Int. J. Sport Psychol., 2025; 56: 071-088
doi: 10.7352/IJSP.2025.56.071

Physical activity, social capital and subjective well-being. The moderating roles of optimism

Dianxi Wang, Yuwen Zhang, Ru Yang

School of Marxism, Beijing Sport University, Republic of China

Based on the China General Social Survey (CGSS) data in 2017, conditional process analysis was used to examine the relationship between physical activity and subjective well-being (SWB). This study found that, first of all, physical activity positively predicts SWB. Second, social networks mediate the relationship between physical activity and SWB. Physical activity has an indirect effect on SWB through social networks. Third, optimism can moderate the mediating effect of social networks on the relationship between physical activity and SWB. As optimism scores increased, the link between physical activity and social capital weakened, further affecting SWB. The results of this study further reveal the mechanism of relationship between physical activity and the improvement of subjective well-being, which is of great significance for strengthening the construction of physical activity facilities and social relationship networks to improve residents' well-being.

KEY WORDS: Physical activity; Subjective well-being; Social capital; Optimism.

Subjective well-being (SWB) refers to an individual's evaluation of how closely their current life aligns with their ideal vision, resulting in positive emotions and attitudes (Diener, 1984). A large body of studies highlights an active lifestyle as a key factor in maintaining and enhancing well-being. Practicing an active lifestyle, developing developmental skills, and expanding the scope of social participation are also conducive to supporting and promoting people's subjective well-being (Buecker et al., 2021; Jiang & Chen, 2021; Liu & Xie, 2021) and life satisfaction (Jin & Zhao, 2019; Liu & Liu, 2021), thereby enhancing the overall well-being of individuals. Among the various active lifestyles, physical activity is a key positive lifestyle factor for maintaining and enhancing well-being. Engaging in physical activity can improve

Correspondence to: Dianxi Wang, School of Marxism, Beijing Sport University, No. 48 Xinxi Road, Haidian District, Beijing, 100084, People's Republic of China. (E-mail: wangdianxigod@sina.com)

residents' well-being and enable individuals to maintain higher levels of perceived well-being (Downward et al., 2018; Tan et al., 2020).

Under the concept of active lifestyle, participation in physical activity can enhance the possibility of achieving sustained social interaction, thus accumulating rich social capital and further affecting their SWB (Gao & Wang, 2022; Yang, 2021). However, the mechanism of the relationship between physical activity, social capital, and SWB is still unclear. Therefore, this study uses the data from the China General Social Survey (CGSS) in 2017, takes social capital as the mediating variable and optimism as the moderating variable, and hypothesizes that physical activity can promote the acquisition of social capital, thus affecting residents' SWB, and this influence is moderated by optimism, to further reveal the mechanism by which participation in physical activity affects SWB.

1. Theoretical framework

Regarding the relationship between physical activity and SWB, previous studies have shown that extensive participation in physical activity is significantly correlated with individual health, well-being, and quality of life (Buecker et al., 2021; Wicker et al., 2015; Zhang et al., 2020). For example, some studies found that participation in physical activity has a significant positive effect on improving residents' SWB (Wang et al., 2021; Zhang & Li, 2021; Zhi, 2020), that is, the higher the level of physical activity, the stronger the SWB (Han & Duan, 2012; Zhang et al., 2022).

As for the influencing mechanism of SWB, Diener (2000) believes that factors affecting SWB mainly include external factors (environmental factors) and internal factors (individual factors). The health behavior theoretical model also believes that the influencing factors of happiness in life include three dimensions: environment and individual characteristics, health behavior, and effect. In essence, this theoretical model also pays attention to the internal and external factors that affect happiness. Liu (2016) found that "health motivation" and "social motivation" are the main driving forces for individuals to participate in physical activity, which are conducive to reducing anxiety and tension and improving happiness. In fact, "health motivation" can be regarded as an internal motivation for participation in physical activity, while "social motivation" can be classified as an external motivation for physical activity. Based on the above theoretical discussion, regarding the relationship between physical activity and individual SWB, it can be judged that participation in physical activity further promotes

SWB as a perceived result through the generation of internal and external effects.

The external utility of physical activity on SWB focuses on the well-being brought about by social interaction and interaction with others during physical activity (Frey & Stutzer, 2002). For example, some scholars found that physical activity is an activity with social attributes, and carrying out physical activity is not only conducive to improving physical fitness but also to cultivating and developing social networks (Putnam et al., 1994; Yang et al., 2021). Based on the "social nature of sport", physical activity is also seen as a positive social capital that solves social problems and promotes social cohesion, trust, and social connectedness. Building social capital through sports associations has become a common form of enhancing social solidarity, generating reciprocal ties and trust in others, thereby enhancing social cohesion and eliminating social exclusion. For example, studies have found that community sports participation can expand social relationship networks, and those residents who regularly participate in physical activity have high interaction and intimate social networks (Yang et al., 2021), which contributes to the accumulation and formation of rich social capital. Recently, extensive and growing studies have explored the relationship between social capital and SWB. The consistent findings suggest that social capital significantly and positively affects residents' SWB and quality of life (Gao & Wang, 2022; Yang, 2021). Therefore, physical activity can not only satisfy the physical and mental health and emotional experience at the individual level but also expand interpersonal communication and relationship networks and promote social solidarity. Based on these findings, this study integrates the concept of social capital into the analysis of the relationship between physical activity and SWB, aiming to elucidate the underlying mechanisms through which social capital enhances residents' overall happiness.

