229, the bia-corrected95%CI confidence interval is [0.150,0.303], and the percentile 95%CI confidence interval [0.153,0.448], excluding 0, indicating that the direct effect is significant. The indirect effect value of Taijiquan exercise on subjective well-being through basic psychological needs is -0.147. The results of the mediation effect test based on Bootstrap method showed that the biascorrected95%CI confidence interval was [0.022,0.252] and the Percentile95%CI confidence interval [0.032,0.260], excluding 0, indicating that the mediation effect was significant. The total effect value of Taiji exercise on subjective well-being was 0.376, biascorrected95%CI confidence interval was [0.294,0.436], Percentile95%CI confidence interval [0.305,0.448], excluding 0, indicating that the total effect was significant. Therefore, basic psychological needs play a partial mediating role between Tai chi exercise and subjective well-being.

According to the above results, this study proposed H1 and H2 hypotheses on the direct and mediating effects of Taijiquan exercise on subjective well-being, and the H1 and H2 hypotheses were verified by testing, as shown in the following table:

Table 7. Results of hypothesis verification of direct action and mediation mechanism.

Hypothetical number	Suppose the content	Test result
H1	Taijiquan exercise has a positive effect on subjective well-being	support
H2	Taijiquan exercise has a positive effect on subjective well-being through the mediating effect of basic psychological needs	support

2.4. Adjustment effect test

On the basis of the existing literature, this study further introduced the moderating variables, aiming to comprehensively and deeply explore the specific impact of Taijiquan exercise on subjective well-being. At the same time, in order to analyze more accurately, we choose gender, grade, major and the place of origin of students as four controlling variables. In the PROCESS of research and implementation, we adopted the advanced statistical software SPSS27.0 to process and analyze the relevant data, and carried out a more

detailed test with the help of PROCESS software. Specific research details and results are shown in the table below:

Table 8. Test of the moderating effect of psychological resilience.

Regression equation (N = 810)		Fitting index			Coefficient significance	
Result variable	**Predictor**	**R**	**R^2**	**F(df)**	**β**	**T**
Subjective well-being		0.428	0.183	25.578		
	sex				-0.026	-0.825
	grade				-0.015	-0.471
	profession				-0.011	-0.358
	Source of students				0.009	0.269
	Taijiquan exercise				0.272	7.227***
	Mental resilience				0.187	4.962***
	Tai Chi exercises x mental resilience				0.166	5.182***

Note: *"×" represents the cross-multiplication term, * represents p <0.05, *** represents p <0.00.*

According to the results of **Table 8**, the β value and T-value coefficient of grade were significant (P <0.05), but the β value and T-value coefficient of gender, grade, major and student origin were not significant (P>0.05). By examining the main effect, it is concluded that Taijiquan exercise has a significant positive impact on subjective well-being (β=0.272, P<0.001,), and mental resilience has a significant positive impact on subjective well-being (β=-0.187, P<0.001). By testing the regulating effect of mental resilience, it can be seen that the influence of "Tai chi exercise x mental resilience" on subjective well-being is 0.166 (P<0.001), indicating that mental resilience has a positive regulating effect between Tai chi exercise and subjective well-being, that is, Tai chi exercise has a positive influence on subjective well-being, and the interaction term is also a positive influence.

According to the above results, this study proposed H3 hypothesis on the direct and mediating effects of Taijiquan exercise on subjective well-being, and the H3 hypothesis has been verified by testing, as shown in the following table:

Table 9. Results of hypothesis verification of direct action and mediation mechanism.

