

Pathways Linking Family Sports Environment to Negative Emotions in Chinese Junior High School Students: The Mediating Role of Psychological Resilience—A Cross-Lagged Analysis

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Research Article

Keywords: family sports environment, negative emotion, psychological resilience, junior high school student, cross-lagged analysis

Posted Date: October 12th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11041408/v1>

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Additional Declarations: No competing interests reported.

Abstract

Objective

This study employed a longitudinal design to not only examine the cross-temporal relationship between family sports environment and negative emotions among Chinese junior high school students but also test the half-longitudinal mediating role of psychological resilience.

Methods

Using a longitudinal design, two waves of data (T1 and T2) were collected from 628 junior high school students. A cross-lagged panel model and a half-longitudinal mediation model were constructed to analyze the dynamic relationships among the variables.

Results

Family sports environment at T1 significantly and negatively predicted negative emotions at T2 ($\beta = -0.358$, $SE = 0.037$, $p < 0.01$). Negative emotions at T1 also significantly and negatively predicted family sports environment at T2 ($\beta = -0.104$, $SE = 0.037$, $p = 0.005$), indicating a bidirectional cross-temporal predictive relationship. Psychological resilience exhibited a significant half-longitudinal mediating effect in the association between family sports environment and negative emotions ($IND = -0.032$, 95% CI $[-0.063, -0.002]$). The sex difference analysis further revealed that neither the predictive path from family sports environment at T1 to negative emotions at T2 nor the mediating effect of psychological resilience differed significantly by sex. However, the predictive path from negative emotions at T1 to family sports environment at T2 revealed a significant sex difference—an effect that was significant only among girls.

Conclusion

A bidirectional cross-temporal predictive relationship was found between family sports environment and negative emotions. Psychological resilience may be an important explanatory pathway through which family sports environment is associated with subsequent negative emotions. In turn, negative emotions may weaken the subsequent family sports environment. These findings provide empirical evidence to promote emotional health and prevent negative emotional problems among junior high school students from the perspective of the family sports context.

1. Introduction

Negative emotions generally refer to adverse emotional experiences such as anxiety, depression, anger, and tension that arise when individuals experience stress or unfavorable situations¹. Junior high school years represent a critical developmental stage during which individuals transition from childhood to

adulthood, and students face multiple pressures—including academic competition, interpersonal communication, peer relationships, and identity development—making them more vulnerable to negative emotions such as anxiety and depression. Previous studies have revealed that negative emotional states among junior high school students not only intensify psychological distress but also gradually develop into severe mental disorders² and are closely associated with non-suicidal self-injury behaviors^{3,4}. According to the Report on National Mental Health Development published by the Chinese Academy of Sciences in 2023, 14.8% of adolescents in a nationwide survey were at varying levels of risk for depression, indicating a relatively high prevalence and underscoring the need for sustained attention to the emotional health of this population⁵. Moreover, fostering junior high school students' positive mental health during this key developmental period may have profound implications across their life course. Therefore, exploring effective ways to alleviate their negative emotions, improve emotional regulation, and promote physical and mental well-being is of clear theoretical and practical significance. The family environment is an important external factor influencing the emotional development and mental health of junior high school students. According to Bronfenbrenner's ecological systems theory⁶, the family, as one of the most immediate microsystems in individual development, exerts a considerable influence on adolescents' emotional and behavioral development. Previous studies have also revealed that the family's influence on adolescents' emotional development is mainly reflected in the quality of parent-child interactions⁷, parenting styles⁸, intergenerational transmission⁹, and family structure^{10,11}, all of which are closely related to the emotional adjustment of junior high school students. In general, the more stable, harmonious, and healthy the family environment is, the better the mental health status of junior high school students tends to be¹². In contrast, a conflictual or insufficiently supportive family environment may pose a significant risk for mental health problems among junior high school students¹³. Among its many dimensions, family sports environment represents a family context closely related to daily behavioral support and emotional interaction. It refers to the overall set of supportive conditions and atmospheres within the family that are related to adolescents' participation in sports. It typically includes parents' attitudes toward and values regarding physical activity, behavioral modeling, encouragement and companionship, frequency of joint participation in sports activities, as well as the family's sport-related cultural atmosphere and resource support¹⁴. A positive family sports environment can provide more opportunities for participation in physical activity, interaction, and companionship, thereby further influencing adolescents' emotional states by enhancing emotional communication and positive experiences¹⁵. Research on the relationship between factors related to family sports environment and emotional health has predominantly provided supportive evidence, although the findings are not entirely consistent across different populations and research contexts. For example, previous studies have revealed that elementary school students with higher levels of family participation in sports activities tend to report fewer symptoms of depression and anxiety¹⁶. Research on junior high school students has also shown that greater family participation in physical activities is associated with better mental health and lower levels of anxiety, depression, and life stress symptoms¹⁷. These studies suggest that factors related to family sports environment may contribute to alleviating adolescents' emotional problems and maintaining positive psychological states. The relationship between family