The internal effect of physical activity on SWB mainly emphasizes that physical activity can bring individual emotional experience, health promotion, and goal achievement, and thus bring individual pleasure and happiness. For example, according to Maslow's Hierarchy of Needs, individual needs are divided into five levels: physiological, safety, love and belonging, esteem, and self-actualization (Maslow, 1943). As an important way to meet individual needs, physical activity can give individuals confidence, recognition, and support, to obtain happiness. According to the self-efficacy theory, self-efficacy has a significant predictive effect on physical activity, and physical activity with goals and intentions can improve self-efficacy, thus generating subjective well-being. In addition, goal-oriented theory also holds that goal orientation determines people's happiness, and achieving goals is also

the main source of obtaining and maintaining happiness (Ames & Archer, 1988; Dweck, 1999; Kaplan & Maehr, 2007). In the process of physical activity, the achievement of individual goals can produce positive emotions, such as self-confidence and satisfaction, and then obtain SWB.

Optimism may be a positive emotion arising from physical activity. Optimism refers to the overall expectation of a favorable outcome (Luthans, et al., 2007; Youssef & Luthans, 2007). Optimism emphasizes the key role of expectation in regulating behavior, and optimists tend to believe that their goals can be achieved. When individuals have positive expectations for the goal, they will take the approach behavior to shorten the distance between themselves and the goal until the goal is achieved. Optimism is related to self-regulation behavior. A large number of studies have found that self-efficacy and optimism are beneficial to physical health, happiness, quality of life, and job satisfaction (Avey et al., 2010; Culbertson et al., 2010; Huang et al., 2021). In addition, previous studies have shown that optimism can regulate the relationship between self-factors and a person's positive motivation or behavior (Lara et al., 2020; Makikangas & Kinnunen, 2003; Michael et al., 2011). Therefore, this study also examined whether optimism moderates the relationship between physical activity and SWB.

Based on the analysis above, this study has developed a theoretical framework, as depicted in Figure 1, by integrating the principles of social network analysis and theoretical debates on the connections between physical activity, social capital, optimism, and subjective well-being. Specifically,

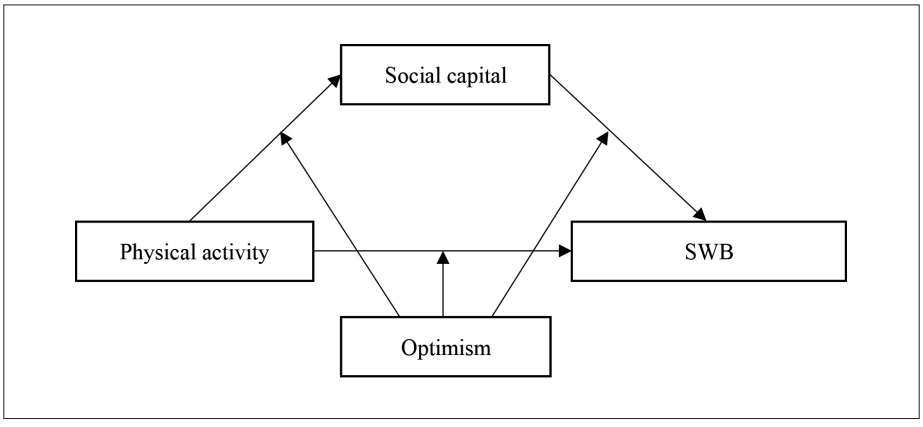

Figure 1. Theoretical model of this study

we hypothesize that participation in physical activity can not only directly enhance residents' SWB, but also indirectly affect SWB through the promoting effect of social capital, and these effects are moderated by optimism.

Based on the analytical framework presented in Figure 1, the following research hypotheses are proposed:

Hypothesis I: Physical activity positively predicts SWB.

Hypothesis II: Physical activity may indirectly affect SWB through the mediating role of social capital.

Hypothesis III: Optimism moderates the relationships among physical activity and SWB, physical activity, and social capital, as well as social capital and SWB.

2. Methods

2.1 Data

This study utilized data from China General Social Survey (CGSS) in 2017. The CGSS, hosted by the National Survey Research Center at Renmin University of China, is a large-scale social survey project in China. Since 2003, CGSS has sampled more than 10,000 households across the country. It is the earliest nationwide, comprehensive, and continuous academic survey project in China. The CGSS 2017 utilized a multi-stage stratified sampling method, selecting respondents from 29 provinces, municipalities, and autonomous regions throughout China. Face-to-face interviews were conducted with respondents, totaling 12,582 samples. In this study, cases with missing data were excluded, and only observations with complete information were retained. The final sample size was 4,095. Demographic characteristics of the sample are presented in Table I.