Hypothetical number	Suppose the content	Test result
H3	Taijiquan exercise has a positive effect on subjective well-being through the adjustment of mental resilience	support

3. Discuss

3.1. The direct effect of Taijiquan exercise on subjective well-being

The results of this study show that Taijiquan exercise has a significant positive impact on college students' perception of happiness, and this traditional exercise can directly predict the improvement of happiness, that is, the higher the frequency of participating in Taijiquan, the higher the degree of happiness experienced by college students. As an important index to measure personal life satisfaction, subjective well-being can effectively reflect individual life quality. With the advancement of sports psychology, a large number of studies have begun to focus on the positive effects of physical activity on enhancing an individual's perception of well-being. A number of foreign studies have confirmed that active participation in

physical exercise can significantly improve individuals' perception of happiness[33]. Scholars have pointed out that physical exercise can not only expand an individual's social scope, but also enhance social support network and interpersonal skills[34], which together can bring positive happiness experience to participants[35]. Among various forms of exercise, Taijiquan has a particularly prominent effect on improving the perception of personal happiness. Studies have shown that regular participation in Taijiquan exercises can significantly improve the positive emotions of college students, and at the same time can effectively relieve negative emotions, thus enhancing their perception of happiness to varying degrees[36]. In addition, long-term adherence to physical activity not only helps to enhance individual cognitive function, but also improves the quality of life, and active participation in sports and leisure activities is regarded as an important way to achieve a happy life[37]. This may be because regular participation in physical activities such as Tai Chi can stimulate positive emotions and improve the life happiness index, thus enhancing the overall happiness experience of participants[38]. When individuals actively participate in physical exercise, their cognitive ability is improved, their mental state is maintained, and they can alleviate negative emotions and improve the quality of life, so they show a higher perception of happiness than people who do not exercise regularly. Therefore, the first hypothesis of this study has been verified. However, although there are many researches on physical exercise and happiness perception at home and abroad, there are relatively few researches on the influence of Taijiquan on the happiness perception of college students. It is worth noting that Taijiquan, as a representative of Chinese traditional sports culture, has a broad mass base and promotion potential among college students. In order to promote the development of traditional sports such as Taijiquan and promote the improvement of national happiness, it is important to clarify the relationship between Taijiquan exercise and happiness perception and its mechanism of action. Further analysis shows that Taijiquan exercises can improve the happiness perception of college students not only in the psychological level, but also in the physiological level. Studies have shown that Tai Chi exercises can indirectly improve individuals' perception of happiness by regulating the nervous system, improving blood circulation and enhancing immunity. For example, the slow movements and deep breathing exercises of Tai Chi can effectively reduce stress hormone levels, which can relieve anxiety and depression. In addition, Tai chi exercise can further improve the quality of life of individuals by improving sleep quality, strengthening physical strength and endurance, thereby enhancing their perception of happiness.

In summary, the findings of this study strongly support the theoretical hypothesis that Tai chi exercise can significantly improve the perception of happiness and its dimensions, and effectively promote individual mental health through specific mechanisms of action.

3.2. Mediating role of basic psychological needs

According to the correlation analysis, Taijiquan exercise, subjective well-being and basic psychological needs can be significantly correlated. Taijiquan exercise can not only directly improve the degree of subjective well-being of college students, but also indirectly promote their subjective well-being through the mediating effect of basic psychological needs.

The results of correlation analysis show that there is a significant correlation between basic psychological needs, Tai chi exercise and happiness perception, and each dimension of basic psychological needs can significantly predict happiness perception. In addition, the mediating effect analysis shows that basic psychological needs play a part in the relationship between Taijiquan exercise and happiness perception of college students. This means that the influence of Taijiquan exercise on the happiness perception of college students is partly achieved by satisfying the basic psychological needs. In other words, students participating in Taijiquan exercise can indirectly improve their happiness perception when their basic psychological needs are met. This finding is consistent with previous research results on the