sports environment and negative emotions may not be unidirectional. While on the one hand, a positive family sports environment may reduce subsequent levels of negative emotions among adolescents by enhancing their sense of support, belonging, and positive experiences¹⁸, on the other hand, higher levels of negative emotions may reduce adolescents' motivation to participate in physical activities and weaken their engagement in family interactions, potentially undermining the maintenance of shared family sports activities and the continued development of a positive family sports environment^{19,20}. For junior high school students, this bidirectional relationship has a realistic basis. Both the formation of family sports environment and the development of negative emotions are dynamic processes. While individual emotional states fluctuate greatly, cultivating a family sports environment often depends on the long-term accumulation of interactions and behaviors among family members. Therefore, these relationships need to be explored from a temporal perspective. However, the extant evidence is derived primarily from cross-sectional studies, making it difficult to identify the temporal order and predictive direction between family sports environment and negative emotions among junior high school students. Based on the above theoretical framework and previous research, this study adopted a longitudinal design to examine the predictive effect of family sports environment on subsequent negative emotions among junior high school students. Accordingly, the following hypotheses were proposed:

H1: Family sports environment at T1 can significantly and negatively predict negative emotions at T2.

H2: Negative emotions at T1 can significantly and negatively predict family sports environment at T2.

The American Psychological Association defines psychological resilience—also known as elasticity or resilience—as the process of effectively adapting to and regulating oneself in the face of adversity, trauma, tragedy, threats, or other sources of stress²¹. The systems model of resilience mechanisms suggests that psychological resilience represents a capacity for positive adaptation to adversity, serving as a psychological buffer that mitigates the adverse effects of stress and promotes emotional stability. Junior high school students are adolescents undergoing a developmental stage characterized by profound physiological and psychological changes. As a positive psychological capacity, resilience helps them cope with negative emotions²². Longitudinal evidence has further revealed that the level of psychological resilience during adolescence is persistently associated with emotional health outcomes in early adulthood. A 32-year study of 660 children in Hawaii found that psychological resilience could be continuously strengthened through ongoing improvements in the postnatal environment, thereby effectively alleviating negative emotions²³. In other words, psychological resilience is not static but can be enhanced through sustained optimization of the environment, in turn exerting a buffering effect on negative emotions. Regarding the pathway from family sports environment to psychological resilience, the family constitutes an important life context for junior high school students' psychological development and behavioral formation, with family sports environment characterized by emotional support, behavioral modeling, and shared experiences. Junior high school students who grow up in a positive family environment often exhibit stronger psychological resilience and are better able to communicate and regulate negative emotions^{24,25}. By participating in physical activities—such as

running, ball games, and cycling—with family members, adolescents can gain more positive emotional experiences and enhance their level of psychological resilience²⁶. Moreover, adolescents in a positive family sports environment are more likely to develop good exercise habits and have greater opportunities to engage in physical activity²⁷. A longitudinal study further revealed that regularly engaging in exercise not only improves adolescents' physical fitness but also enhances their psychological resilience over time through sustained physical activity²⁸. Regular exercise also helps adolescents gradually develop positive coping strategies when facing challenges, failure, and competitive pressure, thereby strengthening their stress resistance, self-regulation, and emotional recovery capacities. However, longitudinal research examining the relationships among family sports environment, psychological resilience, and negative emotions in junior high school students remains limited and determining whether family sports environment exerts a sustained influence on junior high school students' negative emotions through the mediating role of psychological resilience requires further verification. Therefore, this study proposed the following hypothesis:

H3: Psychological resilience at T1 mediates the relationship between family sports environment at T1 and negative emotions at T2.

Meanwhile, junior high school students undergo rapid changes in physiological maturation and social role identity. During adolescence, boys and girls may differ in emotional experiences, modes of emotional expression, and strategies for coping with stress. Previous studies have revealed that, adolescent girls are more likely than boys to exhibit negative emotions such as anxiety and depression, whereas boys are more likely to cope with stress through behavioral activity or other externalizing means. Family support for sports participation may also vary by sex. For example, parents may differ not only in their expectations of children of different sexes but also in the forms of encouragement, modes of companionship, and opportunities for participation they provide, thereby influencing the actual effects of family sports environment²⁹. In addition, as an important psychological resource for coping with stress and adapting to adversity, the development patterns of psychological resilience may vary across sex groups. Among junior high school students, sex differences in emotion regulation³⁰, use of social support³¹, and motivation for sports participation³² may further affect the strength of the pathway through which family sports environment influences negative emotions via psychological resilience. Therefore, based on examining the longitudinal relationships among family sports environment, psychological resilience, and negative emotions, further exploration of whether these relationships differ by sex is necessary to more accurately reveal the characteristics of emotional health development among junior high school students of different sexes. Accordingly, this study proposed the following hypothesis:

H4: The longitudinal relationships among family sports environment, psychological resilience, and negative emotions would differ significantly between male and female junior high school students.

