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Social Anxiety, Physical Exercise, Regulatory Emotional Self-Efficacy, and Social Avoidance Among Junior High School Students in School Contexts: A Cross-Sectional Study

Yihang Du
Capital University of Physical Education and Sports
Kaiyi Zhang
China Youth Sports and the Integration of Sports and Education Public Policy Research Center
Wenbo Wu
WLSA Shanghai School
Mingyi Liu
mingyi84@aliyun.com

China Youth Sports and the Integration of Sports and Education Public Policy Research Center

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Abstract

Objective

Guided by social cognitive theory and emotion regulation models, this study examined correlates of social anxiety among junior high school students in school contexts. Specifically, it investigated the cross-sectional associations of physical exercise, regulatory emotional self-efficacy, and social avoidance with social anxiety, aiming to inform a developmentally grounded understanding of social-emotional adjustment in early adolescence.

Methods

A school-based cross-sectional survey was conducted among 817 students from five junior high schools in Nanyang, Henan Province, China. Physical exercise, regulatory emotional self-efficacy, social avoidance, and social anxiety were assessed using the Physical Activity Rating Scale, the Regulatory Emotional Self-Efficacy Scale, the social avoidance dimension of the Social Avoidance and Distress Scale, and the Social Anxiety Scale for Adolescents, respectively. Data were analyzed using descriptive statistics, Pearson correlation analyses, partial correlation analyses controlling for sex, grade, and household registration, multiple linear regression analyses, and sex-stratified sensitivity analyses.

Results

Pearson correlation analyses showed that social anxiety was negatively associated with physical exercise ($r = -0.320$, $p < .001$) and regulatory emotional self-efficacy ($r = -0.330$, $p < .001$), and positively associated with social avoidance ($r = 0.434$, $p < .001$). After adjusting for sex, grade, and household registration, physical exercise ($\beta = -0.172$, $p < .001$), regulatory emotional self-efficacy ($\beta = -0.186$, $p < .001$), and social avoidance ($\beta = 0.324$, $p < .001$) remained significantly associated with social anxiety. The final model explained 26.0% of the variance in social anxiety. Sex-stratified analyses showed broadly consistent patterns among boys and girls.

Conclusion

Social anxiety in junior high school students is not merely an internal anxiety experience, but is also linked to physical activity participation, perceived emotional controllability, and social avoidance in school life. Understanding social anxiety in early adolescence therefore requires attention to students' exercise experiences, emotion-regulation confidence, and peer-interaction patterns.

Introduction

Social anxiety (SA) is a salient mental health concern during adolescence, typically characterized by persistent concerns about negative evaluation by others, together with tension, distress, and avoidance in social situations [1]. For adolescents, social interaction is not merely an external context for everyday communication; it is also a central developmental arena in which peer belonging, social evaluation, self-awareness, and social identity are formed [2–5]. As students enter junior high school, peer relationships become increasingly important, social comparison intensifies, and sensitivity to others' scrutiny and negative evaluation increases. As a result, ordinary social encounters may be experienced as increasingly stressful or threatening [3, 6]. Evidence indicates that higher levels of SA are associated not only with tension and discomfort in social situations, but also with broader developmental difficulties, including impaired peer relationships, reduced social functioning, poorer school adjustment, and constrained educational development [6–8]. Identifying behavioral and psychological factors associated with SA among junior high school students is therefore important for understanding individual differences in social-emotional adjustment during early adolescence.