2.2 Variables

2.2.1 Dependent Variable

The dependent variable in this study is subjective well-being. CGSS uses the abbreviated version of the Chinese Subjective Well-being Scale (SWBS-CC20) developed by Xing (2003) to assess SWB. This scale encompasses 10 dimensions with 20 items, covering experiences related to adaptation to interpersonal relations, mental health, goals and personal values, psychological balance, physical health, family atmosphere, confidence towards society, growth and progress, satisfaction and abundance, and self-acceptance. Each item is rated on a 6-point scale, ranging from "strongly disagree," "disagree," "somewhat disagree," "somewhat agree," "agree," to "strongly agree," with scores ranging from 1 to 6, respectively. In this study, reverse items are converted, and the overall SWB score is derived by summing the values of each item. The minimum value is is 20, with a maximum of 120. Cronbach's α of this *scale is 0.855.*

TABLE I
Sample Characteristics (N=4095)

Variables	Frequency	Percentage (%)
Gender:		
Male	1893	46.23
Female	2202	53.77
Age group:		
18-35 years old	902	22.03
36-45 years old	620	15.14
46-60 years old	1251	30.55
Over 60 years old	1322	32.28
Ethnicity:		
Ethnic Minority	298	7.28
Han Nationality	3797	92.72
Hukou:		
Agricultural Hukou	2152	52.55
Non-agricultural Hukou	1943	47.45
Educational level:		
Elementary and below	1373	33.53
Middle school	1152	28.13
High school	747	18.24
College or above	823	20.10
Political Affiliation:		
Non-party Member	3429	83.74
Party Member	666	16.26
Marital Status:		
Unmarried	978	23.88
Married	3117	76.12
Religious belief:		
No	3667	89.55
Yes	428	10.45

2.2.2 *Independent Variable*

The independent variable in this study is physical activity, which is measured by a single question from the questionnaire: "How many times per week, on average, do you engage in physical activity *that lasts at least 30 minutes and makes you sweat?*" This variable is continuous, ranging from 0 to 70, with a mean value of 2.323.

2.2.3 *Mediating Variables*

In this study, these two indicators are adopted to measure social capital based on existing literature. Following the study by Li and Chen (2012), two questions, "Over the past year, how frequently do you engage in social and entertainment activities with your neighbors?"

and "Over the past year, how often do you participate in social and entertainment activities with other friends?" were chosen to measure social networks. Responses to these questions include: "Never" (1), "Once a year or less" (2), "A few times a year" (3), "About once a month" (4), "A few times a month" (5), "Once or twice a week" (6), "Almost every day" (7). Scores of social network is derived by summing the values of these two indicators. Drawing from the measurement approach outlined by Zhang and Wan (2020), the question "In general, do you believe that, in this society, most people can be trusted?" is utilized to measure social trust. Responses to this question include five options: "Strongly disagree" (1), "Disagree" (2), "Neither agree nor disagree" (3), "Agree" (4), "Strongly agree" (5).

2.2.4 Moderating Variable

The moderating variable examined in this study is optimism. The Life Orientation Test-Revised (Scheier et al., 1994) was used to measure optimism. This scale consists of six formal items: "In uncertain times, I usually expect the best", "If something can go wrong for me, it will", "I'm always optimistic about my future", "I hardly ever expect things to go my way", "I rarely count on good things happening to me", and "Overall, I expect more good things to happen to me bad ones". The responses to these items ranged from 1 ("strongly agree") to 5 ("strongly disagree"). After inverting the opposing items, the optimism score is obtained by summing the values of those items. Cronbach's α of this scale is 0.796.

2.2.5 Control Variables

Control variables such as gender, age, ethnicity, hukou status, education level, marital status, political affiliation, and religious belief are included in our analysis. Gender is a binary variable, with 0 representing male and 1 representing female. Age is divided into four groups: 18-35, 36-45, 46-60, and over 60 years old. Ethnicity is categorical, with 0 denoting a minority ethnic group and 1 denoting Han ethnicity. Hukou is categorized into agricultural hukou (=0) and non-agricultural hukou (=1). Education levels have four types: elementary and below (=1), middle school (=2), high school (=3), and college or above (=4). Marital status includes unmarried (=0) and married (=1). Political affiliation comprises non-party members (=0) and party members (=1). Religious belief is divided into two categories: not have religious belief (=0) and have religious belief (=1).

2.3 Statistical methods

This study mainly used the conditional process analysis method proposed by Hayes (2017) to examine the mediating effect of social capital and the moderating roles of optimism. Model 4 (Simple Mediation Model) from Hayes' SPSS macro is used to estimate the mediating effect of social capital on the relationship between physical activity and SWB. The bootstrap method was also applied to estimate a 95% confidence interval based on 5000 random samples to test the significance of the mediating effect. If the 95% confidence interval does not contain 0, it is statistically significant. Subsequently, Model 59 from the SPSS macro is applied to test the moderated mediation model. The formulated model equations are as follows:

$$Y = \lambda_0 + \lambda_1 X + \lambda_2 C_1$$

$$M = \beta_0 + \beta_1 X + \beta_2 M_i + \beta_3 C_2$$

$$Y = \gamma_0 + \gamma_1 X + \gamma_2 M_i + \gamma_3 W + \gamma_4 XW + \gamma_5 M_i W + \gamma_6 C_3$$

