The Relationship Between Physical Exercise Behavior and Psychological Resilience of Teenagers: An Analysis of Chain Mediating Effect

Na Li  
Shandong University of Science and Technology

Dianguo Wang  
Shandong University of Science and Technology

Xiang Zhao  (✉️ zhaox@chnu.edu.cn)  
Huaibei Normal University

Zhen Li  
Shandong University of Science and Technology

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Abstract

Objective This study aimed to understanding the mechanisms underlying the association between physical exercise behavior and psychological resilience among teenagers, and the mediating role of social sensitivity and need to belong.

Methods Using the method of cluster sampling, 1106 students (average age = 15.7, SD = 0.598) that complied with the requirements were surveyed from Shandong Province in China. Physical Exercise Behavior, Psychological Resilience, Social Sensitivity and Need to Belong were assessed using standard scales. For data analysis, Pearson's correlation analysis and bias-corrected percentile Bootstrap method were carried out in turn.

Results 1 Common method deviation can be accepted in this study, and the correlation among physical exercise behavior, psychological resilience, social sensitivity and need to belong are all significant; (2) Based on the self-determination theory to explain the relationship between teenagers physical exercise behavior and psychological resilience, the following conclusions are drawn: physical exercise behavior can directly and positively predict need to belong and psychological resilience, negatively predict social sensitivity. Likewise, social sensitivity can negatively predict need to belong and psychological resilience, need to belong can directly and positively predict psychological resilience; (3) The indirect effect of the path with social sensitivity as the mediating variable is 0.009, the indirect effect of the path with need to belong as the mediating variable is 0.033, and the indirect effect of the path with social sensitivity and need to belong as the mediating variable is 0.014. (4) The total of all indirect effects is 0.056.

Conclusion 1 Physical exercise behavior can significantly positively predict psychological resilience. 2 Social sensitivity and need to belong play a significant mediating role between physical exercise behavior and psychological resilience. 3 There are three mediating paths, namely, the separate mediating effect of social sensitivity, the separate mediating effect of need to belong, and the chain mediating effect of social sensitivity and need to belong.

Introduction

The youth stage is the "jointing booting stage" of life, the healthy development of teenagers is the booster for the healthy development of the whole people, which needs careful guidance and cultivation. At the same time, this is a golden period for the formation of healthy psychological needs, and they need to learn to balance various increasing needs. However, due to the imbalance between the physiological and psychological development of teenagers, it is necessary to actively guide them, make them firm in their ideals and beliefs, and promote the shaping of healthy and ideal personality, so that they can live up to the historical responsibility entrusted by the times. Psychological resilience mainly refers to that when facing external pressure and crisis situations, individuals use their own characteristics, abilities, social resources and other protective factors to actively respond, so that individuals in adversity can obtain a good adaptation outcome. Psychological resilience refers to the good psychological adaptation of an individual when facing or experiencing adversity, which can stimulate the individual's internal cognition, ability or psychological characteristics, and obtain the process or results towards the goal through active repair and debugging with
internal and external resources. Teenagers are in a critical period of healthy, mature development of mind and plasticity of personality. While developing physically and mentally in an all-round way, they are also in a stage of psychological vulnerability. Good psychological resilience is the basis for maintaining healthy psychological characteristics, which helps reduce problematic behaviors and mental diseases. However, in the face of higher education, competitive pressure, family expectations and the decline of the overall resistance of the population, the psychological problems of teenagers tend to be lower. It will not only affect their academic achievements, interpersonal relationships, social resources and many other aspects, but also affect their adult life, which needs to be highly valued. Therefore, the psychological resilience of teenagers can make them have better adaptability when facing difficulties or experiencing adversity, and the development of psychological resilience will have a continuous impact on the adolescent's life, which is a common concern of family education and school education at this stage. The study of psychological resilience can not only broaden the theory of mental health, but also guide teenagers to actively cope with the difficulties and crises in the process of growth by exploring the protective factors of teenagers' healthy psychology. Exploring the relationship between physical exercise behavior and teenagers' psychological resilience is an important way to improve their healthy psychology. In recent years, the study of the relationship between the two has attracted more attention in the field of physical education psychology. Based on this, this study aims to explore the relationship between physical exercise behavior and psychological resilience, and to provide practical and theoretical support for the intervention study of physical exercise behavior to promote psychological resilience in teenagers.