Among the everyday factors associated with adolescent SA, physical exercise (PE) represents not only a modifiable form of physical activity, but also a routine school-based context embedded in peer interaction, collective participation, and social feedback. Existing evidence consistently links physical activity with better mental health among children and adolescents [9, 10]. Systematic reviews and meta-analyses further suggest that higher levels of physical activity and lower levels of sedentary behavior are generally associated with more favorable mental health outcomes in youth [11]. A meta-analysis of prospective cohort studies also reported that higher physical activity is associated with a lower subsequent risk of anxiety [12]. More specifically, in relation to SA, a systematic review and meta-analysis found a significant association between physical activity and SA symptoms, with individuals reporting higher physical activity generally reporting lower levels of SA [13]. Unlike purely individual health behaviors, adolescent PE—particularly school-based physical education and collective sport contexts—often involves peer contact, rule-based participation, cooperative tasks, and group feedback. These characteristics may make PE especially relevant to the social-evaluative sensitivity, interpersonal stress, and peer participation experiences that are central to SA [14, 15]. Prior adolescent studies have found a significant negative association between PE and SA [16], and longitudinal and cross-lagged evidence further suggests that higher PE is associated with lower subsequent SA, while higher SA may also be associated with lower later physical activity participation [17, 18]. Taken together, these findings indicate that PE is a potentially important everyday behavioral correlate of adolescent SA. However, the PE–SA association should be understood within the broader developmental context of school life and peer interaction during adolescence, rather than being reduced to a simple physical activity–mental health link.

Regulatory emotional self-efficacy (RESE) refers to individuals' beliefs about their ability to manage negative emotions effectively and express positive emotions appropriately. It includes confidence in regulating emotions such as sadness, distress, anger, and irritation, as well as perceived capability in expressing positive affect [19]. From the perspectives of social cognitive theory and emotion regulation models, efficacy beliefs shape how individuals appraise stressful situations, experience emotional

responses, and select coping behaviors; similarly, how individuals understand, regulate, and express emotions is closely linked to psychological adjustment [20–22]. For junior high school students, who are highly sensitive to peer evaluation, tension, shame, worry, and embarrassment in social situations are not merely transient emotional experiences. They may also shape perceptions of threat, perceived controllability, and coping choices in social interaction. RESE may therefore constitute an important emotion-regulation belief relevant to adolescent SA: when adolescents believe they can manage negative emotions during social encounters, they may experience less perceived loss of control and lower threat in such situations. Existing studies have shown that PE is significantly associated with RESE, and that RESE is closely related to anxiety, depression, interpersonal distress, and SA [23–26]. Clinical evidence further suggests that individuals with social anxiety disorder show marked impairments in RESE, and that adolescents with SA use fewer adaptive emotion regulation strategies and rely more heavily on maladaptive strategies [27, 28]. In addition, recent work on emotion regulation frequency and self-efficacy has shown that reappraisal self-efficacy is robustly associated with negative affective outcomes, including anxiety [29]. These findings suggest that RESE is not merely a general indicator of emotion-regulation confidence; it may also capture adolescents' perceived ability to understand and manage emotions in socially evaluative contexts and may therefore be closely linked to SA experiences.

Social avoidance (SAV) refers to avoidance tendencies and withdrawal responses in social situations, including reduced social contact and avoidance of interpersonal contexts that may elicit tension, embarrassment, or negative evaluation. Prior research suggests that adolescent SA is not limited to emotional tension and discomfort; it is also closely linked to negative social cognitions, safety behaviors, and avoidance tendencies. In both clinical and community samples, adolescents with higher SA tend to show stronger negative social cognitions and more frequent avoidant safety behaviors [30–32]. During early adolescence, peer relationships and group participation are core developmental tasks. Higher SAV may therefore mean not only that adolescents enter fewer social situations, but also that they have fewer opportunities to receive positive peer feedback, revise negative social expectations, and accumulate successful interaction experiences. Longitudinal evidence also indicates that higher perceived social threat is associated with increases in later adolescent SA symptoms, underscoring the importance of threat interpretation and avoidance tendencies in SA research [33]. At the same time, school-based physical education and collective sport contexts typically involve peer contact, rule-based participation, cooperative interaction, and group feedback, making them potentially relevant to adolescents' social participation and avoidance tendencies. Studies have shown that participation in organized team sports is associated with fewer anxiety, withdrawal, and social problems among children and adolescents [34]. More direct cross-sectional evidence also indicates that moderate-to-vigorous physical activity is negatively associated with adolescent SAV, whereas SAV is positively associated with SA [35]. Thus, SAV is not only an important behavioral correlate of SA, but may also serve as a key behavioral indicator linking PE, peer interaction, and adolescent social-emotional adjustment.