In the given equations, X, M, W, and Y correspond to the independent variable, mediating variables, moderating variable, and dependent variable, respectively. C1, C2, and C3 represent control variables. To examine how variable W moderates the mediating effect (conditional process), the regression equation incorporates the main effects of the moderating variable W, along with interaction terms between W and X, as well as W and M. Furthermore, the parameter tests for γ4 and γ5 help ascertain whether W significantly moderates the direct effect of the independent variable X on the dependent variable Y and the effect of the mediating variable M on Y. The moderated mediation model requires a simple slope analysis, which involves substituting values for the moderating variable at low levels (W mean minus 1 standard deviation, W-1SD), moderate levels (W mean), and high levels (W mean plus 1 standard deviation, W+1SD) into the equation. This operation illuminates the variations in direct, indirect, and total effects under different values of the moderating variable.

3. Results

3.1 Descriptive analysis results

Table II displays differences in the SWB of different groups. The SWB of males is significantly higher than that of females. With the increase of age, subjective well-being decreases. Han ethnicity respondents tend to report higher SWB compared to their ethnic minority counterparts, but the difference is not significant. The SWB of non-agricultural residents is significantly higher than that of agricultural residents. SWB increases with the improvement of education level. Respondents who are members of the Communist Party show a significant increase in SWB compared to non-members. Additionally, respondents with spouses demonstrate significantly higher SWB than those without spouses. Non-religious people report higher subjective well-being than non-religious people. In addition, except for political affiliation differences, Cohen's d and Cohen's f mostly range from 0.2 to 0.5, indicating that the effect size is generally small.

Table III displays the Pearson correlation coefficients among the key variables. According to Table III, there is a positive correlation between physical activity and social networks, optimism, and SWB. Additionally, social networks exhibit positive correlations with optimism and SWB, although the correlation coefficients are relatively small. Social trust shows a positive

TABLE II
Differences in swb of different groups

Variables	Mean ± standard deviation	Test value	P-value	Effect Size
Gender:				
Male	82.471±12.622	T = 2.631	P = 0.009	Cohen's d=0.083
Female	81.417±12.913			
Age group:				
18-35 years old	84.778±11.274	F = 31.23	P < 0.001	Cohen's f=0.149
36-45 years old	83.671±11.234			
46-60 years old	80.832±13.017			
Over 60 years old	80.129±13.759			
Ethnicity:				
Ethnic Minority	81.000±12.786	T = -1.267	P = 0.205	Cohen's d=-0.076
Han Nationality	81.975±12.787			
Hukou:				
Agricultural hukou	79.555±12.455	T = -12.605	P < 0.001	Cohen's d=-0.394
Non-agricultural hukou	84.505±12.652			
Educational level:				
Elementary and below	77.087±13.013	F = 130.05	P < 0.001	Cohen's f=0.325
Middle school	82.438±12.218			
High school	84.228±11.788			
College or above	87.084±11.216			
Political affiliation:				
Non-party Member	80.899±12.720	T = -11.591	P < 0.001	Cohen's d=-0.502
Party Member	87.077±11.893			
Marital Status:				
Unmarried	80.416±14.110	T = -4.179	P < 0.001	Cohen's d=-0.148
Married	82.371±12.310			
Religious belief:				
No	82.043±12.663	T = 2.034	P = 0.042	Cohen's d=0.101
Yes	80.715±13.720			

TABLE III
The Results of Pearson Correlation Analysis

	Physical activity	Social network	Social trust	Optimism	SWB
Physical activity	1				
Social network	0.058 ***	1			
Social trust	0.022	-0.003	1		
Optimism	0.067***	0.042**	0.102***	1	
SWB	0.118***	0.074***	0.128***	0.516***	1

Note: ** p<0.01; *** p<0.001.

correlation with optimism and SWB. Optimism also shows a positive correlation with SWB. It is important to note that since Pearson correlation only reflects the bivariate correlation between variables, conducting CPA analysis is essential to provide stronger support for hypothesis testing.

3.2 Conditional process analysis results

In our study, Model 4 from Hayes' SPSS macro plugin Process v3.3 was used to examine the mediating effects of social capital on the relationship between physical activity and SWB. This analysis controlled for variables such as gender, age, ethnicity, hukou, political affiliation, educational level, marital status, and religious belief as presented in Table IV. In Table IV, Model 1 revealed a significant positive effect of physical activity on SWB, that is, each unit increase in physical activity corresponds to a 0.217-unit increase in SWB scores, supporting hypothesis 1. Further examination in Models 2 and 3 indicates that physical activity significantly affects social networks but not social trust. In Model 4, after including the mediating variable of social capital, the direct predictive effect of physical activity on SWB remained significant, and each unit increase in physical activity is associated with a 0.196-unit increase in SWB scores.