In summary, although previous studies have suggested that family-related factors, physical activity, and adolescent emotional health are interconnected, the existing literature reflects three major limitations:

First, most studies have focused on the general family environment, with relatively little attention paid to the specific context of family sports environment and its influence on adolescents' negative emotions. Second, the current evidence is derived largely from cross-sectional designs, making it difficult to identify the possible bidirectional temporal relationship between family sports environment and negative emotions. Third, longitudinal evidence regarding the mechanism through which family sports environment may influence subsequent negative emotions via internal positive psychological resources is lacking. Therefore, the present study adopted a two-wave longitudinal design to examine the bidirectional cross-temporal relationship between family sports environment and negative emotions among junior high school students, further investigating the half-longitudinal mediating role of psychological resilience. By constructing a cross-lagged panel model, four hypotheses were proposed, as mentioned above.

2. Methods

2.1 Participants

Using a stratified cluster sampling method, junior high school students from seven schools in Guangzhou, China, were recruited. Within each school, four classes were randomly selected from Grades 7 and 8 each, as the sampling units. A 12-month, two-wave longitudinal survey was then conducted. The first survey (T1) was administered from October 14 to 18, 2024, and 720 questionnaires were collected. Based on the screening criteria for invalid questionnaires—including more than 25% missing responses, failure on reverse-coded item checks, patterned responding, and missing the last eight digits of the student identification number—692 valid questionnaires were retained, yielding an effective response rate of 94%. The second survey (T2) was conducted from October 13 to 17, 2025. Owing to objective reasons such as illness or school transfer, some students did not complete the second survey, and 628 questionnaires were ultimately collected. To verify that sample attrition was non-random, participants were grouped according to their participation in the second-wave follow-up survey (retained group = 0, attrition group = 1). A chi-square test was conducted for sex distribution, and independent-samples *t* tests were performed for age and T1 scores on family sports environment, negative emotions, and psychological resilience. The results revealed no significant difference between the attrition and retained groups in terms of sex distribution ($\chi^2 = 0.335$, *df* = 1, *p* = 0.563). Likewise, no significant differences were found for age (*t* = -1.315, *df* = 72.88, *p* = 0.193), T1 family sports environment (*t* = 1.590, *df* = 690, *p* = 0.112), negative emotions (*t* = -0.634, *df* = 658, *p* = 0.526), or psychological resilience (*t* = 0.120, *df* = 690, *p* = 0.904), indicating that the sample attrition was non-structural rather than systematic. Thus, the representativeness of the initial sample was not affected by systematic bias during the follow-up period, making the data suitable for subsequent cross-lagged analyses.

2.2 Measures

2.2.1 Family Sports Environment Scale

Family sports environment was assessed using the Chinese Adolescents' Physical Activity Habit Formation Scale: Family Environmental Influencing Factors, developed by Zhang et al.¹⁴ for Chinese adolescents. The scale comprises three dimensions: family environment construction (4 items), family action support (6 items), and family health awareness (5 items), totaling 15 items. Each item was rated on a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5), with the total score indicating the level of the participant's family sports environment. The Cronbach's α coefficients were 0.918 at T1 and 0.903 at T2.

2.2.2 Psychological Resilience Scale

Psychological resilience was measured using the Adolescent Psychological Resilience Scale, developed by Hu and Gan³³. The scale includes five dimensions: goal focus (5 items), emotional control (6 items), positive cognition (4 items), family support (6 items), and interpersonal assistance (6 items), totaling 27 items. Each item was rated on a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5), with the total score reflecting the participant's level of psychological resilience. The Cronbach's α coefficients were 0.871 at T1 and 0.845 at T2.

2.2.3 Negative Emotion Scale Negative emotions were measured using the simplified Chinese version of the Depression Anxiety Stress Scales-21 (DASS-21), originally developed by Lovibond³⁴. The scale comprises three dimensions: depression (7 items), anxiety (7 items), and stress (7 items), totaling 21 items. Each item was rated on a 4-point Likert scale ranging from "does not apply to me" (1) to "applies to me most of the time" (4), with the total score indicating the participant's level of negative emotions. The Cronbach's α coefficients were 0.879 at T1 and 0.868 at T2.