relationship between Tai chi exercise and happiness perception[39]. On the one hand, Tai Chi exercise has a positive impact on basic psychological needs. The basic psychological needs measured in this study reflect the degree of psychological satisfaction obtained by Taijiquan exercise. Research shows that the higher the level of Tai Chi exercise, the stronger the psychological satisfaction of individuals through exercise. On the other hand, the satisfaction of basic psychological needs can positively affect the perception of happiness. The satisfaction of autonomy needs, ability needs and relationship needs is closely related to the positive development results of individuals, which helps individuals better cope with life challenges, show a more positive attitude toward life, experience life more deeply, and obtain a higher level of happiness perception[40]. Therefore, when college students participate in Taijiquan exercise, their basic psychological needs can be met, which can stimulate more positive emotions and good exercise experience, and thus enhance their happiness perception. On the contrary, if the individual's psychological needs for exercise are suppressed or cannot be met, it may lead to maladaptation or negative reactions, directly weaken the basic psychological needs, and even cause anxiety, depression and other negative emotions[41]. To sum up, by participating in Taijiquan exercise, college students can improve their perception of happiness by satisfying their basic psychological needs. Through empirical analysis, this study found that basic psychological needs played a mediating role in the process of physical exercise affecting happiness perception. At the same time, there is a mutual promotion relationship between physical exercise and basic psychological needs. This result not only validates the research hypothesis proposed above, but also supports the theoretical views of experts and scholars on the relationship between the two. Specifically, Taijiquan exercise can not only directly improve the happiness perception of college students, but also indirectly enhance their happiness by satisfying their basic psychological needs. This dual mechanism of action provides a new perspective for understanding the positive effects of physical exercise on mental health.

In addition, this study further revealed the specific role of each dimension of basic psychological needs in the relationship between Tai chi exercise and happiness perception. The satisfaction of autonomy needs makes individuals feel more sense of control and freedom of choice in the process of exercise, thus enhancing their perception of happiness; The satisfaction of ability needs further promotes the improvement of happiness by enhancing individual self-efficacy and achievement; The satisfaction of relational needs provides emotional satisfaction and a sense of belonging by enhancing the social connection and support between individuals and others. These findings show that Taijiquan exercise is not only a way of physical exercise, but also an activity that can fully meet individual psychological needs. From a practical point of view, the results of this study provide an important theoretical basis for college students' mental health intervention. By encouraging college students to participate in tai chi exercises, educators can help students better meet their basic psychological needs, thereby boosting their perception of happiness and overall mental health.

To sum up, Taijiquan exercise, as an exercise method integrating body and mind, can not only directly improve the happiness perception of college students, but also indirectly enhance their happiness by meeting their basic psychological needs. This dual action mechanism provides a new perspective for understanding the positive impact of physical exercise on mental health, and also provides an important theoretical basis and practical guidance for mental health intervention of college students.

3.3. The regulating effect of mental resilience

This study shows that psychological resilience regulates the influence of Taijiquan exercise on subjective well-being, which is consistent with previous research conclusions. In exploring the complex network of interactions between subjective well-being and other factors, psychological resilience is often regarded as a key regulatory hub. This study focuses on how mental resilience mediates the relationship

between Tai chi exercise and subjective well-being, and reveals the central regulatory role of mental resilience in this process. To be specific, Taijiquan exercise, as an external physical activity form, does not directly shape the internal psychological state of individual subjective well-being, but indirectly promotes the improvement of subjective well-being by stimulating and enhancing the internal psychological characteristics of individual psychological resilience. For college students, continuous participation in physical exercise activities such as Taijiquan can not only strengthen their physique, but also unconsciously temper their willpower and ability to cope with adversity. In this process, in the face of various challenges in exercise, college students learn to persevere and not give up, and this experience translates into a high tolerance for setbacks and resilience in the face of difficulties. With the enhancement of psychological resilience, individuals can respond more confidently in the face of life pressure or traumatic events, quickly restore mental balance, and then show a higher sense of self-efficacy and positive emotions in daily life. The accumulation of such positive emotional states effectively reduces the frequency of negative emotions, making individuals full of optimism and satisfaction in life, and significantly improving their subjective well-being[42]. Furthermore, the influence mechanism of physical exercise on subjective well-being is not a single path, but a comprehensive effect involving various changes. Foreign studies have shown that Tai Chi exercises indirectly promote the increase of subjective well-being by promoting neurobiological adjustment, enhancing self-efficacy, enhancing social connection, and deepening personal ability and value identity[43]. These findings echo the role of mental resilience as a moderating variable in this study, and jointly emphasize the importance of physical exercise indirectly promoting mental health and happiness through the optimization of internal psychological characteristics[44]. For college students with a high level of mental resilience, they show stronger adaptability to the environment and self-regulation skills, can actively respond to external stimuli, and maintain a high level of mental health. Even in the face of adversity, they can make effective use of internal psychological resources and external social support to effectively manage pressure and maintain an optimistic attitude, thus achieving significant improvement in subjective well-being[45].