The relationship between physical exercise behavior and psychological resilience

Physical exercise behavior is necessary to form a healthy and active lifestyle, and is a key period for the formation of lifelong health awareness and behavior; thus the formation of strong physique, sunshine mentality is not only an important prerequisite for the growth of teenagers, but also an important way to cultivate healthy psychology, which is related to the physical and mental health of teenagers. It has been proved that physical exercise can promote teenagers' mental health, reduce bad emotions, and improve self-efficacy and psychological resilience. Physical exercise can not only enhance physical fitness, but also promote mental health and improve sleep quality. Participation in physical exercise can promote the psychological development of teenagers in a positive direction. Research shows that low physical activity actors are more likely to have unhealthy lifestyles and psychological problems due to less physical participation. Regularized physical exercise can make people experience the sense of pleasure and improve the ability of anti-frustration, which is the most economical and effective means to promote physical health, prevent mental diseases and improve the quality of life. At the same time, research in the field of rehabilitation medicine and sports science points out that physical exercise has a positive effect on depression. Therefore, teenagers' physical exercise behavior is closely related to their psychological resilience. In terms of coping with psychological problems, compared with medical treatment, psychological counseling and education, sports therapy based on physical exercise is the most green, economic and lasting way. The positive emotional experience generated in the process of sports and the resulting sense of happiness will weaken the psychological troubles and fatigue of teenagers in learning and life, and have a
more significant role in improving positive emotions. Brawley et al. have proved that regular physical exercise is more likely to form close relationships with others, thereby reducing psychological problems. Therefore, we put forward the hypothesis 1: physical exercise behavior can positively predict the psychological resilience of teenagers.

The mediating role of social sensitivity

Teenagers are between childhood and adulthood, and they are highly sensitive, showing shyness and withdrawal in unfamiliar social situations. Teenagers’ social anxiety gradually emerged at the age of 13–19, mainly manifested as fear of social interaction, avoidance of social interaction, and some even appeared autonomic nervous disorder, so their social interaction ability declined. Social sensitivity refers to the degree of perception of their own behavior and social status being evaluated and concerned by others. It refers to the continuous or repeated fear, anxiety or avoidance behavior of teenagers to new environment or strangers in social interaction. In social interaction, they tend to be aware of others’ opinions and evaluations, and thus change the behavior accordingly. Social sensitivity refers to the ability of individuals to recognize, perceive and understand hints and backgrounds in social interactions, as well as the degree of understanding others’ feelings and ideas, and the degree of familiarity with social norms and common sense. Teenagers with strong social sensitivity are eager for others’ recognition and pay more attention to social evaluation. When they are in a social situation, they will increase a strong sense of tension[1], which may lead to fear and worry about the evaluation results, and experience the pressure of social interaction, resulting in more maladjustment problems[1]. Therefore, teenagers with strong social sensitivity are easy to feel uncomfortable in social occasions, and have negative expectations. They feel that others hold a negative evaluation of themselves, so they will have nervous and distressed emotional experiences, and thus have social avoidance behaviors to escape places where they perceive negative evaluation. Faced with social difficulties and pressures, teenagers with high social sensitivity are under great psychological pressure, and they can not use internal and external resources to obtain good psychological adaptation, so their psychological resilience is reduced. If they cannot be controlled in time, they are more likely to form social avoidance and even social phobia. However, physical exercise behavior may negatively predict social sensitivity, and the positive emotional experience generated by physical exercise can improve teenagers’ psychological problems and promote the development in a benign direction. At the same time, participating in sports activities has a significant effect on improving the social skills, solidarity and cooperation of teenagers, and also reduces teenagers’ social sensitivity. The weak social sensitivity is positively correlated with mental health, which will positively predict the psychological resilience of teenagers. To sum up, physical exercise behavior may improve the psychological resilience of teenagers by negatively predicting social sensitivity. Therefore, based on the above research, hypothesis 2 is put forward: social sensitivity plays a mediating role between physical exercise behavior and psychological resilience.