RESE and SAV capture different but complementary dimensions of adolescent SA-related functioning: RESE reflects perceived confidence in emotion regulation, whereas SAV reflects avoidance tendencies in

social situations. For adolescents who are especially sensitive to peer evaluation, lower emotion-regulation confidence may make social tension, shame, or worry feel more difficult to control. In contrast, higher SAV may reduce opportunities to enter social contexts, receive positive feedback, and revise negative expectations. Previous research has shown that adolescent physical activity is significantly associated with emotional self-efficacy, and that organized sport participation is related to belongingness, social support, and psychosocial developmental outcomes [36, 37]. A systematic review of SA in children and adolescents further indicated that socially anxious youth often show greater emotion dysregulation, together with higher levels of social avoidance, safety behaviors, and biased interpretation of social information [38]. Clinical studies similarly show that adolescents with social anxiety disorder report more negative social cognitions, avoidant attitudes, and safety behaviors than control groups [31]. Accordingly, integrating PE, RESE, SAV, and SA within a single cross-sectional association framework may help clarify the multidimensional features of SA-related functioning among junior high school students, spanning everyday behavioral participation, emotion-regulation beliefs, and social avoidance tendencies.

Overall, the existing literature indicates that SA is a key issue in social-emotional adjustment during early adolescence, and that PE, RESE, and SAV represent distinct but related domains of daily behavioral participation, emotion-regulation beliefs, and social avoidance tendencies. Nevertheless, important gaps remain. Although prior studies have separately examined the associations between PE and SA, between RESE and anxiety or SA, and between SAV and SA, comparatively little research has integrated PE, RESE, and SAV within the same school-based sample of junior high school students while treating SA as the primary outcome. This fragmented approach limits our ability to understand how physical activity participation, perceived emotional controllability, and avoidance in peer-interaction contexts jointly characterize SA-related functioning in early adolescence. To address this gap, the present study used a cross-sectional questionnaire design to examine the associations of PE, RESE, and SAV with SA among junior high school students, and further tested whether these associations remained stable after adjusting for sex, grade, and household registration. Specifically, this study addressed the following research questions:

1. Is SA significantly associated with PE, RESE, and SAV among junior high school students?

2. Do PE, RESE, and SAV remain significantly associated with SA after adjusting for sex, grade, and household registration?

3. Do PE, RESE, and SAV show stable cross-sectional associations with SA from the perspectives of daily behavioral participation, emotion-regulation beliefs, and social avoidance tendencies, respectively?

Methods

Participants and Study Design

Junior high school corresponds to early adolescence, a developmental period during which experiences related to SA are likely to emerge. After entering junior high school, students typically face increasing peer salience, heightened sensitivity to others' evaluations, and physiological and psychological changes associated with puberty, all of which may increase evaluative pressure and adjustment demands in social situations [39–41]. Therefore, this study recruited junior high school students as participants and adopted a cross-sectional questionnaire design. Data were collected from March 18 to March 25, 2026, using convenience sampling in five junior high schools in Nanyang, Henan Province, China, namely Nanyang No. 3 Junior High School, Nanyang No. 9 Junior High School, Nanyang No. 13 Junior High School, Nanyang No. 21 Junior High School, and Nanyang No. 22 Junior High School. Approximately 200 students were recruited from each school. To improve coverage across grade levels within the participating schools, several classes from Grade 7, Grade 8, and Grade 9 were selected in each school, and the questionnaire survey was administered at the class level. The sample included students of different sexes, grades, and household registration statuses, providing a basis for subsequent adjustment for basic demographic variables, comparison of SA levels across demographic groups, and sex-stratified sensitivity analyses. The inclusion criteria were as follows: (1) students who voluntarily participated after written informed consent had been obtained from both the students and their parents or legal guardians; and (2) students currently enrolled in school. The exclusion criteria were as follows: (1) questionnaires completed in less than 180 seconds; and (2) questionnaires showing an invalid response pattern, such as selecting the same option throughout. This study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participating students and their parents or legal guardians. The study protocol was approved by the Ethics Committee of the Academic Committee of Capital University of Physical Education and Sports (approval number: 2026A071).