2.3 Procedure

The persons in charge of the sampled schools received standardized training prior to data collection. The procedures used in the two waves of investigation were kept consistent: Data were collected using a paper-and-pencil survey administered in a group testing format within participants' classrooms. Before the test, the person in charge read the informed consent statement aloud, explaining the purpose of the study, confidentiality, and data storage procedures. Participants were also assured that they could voluntarily terminate or withdraw from the survey at any time during the testing process. Each survey session lasted approximately 5 to 10 minutes. After completion, all questionnaires were collected on site by the survey administrators. In each wave, demographic information was collected, including sex (1 = male, 2 = female), age, and grade level. In addition, under the condition of guaranteed anonymity, participants' student identification numbers were collected to enable matching of the two waves of data.

2.4 Data Collection and Analysis

The data from the two waves were matched to each participant using a coding function. After matching, the final valid sample was imported into SPSS 27.0 for data processing. Reliability analyses, test-retest reliability, and exploratory factor analysis were conducted to examine the reliability and validity of the measurement instruments.

After standardization of the valid data, conventional statistical methods—including descriptive statistics and correlation analysis—were used to examine the characteristics of the variables and their internal associations. In addition, Mplus was employed to construct and analyze the cross-lagged panel model. Cross-lagged analysis was performed using the maximum likelihood estimation method, and model fit was evaluated in accordance with established theoretical criteria.

2.5 Common Method Bias Test

Procedural control and Harman's single-factor test were used to examine the potential problem of common method bias across the two waves of data collection. First, well-established measurement instruments with demonstrated reliability and validity in both domestic and international research were selected. In designing the questionnaire, the instructions emphasized—in bold—the purpose of the survey and the confidentiality of the responses. In both waves, data were collected through on-site completion and immediate collection of the questionnaires.

Second, excluding demographic variables, all items from the two waves were entered into an unrotated exploratory factor analysis. The results revealed that the variance explained by the first common factor was 38.93% at T1 and 30.91% at T2. Because it was below the critical threshold of 40%, this indicated that no serious common method bias was present in this study.

3. Results and Analysis

3.1 Descriptive Statistics and Correlation Analysis

Table 1 presents the descriptive statistics and correlations of family sports environment, psychological resilience, and negative emotions among junior high school students at T1 and T2. The results revealed that, across the two time points, T1 family sports environment, T1 psychological resilience, T2 family sports environment, and T2 psychological resilience were all significantly and positively correlated with one another ($p < 0.01$). In contrast, T1 family sports environment, T1 psychological resilience, T2 family sports environment, and T2 psychological resilience were all significantly and negatively correlated with T1 negative emotions and T2 negative emotions ($p < 0.01$). These findings served as the foundation for the subsequent testing of the cross-lagged panel model.

Table 1
Descriptive Statistics and Correlations Among the Study Variables

1 Family sports environment T1	M ± SD	1	2	3	4	5	6
	2.38 ± 0.80	-					
2 Psychological resilience T1	1.74 ± 0.86	0.320**	-				
3 Negative emotions T1	2.06 ± 0.66	-0.250**	-0.273**	-			
4 Family sports environment T2	2.76 ± 0.60	0.435**	0.464**	-0.207**	-		
5 Psychological resilience T2	2.75 ± 0.66	0.459**	0.340**	-0.355**	0.438**	-	
6 Negative emotionsT2	1.73 ± 0.41	-0.411**	-0.248**	0.297**	-0.469**	-0.456**	-
Note: Correlation is significant at the 0.01 level (2-tailed).							

3.2 Longitudinal Measurement Invariance Testing

To ensure comparability of the measurements across time, longitudinal measurement invariance tests were conducted for family sports environment, negative emotions, and psychological resilience. The results revealed that all three variables satisfied configural, metric, and scalar invariance. In addition, the chi-square differences between the nested models were all non-significant, indicating that the scales demonstrated good longitudinal measurement equivalence between T1 and T2. Therefore, the data were suitable for subsequent cross-lagged analyses.

Table 2
Longitudinal Measurement Invariance of the Study Variables

Variable	Model	χ^2	df	RMSEA	CFI	TLI	SRMR
Family sports environment	Configural	555.941	180	0.058	0.931	0.920	0.051
	Metric	588.238	194	0.057	0.928	0.922	0.054
	Scalar	620.556	208	0.056	0.925	0.924	0.055
Negative emotions	Configural	925.716	376	0.048	0.935	0.927	0.042
	Metric	949.321	396	0.047	0.934	0.930	0.044
	Scalar	975.792	416	0.046	0.934	0.933	0.044
Psychological resilience	Configural	1468.181	648	0.045	0.950	0.946	0.037
	Metric	1509.040	674	0.044	0.949	0.947	0.040
	Scalar	1544.213	700	0.044	0.949	0.948	0.041

3.3 Cross-Lagged Effects of Family Sports Environment and Negative Emotions

A cross-lagged panel model was estimated in Mplus to examine the bidirectional association between family sports environment and negative emotions among junior high school students. Maximum likelihood estimation was used, with sex included as a control variable. The model demonstrated a good fit to the data: $\chi^2 (2) = 4.518$, $p = 0.104$, root mean square error of approximation (RMSEA) = 0.045, comparative fit index (CFI) = 0.993, Tucker–Lewis’s index (TLI) = 0.975, and standardized root mean square residual (SRMR) = 0.023.