The mediating role of need to belong

Need to belong is a basic psychological need and a social need of individuals. In communication, we attribute oneself to a certain group and, as a member of the group, we perceive the emotional experience of being accepted, respected and supported, including the psychological experience of cognition and emotion. The essence of need to belong is the psychological need to establish a harmonious interpersonal relationship
with others and be accepted by groups. It is a process of "embedding" oneself into groups (fields) in order to establish a stable and sustainable interpersonal relationship. In order to meet the need to belong, individuals need to construct the beliefs of others by being accepted and perceiving others' preferences. It affects individual cognition, emotion, and behavior. The theory of need to belong believes that, as a social attribute, it is a basic human need to establish contact with others, so it is necessary to maintain the lowest sense of interpersonal belonging. When there is a lack of interpersonal belonging in some aspect, individuals are encouraged to invest time and energy in other groups to seek to establish a sense of belonging. While in sports, they can gain a strong sense of collective identity and organizational attachment. Higher emotional commitment will further improve sports experience and enhance the sense of belonging of teenagers. Therefore, the characteristics of sports projects make it enhance the need to belong, and promote the positive belonging emotions and higher needs to belong. Higher sense of belonging are more desire to be accepted and perceived. They will be more active and enthusiastic in the group, and can face adversity with a good and positive psychological state, which will enable teenagers to form a strong psychological resilience. Thus, need to belong may positively predict psychological resilience in teenagers. Due to the physical exercise behavior makes the teenagers have a higher need to belong, so that they try to integrate into the collective in a more positive way, which will produce higher psychological resilience. Therefore, hypothesis 3 is put forward: need to belong plays a mediating role in the relationship between physical exercise behavior and psychological resilience in teenagers.

The chain mediating effect of social sensitivity and Need to belong

Studies have shown that the desire to be accepted by groups and the need to avoid social exclusion and belonging needs are the reasons for social sensitivity among individuals. Teenagers with high social sensitivity are eager to be recognized by groups and organizations, and they also want to get recognition and have a sense of group belonging, and devote more energy to maintaining interpersonal relationships. While socially sensitive individuals will pay more attention to the views and evaluations of other members of the group in their actual actions, this behavior can promote individuals to establish and maintain good personal and group relationships to meet their needs of belonging. While teenagers with lower social sensitivity are more likely to have a satisfactory sense of group belonging. It can be seen that social sensitivity and need to belong are in a positive and complementary relationship. At the same time, physical exercise behavior is positively related to psychological resilience and need to belong \(^{[4]}\), and negatively associated with social sensitivity, physical exercise behaviors is able to influence psychological resilience through the mediating role of social sensitivity and need to belong. To sum up, young people's physical exercise behavior affects social sensitivity and sense of need to belong in different ways, thus shaping a good psychological resilience. Therefore, hypothesis 4 is put forward: social sensitivity and need to belong plays a chain mediating role between physical exercise behavior and psychological resilience.

The existing studies have discussed the relationship between adolescent physical exercise behavior and social sensitivity, psychological resilience and need to belong, but further analysis of its internal mechanism is needed to understand the impact of adolescent physical exercise behavior on psychological resilience, based on an analysis of existing studies, this study intends to construct a chain mediation model.
(as shown in Fig. 1 and verify the following aspects:(1) Physical exercise behavior significantly positively predicted adolescent psychological resilience; (2) Social sensitivity and need to belong play a separate intermediary role between physical exercise behavior and psychological resilience; (3) Social sensitivity and need to belong play chain intermediary role between physical exercise behavior and psychological resilience.

Materials and methods

Participants and procedure

Using the cluster sampling method, one school was selected from each of the eight regions in Shandong province, each school randomly selected 3 classes, with 50 students in each class, and a total of 1200 questionnaires were issued. The students in the selected school have a PE class 3 times a week. The schools have enough places for exercise and fitness, and all the students are in good health. After removing the invalid questionnaires due to regular answers, missing data and other reasons, 1106 valid questionnaires were finally obtained, the recovery rate was 92.2%. In the valid questionnaire, 433 girls (39.2%) and 673 boys (60.8%) were selected, with an average age of $15.7 \pm 0.598$.