Sample Size

In questionnaire-based studies and multivariable statistical analyses, sample size should be determined by considering the number of measurement items, the planned statistical analyses, and the stability of parameter estimation. Methodological recommendations suggest that, in scale-based research, the sample size can be estimated as 5 to 10 times the total number of items [42, 43]. Accordingly, this study estimated the minimum required sample size using 10 times the total number of items. The four scales used in this study contained 51 items in total; therefore, the theoretical minimum sample size was approximately 510 participants. Considering the exclusion of invalid questionnaires, the need to assess internal consistency and structural suitability of the measurement instruments, and the stability requirements of correlation analyses, 932 questionnaires were distributed. A total of 871 questionnaires were returned, 54 invalid responses were excluded, and 817 valid questionnaires were retained, yielding an effective response rate of 87.66%.

Measurement Instruments

Social Anxiety Scale for Adolescents

This study used the Social Anxiety Scale for Adolescents (SAS-A) developed by La Greca and Lopez [44] to assess levels of SA among adolescents. The scale contains 22 items, of which 18 are formally scored and 4 are filler items. The scored items comprise three dimensions: Fear of Negative Evaluation (FNE; 8 items), Social Avoidance and Distress in New Situations (SAD-N; 6 items), and General Social Avoidance and Distress (SAD-G; 4 items). Items are rated on a 5-point Likert scale, ranging from 1 = “not at all true” to 5 = “very true.” The filler items are not included in the total score. Total scores range from 18 to 90, with higher scores indicating higher levels of SA. It should be noted that the SAS-A was used to assess SA symptom levels in adolescents and does not represent a clinical interview-based diagnosis of social anxiety disorder. In the present study, the Cronbach’s α coefficient for this scale was 0.882.

Physical Activity Rating Scale-3

This study used the Physical Activity Rating Scale-3 (PARS-3), revised by Liang [45], to assess adolescents’ PE levels. The scale assesses exercise volume across three aspects: intensity, duration, and frequency. Exercise volume is calculated as intensity × duration × frequency. Intensity and frequency are each scored on a 5-point scale from 1 to 5, whereas duration is scored on a 5-point scale from 0 to 4. Total scores range from 0 to 100. In this study, the PARS-3 total score was used as the indicator of PE, with higher scores indicating higher levels of PE. The Cronbach’s α coefficient for this scale was 0.811.

Regulatory Emotional Self-Efficacy Scale

This study used the Regulatory Emotional Self-Efficacy Scale (RESES) developed by Caprara et al. [19] to assess adolescents’ perceived confidence in their ability to regulate emotions. The scale consists of 12 items across three dimensions: managing despondency or distress (DES; 5 items), managing anger or irritation (ANG; 4 items), and expressing positive emotions (POS; 3 items). Items are rated on a 5-point Likert scale, ranging from 1 = “not well at all” to 5 = “very well.” In this study, the mean score across all items was used as the overall RESE indicator, with higher scores indicating stronger perceived confidence in one’s emotion-regulation ability. The Cronbach’s α coefficient for this scale was 0.843.

Social Avoidance and Distress Scale

This study used the SAV dimension of the Social Avoidance and Distress Scale (SAD) developed by Watson and Friend [46] to assess adolescents’ avoidance tendencies in social situations. This dimension contains 14 items and uses a dichotomous “yes/no” response format, with both positively and reversely scored items. Items 2, 8, 13, 18, 21, 24, and 26 are positively scored, whereas items 4, 9, 17, 19, 22, 25, and 27 are reversely scored. For positively scored items, a “yes” response is scored as 1; for reversely scored items, a “no” response is scored as 1. All other responses are scored as 0. Total scores range from 0 to 14, with higher scores indicating higher levels of SAV. In the present study, the Cronbach’s α coefficient for this dimension was 0.938.