Table V shows the results of the mediating effect test. The upper and lower limits of the bootstrap 95% confidence interval for both the direct effect of physical activity on SWB and the mediating effect of social networks do not contain 0. This indicates that physical activity not only directly affects SWB, but also affects it through the mediating role of social networks. The direct effect of physical activity on SWB is 0.196, while the mediating effect of social networks is 0.014. These account for 90.32% and 6.45% of the total effect, respectively. However, the mediating effect of social trust is not significant, offering partial support for Hypothesis 2.

This study employed Model 59 from Process v3.3, which assumed that the various paths of the mediating model were moderated. Table VI presents the results of the moderated mediation model. In Model 5, optimism has a positive effect on social trust, that is, for each unit increase in optimism, the social trust increases by 0.037. The interaction term between physical activity and optimism on social trust is not significant. In Model 6, optimism demonstrates a positive effect on social networks. This suggests that for each unit increase in optimism, the social network score increases by 0.039. The interaction term between physical activity and optimism on social networks is significant. This suggests that as optimism increases, the impact of physical

TABLE IV
Results of regression analysis model on the relationship between physical activity and swb mediated by social capital

	Model 1: SWB		Model 2: Social trust		Model 3: Social network		Model 4: SWB	
	B	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**
Gender (Ref. = male)	-0.127	0.383	-0.005	0.032	0.294**	0.112	-0.193	0.378
Age group (Ref. = 18-35 years old)								
36-45 years old	-0.132	0.664	0.171**	0.056	-0.165	0.195	-0.390	0.656
46-60 years old	-2.145***	0.598	0.285***	0.050	-0.578***	0.175	-2.500***	0.593
Over 60 years old	-1.376*	0.624	0.463***	0.052	-0.609***	0.183	-2.034**	0.622
Ethnicity (Ref. = ethnic minority)	-0.308	0.739	-0.122†	0.062	-0.025	0.217	0.090	0.730
Hukou (Ref. = agricultural hukou)	1.935***	0.452	-0.070†	0.038	-0.582***	0.132	2.202***	0.448
Educational level (Ref. = Elementary and below)								
Middle school	4.124***	0.520	-0.074 †	0.044	0.346*	0.152	4.167***	0.514
High school	5.006***	0.636	-0.068	0.053	0.299	0.186	5.049***	0.628
College or above	6.751***	0.742	0.102	0.062	-0.193	0.218	6.622***	0.733
Marital status (Ref. = unmarried)	3.132***	0.470	0.060	0.039	0.141	0.138	2.992***	0.463
Political affiliation (Ref. = non-party member)	3.280***	0.559	0.134**	0.047	0.197	0.164	2.998***	0.552
Religious belief (Ref. = No)	-0.451	0.628	-0.085	0.053	-0.167	0.184	-0.261	0.620
Physical activity	0.217***	0.040	0.004	0.003	0.057***	0.011	0.196***	0.039
Social trust							1.747***	0.182
Social network:							0.249***	0.052
Constant	67.744***	1.968	3.291***	0.166	10.229***	0.578	59.445***	2.101
R-sq	**0.117**		**0.031**		**0.021**		**0.141**	
F	**41.635*** **		**10.039*** **		**6.658*** **		**44.729*** **	

Note: † p<0.1; * p<0.05; ** p<0.01; *** p<0.001.

TABLE V
Decomposition of total, direct, and mediating effects

	Effect Value	Boot Standard Error	Boot CI Lower Bound	Boot CI Lower Bound	Relative Effect Proportion
Total Effect	0.217	0.049	0.137	0.335	——
Direct Effect	0.196	0.047	0.006	0.041	90.32%
Mediating Effect in Social Network	0.014	0.005	0.006	0.027	6.45%
Mediating Effect in Social Trust	0.007	0.006	-0.005	0.019	3.23%

activity on social networks decreases by 0.010. Based on Model 7, optimism positively predicts SWB. Specifically, the SWB score of residents increases by 1.846 for every unit increase in optimism. The interaction terms between physical activity and optimism on SWB are not significant. These findings indicate that optimism moderates the predictive effect of physical activity on social networks.

Table VII shows the test results of moderated mediation effects. Among respondents with low and medium levels of optimism, the mediating effect of social networks on the relationship between physical activity and SWB is significant. Conversely, for those with a high level of optimism, this mediating effect is not significant. These findings indicate that for individuals with medium and low optimism, the mediating role of social networks in the relationship between physical activity and SWB is more significant. As optimism increases, physical activity is less likely to enhance SWB by expanding social networks. However, the mediating effect of social trust is also not significant.

This study further conducted a simple slope analysis to illustrate the moderating effect of optimism, as depicted in Figure 2. Figure 2 shows that the social network of residents who have high-level optimism is larger than that of residents who have low-level optimism, regardless of whether their physical activity frequency is high or low. For respondents with a lower level of optimism (W-1SD), physical activity significantly and positively predicts social networks (simple slope = 0.091, $t = 4.598$, $p<0.001$). However, for individuals with a higher level of optimism (W + 1SD), the effect of physical activity on social networks is not statistically significant (simple slope = 0.028, $t = 1.807$, $p = 0.071$). This result suggests that optimism has a moderating effect on the relationship between physical activity and social networks.