Study consent was obtained from the school leader, the head teacher and the subject himself before testing. The questionnaire follows the principles of voluntary filling, data confidentiality and anonymous filling, and is tested by the collective test method. The questionnaire included control variables including participant age and gender, and the data were collected from 3 September to 1 November, 2022, and the questionnaire was completed within 30 minutes.

Measures

The physical activity level scale (PARS-3)

The Physical Activity Level Scale was assessed by Deqing, as a tool to measure teenagers’ participate in physical activities, this scale has been widely used in the study of physical activity participation. The scale contains three test questions, which mainly assess the amount of exercise in terms of exercise intensity, exercise time and exercise frequency. Each question was recorded as 1–5 points according to the grade. The mean score of the exercise amount was used as a quantitative indicator of the participants’ exercise behavior evaluation. The average score of the exercise amount was used as a quantitative indicator of the participants’ Physical exercise behavior evaluation. The internal consistency coefficient $\alpha = 0.839$, and the half-degree of reliability is 0.816. In this study, cronbach's $\alpha$ of the scale was 0.82, indicating the high reliability.

Social sensitivity

The Social Sensitivity was evaluated by “The Social Sensitivity scale”, which was developed by Chen et al. (2018). The scale is used to measure teenagers’ social perception and attitudes. The scale included 13 items, with a grade 5 rating, 1 as "complete inconformity" and 5 as "full conformity". A higher score indicates a higher level of social sensitivity. The Cronbach's $\alpha$ coefficient of this scale was 0.88. In this study, the scale showed good reliability, with an internal consistency coefficient $\alpha = 0.91$.

Psychological resilience
The Psychological Resilience was assessed by Psychological Resilience scale (CD-RISC), which is formatted by Connor and Davidson (2003), and the revised version was modified by Yu and Zhang (2007). The scale contains three dimensions of resilience, perseverance and optimism, with good reliability and validity. There are 25 items in total. Using the Likert 5-level scoring method, higher scores indicate higher levels of psychological resilience. The Cronbach's $\alpha$ coefficient of this scale was 0.858. In this study, the internal consistency coefficient was 0.97.

**Need to belong scale**

Need to Belong was measured by Leary in 2013. It is used to measure individuals' need for acceptance and belonging (e.g. "If others refuse me, I will be bothered about it"). The scale is consisted by 10 questions with 5 rating, 1 as "totally inconformity" and 5 as "totally compliant". When the subject score was higher, you will get a stronger need to belong. In this study, the Cronbach's $\alpha$ coefficient was above 0.8.

**Statistical analyses**

First, IBM SPSS26.0 statistical software was used for data analysis, including descriptive statistics and correlation analysis of Physical Exercise Behavior, Psychological Resilience, Social Sensitivity, Need to Belong and other variables. Also the common method bias was tested by the Harman uni-factorial test. Second, in this study, the mediation variables may form a mediation chain, and the predictor variables have indirect effects on the outcome variables through the mediation chain, model 6 in the macro program PROCESS of SPSS was used to conduct the mediating effect test, it mainly tests the direct effect relationship between Physical Exercise Behavior and Psychological Resilience; The mediating effect of Social Sensitivity and Need to Belong; The Chain mediating effect of Physical Exercise Behavior and Psychological Resilience. Third, AMOS26.0 software was used to test the fitting degree of the mediating model between Physical Exercise Behavior and Psychological Resilience.

**Results**

**Common method deviation test**

In this study, all the data were collected from self-presentation questionnaire survey, and there may be a problem of common method deviation, therefore, three reverse questions were designed in the Social Sensitivity Scale during the questionnaire design, and data were collected by on-site filling, on-site answering and on-site recovery. Furthermore, Harman Single-factor Test was used, Extracting the exploratory factor analysis of all items included in the univariate unrotated, and it found that there were 7 factors with eigenvalues greater than 1, the explained variation for the maximum factor was 32.2%, which was less than the 40% criterion recommended by Hair et al. Therefore, there was no significant common methodological bias in this study.