As depicted in Fig. 1, the autoregressive paths for family sports environment and negative emotions were both significant ($\beta = 0.413$, $SE = 0.037$, $p < 0.01$; $\beta = 0.208$, $SE = 0.037$, $p < 0.01$). Moreover, family sports environment at T1 significantly and negatively predicted negative emotions at T2 ($\beta = -0.358$, $SE = 0.037$, $p < 0.01$), while negative emotions at T1 significantly and negatively predicted family sports environment at T2 ($\beta = -0.104$, $SE = 0.037$, $p = 0.005$). Collectively, these results suggest a bidirectional cross-lagged relationship.

3.4 Half-Longitudinal Mediating Effect of Psychological Resilience on the Relationship Between Family Sports Environment and Negative Emotions

Following the first-order longitudinal mediation analysis approach proposed by Fang et al.³⁵, a cross-lagged model was constructed in Mplus (Fig. 2) to examine the mediating role of psychological resilience among junior high school students, while controlling for sex. The model demonstrated an acceptable fit to the data: $\chi^2 = 5.016$, $df = 3$, $p = 0.171$, RMSEA = 0.033, CFI = 0.997, TLI = 0.986, and SRMR = 0.010.

The results revealed that family sports environment at T1 significantly and negatively predicted negative emotions at T2 ($\beta = -0.333$, $p < 0.001$), and significantly and positively predicted psychological resilience at T1 ($\beta = 0.320$, $p < 0.001$). In addition, psychological resilience at T1 significantly and negatively predicted negative emotions at T2 ($\beta = -0.092$, $p = 0.038$). The bootstrap results further demonstrated that the indirect effect of psychological resilience was significant (IND = -0.032, 95% CI [-0.063, -0.002]). Because the confidence interval did not include zero, the findings suggest that psychological resilience exerted a significant half-longitudinal mediating effect on the relationship between family sports environment and negative emotions.

(* $p < 0.05$; ** $p < 0.01$; $p < 0.001$)

3.5 Sex Differences in the Structural Paths

To further examine whether the pathways among family sports environment, negative emotions, and psychological resilience differed by sex, a multi-group model comparison was conducted. As depicted in Table 3, the predictive path from family sports environment at T1 to negative emotions at T2 was significant in both the male and female groups, with the path coefficient being $\beta = -0.308$, $p < 0.001$ for boys and $\beta = -0.366$, $p < 0.001$ for girls. However, the between-group difference test was not significant (Wald = 0.586, $p = 0.444$), indicating that this path did not differ significantly by sex.

In contrast, the between-group difference test for the predictive path from negative emotions at T1 to family sports environment at T2 was significant (Wald = 4.046, $p = 0.044$). Specifically, it was significantly negative in the female group ($\beta = -0.105$, $p = 0.030$) but not significant in the male group ($\beta = 0.035$, $p = 0.483$). This suggests that the negative predictive effect of negative emotions on subsequent family sports environment was mainly present among girls.

Furthermore, in the half-longitudinal mediation model, the indirect effects were IND1 = -0.039 for boys and IND2 = -0.024 for girls. A direct comparison between the two groups revealed that the difference was not significant (DIFF = -0.015, $p = 0.629$), and the bootstrap 95% confidence interval included zero. Thus, that the half-longitudinal mediating effect of psychological resilience between family sports environment at T1 and negative emotions at T2 did not differ significantly by sex.

Overall, the results suggest that the main sex difference was observed in the predictive path from negative emotions at T1 to family sports environment at T2, whereas neither the predictive path from family sports environment at T1 to negative emotions at T2 nor the half-longitudinal mediating effect of psychological resilience revealed significant sex differences.

Table 3
Sex Differences in the Structural Paths

Path/Effect	Boys $\beta(p)$	Girls $\beta(p)$	Test of Sex Difference	Conclusion
family sports environment T1 →negative emotions T2	-0.308(< 0.001)	-0.366(< 0.001)	Wald = 0.586, p = 0.444	No significant Sex difference
Negative emotions T1→ family sports environment T1	0.035 (0.483)	-0.105(.030)	Wald = 4.046, p = 0.044	Significant Sex difference
family sports environment T1→psychological resilience T1→negative emotions T2	IND1=-0.039 (0.078)	IND2=-0.024 (0.270)	DIFF=-0.015, p = 0.629	No significant Sex difference

4. Discussion

4.1 Relationship Between Family Sports Environment and Negative Emotions in Junior High School Students

Based on two-wave longitudinal data from Chinese junior high school students and using a cross-lagged panel model, this study found that family sports environment at T1 significantly and negatively predicted negative emotions at T2. Therefore, H1 was supported. This finding indicates that a positive family sports environment helps reduce subsequent negative emotions in junior high school students, aligning with previous research on the relationships among family environment, physical activity participation, and mental health in junior high school students.

