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The impact of appreciating social support on college students' gratefulness: the chain mediating role of physical exercise and sense of meaning in life

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Abstract

Objective To explore the mechanism of the impact of appreciating social support on college students' physical exercise and to analyze the chain-mediated effect between physical exercise and the sense of meaning in life.

Methods A questionnaire survey was conducted on 1073 Chinese university students using the Appreciative Social Support Scale, Gratefulness Scale, Physical Exercise Rating Scale, and Sense of Meaning in Life Scale. Among them, 503 were male college students and 570 were female college students. (The mean age of the subjects was 19.21 ± 1.02 years).

Results (1) There is a significant correlation between appreciated social support, physical exercise, sense of meaning in life, and gratefulness; (2) appreciated social support significantly and positively predicts physical exercise, sense of meaning in life, and gratefulness; (3) appreciated social support has both a significant direct and an indirect effect on college students' gratefulness.

Conclusion Appreciating social support can significantly predict college students' gratefulness through the independent mediating effects of physical exercise and sense of meaning in life and through the chain mediating effects of physical exercise and sense of meaning in life. These results provide theoretical references for improving college students' gratefulness level and mental health education. These results provide theoretical references for improving college students' gratefulness level and mental health education.

Keywords Appreciating social support, Gratefulness, Physical exercise, Sense of meaning in life

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Introduction

As senior specialists trained by the state, college students are a vigorous force to promote future social and economic development. “The grace of a drop of water should be repaid when it springs from the spring [1]”. Knowing gratefulness has always been a traditional virtue of the Chinese nation, and being grateful should also be a basic moral code that every person should have. Gratefulness can improve the individual’s ability to cope with setbacks, increase the individual’s positive emotions, and then reduce anxiety, depression, and other psychological problems [2]. However, in recent years, some contemporary college students have gradually forgotten the virtue of gratefulness, disregarded family, friendship, and kindness, and have a weak sense of gratefulness [2]. This lack of gratitude can easily lead to negative emotions, which, to a certain extent, influences college students to pay too much attention to the negative events around them and fail to evaluate their own lives positively and optimistically. In the long run, college students cannot feel the positive energy in their lives, thus producing helplessness, irritability, depression, mental instability, and other destructive emotions, affecting the formation of the typical personality of college students and jeopardizing their mental health [3]. Among the many factors affecting college students’ gratefulness, comprehending social support is an important indicator for predicting mental health [4], which refers to the degree to which individuals subjectively feel the support, care, and help from others in the social network, such as the degree of emotional experience of being respected and understood and the degree of satisfaction, etc [5], which is not actually whether or not someone is providing help. Instead, it is the individual’s self-perceived emotional and psychological support [6]. In recent years, comprehension of social support has been widely noticed and recognized by experts in sociology, sports psychology, and other fields for its positive role in individual self-emotion regulation and mental health maintenance. Appreciative social support is an important foundation for gratefulness and grateful behavior, and higher social support has a positive gain function on individual development, helping individuals to produce more grateful emotions in their lives [6–7]. According to social cognitive theory, after receiving help from others, individuals will make self-cognitive attributions about the nature of the help provided by others, and positive attributions will prompt individuals to produce gratefulness. In contrast, the negative attributions will induce individuals’ negative emotional experiences [8]. Research has shown that apprehending social support is of great value in enhancing mental health [10]. However, the research on the mechanism of the role of cognitive social support on college students’ gratefulness needs to be in-depth, and there are still many areas to

be explored. Previous studies have more often explored physical exercise and a sense of the meaning of life as separate mediating variables in the influence of cognitive and social support on college students’ gratefulness. Based on the existing mediating variables research, the present study included and analyzed physical exercise and a sense of the meaning of life as sequential variables simultaneously, which enriched the influence of cognitive and social support on college students’ gratefulness. This study enriches the internal mechanism of the impact of appreciation of social support on college students’ gratefulness. It provides the theoretical basis and practical guidance for promoting college gratefulness.

Appreciating the relationship between social support and college student gratefulness

Appreciated social support is the individual’s subjective knowledge and evaluation of objective social support [9], which is mainly reflected in the individual’s favorable experience under the help, understanding, and respect provided by others [10]. Regarding the relationship between appreciated social support and gratefulness, the former is the social environment perceived by the individual. The latter is the positive response to stimuli in the external environment, i.e., gratefulness can be regarded as an emotional product under the effect of appreciated social support, reflecting the relationship between knowledge and emotion [11]. The leading effect theory of perceptual social support suggests that an individual’s integration, utilization, and appreciation of social resources can positively affect his or her sense of purpose, sense of belonging, and identity of self-worth [12]. In other words, a higher appreciation of social support as an important individual protective resource for individual development has a positive gain function; when individuals subjectively feel the support from family, friends, or other people, it is like having a psychological “safety net,” which in turn helps individuals to produce more gratefulness in life [13]. Moral emotion theory suggests that when individuals perceive social support, the principle of reciprocity in interpersonal interactions is activated, prompting individuals to feel grateful [14]. Research has shown that appreciating social support has a significant positive predictive effect on college students’ gratefulness depth, gratefulness breadth, and gratefulness density [15]. Individuals with a high level of perceptual social support can enhance gratefulness through positive perceptions of other people’s behaviors; on the contrary, individuals who lack perceptual social support tend to have a lower level of gratefulness [16]. Given this, the present study proposed hypothesis H1: Appreciative social support positively predicts college students’ gratefulness.