**Descriptive statistical and correlation analysis**

As shown in Table 1, the correlation coefficients of physical exercise behavior, psychological resilience, social sensitivity and need to belong are all statistically significant. The correlation analysis shows that physical exercise behavior is positively correlated with psychological resilience and need to belong ($p < 0.01$, $P < 0.05$),
also there was a significant negative correlation with social sensitivity ($p < 0.01$). Also, there are Sex differences in Physical Exercise Behavior ($P < 0.01$), Age has no correlation with each index. A chi-square test was further performed for Teenagers of different sex, As can be seen from Table 2, female had a higher Physical Exercise Behavior than males ($p < 0.001$), and the difference was not significant for the other indicators.

### Table 1
Descriptive statistics and correlation analysis.

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Sex</th>
<th>Age</th>
<th>Physical Exercise Behavior</th>
<th>Psychological Resilience</th>
<th>Social Sensitivity</th>
<th>Need to Belong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>1.61</td>
<td>0.488</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>15.7</td>
<td>0.598</td>
<td>0.17</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Exercise Behavior</td>
<td>2.65</td>
<td>0.856</td>
<td>-0.301**</td>
<td>0.030</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological Resilience</td>
<td>3.65</td>
<td>0.653</td>
<td>-0.026</td>
<td>0.047</td>
<td>0.194**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Sensitivity</td>
<td>3.18</td>
<td>0.694</td>
<td>0.008</td>
<td>0.031</td>
<td>-0.085**</td>
<td>0.050*</td>
<td>0.050*</td>
<td>1</td>
</tr>
<tr>
<td>Need to Belong</td>
<td>3.46</td>
<td>0.584</td>
<td>-0.030</td>
<td>0.023</td>
<td>0.050*</td>
<td>0.470**</td>
<td>0.394**</td>
<td>1</td>
</tr>
</tbody>
</table>

$N = 1106. * p < 0.05; ** p < 0.01.$

### Table 2
Differences in gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number</th>
<th>M ± SD</th>
<th>$\times\times\times$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Exercise Behavior</td>
<td>female</td>
<td>433</td>
<td>2.97 ± 0.88</td>
<td>131.134</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>673</td>
<td>2.45 ± 0.77</td>
<td></td>
</tr>
<tr>
<td>Psychological Resilience</td>
<td>female</td>
<td>433</td>
<td>3.68 ± 0.72</td>
<td>93.049</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>673</td>
<td>3.64 ± 0.60</td>
<td></td>
</tr>
<tr>
<td>Social Sensitivity</td>
<td>female</td>
<td>433</td>
<td>3.17 ± 0.72</td>
<td>57.320</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>673</td>
<td>3.19 ± 0.68</td>
<td></td>
</tr>
<tr>
<td>Need to Belong</td>
<td>female</td>
<td>433</td>
<td>3.48 ± 0.67</td>
<td>49.729</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>673</td>
<td>3.44 ± 0.52</td>
<td></td>
</tr>
</tbody>
</table>

$N = 1106. *** p < 0.001.$

**Significance test of mediation effect**
The correlation analysis result met the statistical requirements for further testing the mediating effect of physical exercise behavior and psychological resilience. Consequently, the model 6 of SPSS macro program PROCESS was made to perform the mediation effect test. Table 3 shows that physical exercise behavior significantly positively predicts psychological resilience (β = 0.148, p < 0.001), and hypothesis 1 is established. Next, after incorporating social sensitivity and need to belong into the regression equation, physical exercise behavior can significantly negatively predict social sensitivity (β = -0.069, p < 0.01), positively predicts need to belong (β = 0.058, p < 0.01), social sensitivity can significantly negatively predict need to belong (β = -0.337, p < 0.001) and negatively predict psychological resilience (β = -0.132, p < 0.001), need to belong is significantly positively predicts psychological resilience (β = 0.580, p < 0.001). At this time, physical exercise behavior can still predict psychological resilience (β = 0.119, p < 0.001).