Family sports environment essentially encompasses not only material conditions within the family—such as sports equipment and exercise space—but also a comprehensive ecosystem involving parents' attitudes toward physical activity, behavioral support, joint participation, and the atmosphere surrounding daily activities³⁶. Junior high school students in a positive family sports environment typically have more opportunities to engage in physical activity and are more likely to develop good exercise habits with the companionship of family members. Regularly engaging in physical activity has been widely documented to effectively alleviate negative emotions such as tension, anxiety, and depression³⁷.

From the perspective of underlying mechanisms, the beneficial effect of family sports environment on negative emotions in junior high school students can be explained at three levels. First, at the behavioral level, a positive family sports environment can effectively increase both the frequency and quality of adolescents' participation in physical activity, thereby reducing the risk of negative emotions by promoting neurophysiological regulation, improving sleep quality, and enhancing positive emotional experiences^{38,39}. Second, at the relational level, a positive family sports environment is often associated with more positive parent–child relationships. Joint physical activity with family members, along with emotional support and behavioral praise, not only strengthens adolescents' sense of belonging and

security but also effectively buffers the pressures arising from academic demands, interpersonal relationships, and pubertal development, thereby lowering levels of negative emotions^{40,41}. Third, at the developmental level, during the rapid physical and psychological changes that occur in junior high school, because students' emotion regulation abilities are not yet fully mature, they rely more heavily on external support⁴². At this stage, family sports environment—a sustainable external protective factor—can provide these students with relatively stable positive experiences and adaptive resources, thereby helping them develop healthier lifestyles and more effective stress-coping patterns⁴³.

Because the present study examined cross-temporal pathways while controlling for autoregressive effects, the results reflect not only static associations at the same time point but also—to some extent—the cross-temporal predictive significance of family sports environment for subsequent negative emotions. This finding strengthens the explanatory power of the results and provides more robust empirical support for the value of family sports environment in promoting the mental health of junior high school students.

4.2 Relationship Between Negative Emotions and Family Sports Environment in Junior High School Students

This study revealed that negative emotions at T1 significantly and negatively predicted family sports environment at T2, thereby supporting H2. This is one of the key findings of the study. It suggests that the relationship between family sports environment and negative emotions is not a unidirectional pathway in which only the family influences junior high school students; rather, adolescents' emotional states may also affect the subsequent family sports environment. In other words, negative emotions are not only an outcome of family sports environment but may also serve as an important risk factor influencing changes within it. This finding extends previous research that has primarily viewed family sports environment as an external antecedent factor, revealing that a continuous dynamic relationship may exist between family sports environment and individual psychological states during the psychological development of junior high school students.

This reverse predictive pathway may be explained from several perspectives: First, higher levels of negative emotions are often characterized by behavioral withdrawal, increased fatigue, and reduced willingness to participate. Junior high school students in such a state may be less likely to actively engage in physical activities, even avoiding exercise-related interactions with family members⁴⁴. Under these circumstances, even when the family originally possesses the required sports resources and supportive conditions, the actual function of these resources may be weakened because of adolescents' low participation and limited responsiveness.

According to family systems theory, the family is a dynamic system characterized by ongoing interaction and mutual influence, in which family members' behaviors and emotional states continuously shape one another⁴⁵. As important members of this system, junior high school students elevated negative emotional states may affect both interaction patterns among family members and the overall family

atmosphere⁴⁶. This dynamic relationship between individual emotions and the family system reflects the nature of family sports environment as a relational environment, whose quality depends not only on objective material resources but also on emotional interactions and behavioral engagement among family members. Therefore, the reverse cross-temporal predictive path identified in this study suggests that junior high school students' negative emotions are not only related to their own psychological health but also with the maintenance and development of the subsequent family sports environment.

4.3 Relationships Among Family Sports Environment, Psychological Resilience, and Negative Emotions in Junior High School Students

The results revealed that psychological resilience at T1 played a half-longitudinal mediating role between family sports environment at T1 and negative emotions at T2, indicating that the influence of family sports environment on junior high school students' negative emotions is not exerted solely through a direct pathway but also indirectly by enhancing their psychological resilience, which in turn affects subsequent levels of negative emotions. These results suggest that family sports environment not only directly alleviates negative emotions as an external resource but also further strengthens adolescents' emotional regulation abilities by fostering the development of internal positive psychological resources.