TABLE VI
Results of regression analysis model on the relationship between physical **activity** *and SWB moderated by optimism*

	Model 5: Social trust		**Model 6: Social network**		**Model 7: SWB**	
	B	**SE**	**B**	**SE**	**B**	**SE**
Gender (Ref. = male)	-0.017	0.033	0.295*	0.114	-0.926**	0.323
Age group (Ref. = 18-35 years old)						
36-45 years old	0.178**	0.056	-0.154	0.196	0.306	0.554
46-60 years old	0.297***	0.051	-0.547**	0.177	-1.748***	0.502
Over 60 years old	0.460***	0.053	-0.586**	0.185	-1.350*	0.528
Ethnicity (Ref. = ethnic minority)	-0.107†	0.064	-0.031	0.221	0.200	0.625
Hukou (Ref. = agricultural hukou)	-0.060	0.038	-0.573***	0.134	1.968***	0.381
Educational level (Ref. = Elementary and below)						
Middle school	-0.096*	0.045	0.280†	0.156	2.704***	0.442
High school	-0.089	0.055	0.192	0.189	3.579***	0.534
College or above	0.058	0.063	-0.285	0.221	4.295***	0.625
Marital status (Ref. = unmarried)	0.041	0.040	0.153	0.141	2.212***	0.398
Political affiliation (Ref.= non-party member)	0.118*	0.047	0.232	0.165	2.171***	0.468
Religious belief (Ref.= No)	-0.082	0.054	-0.210	0.189	-0.092	0.534
Physical activity	0.003	0.003	0.060***	0.012	0.136***	0.034
Social trust					1.066***	0.156
Social network					0.181***	0.045
Optimism	0.037***	0.005	0.039*	0.018	1.846***	0.053
Optimism × Physical activity	-0.001	0.001	-0.010*	0.004	-0.014	0.012
Social network × Physical activity					-0.018	0.014
Social trust × Physical activity					-0.038	0.046
Constant	-0.111	0.170	0.267	0.592	72.798***	1.671
R-sq	0.042		0.023		0.342	
F	11.355***		6.106***		106.996***	

Note: † p<0.1*; p<0.05**; p<0.01***; p<0.001.

TABLE VII
Mediating effects across different levels of optimism

	Optimism	Effect Value	Boot Standard Error	Boot CI Lower Bound	Boot CI Lower Bound
Mediating Effect in Social Network	W-1SD	0.021	0.009	0.007	0.041
	W	0.011	0.004	0.005	0.020
	W+1SD	0.004	0.004	-0.001	0.014
Mediating Effect in Social Trust	W-1SD	0.007	0.007	-0.007	0.023
	W	0.004	0.004	-0.004	0.012
	W+1SD	0.001	0.005	-0.007	0.011

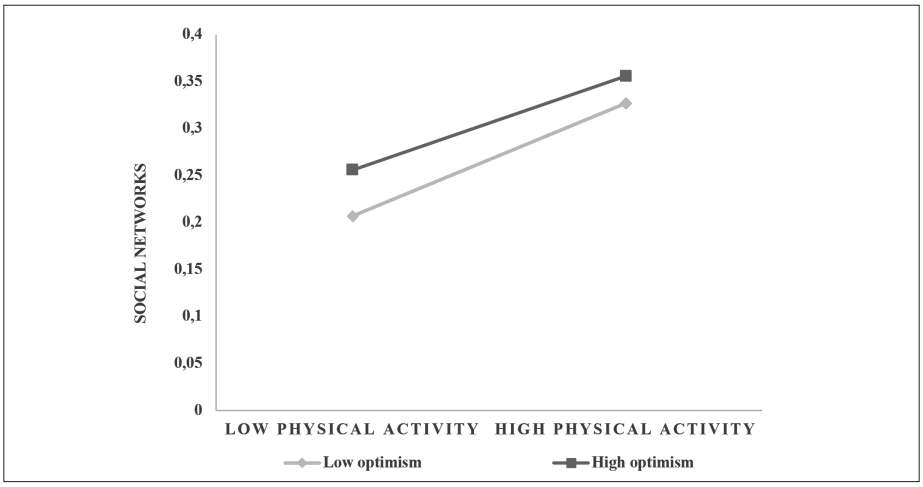

Figure 2. The moderating effect of optimism on the relationship between physical activity and social networks.

4. Discussion and conclusion

Based on the data from CGSS 2017, this study examines the mediating effect of social capital between physical activity and SWB, as well as the moderating role of optimism. First, we found that physical activity has a significant positive effect on SWB. Second, social networks play a mediating role in the relationship between physical activity and SWB. However, the mediating effect of social trust is not significant. Third, optimism moderates the mediating role of social networks.

The findings of this study are consistent with studies on the relationship between physical activity and SWB. For example, participating in physical activity can significantly predict individuals' SWB (Buecker et al., 2021; Wang et al., 2021; Zhang et al., 2020). Furthermore, the increase in optimism is correlated with individuals' SWB, which also supports the relevant view that optimism can improve SWB (Culbertson et al., 2010; D'Souza et al., 2020). This study found that as optimism increases, physical activity is less likely to enhance SWB by expanding social networks. This highlights the impact of optimism on the association between physical activity and SWB.