### Table 3

<table>
<thead>
<tr>
<th>Effect</th>
<th>Item</th>
<th>Effect</th>
<th>SE</th>
<th>t</th>
<th>LLCI</th>
<th>ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effect</td>
<td>Physical Exercise Behavior-Psychological Resilience</td>
<td>0.119</td>
<td>0.020</td>
<td>6.0***</td>
<td>0.080</td>
<td>0.158</td>
</tr>
<tr>
<td>indirect effect</td>
<td>Physical Exercise Behavior-Social Sensitivity</td>
<td>-0.069</td>
<td>0.024</td>
<td>-2.83**</td>
<td>-0.117</td>
<td>-0.021</td>
</tr>
<tr>
<td></td>
<td>Physical Exercise Behavior-Need to Belong</td>
<td>0.058</td>
<td>0.019</td>
<td>3.05**</td>
<td>0.020</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>Social Sensitivity-Need to Belong</td>
<td>-0.337</td>
<td>0.023</td>
<td>-14.51***</td>
<td>-0.383</td>
<td>-0.291</td>
</tr>
<tr>
<td></td>
<td>Social Sensitivity-Psychological Resilience</td>
<td>-0.132</td>
<td>0.027</td>
<td>-4.975***</td>
<td>-0.184</td>
<td>-0.080</td>
</tr>
<tr>
<td></td>
<td>Need to Belong-Psychological Resilience</td>
<td>0.580</td>
<td>0.032</td>
<td>18.38***</td>
<td>0.518</td>
<td>0.641</td>
</tr>
<tr>
<td>Total effect</td>
<td>Physical Exercise Behavior-Psychological Resilience</td>
<td>0.148</td>
<td>0.023</td>
<td>6.57***</td>
<td>0.103</td>
<td>0.192</td>
</tr>
</tbody>
</table>

N = 1106. **p < 0.01, ***p < 0.001.

The mediating effect size analysis results show that (see Table 4 and Fig. 2) social sensitivity and need to belong are used in physical exercise behavior and psychological resilience. There is a significant mediating effect between adaption, the indirect effect of the path with social sensitivity as the mediating variable is 0.009 (95%CI=[0.002,0.019]), the indirect effect of the path with need to belong as the mediating variable is 0.033 (95%CI=[0.009,0.058]), the indirect effect of the path with psychological resilience social sensitivity and need to belong as the mediating variable is 0.014 (95%CI=[0.003,0.024]), the 95% confidence intervals of the three indirect paths do not contain the number 0, indicating that the three indirect effects have reached a significant level, and hypothesis 2, hypothesis 3 and hypothesis 4 are valid.
Table 4  
Mediating effect analysis of physical exercise behavior and psychological resilience

<table>
<thead>
<tr>
<th>Influence path</th>
<th>Indirect Effect</th>
<th>BootSE</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Exercise Behavior-Social Sensitivity-</td>
<td>0.009</td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td>Psychological Resilience</td>
<td></td>
<td></td>
<td>0.019</td>
</tr>
<tr>
<td>Physical Exercise Behavior-Need to Belong-</td>
<td>0.033</td>
<td>0.013</td>
<td>0.009</td>
</tr>
<tr>
<td>Psychological Resilience</td>
<td></td>
<td></td>
<td>0.058</td>
</tr>
<tr>
<td>Physical Exercise Behavior-Social Sensitivity-Need</td>
<td>0.014</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td>to Belong-Psychological Resilience</td>
<td></td>
<td></td>
<td>0.024</td>
</tr>
</tbody>
</table>

**Discussion**

**The relationship between physical exercise behavior and psychological resilience**

This study found that physical exercise behavior can positively predict the psychological resilience of teenagers, which is consistent with existing studies\(^1\), and provides a new perspective for further promoting and understanding the relationship between physical exercise behavior and psychological resilience in the future. Strong psychological resilience can still face everything with a good adaptation state after experiencing trauma and frustration. As an objective and universal psychological phenomenon, psychological resilience reflects the positive and healthy psychological connotation. The positive effect of physical exercise behavior on teenagers is not only reflected in their physical health, but also in the positive promotion of mental health. It is shown that they can perceive the benefits of self shaping in their physical activities, so as to maintain more frequent, positive and stable physical behavior\(^1\). Students who often participate in physical exercise have a healthier mental state, which is related to the social support gained during physical exercise. Communication and contact, cooperation and confrontation in sports help teenagers build self-confidence and self-esteem, and establish good interpersonal relationships in sports. The psychological energy accumulated by physical exercise has improved the teenagers' ability to resist frustration and stress. When dealing with adversity and stress in life, the stress reaction is reduced and the psychological resilience is enhanced\(^1\). Teenagers are in the critical period of shaping consciousness and behavior, which is also the critical period of healthy reserves. Good behavior and lifestyle are important guarantee factors for mental health, the higher sports experience generated by physical exercise behavior enables the individuals to have a healthier psychological level. Therefore, we should improve the level of adolescent physical activity, enhance their physical fitness, improve their psychology, so that they have a higher social adaptability.