The mediating role of physical exercise

Physical exercise is defined as physical exercise people perform based on self-selection according to their needs, using various physical means and combining natural forces and hygienic measures [17]. Under complex social network relationships, social support from family, friends, or other individuals is strongly associated with physical exercise. Research has shown that collateral social support positively predicts the occurrence of physical exercise behavior [18]. Appreciating social support as a significant factor influencing physical exercise in adolescents can improve the autonomy and self-motivation of physical exercise [19]. It can create conditions for forming and transforming adolescents' autonomous motivation to exercise and predict their exercise behavior [20]. The higher the ability to appreciate social support, the stronger the motivation to exercise [21], which positively affects the individual's participation in physical exercise [22], which leads to the manifestation of specific exercise behaviors [23]. Social support theory suggests that various supports for people who are ready to exercise or have already started exercising are effective interventions to promote their adherence to physical exercise [24]. According to this theory, if individuals can fully feel the support from family, peers, and society, it can effectively promote individuals to improve their ability to cope with frustration, overcome resistance to exercise, and help them to start or adhere to physical exercise behaviors. In addition, studies have shown that participation in physical exercise is significantly associated with gratefulness [25], and adolescents who participate in sports-related training have higher levels of gratefulness to both coaches and parents [26]. Given this, the present study proposes hypothesis H2: physical exercise mediates the appreciation of social support and gratefulness.

The mediating role of a sense of meaning in life

The sense of meaning of life as a positive psychological variable [27] is the individual's perception and realization of the nature and meaning of their existence, including the two parts of the search for meaning and the existence of meaning [28]. Appreciating social support as an objectively existing reality, while the individual's appreciation and understanding of social support belongs to the subjective consciousness [29], only when the individual can truly appreciate and understand the social support received this support is more able to satisfy the individual's need for belonging and love, which in turn enhances the experience of the sense of meaning in life [30]. Research has shown that understanding social support (family, peers, and teachers) significantly predicts college students' sense of meaning in life [31]. The increase in the degree of social support that college students understand is conducive to the formation of a sense of meaning in

life, and good social support can provide college students with emotional dependence and support so that they are more capable of experiencing and pursuing the meaning of life [32]. Cognitive-behavioral theory holds that the formation of individual attitudes and behaviors does not originate from objective facts but from the beliefs held by individuals about things [33]. For this reason, social support is an objectively existing reality. At the same time, the individual's perception and understanding of social support belongs to the subjective consciousness; only when the individual can truly appreciate and understand the social support received can this support meet the individual's need for belonging and love and promote the experience of a sense of meaning in life [34]. Research has shown that individuals who feel more social support are better at constructing positive belief systems about themselves, which help them find solutions to problems in the face of work-life adversity, achieve a strong sense of self-fulfillment and self-worth, and positively predict a sense of meaning in their lives [35]. In addition, individuals with a higher sense of meaning in life are more likely to be grateful, which contributes to the enhancement of individual gratefulness level [36]. Given this, the present study proposes hypothesis H3: a sense of the meaning of life mediates the relationship between comprehending social support and gratefulness.

Chain mediation of physical exercise and sense of meaning in life

Physical exercise, as a proven psychological intervention, has a significant role in improving mental health, significantly improving college students' sense of pleasure while strengthening their interpersonal support, providing a cathartic channel for college students to alleviate their bad moods, and then better experience the meaning of life [37]. The sense of meaning in life runs through the entire life cycle of an individual, directly affects the overall development of college students' bodies and minds, and plays an important leading role in improving students' ability to cope with frustration and develop comprehensive quality [38]. Studies have shown a significant positive correlation between physical exercise and college students' sense of the meaning of life [39], and strengthening physical exercise is conducive to improving the level of college students' sense of the meaning of life [40]. When college students engage in physical exercise, physical exercise can promote changes in the content of neurotransmitters such as endorphins, catecholamines, etc. Catecholamines are closely linked to the positive emotions of individuals, and their secretion can reduce the level of anxiety and other negative emotions of individuals, make a positive change in the state of mind, and produce a positive touch on life so that the sense of the meaning of life can be strengthened [41]. Additionally,

the social function unique to physical exercise is an important condition for building interpersonal trust and security, which will experience the existential value of the meaning of life by obtaining material or spiritual support from different people [42]. Longitudinal studies have found that intentional participation in physical exercise positively predicts a sense of purpose and mission in life. College students who regularly engage in physical exercise [43] have a higher overall sense of meaning in life [44]. Given this, this study proposed hypothesis H4: physical exercise positively predicts a sense of meaning in life.

In summary, in order to examine the effects of appreciative social support on college students' gratefulness, this study intends to construct a chain mediation model (as shown in Fig. 1) and will validate that (1) appreciative social support significantly and positively predicts college students' gratefulness; (2) physical exercise and sense of meaning in life play separate mediating roles between appreciative social support and college students' gratefulness; and (3) physical exercise and sense of meaning in life play a chain mediating role between (3) physical exercise and sense of meaning in life mediated the chain between appreciation social support and college students' gratefulness.

Research objectives and methods

Subjects and sampling

Using the convenience sampling, 1092 college students from 10 colleges and universities in Liaoning and Jiangsu provinces were targeted, and questionnaires were distributed to them. A total of 1073 valid questionnaires were finally recovered, including 503 male college students (46.88%) and 570 female college students (53.12%), with a recovery rate of 98%. Among them, there existed too short a time for answering; the answer to the reverse scoring question was inconsistent; regular answers were regarded as invalid questionnaires and deleted.

Research tools

Appreciating social support scale

The scale was revised by Jiang Qianjin (2001) [45], and the questionnaire consists of three dimensions with 12 question items. They are: family support (4 items such as "I can get emotional help and support from my family when I need it"), friend support (4 items such as "I can rely on my friends when I am in trouble"), and other support (4 items such as "I can rely on my friends when I am in trouble"). "Leaders, relatives, and coworkers are there for me when I have problems"). A 7-point Likert scale was used. The higher the total score, the higher the level of support the individual perceives. In this study, it was empirically verified that the scale had good reliability. The internal consistency reliability alpha coefficient was 0.873.

Gratefulness scale

The scale was revised by Wei Chang et al. (2011) [46], which consists of 6 questions, such as There is so much in life that I feel thankful for. A 7-point Likert scale was used, ranging from 1 representing total disagreement to 7 total agreement, with questions 3 and 6 being reverse scored. The total score obtained by the subjects can reflect their trait gratefulness level, i.e., the higher the total score, the higher the gratefulness level. In this study, the scale was tested to have good reliability, and the internal consistency coefficient of the questionnaire was 0.796.