Results

Sample Characteristics and Measurement Instrument Evaluation

A total of 817 valid questionnaires were obtained. The demographic characteristics of the sample are shown in Table 1. Among the participants, 412 were boys (50.43%) and 405 were girls (49.57%); 280 students were in Grade 7 (34.27%), 260 were in Grade 8 (31.82%), and 277 were in Grade 9 (33.90%); 430 students had urban household registration (52.63%), and 387 had rural household registration (47.37%). Overall, the sample was relatively balanced in terms of sex, grade, and household registration.

Table 1
Demographic characteristics of the sample

Category	Option	Frequency	Percentage (%)
Sex	Male	412	50.43
	Female	405	49.57
Grade	Grade 7	280	34.27
	Grade 8	260	31.82
	Grade 9	277	33.90
Household registration	Urban	430	52.63
	Rural	387	47.37
Total		817	100.0

To assess common method bias, Harman's single-factor test was conducted. The unrotated factor analysis showed that the first common factor explained 24.214% of the variance, which was below the 40% threshold, indicating no serious common method bias in this study. Reliability analysis showed that the Cronbach's α coefficients for the core variables and their dimensions ranged from 0.811 to 0.938 (Table 2), all exceeding the commonly accepted threshold of 0.70, indicating good internal consistency of the measurement instruments in the present sample [47]. Exploratory factor analysis showed a Kaiser–Meyer–Olkin value of 0.935, and Bartlett's test of sphericity was significant ($\chi^2 = 19997.319$, $df = 1081$, $p < .001$), indicating that the data were suitable for factor analysis. Eight common factors with eigenvalues greater than 1 were extracted, and the cumulative variance explained was 63.928%, suggesting acceptable structural suitability of the measurement instruments in this sample.

Table 2
Reliability analysis results for the scales and dimensions

Dimension	Number of items	Cronbach's α
PE	3	**0.811**
DES	5	0.885
ANG	4	0.847
POS	3	0.816
RESE	12	**0.843**
SAV	14	**0.938**
FNE	8	0.911
SAD-N	6	0.897
SAD-G	4	0.831
SA	18	**0.882**

Descriptive Statistics and Correlation Analysis of the Main Variables

Descriptive statistics and correlation results for the main variables are presented in Table 3. Pearson correlation analyses showed that SA was negatively associated with PE ($r = -0.320$, $p < .001$) and RESE ($r = -0.330$, $p < .001$), and positively associated with SAV ($r = 0.434$, $p < .001$). In addition, PE was positively associated with RESE ($r = 0.256$, $p < .001$) and negatively associated with SAV ($r = -0.303$, $p < .001$); RESE was negatively associated with SAV ($r = -0.315$, $p < .001$). These results indicate that, at the bivariate level, higher SA was associated with lower PE, lower RESE, and higher SAV.

Table 3
Descriptive statistics and correlations among the main variables

Variable	M ± SD	PE	RESE	SAV	SA
PE	23.26 ± 26.48	1			
RESE	3.03 ± 0.74	0.256***	1		
SAV	6.30 ± 5.10	-0.303***	-0.315***	1	
SA	53.15 ± 12.61	-0.320***	-0.330***	0.434***	1
Note. ***p < .001.					
Differences in SA by Demographic Characteristics					

To further examine differences in SA across basic demographic characteristics, SA levels were compared by sex, grade, and household registration (Table 4). The results showed no significant difference in SA between boys and girls ($t = 0.899$, $p = .369$), and no significant difference between students with urban and rural household registration ($t = 0.123$, $p = .902$). However, SA differed significantly across grades ($F = 4.766$, $p = .009$), with Grade 8 students reporting relatively higher SA scores. Further post hoc comparisons showed that SA levels were significantly higher in Grade 8 students than in Grade 7 students, whereas the differences between Grade 7 and Grade 9 students and between Grade 8 and Grade 9 students were not significant.