This study found that social capital plays a mediating role between physical activity and SWB. Strengthening the link between physical activity and social capital can enhance the positive effect of physical activity on SWB. In addition, as optimism increases, the link between physical activity and social capital weakens, leading to a dampening effect on SWB. The main contribution of this study is to provide further insights into the mechanisms of the link between physical activity and SWB, thereby enriching the research on the mechanisms of the relationship between physical activity and SWB.

The findings of this study have significant policy implications. Firstly, the supply of national public fitness services should fully take into account the actual fitness needs of people. By strengthening the construction and transformation of community physical exercise facilities, the basic conditions are provided for the participation of people in community physical activity, to improve the accessibility of community sports venues for people. Secondly, it is necessary to improve the network of sports organizations for the elderly in grassroots communities, establish sports associations for people in grassroots units, and cultivate a community communication network for people, thereby providing organizational support for people to participate in physical activity and promote health in the community. Thirdly, we should attach importance to cultivating people's positive emotional experiences such as hope and optimism in participating in physical activity, to lay a foundation for improving people's SWB.

This study has certain limitations. First of all, due to the questionnaire module D to which the SWB scale belongs was designed separately from the 2016 East Asian General Social Survey, only 4132 respondents were surveyed. We removed respondents who were not asked to respond in this module, and this may affect the validity of the conclusions. Moreover, the mediating role of social capital and the moderating role of optimism may vary by gender, age, hukou, and education level of respondents. Future studies could further examine the heterogeneity of these mechanisms across different groups, and enrich the studies on the impact mechanism of physical activity and SWB.

Authors' contributions

The authors led study conceptualization, design, tools development, and performed statistical analysis and manuscript writing. The authors read and approved the final manuscript.

Acknowledgments: The authors would like to thank the project of "Chinese General Social Survey (CGSS)" for providing data open services.

Funding: This study is one of the results of the project "Research on the Methods and Pathways for Integrating Sports into Social Development and Governance" funded by China's Central Government Funding for Basic Research.

Consent for publication

This manuscript does not contain any individual person's data in any form.

Competing interests

The views expressed in the submitted article are the authors' own and not an official position of the institution or the funders.

Ethical approval statement

This study was approved by the Institutional Review Board of Renmin University.

Acknowledgment

The authors would like to thank the project "China General Social Survey (CGSS)" for providing data open services.

REFERENCES

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*(3), 260-267. https://doi.org/10.1037/0022-0663.80.3.260

Avey, J.B., Luthans, F., & Youssef, C.M. (2010). The additive value of positive psychological capital in predicting work attitudes and behaviors. *Journal of Management*, *36*(2), 430-452. https://doi.org/10.1177/0149206308329961

Buecker, S., Simacek, T., Ingwersen, B., Terwiel, S., & Simonsmeier, B.A. (2021). Physical activity and subjective well-being in healthy individuals: a meta-analytic review. *Health Psychology Review*, *15*(4), 574-592. https://doi.org/10.1080/17437199.2020.1760728

Culbertson, S.S., Fullagar, C.J., & Mills, M.J. (2010). Feeling good and doing great: the relationship between psychological capital and well-being. *Journal of Occupational Health Psychology*, *15*(4), 421-433. https://doi.org/10.1037/a0020720

D'Souza, J.M., Zvolensky, M.J., Smith, B.H., & Gallagher, M.W. (2020). The unique effects of hope, optimism, and self-efficacy on subjective well-being and depression in German adults. *Journal of Well-Being Assessment*, *4*(3), 331-345. https://doi.org/10.1007/s41543-021-00037-5

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*(3), 542. https://doi.org/10.1037/0033-2909.95.3.542

Downward, P., Hallmann, K., & Rasciute, S. (2018). Exploring the interrelationship between sport, health and social outcomes in the UK: implications for health policy. *The European Journal of Public Health*, *28*(1), 99-104. https://doi.org/10.1093/eurpub/ckx063

Dweck, C.S. (2013). *Self-theories: Their role in motivation, personality, and development*. Psychology press.

Frey, B.S., & Stutzer, A. (2010). Happiness and economics: How the economy and institutions affect human well-being. Princeton University Press.

Gao, H., & Wang, G.C. (2022). Social capital and the subjective well-being of middle-aged and elder population in rural: analysis based on CHARLS data with hierarchical linear model. *Journal of Chongqing University of Technology (Social Science)*, *36*(6), 123-133. [in Chinese]

Han, H.J., & Duan, Q.T. (2012). Study on the relationship between sports participation and subjective well-being of undergraduates. *Journal of Guangzhou Sport University*, *32*(6), 97-100. [in Chinese]

Hayes, A.F. (2017). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford publications.