Physical exercise rating scale

The scale was revised by Leung, D.C. et al. (1994) [47] to measure physical exercise participation, which has three entries, namely: what is the intensity with which you engage in physical exercise, how many minutes at a time do you engage in said physical exercise, and how many times do you engage in said physical exercise. The scale is scored on a 5-point Likert scale, with each question scored on a 5-point scale (1 to 5 scoring). A higher

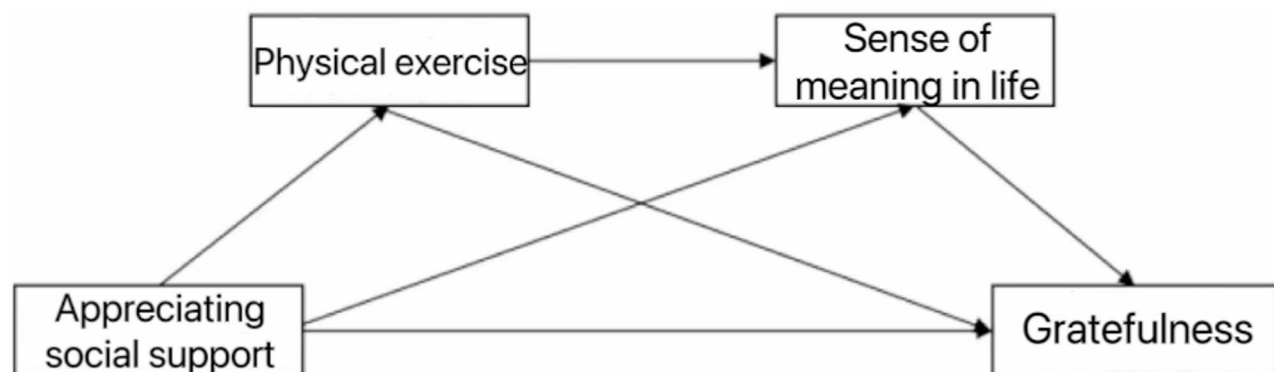


Fig. 1 Conceptual model diagram

total score indicates a higher amount of physical exercise, which is scored as $\text{exercise} = \text{Intensity} \times (\text{Time} - 1) \times \text{Frequency}$. In this study, it was verified that the scale had good reliability. Among them, the internal consistency reliability alpha coefficient was 0.879.

Meaning of life scale

The scale was revised by Steger et al. (2006) [48], which categorizes the sense of meaning in life into two dimensions, namely, the meaning-seeking subscale of life and the meaning-experiencing subscale of life. The scale consists of 10 items, of which 1, 4, 5, 6, and 9 are titled meaning seeking subscale of life, e.g., I am well aware of the meaning of my life. Items 2, 3, 7, 8, and 10 are entitled Meaningful Life Experience subscale, e.g., I am looking for something that will make my life meaningful. The scale is scored on a 7-point Likert scale from 1 representing total disagreement to 7 total agreement, with question 9 being reverse scored. In this study, it was empirically verified that the scale has good reliability. Where the internal consistency reliability alpha coefficient was 0.891.

Statistics and analysis of data

First, SPSS 27.0 was used for preliminary data organization and analysis, including common method bias, independent samples t-test, one-way ANOVA, Pearson correlation analysis, and regression analysis. Secondly, the mediation effect test was conducted using the variance excellent likelihood method, verifying the model fit index and bias correction percentile Bootstrap. Finally, the chained mediation effect model was constructed. In addition, the sample size of the questionnaire was calculated using the Power analysis software G*Power. In this case, the effect size was set to 0.3, significance to 0.05, statistical power to 0.8, and the required sample size was calculated to be 82. The final sample size of this study was 1073, which is much more than the 82 sample size required for the G*Power analysis. The reason for this decision comes from the fact that in order to improve statistical validity and precision, a larger sample size can make the estimation value closer to the actual value of

the overall parameter and reduce the sampling error is reduced.

Findings

Common method bias test

Standard method bias is one of the systematic errors when constructing mediation models. Since the data in this study were collected using a questionnaire, common method bias may affect the results. Therefore, this study mainly used the Harman one-factor test to identify the standard method bias problem. The results showed that there were six factors with eigenvalues greater than 1, and the amount of variation explained by the first factor was 25.7%, which was far below the critical criterion of 40% (Podsakoff et al., 2003), indicating that there was no standard method bias problem in this data.

Descriptive statistics and correlation analysis of variables

Independent samples t-test was used to analyze the differences between the four variables across genders. The results showed that female university students outperformed male university students, showing significant differences (see Table 1).

A one-way ANOVA was used to compare the differences in appreciation of social support, gratefulness, physical exercise, and sense of meaning in life across grades. The test results showed a significant difference between college students of all grades in terms of perceptual social support, and in general, college students of lower grades were better than college students of higher grades. Gratefulness levels differed significantly among college students of all grades, with senior students having the lowest and first-year students having the best. The level of physical exercise was best among juniors, and the sense of meaning in life was lowest among seniors (see Table 2).

Among them, all four indicators (appreciated social support, physical exercise, sense of meaning in life, and gratefulness) are higher for female than male students. The possible reasons are as follows: Appreciating social support: Regarding psychological perception differences, women are emotionally delicate and more sensitive to the

Table 1 Gender differences between different variables

	Sex	Number	M ± SD	F	P
Appreciating social support	Male	503	5.31 ± 1.13	17.785	0.000**
	Female	570	5.59 ± 1.07		
Gratefulness	Male	503	4.91 ± 0.94	16.348	0.000**
	Female	570	5.15 ± 0.95		
Physical exercise	Male	503	3.41 ± 0.80	5.159	0.000**
	Female	570	3.51 ± 0.67		
Sense of meaning in life	Male	503	4.76 ± 0.92	11.480	0.001**
	Female	570	4.95 ± 0.91		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2 Differences in grade levels between variables