In summary, combined with previous research results, it can be clearly seen that the positive impact of physical exercise on subjective well-being is essentially achieved by improving the level of individual psychological resilience. In the face of life adversity and pressure, college students with high psychological resilience can mobilize personal resources and external support more effectively, show more positive emotions and reduce the impact of negative emotions, so as to better adapt to the environment and improve life satisfaction and happiness. This process not only reveals the intrinsic relationship between physical exercise and subjective well-being, but also provides important implications for improving public mental health by promoting mental resilience.

4. Conclusions

This paper takes students' subjective well-being as the research background, based on the perspective of basic psychological needs, and introduces basic psychological needs to build a mediating mechanism model of Taijiquan exercise on subjective well-being. At the same time, taking psychological resilience as the regulating variable, this paper analyzes the regulating mechanism of Taijiquan exercise on subjective well-being, and through correlation analysis and structural equation model and other statistical methods, the following conclusions are drawn:

(1) Taijiquan exercise of college students has a significant positive impact on subjective well-being; Taijiquan exercise has a positive effect on subjective well-being through the partial mediating effect of basic psychological needs; Psychological resilience positively regulates the relationship between Taijiquan exercise and subjective well-being.

(2) Through the theoretical analysis of Taijiquan exercise to improve the subjective well-being of college students, a new path of Taijiquan exercise to promote the subjective well-being of college students is established by introducing basic psychological needs as the mediating variable and psychological resilience as the moderating variable.

(3) Through the research, it is found that Tai chi exercise is varied and interesting, which can improve psychological resilience, and adjust Tai chi exercise through psychological resilience, and promote the subjective well-being of college students. It shows that the mediating effect of basic psychological needs and the regulating effect of psychological resilience are valid.

Conflict of interest

The authors declare no conflict of interest.