The promoting effect of family sports environment on psychological resilience is strongly supported by theory. On the one hand, a positive family sports environment can provide junior high school students with opportunities for regular exercise, goal persistence, skill improvement, and coping with setbacks. While participating in physical activities, adolescents experience physical fatigue, failure, and competitive pressure, among other challenges⁴⁷, which are more likely to be transformed into positive growth experiences—thereby enhancing psychological resilience—when they occur within a supportive family sports environment⁴⁸. On the other hand, parental support, companionship, encouragement, and positive feedback—embedded within family sports environment—also constitute an important emotional foundation for the development of psychological resilience. For junior high school students, the family not only involves daily life routines but also provides an important context to cultivate resilience and strengthen stress resistance. When families foster positive and supportive relationships through sports participation, adolescents are more likely to develop the belief that they are “capable of coping” when facing stress, along with stronger emotional regulation abilities, thereby improving their level of psychological resilience⁴⁹.

Simultaneously, the negative predictive effect of psychological resilience on subsequent negative emotions was also supported by the findings of this study. Junior high school students with higher psychological resilience will likely adopt positive coping strategies, cognitive reappraisal, and problem-solving approaches to confront academic stress, difficulties in peer relationships, and the physical and psychological changes associated with puberty rather than resort to avoidance or develop feelings of helplessness. Consequently, they are less likely to experience intense negative emotions⁵⁰. Therefore, in this study, psychological resilience functions as an “internal protective resource,” enabling the

transformation of the external support provided by family sports environment into an individual internal capacity and further reducing the risk of negative emotions. Although the effect of family sports environment on negative emotions may involve multiple pathways, psychological resilience appears to be one of the more critical mediating variables.

4.4 Gender Differences

This study further employed a multi-group model to examine sex differences in the pathways linking family sports environment, negative emotions, and psychological resilience. The results revealed that sex differences were not universal across all pathways: the negative predictive effect of family sports environment at T1 on negative emotions at T2 was significant for both boys and girls, but the between-group difference was not significant. Likewise, the half-longitudinal mediating effect of psychological resilience did not differ significantly between boys and girls. Instead, sex differences were primarily reflected in the reverse predictive path from T1 negative emotions to T2 family sports environment.

First, the predictive effect of T1 negative emotions on T2 family sports environment revealed a significant sex difference, with this pathway primarily evident among girls. One possible explanation is that adolescent girls are more likely than boys to be influenced by fluctuations in emotional states in terms of negative emotional experiences, emotional sensitivity, and involvement in family interactions⁵¹. Therefore, when experiencing higher levels of negative emotions, they may be more likely to participate less in shared family physical activities, have weaker positive interactions with their parents, and consequently affect the maintenance and development of subsequent family sports environment⁵². In other words, family sports environment is not only an important external protective factor for adolescents' emotional health but also a relational context that may itself be affected by adolescents' emotional states, with this reverse effect being more pronounced among girls.

Second, the negative predictive effect of T1 family sports environment on T2 negative emotions reached significance in both the male and female groups, although the between-group difference did not reach statistical significance. This suggests that the protective effect of family sports environment on subsequent negative emotions among junior high school students demonstrates a certain degree of cross-sex stability. Thus, a positive family sports climate, parental support, and joint participation in physical activities may provide relatively universal emotional support and positive experiences for adolescents during puberty, thereby reducing the risk of negative emotions^{53,54}.

Third, the half-longitudinal mediating effect of psychological resilience did not demonstrate a significant difference between the male and female groups. Although a numerical tendency toward difference in the indirect effects between the two groups was observed, the difference value did not reach statistical significance. These results indicate that psychological resilience—an important internal psychological resource through which family sports environment influences negative emotions—may operate relatively consistently across sexes among junior high school students. In other words, the process by which family sports environment alleviates negative emotions by promoting the development of psychological

resilience may reflect a common developmental mechanism during adolescence rather than a sex-specific mechanism strongly dependent on sex differences.

4.5 Strengths and Limitations of the Study

Through a one-year, two-wave longitudinal follow-up design, this study highlighted the cross-temporal predictive relationship between family sports environment and negative emotions among junior high school students, while also providing an in-depth analysis of the half-longitudinal mediating effect among family sports environment, psychological resilience, and negative emotions. Because the findings help clarify the important role of family sports environment in junior high school students' mental health, they offer practical significance.

However, several limitations should also be acknowledged. First, this study mainly relied on junior high school students' self-reports and used a subjective, single-dimensional approach for data collection and analysis. Future studies should adopt a multi-informant, multi-method perspective by combining parent reports, behavioral observations, and self-reports to further evaluate the relationship between family sports environment and negative emotions among junior high school students. Second, although the two-wave longitudinal design is more advantageous than a cross-sectional design in revealing cross-temporal relationships among variables, the number of time points remained limited. Future research should employ a three-wave or longer longitudinal design to further examine the long-term dynamic changes in the relationships among these variables.