	Grade	Number	M ± SD	F	P
Appreciating social support	Freshman	275	5.63 ± 1.04	5.381	0.001**
	Sophomore	254	5.53 ± 1.13		
Gratefulness	Junior	279	5.41 ± 1.05	6.847	0.000**
	Senior	265	5.27 ± 1.18		
	Freshman	275	5.18 ± 0.91		
	Sophomore	254	5.10 ± 0.98		
Physical exercise	Junior	279	5.04 ± 0.96	8.127	0.000**
	Senior	265	4.82 ± 0.92		
	Freshman	275	3.50 ± 0.64		
	Sophomore	254	3.45 ± 0.65		
Sense of meaning in life	Junior	279	3.59 ± 0.83	5.819	0.001**
	Senior	265	3.29 ± 0.77		
	Freshman	275	4.99 ± 0.85		
	Sophomore	254	4.92 ± 0.97		
	Junior	279	4.87 ± 0.94		
	Senior	265	4.68 ± 0.89		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 Correlation analysis between variables

	M	SD	1	2	3	4
Appreciating social support	5.460	1.110	1			
Gratefulness	5.040	0.950	0.764**	1		
Physical exercise	3.460	0.740	0.395***	0.484**	1	
Sense of meaning in life	4.870	0.920	0.662**	0.729**	0.488**	1

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

supportive behaviors of others [49]. For example, when others offer a small suggestion or a comforting word, female students are more likely to regard it as a powerful support and sincerely appreciate the value of such support. Men, on the other hand, may ignore these details to a certain extent. Physical exercise: Regarding health consciousness, most female college students pay more attention to their external image and internal health [50] and take physical exercise as an important way to build up their body shape and maintain their health. Sense of meaning in life: Regarding values, female college students tend to pay more attention to emotional ties and interpersonal relationships [51]. They tend to find the meaning of life in their close interactions with family and friends. For example, they may derive a strong sense of belonging and value from caring for their family members and supporting and encouraging each other with their friends. This close emotional bond makes their lives more meaningful. Gratefulness: Regarding psychological characteristics, women may tend to be more introspective than men. This introspective thinking makes it easier for female college students to realize that others have helped them, thus generating gratefulness [52].

Pearson's correlation analysis was performed on the variables to verify the potential relationship between comprehending social support, gratefulness, physical exercise, and sense of meaning in life. As shown in Table 3, there is a significant positive correlation between

appreciated social support, physical exercise, and sense of meaning in life ($p < 0.01$), and a significant positive correlation between appreciated social support, physical exercise, sense of meaning in life and gratefulness ($p < 0.01$), indicating that the higher the level of appreciated social support, the greater the physical exercise and sense of meaning in life, and the higher the level of gratefulness. Thus, individuals who felt more social support were more emotionally positive and less burdened by negative emotions that inhibited physical exercise. If individuals feel more emotionally positive, they have more psychological energy and are more likely to express it through physical exercise. Hypothesis H1 was tested. The significant strong correlation between the variables indicates that a subsequent mediating effect analysis is appropriate and supports the subsequent hypothesis testing.

Since there is a significant correlation between all the variables, there may be a multicollinearity problem, which may cause unstable results. Therefore, this study performs the diagnosis of covariance and standardization (Z-score) of predictor variables in each subsequent equation. The VIF values (1.224–3.800) of all Variance Inflation Factor (VIF) predictor variables were less than 5. Therefore, the data did not suffer from the problem of multicollinearity and were eligible for further chained mediation effect tests.

Table 4 Model fit indices for appreciating social support, gratefulness, physical exercise, and sense of meaning in life

	χ^2/df	CFI	NFI	GFI	NNFI	RMSEA
Model 1	2.41	0.93	0.91	0.91	0.76	0.081
Model 2	2.46	0.87	0.91	0.91	0.81	0.085
Model 3	2.51	0.89	0.89	0.90	0.87	0.084
Model 4	2.57	0.93	0.92	0.93	0.92	0.064

Table 5 Regression analysis of appreciation of social support, physical exercise, and sense of meaning in life on gratefulness

Outcome variable	Predictor variable	Goodness-of-fit indicator			Significance of coefficients	
		R	R ²	F	β	t
Physical exercise	Grade	0.396	0.157	66.151***	-0.024	-0.647
	Sex				-0.017	-0.213
	Appreciating social support				0.261	13.837***
Sense of meaning in life	Grade	0.708	0.502	268.665***	-0.070	-1.988
	Sex				-0.110	-1.394
	Appreciating Social support				0.460	23.425***
	Physical exercise				0.334	11.356***
Gratefulness	Grade	0.827	0.684	462.708***	-0.020	-0.707
	Sex				-0.008	-0.122
	Appreciating social support				0.417	20.886***
	Physical exercise				0.158	6.152***
	Sense of meaning in life				0.360	14.231***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Structural equation modeling analysis

This study used the excellent likelihood method for structural equation model test analysis to measure how well the structural equation model fits the actual data. The results showed that the models fit the data well: $\chi^2/df = 2.57$, $RMSEA = 0.064$, $NFI = 0.92$, $GFI = 0.93$, and $CFI = 0.93$. All the fit indices were higher than the criterion of 0.9. Model 4 had the best fit compared to Models 1, 2, and 3 (Table 4).

Model 1: Appreciating Social Support - Gratefulness.

Model 2: Appreciating Social Support-Physical exercise-Gratefulness.

Model 3: Appreciating Social Support - Sense of Meaning in Life - Gratefulness.

Model 4: Appreciating Social Support - Physical exercise - Sense of Meaning in Life - Gratefulness.

With Appreciation Social Support as the independent variable, physical exercise and Sense of Meaning in Life as the mediator variable, and gratefulness as the dependent variable, the chained mediation model effect test was conducted using the SPSS plug-in PROCESS macro program provided by Hayes (2013) using the Model 6 mediation model with grade and gender as the control variables, where Bootstrap Samples was set to 5000, and the default 95% confidence interval, which is significant when the confidence interval does not contain zero. The results showed that before the mediator variable was put in, comprehension of social support was a significant predictor of college students' gratefulness ($\beta = 0.888$, $t = 38.778$, $p < 0.001$). When the mediator variable was put

in, comprehending social support refining was equally significant in predicting college students' gratefulness ($\beta = 0.395$, $t = 23.638$, $p < 0.001$). In particular, the path coefficient (β) of comprehending social support on physical exercise was 0.261, the path coefficient of physical exercise on gratefulness was 0.158, the path coefficient of comprehending social support on sense of meaning in life was 0.460, the path coefficient of sense of meaning in life on gratefulness was 0.360. The path coefficient of physical exercise on the sense of meaning in life was 0.334 (Table 5).