Table 4
Differences in SA by demographic characteristics

Variable	Group	n	M ± SD	t/F	p
Sex	Boys	412	53.55 ± 12.15	0.899	.369
	Girls	405	52.75 ± 13.07		
Grade	Grade 7	280	51.54 ± 12.29	4.766	.009
	Grade 8	260	54.87 ± 13.31		
	Grade 9	277	53.17 ± 12.07		
Household registration	Urban	430	53.20 ± 12.62	0.123	.902
	Rural	387	53.10 ± 12.62		

Note. Independent-samples t tests were used for sex and household registration; one-way analysis of variance was used for grade.

Partial Correlation Analysis After Controlling for Basic Demographic Variables

Partial correlation analyses were conducted after controlling for sex, grade, and household registration (Table 5). The results showed that SA remained negatively associated with PE ($r = -0.318$, $p < .001$) and RESE ($r = -0.332$, $p < .001$), and positively associated with SAV ($r = 0.435$, $p < .001$). In addition, PE remained positively associated with RESE ($r = 0.257$, $p < .001$) and negatively associated with SAV ($r = -0.303$, $p < .001$); RESE remained negatively associated with SAV ($r = -0.314$, $p < .001$). These findings indicate that the directions of the cross-sectional associations among SA, PE, RESE, and SAV remained stable after controlling for basic demographic variables.

Table 5
Partial correlations after controlling for basic demographic variables

Variable 1	Variable 2	Partial correlation coefficient, r	p
SA	PE	-0.318	< .001
SA	RESE	-0.332	< .001
SA	SAV	0.435	< .001
PE	RESE	0.257	< .001
PE	SAV	-0.303	< .001
RESE	SAV	-0.314	< .001
Note. Sex, grade, and household registration were controlled.			
Hierarchical Regression Analysis of SA			

After controlling for sex, grade, and household registration, multiple linear regression analysis was performed to examine the adjusted associations of PE, RESE, and SAV with SA. As shown in Table 6, the final model explained 26.0% of the variance in SA (adjusted $R^2 = 0.255$). In this model, PE was negatively associated with SA (B = -0.082, β = -0.172, 95% CI [-0.112, -0.052], p < .001), RESE was negatively associated with SA (B = -3.169, β = -0.186, 95% CI [-4.252, -2.086], p < .001), and SAV was positively associated with SA (B = 0.800, β = 0.324, 95% CI [0.640, 0.959], p < .001). The variance inflation factor values for all core variables were below 5, indicating no serious multicollinearity. Based on the standardized coefficients, SAV showed the strongest association with SA, followed by RESE and PE.

Table 6
Adjusted Associations of Core Variables With Social Anxiety

Variable	B	SE	β	95% CI	p	VIF
PE	-0.082	0.015	-0.172	[-0.112, -0.052]	< .001	1.139
RESE	-3.169	0.552	-0.186	[-4.252, -2.086]	< .001	1.148
SAV	0.800	0.081	0.324	[0.640, 0.959]	< .001	1.181
Note. The model controlled for sex, grade, and household registration. B = unstandardized regression coefficient; SE = standard error; β = standardized regression coefficient; CI = confidence interval; VIF = variance inflation factor.						
Sex-Stratified Sensitivity Analysis						

To examine whether the main associations were consistent across sex groups, sex-stratified sensitivity analyses were conducted. As shown in Table 7, in both boys and girls, PE and RESE were negatively associated with SA, whereas SAV was positively associated with SA. The model explained 30.4% of the variance in SA among boys and 22.6% among girls. These results indicate that the main directions of the

associations of PE, RESE, and SAV with SA were broadly consistent across boys and girls, suggesting that the primary findings were not driven by a single sex group.