5. Conclusion

Based on a two-wave cross-lagged design, this study uncovered a significant bidirectional longitudinal relationship between family sports environment and negative emotions among Chinese junior high school students. Specifically, a positive family sports environment was found to reduce subsequent negative emotions, whereas higher levels of negative emotions were found to weakened the subsequent family sports environment. In addition, psychological resilience played a half-longitudinal mediating role in the association between family sports environment and negative emotions, suggesting that the former is an important external protective factor for adolescents' emotional health and can further alleviate the latter by enhancing positive psychological resources. This conclusion not only extends the theoretical connotation of family sports environment but also provides new empirical evidence and practical directions to promote adolescent mental health within the family context.

Declarations

Conflicts of interest

No potential conflict of interest was reported by the author(s).

Funding

This work was funded by the Ministry of Education Humanities and Social Sciences Research Project (No. 25YJA890041) and the Guangdong Provincial Social Science Foundation Project (No. GD22CTY08).

Author Contribution

Xiao.GH (Conceptualization [lead], Writing—original draft [lead])Yue J (Writing—original draft [equal], Visualization [equal])Xu GC (Writing—original draft [equal], Formal analysis [lead])Gu XY (Writing—original draft [equal], Visualization [equal])Jing wang (Visualization [equal], Writing—review & editing [supporting])Zhang. BG (Conceptualization [lead], Writing—review & editing [lead])

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Figures

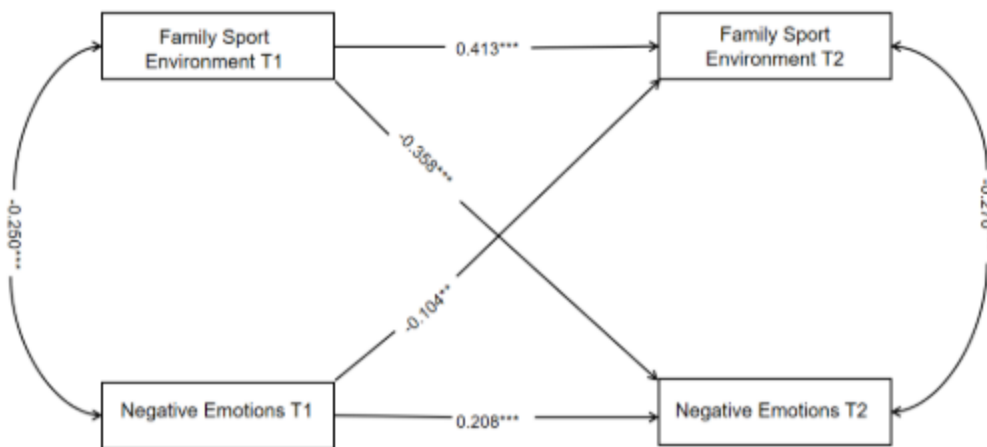


Figure 1

Cross-lagged panel model of family sports environment and negative emotions among junior high school students. (** $p < 0.01$; $p < 0.001$)

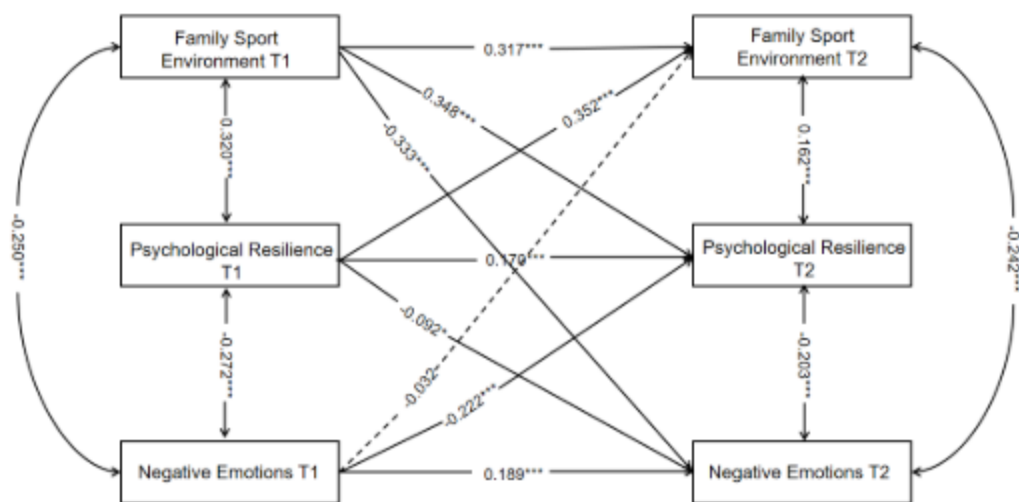


Figure 2

Half-longitudinal mediation effect of psychological resilience

(* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)