References

1. LIU Limeng, Jing Yunyao, Wang Ronghuan. Analysis of the influence of Taijiquan on the Physical health of college students [C]// Wushu and Traditional National Sports Branch of Chinese Sports Science Society, Chinese Excellent Traditional Culture Inheritance Base of the Ministry of Education (Wushu), National School Sports League (Chinese Wushu). Summary of Wall post Exchange of 2022 China Sports Intangible Cultural Heritage Conference.
2. Shen Yifei. On the influence of Taijiquan Exercise on college students' Physical health [J]. Physical Education Fengshang,2020,No.386(02):91.
3. Lu Shibin. Enlightenment of Taijiquan Philosophy to Ideological and Political Education of contemporary college students [J]. University of Education,2022,No.140(02):133-135.
4. Chen Zosong, Ji Liu. The Influence of Physical Exercise on high school Students' Subjective well-being and its psychological Mechanism [J]. Acta Psychologica Sinica,2006(04):562-575.
5. Zhang Z , He Z , Chen W . The relationship between physical activity intensity and subjective well-being in college students[J]. Journal of American College Health, 2020(3):1-6.
6. Zhang Yunbang, Tan Gongxia, Tang Hong. Effects of Physical Exercise on psychological capital and Subjective well-being of teachers in universities [J]. Journal of Gannan Normal University,2014,35(06):89-93. (in Chinese)
7. JIANG Huizhen. Effect of Physical Exercise on Subjective well-being and Mental health of college teachers [J]. Journal of Beijing Sport University,2009,32(10):69-72.
8. Buecker S , Simacek T J , Ingwersen B , et al Physical Activity and Subjective Well-Being in Healthy Individuals: A Meta-Analytic Review[J]. Health Psychology Review, 2020.
9. Pan Yan, Li Zongxiang. Effect of Taijiquan exercise on subjective well-being of middle-aged and elderly people from the perspective of healthy aging [J]. Journal of Hubei Normal University (Philosophy and Social Sciences Edition),2016,36(01):92-94.
10. Mei Song, Wang Jinfeng. The influence of Practicing Taijiquan on the emotional well-being of college students: A case study of Wuhan University and Huazhong University of Science and Technology [J]. Science and Technology Information,2013(19):263-264+285.
11. Caldwell K , Mandy E L F H , Jeffrey H M F G , et al Changes in mindfulness, well-being, and sleep quality in college students through taijiquan courses: a cohort control study.[J]. Journal of Alternative & Complementary Medicine, 2011, 17(10):931-8.
12. Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.
13. Deci, E.L., & Ryan, R.M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry, 11(4), 227-268.
14. Ihsan.Effect of satisfaction of the basic psychological needs on gener al self-efficacyand trait anxiety.SPORMETRE itimi ve Spor Bilimler i Dergisi,2015,9(4),149-156.
15. Timo Jaakkola,Sami Yli-Piipari,Vassilis Barkoukis,Jarmo Liukkonen.Re lationships among perceived motivational climate, motivational regulations,enjoyment,and PA participation among Finnish physical education students [J].International Journal of Sport and Exercise Psychology,2017,15(3).