**The mediating role of social sensitivity**

This study found that social sensitization plays a mediating role between physical exercise behavior and psychological resilience, which shows that social sensitization is an important factor in understanding the
relationship between physical exercise behavior and psychological resilience. Physical exercise behavior can promote teenagers to form good and stable interpersonal relationships, and create a more confident and positive attitude. The resulting sense of belonging and happiness reduces social sensitivity, which is consistent with previous research results[1]. Individuals with high social sensitivity pay more attention to the evaluation of peers or groups, and thus produce negative emotions such as self-confidence. When encountering setbacks or difficulties, they have lower psychological resilience than adolescents with low social sensitivity. Therefore, social sensitivity negatively predicts psychological resilience, which is the same as the existing research results. The level of social sensitivity in teenagers is important for psychological adjustment. With the continuous development of social emotion and social cognition, teenagers will pay more attention to and be alert to the attitude of others, and try to change their behavior to be accepted, leading to increased sensitivity to social evaluation[1], if not guided, there will be psychological problems. Social experience has a better regulatory effect on adolescents with high sensitivity, As a highly organized social activity, sports activities provide a communication and exchange platform for teenagers to establish good interpersonal relationships in terms of interaction and cooperation. Whether it is organization and distribution in sports, or cooperation and confrontation, it is conducive to strengthening interpersonal communication and reducing social sensitivity, the positive experience provided by dopamine during exercise is beneficial to the physical and mental health of teenagers, and can reduce negative emotions such as sensitivity and inferiority. Furthermore, a positive positive attitude will help to better adjust their behavior and mood, reduce social emotions such as low self-esteem and avoidance reaction in the face of setbacks, and will have higher life satisfaction and subjective well-being, potentially improving psychological resilience.

The mediating role of need to belong

This study further demonstrates that, in addition to social sensitivity, need to belong act as a partial mediator between physical exercise behavior and psychological resilience, that is, physical exercise behavior can subsequently affect the psychological resilience of adolescents by influencing need to belong. This result is also supported by existing research. Sports participation can improve the sense of honor and collectivism. Teenagers pay attention to the interpersonal relationships in the process of sports, and the continuous attraction formed enables them to obtain a stable sense of belonging. At the same time, whether it is physical confrontation with others or skill learning, individuals are difficult to develop independently and need mutual support and help. The harmonious interpersonal atmosphere they feel in the activity meets the strong need to belong, and their physical exercise behavior will continue to strengthen, and continue to help in mental health. With a high need to belong, they can face adversity in a positive psychological state, This will enable teenagers to form strong psychological resilience. The mechanism can use self-determination theory, individual autonomy and positive emotional experience can guided them to participate in actions that are interest and benefit their own ability development, After meeting their own physical and ability needs, there will have the needs of belonging. Teenagers’ cohesive force and close cooperation in sports make their psychological health develop in a positive and positive direction, thus enhancing their psychological resilience. Teenagers’ cohesive force and close cooperation in sports make their psychological health develop in a positive direction, thus enhancing their psychological resilience. How to make teenagers’ physical and mental more healthy and always maintain a positive and optimistic mental state is the mission and task of educators; this study suggests that physical exercise behavior can improve the psychological resilience of
teenagers through the need to belong. Therefore, creating a good social, sports and cultural environment, developing positive psychological resources of teenagers through physical exercise behavior and good sense of belonging are important ways to enhance the psychological resilience of teenagers. Mental health also feeds back the physical exercise behavior, and then promotes the development of physical and mental health. The research results further indicate that to improve the psychological resilience of young people, we should not only start with external conditions such as economy or policy, but also improve their awareness of physical, stimulate their exercise motivation, and enhance their need to belong in the process of physical exercise.