The bias-corrected percentile Bootstrap was used to test the mediation effect, as seen in Table 6, resulting in a total mediation effect value of 0.240; Bootstrap 95% confidence interval does not contain 0, indicating that the total mediation effect of comprehending social support and college students' gratefulness is significant. The total mediated effect consists of three paths: Ind1:1 "comprehending social support → physical exercise → gratefulness" has an effect value of 0.050; Ind2: "comprehending social support → sense of meaning gratefulness of life → gratefulness" has an effect value of 0.072; Ind3: The effect value of "comprehending social support → physical exercise → sense of the meaning of life →" is 0.083. Among them, Bootstrap's 95% confidence interval does not contain 0, the chain mediation effect is significant, and the results of the three paths validate hypotheses 2, 3, and 4, respectively.

Table 6 Mediated effects test

Trails	Efficiency value	Boot SE	95% Confidence interval	
			BootLLCI	BootULCI
Total effect	0.418	0.020	0.379	0.457
Direct effect	0.658	0.017	0.625	0.691
Path 1	0.042	0.008	0.032	0.065
Path 2	0.167	0.019	0.157	0.234
Path 3	0.032	0.006	0.027	0.048
Total indirect effect	0.240	0.022	0.236	0.323

Discussion

In order to explore the intrinsic mechanism of appreciation of social support affecting college students’ gratefulness, the chain mediation model of the relationship between appreciation of social support and college students’ gratefulness was constructed and verified by introducing two variables, namely, physical exercise and sense of meaning in life. The study’s results reveal the intrinsic mechanism of the impact of social support on college students’ gratefulness and provide empirical evidence to improve the gratefulness level of college students and promote their psychological health.

Appreciating the relationship between social support and gratefulness

This study found a significant positive correlation ($r=0.764$) between appreciation of social support and college students’ gratefulness. After incorporating control and mediating variables, the positive predictive effect of comprehension of social support on college students’ gratefulness was significant ($p<0.001$), indicating that the higher the degree of comprehension of social support, the better the college students’ gratefulness level. This is consistent with the findings of other scholars [14–15], and the research H1 hypothesis is verified. Appreciative social support is the subject’s appreciation and evaluation of objective social support, an individual’s emotional experience, and the degree to which an individual experiences being supported, understood, and respected by significant others [9]. This study concluded that apprehension of social support positively affects individual development, emphasizing the role of external support systems and the individual’s feelings and understanding of the external environment. Appreciative social support positively predicts college students’ gratefulness, a result that is consistent with the Expansion-Construction theory of positive emotions and the Individual Environmental Interaction Model. Appreciation of social support can increase gratefulness. When individuals have higher levels of appreciation of social support, they are more confident in exploring external environmental support, making full use of resources, positively perceiving their surroundings and interpersonal support, and being more open and accepting of their current experiences,

which can lead to a better generation of gratefulness [10]. College students are in early adulthood, a period of gradual transition from campus to society, and improving their level of gratefulness will help them build a harmonious interpersonal network, ensure physical and mental health, and promote comprehensive development. According to the leading effect theory of comprehending social support, social support is the feeling of care and help from others [15], that is, the feeling of support from family, teachers, and peers, which leads to positive cognition and gratefulness to others and the world. Research has shown that perceptual social support positively predicts gratefulness. Individuals with high levels of perceptual social support can understand others’ behaviors with a positive cognition, increasing their level of gratefulness [16]. In conclusion, the results of this study are consistent with previous research findings that show that good social support can effectively promote college students’ gratefulness level.

The mediating role of physical exercise and sense of meaning in life

Mediating variables are important in explaining the influence of comprehension social support on college students’ gratefulness. This study constructed the mediation model of comprehending social support affecting college students’ gratefulness using physical exercise and a sense of meaning in life as mediating variables. Among them, the effect mediated by physical exercise was significant at 95% CI = [0.032, 0.065], and the effect mediated by a sense of meaning in life was significant at 95% CI = [0.157, 0.234]. Appreciating social support is an individual’s expectation and evaluation of social support, the emotional experience and satisfaction of feeling respected, supported, and understood in society [18]. Appreciated social support reflects the closeness and quality of an individual’s connection with society, and good social support promotes mental health [20]. Therefore, when individuals have a good level of perceptual social support, they can be motivated to participate in sports and have a good change in their attitudes toward physical exercise, i.e., perceptual social support is positively related to physical exercise [21]. It has been found that perceptual social support can influence behavioral

intentions through factors such as subjective norms, which influence exercise behavior [22]. This study concluded that physical exercise differed significantly among college students of all grades, with juniors having the best level of physical exercise and seniors having the lowest level of physical exercise. Social support theory suggests that social support can be important in promoting individuals' physical exercise behavior [24]. Under the same exercise motivation, college students with higher levels of appreciated social support are likelier to persist in physical exercise than those with lower levels of appreciated social support [21]. Studies have shown that enhanced perceptual social support positively predicts college students' physical exercise, which promotes college students' level of gratefulness [25], which can be explained by the fact that the recognition, support, and companionship provided by parents, teachers, and peers are conducive to college students' formation of positive gratefulness, which leads to active cognition of their sensations, moods, and emotions during physical exercise [26].