16. Li Qinghua, Liu Huijun. Prediction of Satisfaction level of Basic psychological Needs on Happiness of high school students [A]. Abstracts of the 12th National Psychological Conference [C], China, Chinese Psychological Society,2009:1.
17. Lv Guoqing, Zhou Yan. The relationship between happiness tendency and happiness: the multiple mediating roles of prosocial behavior and basic psychological needs [J]. Psychological Techniques and Applications, 21,9(02):95-101.
18. Zhou Yang, Li Xin, Sheng Weiwei et al. The influence of physical exercise on subjective well-being of empty-nesters: the mediating role of mental resilience [J]. Sichuan Sports Science, 2019,39(02):63-66.
19. Mazo ZG, Balbe P G,Medeiros D A P, et alLevel of resilience in non-practicing andpracticing physical exercise inelderly[J].Motricidade,2017,12(4):4-14.
20. N J K ,D J L ,A E T , et alTai chi or health education for older adults with hypertension: effects on mental health and psychological resilience to COVID-19.[J].Aging mental health,202,27(3):1-9.
21. Xu X. Effect of Taijiquan on depression and hope level of patients with novel coronavirus pneumonia in makeshift hospital [J]. Journal of General Nursing, 2019,18(07):829-830.
22. Wu Yonghui, Chen Ouying, Luo Yaoyue, et al. Application of Taijiquan and Baduanjin in improving anxiety and depression in patients with coronary heart disease [J]. Nursing Research,2016,30(32):4050-4052.
23. Li Xiaobing, Sun Shasha. Empirical Study on Taijiquan Exercise to improve mental resilience and health of College students [J]. Journal of Mobility,2019(01):60-62.
24. Laird K T, Krause B, Funes C, et al Psychobiological factors of resilience and depression in late life [J].Translational psychiatry, 2019,9 (1) : 88.
25. Shin Y C, Kim S M, Kim H, et al Resilience as a protective factor for depressive mood and anxiety among Korean employees [J]. Journal of Korean medical science, 2019,34 (27).
26. Jiang Y, Yi Z, Yao Y, et al Effects of college students' mindfulness on depression symptoms during the epidemic prevention and control period : The mediating effect of psychological resilience. Frontiers in Psychiatry, 2023,13:991449.
27. Liu Youjia, Yu Lu, Zhu Congming, et al. The relationship between mental health and subjective well-being: the moderating effect of mental resilience [J]. Journal of Naval Medicine, 2019, 44 (06) : 562-568.
28. Liang Deqing. Stress level of college students and its relationship with physical exercise [J]. Chinese Journal of Mental Health,1994,(01):5-6. (in Chinese)
29. Li Jing, ZHAO Yujin. The Test Report of Campbell Happiness Scale used in Chinese college students [J]. Chinese Journal of Clinical Psychology,2000,8(4):225-226,224
30. Liu Junsheng, Lin Liling, Lu Yuan, et al. A preliminary test on the reliability and validity of the Basic Psychological Needs Scale in Chinese [J]. Chinese Journal of Mental Health,2013,27(10): 791-795. (in Chinese)
31. Connor K M, Davidson J R. Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC)[J]. Depression and Anxiety, 2010, 18(2):76-82.
32. Wen Zhonglin, Ye Baojuan. Mediation effect analysis: Development of methods and models [J]. Advances in Psychological Science,2014,22(05):731-745. (in Chinese)
33. Murphy, Peter. Sport, physical activity and the establishment of Health and Wellbeing Boards in Nottingham and Nottinghamshire[J]. Managing Leisure.
34. Smith A L . Peer relationships in physical activity contexts: a road less traveled in youth sport and exercise psychology research[J]. Psychology of Sport & Exercise, 2003, 4 (1) : 25 to 39.
35. Downward P , Rasciute S . Does sport make you happy? An analysis of the well-being derived from sports participation[J]. International Review of Applied Economics, 2011, 25 (3) : 331-348.
36. Mei Song, Wang Jinfeng. The influence of Practicing Taijiquan on the emotional well-being of college students: A case study of Wuhan University and Huazhong University of Science and Technology [J]. Science and Technology Information,2013(19):263-264+285.
37. Zheng Yuannan. Does physical exercise have an effect on the subjective well-being of the elderly? -- An empirical study on Chinese elderly recreational sports participants [J]. China Sports Science and Technology,2019,55(10):32-40.
38. Richards J , Jiang X , Kelly P , et al Don't worry, be happy: cross-sectional associations between physical activity and happiness in 15 European countries[J]. BMC Public Health,15,1(2015-01-31), 2015, 15(1):53.
39. ZHANG Huan, DONG Baolin. Bibliometrics Analysis of Evaluation Research on Physical education in China [J]. Journal of Wuhan University of Physical Education, 2013,47(05):74-80.

40. Zhang Xiaozhou, Roger. The mediating role of Social well-being in the relationship between college freshmen's basic psychological needs and sense of life meaning [J]. Journal of Guizhou Normal University (Natural Science Edition), 201,39(02):99-105.
41. The influence of parent-child attachment and school connection on aggressive behavior of junior middle school students [J]. Chinese Journal of Health Psychology,2016,24(01):68-72. (in Chinese)
42. American Psychology Association Help Center:The road to resilience:What is resilience? [OL]. http://wwwApa help center,org/featuredtopics/ feature,php? Id = 6 & ch = : 2200 2.
43. Diener E, Suh E M, Smith H, et al National differences in reported subjective well-being:Why do they occur? [J].Social Indicators Research,1995,34(1):7-32. (in Chinese)
44. Friborg O, Hjemdal O, Rosenvinge J H, et al A New rating scale for adult resilience:what are the Central protective Resources behind healthy adjustment? [J].International Journal of Methods in Psychiatric Research,2003,12(2):65-76.
45. Liu Weiwei, Wang Haibin, Li Mei, et al. Review and prospect of domestic and foreign research on mental resilience [J]. Journal of Ningbo University (Education Science Edition), 2017,39 (01) : 18~23