The chain mediating effect of social sensitivity and need to belong

Through further analysis, this study found that adolescents' physical exercise behavior can predict psychological resilience through the chain mediation of social sensitivity and need to belong. Teenagers will form a positive attitude and a strong sense of collective honor during physical exercise. The optimistic and confident attitude brought by positive emotional experience and optimistic psychological state effectively reduces their social sensitivity and improves their sense of belonging. Higher need to belong will enable teenagers to better adjust their emotions and mood, so as to gain recognition and acceptance from the collective or others, and further promote the improvement of psychological quality. In the face of failure experience, it will less affect their emotional changes, and quickly get rid of bad emotions. Since from middle childhood, socially sensitive children develop self-perception of social competence and interpersonal relationships, middle school stage is the critical period for the physical and psychological development of teenagers. Therefore, schools and families should grasp the education work at this stage, promote their active participation in sports activities, absorb health related knowledge, and develop good health habits, improve their mental health level, and then improve their ability to adapt to society.

Therefore, based on the self-determination theory, physical exercise behavior can promote teenagers' mental health and improve their psychological resilience, while there is a significant negative correlation between social sensitivity and the need to belong. It can be demonstrated that the chain mediation of social sensitivity-need to belong in this study is feasible, it can play a partial mediating role in the role of physical exercise behavior on teenagers' psychological resilience. The mediation effect model thus constructed, to a certain extent, reveals the internal mechanism of teenagers' physical exercise behavior to enhance their psychological resilience, it has certain guiding value for improving the psychological resilience of teenagers, cultivating healthy mentality and social adaptability. At the same time, as teenagers' activity areas are mainly concentrated in families, communities and schools, environmental factors that affect teenagers' psychological resilience and physical exercise behavior should also be considered. Family environment has a continuous effect on the exercise behavior tendency and psychological resilience, family environment has a continuous effect on exercise behavior tendency and psychological resilience, community is the extension of the family environment, it is the closest environment that teenagers are exposed to, the impact on their body and mind cannot be ignored. The school environment is the inexhaustible power and source of strength to improve the health of teenagers, and has a direct impact on improving physical exercise behavior and psychological resilience.
Limitations and prospectives

This study explores the relationship between physical exercise behavior and teenagers’ psychological resilience, constructs a chain mediation model, reveals the internal mechanism of the impact of physical exercise behavior on adolescent psychological resilience, and has important theoretical and practical values for understanding the influencing factors of adolescent psychological resilience. However, this study is a cross-sectional study, and only considers the mediation variables, without considering their causal effects, so it is impossible to determine the causal relationship, which is also the direction of later research of this study. At the same time, environmental factors that affect teenagers’ psychological resilience and physical exercise behavior should also be considered in later study. Secondly, the self-report scale is used in this study, which may be affected by the reaction bias of the subjects in the research process, multi-mode and multi-angle data collection methods can be adopted to more reflect the real in future research. Finally, due to the limitations of research conditions, the youth sample in this study only includes the sample of senior high school students, not all the youth groups, which is also an issue to be considered in future research.

Conclusion

1) Physical exercise behavior can significantly positively predict psychological resilience.

2) Social sensitivity and need to belong play a significant mediating role between Physical exercise behavior and psychological resilience.

3) There are three mediating paths, namely, the separate mediating effect of social sensitivity, the separate mediating effect of need to belong, and the chain mediating effect of social sensitivity and need to belong.

Declarations

These study was reviewed and approved by the Ethics Committee of Institute of Psychology, School of Physical Education at Shandong University of Science and Technology of China, and all participants signed an informed consent form. All procedures were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration.

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Data availability

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Authors’ contributions
N.L and X.Z designed the study, collected, analyzed the data, and wrote the manuscript. NL and Zh.L translated and polished. N.L and D-G W investigated and revised the manuscript. All authors contributed to the article and approved the submitted version.

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Consent for publication

Not applicable.

Competing interests

The authors report no biomedical financial interests or potential conflicts of interest.

References


36. Qinxue, L., Linlin, Z., Yue, L., Zien, D. Negative Representations of Family and Internet Relationship Addiction: The Mediating Role of Need to Belong and Social Sensitivity. Psychological development and


Figures

Figure 1

Conceptual Model
Figure 2

The chain-mediated mediation path of Physical Exercise Behavior to Psychological Resilience

Supplementary Files

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- file.xlsx