The meaning of life refers to the individual's cognition and feelings about the meaning of self-life and the value of life [28]. The study of the relationship between comprehending social support and an individual's sense of meaning in life has received the attention of many scholars. Studies have shown that establishing and maintaining meaningful relationships is a significant determinant of quality of life [53]. For example, the quality of relationships with family and friends, interpersonal intimacy, and the level of social support contribute to positively predicting the sense of meaning in life [50]. Social relationships are essential for individuals to take stock of their experiences, provide purpose, and fill their lives with meaning [54]. This study showed that the sense of meaning in life differed significantly among college students of all grades, with first-year students having the highest meaning in life and seniors having the lowest sense of meaning. According to self-determination theory, the higher the social support an individual feels, i.e., the higher the appreciated social support, the higher the individual's sense of meaning in life [30]. Due to the change of identity from high school to college students, first-year students receive more material and psychological support from family, friends, and others. The rich social support system lays a good foundation for generating an individual's sense of meaning in life. The social support perceived by the individual in daily life reduces the individual's adverse experience, improves the adaptive ability and sense of well-being, and increases the sense of meaning in life [31]. At this time, individuals are clear about the value of their existence and regulate their destructive emotions and behaviors, leading to the emergence of gratefulness behavior [32]. Inferences based on

broader trends, in contrast, students in their fourth year of college, entering the internship stage, with a decrease in controllable time along with a lack of social support and increasing employment pressure, make their self-worth unable to be released, which leads to a low sense of meaning in life [33]. The results of the present study are consistent with previous studies [55], which have shown an interaction between navigational social support and an individual's sense of meaning in life and that navigational social support positively predicts the sense of meaning in life [34]. As a positive health-related variable of the meaning of life, it was significantly associated with gratefulness levels [35]. Individuals with a high sense of meaning in life have relatively high levels of gratefulness, while those with a low sense of meaning in life show more mental illness [36].

Appreciating the chain mediating role of social support in influencing gratefulness

The Bootstrap method validated the chain-mediated roles of physical exercise and a sense of meaning in life in the positive effects of comprehending social support on college students' gratefulness. The constructed chain mediation model provides a new perspective for further advancing and understanding the relationship between comprehending social support and college students' gratefulness in the future. A sense of meaning in life has a spiritual leading effect on college students, increasing learning motivation and promoting upward mobility. As a category of positive emotional experience, it is important for college students' academic careers. The present study concluded that physical exercise positively predicts the sense of meaning in life. The reason for this may be that participation in physical exercise helps to shift the attention of college students from the external world to the individual's body and inner world, which has a positive significance on the individual's ability to find important goals in life and thus contributes to the improvement of the sense of meaning in life. The results of this study are consistent with previous research that states that by participating in physical exercise, college students can enhance their physical fitness, improve endurance and strength, strengthen their immune system, and help prevent disease. Physical health and vigor are the basis for gaining a sense of meaning in life. Physical exercise also helps to release pressure, soothe emotions, improve psychological quality, and cultivate an optimistic mindset, thus enabling college students to face life more positively and optimistically and seek meaning and life goals. Therefore, strengthening the input of physical exercise can enhance college students' sense of the meaning of life [38], and the time, load, and frequency of physical exercise can affect the sense of the meaning of life [39]. When college students are engaged in physical exercise, physical

exercise can promote a change in neurotransmitter content such as endorphins, catecholamines, etc. Catecholamines are closely linked to the positive emotions of an individual [40]. Their secretion can make the state of mind of an individual undergo a secretion of catecholamines, which is closely linked to positive emotions [41]. Their secretion can lead to positive changes in the state of mind of individuals and produce positive touches on life [42], thus significantly increasing the life satisfaction and physical and mental pleasure of college students and strengthening their sense of meaning in life [43].

Conclusion

Comprehending the positive predictive effect of social support on college students' gratefulness was significant. When mediating variables were put in, both the direct and indirect effects of comprehending social support on college students' gratefulness were significant, including two parts of the mediating effect that was independent of physical exercise and sense of meaning in life, and the chain mediating effect that was mediated by physical exercise and sense of meaning in life as a chain mediator. Therefore, it is recommended that families, schools, and society should provide as much social support as possible for college students to enhance their gratefulness and promote exercise adherence to ensure that college students can effectively benefit from physical exercise and promote overall healthy development of body and mind. College students may encounter the following challenges in physical exercise: time management. College students have a complicated curriculum, and the course density and time distribution of different majors and semesters vary greatly, so it is difficult to set aside a complete period for exercise. The consistent time needed for aerobic exercise, such as jogging for half an hour and strength training, is easily disrupted by fragmented study life, making it challenging to ensure the continuity of the exercise program.

Limitations and future prospects

This study explores the relationship between comprehension of social support and college students' gratefulness. The construction of the chain mediation model reveals the internal mechanism of the impact of comprehension of social support on college gratefulness. It provides new perspectives and ideas, which are of great theoretical and practical significance for enhancing college students' gratitude. However, this study has some limitations. First, this study selected college students from some universities in Liaoning and Jiangsu provinces as the research sample. It did not involve college students from other regions and groups, so the representativeness and generalizability of the findings need to be further expanded. Therefore, future research should further expand the

scope of the study and select a broader range of subjects to examine the applicability of the findings. Second, this study is based on cross-sectional research. Although the mechanism of interaction between variables can be obtained through statistical analysis techniques, it has some limitations in revealing the causal role of variables. In the future, longitudinal tracking can be attempted by using the experimental method to explain further the long-term effects of comprehending social support on college students' gratefulness, and an intervention study can be used to obtain relevant experimental data to test the effects of the intervention based on scientifically and accurately clarifying the causal relationship between variables. Finally, although this study focused on comprehending the relationship between the four variables of appreciating social support, physical exercise, sense of meaning in life, and gratefulness, it is still possible that there are unmeasured confounding indicators that could also explain the model and relationship results.

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Author contributions

B-E Z designed the study, collected and analyzed the data, and wrote the manuscript. YJ and H-B Z wrote and translated. LS investigated and revised the manuscript and was responsible for supervising and obtaining funding. All authors have read and finalized the final manuscript and contributed equally to the paper.

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Data availability

The data presented in this study are available on request from the corresponding author.

Declarations

Ethical approval and consent to participate

The design of this study followed the guiding principles and provisions of the Declaration of Helsinki and was approved by the Ethics Committee of Liaoning Normal University (LL2024155), with all participants signing an informed consent form.