Huang, X., Yang, Y.H., Sun, M.Y., Zheng, R.M., Yang, L. (2021). Status and dynamic changes of maternal dispositional optimism at different time point from pregnancy to postpartum in China. *Chinese Journal of Woman and Child Health Research*, *32*(8), 1140-1143. [in Chinese]

Jiang, Q.L. & Chen, Z.H. (2021). Active aging of silver-haired surfers: A study on the mechanism of Internet use to enhance subjective well-being in elderly people. *Journal of Communication University of China*, *43*(12), 41-48. [in Chinese]

Jin, Y.A. & Zhao, M.H. (2019). Internet use and the elderly's active aging in China: A study based on 2016 China longitudinal aging social survey. *Population Journal*, *41*(6), 44-55. [in Chinese]

Kaplan, A., & Maehr, M.L. (2007). The contributions and prospects of goal orientation theory. *Educational Psychology Review*, *19*, 141-184. https://doi.org/10.1007/s10648-006-9012-5

Lara, R., Vázquez, M.L., Ogallar, A., & Godoy-Izquierdo, D. (2020). Optimism and social support moderate the indirect relationship between self-efficacy and happiness through mental health in the elderly. *Health Psychology Open*, *7*(2), 2055102920947905. https://doi.org/10.1177/2055102920947905

Li, S., & Chen, G. (2012). Can "*guanxi*" bring rural residents' happiness? With evidence from rural China. *Chinese Rural Economy*, *8*, 66-78. [in Chinese]

Liu, B.B. & Liu, X.M. (2021). The impact of interpersonal relationship on life satisfaction of the elderly in the context of active aging. *Social Security Studies*, *5*, 49-59. [in Chinese]

Liu, M.N. (2016). How sports affect subjective well-being: study on the effect of sports participation on subjective well-being and its mechanism. *Journal of Sports and Science*, *37*(6), 27-39. [in Chinese]

Liu, Y. & Xie, W.K. (2021). Digital skills and subjective well-being of the elderly: Empirical analysis based on CSS 2019 data. *Journal of Yanzhou University (Humanities & Social Sciences)*, *25*(5), 104-118. [in Chinese]

Luthans, F., Avolio, B.J., Avey, J.B., & Norman, S.M. (2007). Positive psychological capital: Measurement and relationship with performance and satisfaction. *Personnel Psychology*, *60*(3), 541-572. https://doi.org/10.1111/j.1744-6570.2007.00083.x

Mäkikangas, A., & Kinnunen, U. (2003). Psychosocial work stressors and well-being: Self-esteem and optimism as moderators in a one-year longitudinal sample. *Personality and Individual Differences*, *35*(3), 537-557. https://doi.org/10.1016/S0191-8869(02)00217-9

Maslow, A.H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370-396. https://doi.org/10.1037/h0054346

Michael, L.H., HOU, S.T., & FAN, H.L. (2011). Creative self-efficacy and innovative behavior in a service setting: Optimism as a moderator. *The Journal of Creative Behavior*, *45*(4), 258-272. https://doi.org/10.1002/j.2162-6057.2011.tb01430.x

Putnam, R.D. (1993). Making democracy work. Civic traditions in modern Italy. Princeton University Press.

Scheier, M.F., Carver, C.S., & Bridges, M.W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, *67*(6), 1063-1078. https://doi.org/10.1037/0022-3514.67.6.1063

Wicker, P., Coates, D., & Breuer, C. (2015). Physical activity and subjective well-being: the role of time. *The European Journal of Public Health*, *25*(5), 864-868. https://doi.org/10.1093/eurpub/ckv053

Xing, Z.J. (2003). Developing the brief subjective well-being scale for Chinese citizen. *Chinese Journal of Behavioral Medical Science*, *12*(6), 103-105. [in Chinese]

Yang, F., Huang, Y.J. & Wang, F.B.H. (2021). Physical exercises of Chinese older adults and social participation: Health promotion and network expansion. *Population Research*, *45*(3): 97-113. [in Chinese]

Yang, X.Y. (2021). How dose social capital affect resident's subjective well-being? ——Empirical evidence from comprehensive survey of Chinese society. *Journal of the Party School of CPC Ningbo*, *43*(2), 110-120. [in Chinese]

Youssef, C.M., & Luthans, F. (2007). Positive organizational behavior in the workplace: The impact of hope, optimism, and resilience. *Journal of Management*, *33*(5), 774-800. https://doi.org/10.1177/0149206307305562

Zhang, F.L., Huang, J.Y., Han, H.Y, & Deng, X.Y. (2020). Study on the impact of leisure sports activities on the life satisfaction of middle-term young people: based on a sample survey in Shanghai. *Fujian Sports Science and Technology*, *39*(5), 14-17. [in Chinese]

Zhang, T.J., & Wan, G.H. (2020). Opportunity inequality, social capital and subjective well-being of rural residents: empirical analysis based on CGSS data. *Journal of Shanghai University of Finance and Economics*, *22*(5), 94-108. [in Chinese]

Zhang, Z., He, Z., & Chen, W. (2022). The relationship between physical activity intensity and subjective well-being in college students. *Journal of American College Health*, *70*(4), 1241–1246. https://doi.org/10.1080/07448481.2020.1790575

Zhi, H.Y. (2020). Study on the effect of college students' participation goal on the subjective well-being: A case study of the Southern University Town of Zhengzhou. *Journal of Henan University of Engineering (Social Science Edition)*, *35*(4), 89-94. [in Chinese]

Manuscript submitted April 2024. Accepted for publication September 2024.