Consent to participate

Informed consent was obtained from all individuals participating in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Zhou Hongming. Nine idioms dictionary for students [M]. Shanghai: Xue Lin; 1998;291.
2. Lou Shuhua, Liu Jianwei. The core essence of Xi Jinping's view of gratefulness and the qualities of the times [J]. School Party Building Ideological Educ; 2024;16:87–9. <https://doi.org/10.19865/j.cnki.xxdj.2024.16.025>
3. Çiçek İ, Şanlı ME, Gökmen A, Yıldırım M. Problematic social media use, satisfaction with life, and levels of depressive symptoms in university students during the COVID-19 pandemic: mediating role of social support. *Mediation Role Social Support Psihologija*. 2024;57(2):177–97. <https://doi.org/10.2298/P51220613009C>
4. Zhang Yuxue. A study of the relationship between emotional intelligence, mental toughness and interpersonal relationships among college students [J]. *Psychosocial Sci*. 2015;176(30):48–53.
5. Zhai, Dechun Zhai, Guangyu Liu, Xunian, et al. Relationship between social support and coping styles and depression and anxiety among college students [J]. *China Public Health*. 2009;25(2):254–8.
6. Çiçek İ. Effect of hope on resilience in adolescents: social support and social connectedness as mediators. *J Posit School Psychol*. 2021;5(2). <https://doi.org/10.47602/jpsp.v5i2.283>
7. Yıldırım M, Arslan G, Green ZA, Ashraf F, Sugawara D, Tanhan A, İçek İ. Validation and utility of the meaning in life measure for Turkish university students. *J Happiness Health*. 2021;1(1):40–8. <https://doi.org/10.47602/johah.v1i1.2>
8. LEI, Hui LONG, Xinyi YANG, Zilu. The effects of comprehending social support on pro-social behaviors of middle school students: the chain-mediated roles of sense of hope and gratefulness [J]. *Vocat Tech Educ* 2024;45(11):75–80.
9. Richardson GE, White PJ. Mental health promotion through re-silience and resiliency education. *Int J Emergen-cy Mental Health*. 2002;4(1):65–75.
10. MA, Yuhao HU, Zhiqing SUN, Yanjun et al. Medical students' gratefulness and pro-social behavior: A mediated model with moderation [J]. *China Health Care Manage* 2022;39(11):868–73.
11. Goodman R. Psychometric properties of the strengths and difficulties questionnaire. *J Am Acad Child Adolesc Psychiatry*. 2001;40(11):1337–45. <https://doi.org/10.1097/00004583-200111000-00015>
12. Ou Li-Cen. A study on the impact of home-school connection on promoting students' comprehension of social support in secondary schools [J]. *Vocat Educ*. 2022;10:77–80.
13. Li Yanchun, Peng S. A study of the relationship between college students' feelings of attachment and sources of social support. *Chin J Health Psychol*. 2011;19(2):217–8. <https://doi.org/10.13342/j.cnki.cjhp.2011.02.032>
14. Tsang J A. Gravity and prosocial behavior: an experimental test of gratefulness. *Cognition Emot*. 2006;20(1):138–48. <https://doi.org/10.1080/02699930500172341>
15. HSA, Jetten J, Postmes T, et al. Social identity, health and well-being: an emerging agenda for applied psychology. *Appl Psychology: Int Rev*. 2009;58:1–23. <https://doi.org/10.1111/j.1464-0597.2008.00379.x>
16. YANG, Qiang YE, Baojuan. The effects of gratefulness on adolescents' life satisfaction: The mediating role of appreciative social support and the moderating role of stressful life events [J]. *Psychol Sci* 2014;37(03):610–DOI616: <https://doi.org/10.16719/j.cnki.1671-6981.2014.03.018>
17. HU, Shujuan, SHI Lixin. Research on the characteristics of physical exercise and will quality of college students [J]. *J Nanjing Inst Phys Education (Natural Sci Edition)* 2016;15(05):155–60. <https://doi.org/10.15877/j.cnki.nsin.2016.05.029>
18. Tolegenova AA, Kustubayeva AM. Trait Meta-Mood, gender and EEG response during emotion-regulation. *Pers Indiv Differ*. 2004;6575–80. <https://doi.org/10.1016/j.paid.2014.01.028>
19. LIU, Xiangguo JIA, Junjie ZHANG, Minghua et al. Mechanism of due diligence on exercise adherence of secondary school students: a chain mediation model [J]. *J Henan Normal University (Natural Sci Edition)* 2024;52(04):149–56.
20. ZHAO, Yun HUANG, Lihua LI, Yang. Effects of physical exercise on flight trainees' emotional stability: comprehending the chain-mediated roles of social support and self-efficacy [J]. *Chin J Health Psychol* 2023;31(03):446–51. <https://doi.org/10.13342/j.cnki.cjhp.2023.03.024>
21. Yang Shangjian. The relationship between social support, self-efficacy and adolescent physical exercise satisfaction [J]. *J Wuhan Inst Phys Educ*. 2016;50(2):90–4. <https://doi.org/10.15930/j.cnki.wtxb.2016.02.015>
22. Pang Zheng-Min, Huan-Hui L, Zhang J-M. A competence model of emotional intelligence [J]. *Adv Psychol Sci*. 2004;16:817–23.
23. Jin M, Jin Y, Feng L. The effects and internal mechanisms of exercise positivity on adolescents' exercise adherence [J]. *J Capital Inst Phys Educ Sports*. 2022;34(6):679–87. <https://doi.org/10.14036/j.cnki.cn11-4513.2022.06.011>
24. Zhao Yun, Huang Lihua, Li Yang. Effects of physical exercise on flight trainees' emotional stability: comprehending the chain-mediated roles of social support and self-efficacy [J]. *Chin J Health Psychol*. 2023;31(03):446–51. <https://doi.org/10.13342/j.cnki.cjhp.2023.03.024>
25. Ye L, Wang B, Ge Y et al. The effect of athlete gratefulness on mental fatigue: the chain-mediated role of social support and mental toughness [J]. *Sports Sci*. 2016;1(1):39–49. <https://doi.org/10.16469/j.ccs.201611005>
26. SHARIFF RM, MUSTAPH RD. Social support mechanism and input factors on catharsis predictors in sport [J]. *Procedia Social Behav Sci*. 2010;7588–91. <http://doi.org/10.1016/j.sbspro.2010.10.079>
27. Sinclair S, Bryan CJ, Bryan ABO. Meaning in life as a protective factor for the emergence of suicide ideation that leads to suicide attempts among military personnel and veterans with elevated PTSD and depression [J]. *Int J Cogn Therapy* 2016;9(1):87–98. <https://doi.org/10.1521/ijct.2016.9.1.87>
28. Emmons RA. Personal goals, life meaning, and virtue: wellspring of a positive life [J]. *Flourishing Posit Psychol Life Well*. 2003;105–28. <https://doi.org/10.1037/10594-005>
29. Abraham M. A theory of human motivation, psychological Review [J]. *Wikipedia Org* 1943;50(4):370–96. <https://doi.org/10.1037/h0054346>
30. King LA, Hicks JA. The science of meaning in life [J]. *Annual Rev Psychol* 2021;72:561–84. <https://doi.org/10.1146/annurev-psych-072420-12292>
31. Cui Yubao, Guo Kaijiao, Su, Yun, et al. The effects of college students' just world beliefs on social responsibility: the mediating role of gratefulness [J]. *Educational Theory Pract*. 2023;43(12):13–6.
32. TONG, Si-Yao XIAO, Rong ZHANG, Rui-Xue. Medical biomassism values and depression: the mediating role of sense of meaning in life [J]. *J South Med Univ* 2019;39(4):495–9.
33. Li XH. Does Perceived Social Support Impact Mental Health and Creative Tendencies Among Chinese Senior High School Students? [J]. *Behavioral Sciences* (2076-328X). 2024;14(11). <https://doi.org/10.3390/bs14111002>
34. C, Ruilin M, Songli L, Leilei et al. The relationship between gratefulness and internet addiction among college students: the mediating role of core self-evaluation and sense of meaning in life [J]. *Psychol Dev Educ* 2023;39(2):286–94. <https://doi.org/10.16187/j.cnki.issn1001-4918.2023.02.15>
35. Wang Qihong, Li Sanyang, Luo Xinhong, et al. The mediating role of sense of meaning of life between mental health status and self-efficacy in career decision-making among medical school college students [J]. *Chin J Health Psychol*. 2023;31(12):1893–8. <https://doi.org/10.13342/j.cnki.cjhp.2023.12.025>
36. Cole SW. The conserved transcriptional response to adversity [J]. *Curr Opin Behav Sci* 2019;28:31–7. <https://doi.org/10.1016/j.cobeha.2019.01.008>
37. J, Chen. The promotion effect of physical exercise on college students' mental health [J]. *China School Health* 2024;45(03):467.
38. Ding Si-Yuan, Xiao Rong, Zhang Zhao. Relationship between college students' sports and sense of meaning in life [J]. *China School Health* 2016;37(03):445–8. <https://doi.org/10.16835/j.cnki.1000-9817.2016.03.037>
39. Jindou, Dong Yaqi. Effects of physical exercise on college students' sense of meaning in life—the mediating effects of mental toughness and exercise self-efficacy [J]. *Fujian Sports Sci Technol*. 2023;42(05):106–11.
40. Wu Yonghui, Liu Zhihong, Li Hui. A study on the correlation between quality of life and physical exercise factors of college students in China [J]. *China Sports Sci Technol*. 2009;45(2):88–92.
41. SHARIFF RM, MUSTAPH RD. Social support mechanism and input factors on catharsis predictors in sporty [J]. *Procedia Social Behav Sci*. 2010;7(5):888–91. <http://doi.org/10.1016/j.sbspro.2010.10.079>
42. Chaojie Li. The relationship between college students' lifestyles and their sense of meaning in life: the chain-mediated roles of psychological capital and exercise input [D]. Zhengzhou University, 2022.
43. Liu Ling. Research on the correlation between college students' physical exercise and their sense of life satisfaction and sense of meaning in life [D]. Zhengzhou University, 2012.
44. Xia Qifei, Liu Qi, Song Yudong. The relationship between college students' leisure physical exercise and sense of meaning in life: the mediating role of positive psychological capital and gender differences [J]. *Hubei Sports Sci Technol*. 2023;42(02):117–23.
45. Jiang Qianjin. Comprehension social support scale. *Chin Sci Behav Med* 2001;10(10):41–2.
46. Wei Chang, Wu Huiting, Kong Xiangna, et al. Revision and reliability test of the gratitude questionnaire GQ-6 [J]. *Chin School Health*. 2011;32(10):1201–2.
47. Liang DQ. Stress level of college students and its relationship with physical activity [J]. *Chin J Mental Health*. 1994;01:5–6.

48. Steger MF, Frazier P, Oishi S et al. The meaning in life questionnaire: assessing the presence of and search for meaning in life[J]. *J Couns Psychol*. 2006;53(3):80–93.
49. Liu Ling. Research on the correlation between college students' physical exercise and their sense of life satisfaction and sense of meaning in life [D]. Zhengzhou University, 2012.
50. Ding Fengqin, Song Youming. Gratitude and helping behavior of college students: the mediating role of empathic response and its gender differences [J]. *Psychol Dev Educ*. 2017;33(03):289–96.
51. Zhang H, Sang Z, S, et al. Sources of meaning in life among Chinese University Students[J]. *Journal of Happiness Studies*. 2016;17:1473–92.
52. Jiang Y, Zhang B, Zhao H. Analysing the effect of physical exercise on social anxiety in college students using a chained mediation model[J]. *Scientific Reports*[2025-02-22]. <https://doi.org/10.1038/s41598-025-87140-2>
53. Zhao H, Zhang B, Liu W, et al. The relationship between physical activity and depression in college students: the chain mediating role of mindfulness and meaning in life[J]. *Curr Psychol*. 2024;43(27). <https://doi.org/10.1007/s12144-024-05751-w>
54. Zhang M, Zhao J, Zhang Y, et al. The relationship between psychological health development and perceived social support among college students [J]. *Chin School Health*. 2018;39(02):232–5.
55. Xia Qifei, Liu Qi, Song Yudong. The relationship between college students' leisure physical exercise and sense of meaning in life: the mediating role of positive psychological capital and gender differences[J]. *Hubei Sports Science Technol*. 2023;42(02):117–23.

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