Table 7
Sex-stratified sensitivity analysis

Sex	PE(β)	p	RESE(β)	p	SAV(β)	p	R^2	Adjusted R^2
Boys	-0.198	< .001	-0.158	< .001	0.373	< .001	0.304	0.295
Girls	-0.144	.002	-0.220	< .001	0.272	< .001	0.226	0.216

Note. The sex-stratified models controlled for grade and household registration. β = standardized regression coefficient.

Discussion

This study examined the associations of SA with PE, RESE, and SAV using cross-sectional questionnaire data from 817 junior high school students. The results showed that higher SA was associated with lower PE, lower RESE, and higher SAV. After controlling for sex, grade, and household registration, PE and RESE remained negatively associated with SA, whereas SAV remained positively associated with SA. Sex-stratified sensitivity analyses further showed that the main directions of these associations were broadly consistent among boys and girls, suggesting that the findings were not driven by a single sex group. Taken together, these results indicate that SA-related functioning among junior high school students is not an isolated anxiety experience, but is closely embedded in everyday physical activity participation, emotion-regulation beliefs, and social avoidance tendencies within school contexts. In addition, this study found grade-related differences in SA, with Grade 8 students reporting relatively higher SA scores. This pattern may reflect the more pronounced social-evaluative experiences that students in the middle stage of junior high school encounter during peer relationship reorganization, increasing social comparison, and the accumulation of academic adjustment pressures. However, because this study used a cross-sectional design, the grade difference should be interpreted as a supplementary finding rather than evidence of developmental change over time.

Among the three core correlates examined in this study, SAV showed the strongest association with SA. After adjusting for sex, grade, and household registration and simultaneously including PE, RESE, and SAV in the model, SAV remained positively associated with SA. This finding suggests that SA-related functioning among junior high school students involves more than tension, discomfort, or fear of negative evaluation in social situations; it is also closely tied to avoidance tendencies in peer interaction, classroom expression, collective activities, and unfamiliar social encounters. Previous research has shown that adolescents with higher safety behaviors and higher SA show greater difficulties in psychosocial impairment, fear of evaluation, and social skills performance when interacting with unfamiliar peers [48]. Longitudinal evidence also indicates that adolescent social status, fear of negative evaluation, and social avoidance are interrelated, and that social avoidance is linked to lower peer likeability and difficulties in social relationship development [49]. Moreover, recent work on adolescents'

perceived likeability and friendship has shown that adolescents with stronger social avoidance tendencies tend to have fewer friends and are less likely to be liked by peers, suggesting that SAV is not merely a subjective withdrawal experience but is also connected to adolescents' real peer relationship contexts [50]. Therefore, incorporating SAV alongside PE and RESE in a cross-sectional association framework helps extend existing research on anxiety symptoms and emotion regulation by highlighting the behavioral dimension of SA-related functioning and its peer-interaction background.

Beyond this overt behavioral tendency of social avoidance, adolescents' subjective beliefs about their emotion-regulation capacity may also be closely related to SA. The present results showed that RESE was negatively associated with SA, and this association remained significant after PE and SAV were entered into the same model. RESE captures whether individuals believe they can manage negative emotions and express positive emotions; it differs from measures that simply assess the frequency of emotion-regulation strategy use, because it focuses more directly on individuals' subjective confidence in their capacity to regulate emotions [19]. For junior high school students who are particularly sensitive to peer evaluation, whether tension, shame, embarrassment, and worry in social situations are experienced as "manageable" or "difficult to control" may shape their threat appraisals, perceived controllability, and coping choices in social interaction. Prior studies have found that adolescents with social anxiety disorder show more pronounced emotion-regulation difficulties, including less frequent use of adaptive strategies and greater reliance on maladaptive regulation strategies [27]. Among individuals with social anxiety disorder, impaired emotion-regulation capacity has also been linked to anxiety experiences and functional impairment [28]. Evidence from general adolescent samples further indicates that self-efficacy is closely related to anxiety symptoms, with higher emotional or social self-efficacy generally corresponding to lower anxiety levels [51–53]. Recent research on regulatory emotional self-efficacy has also shown that emotion-regulation frequency and regulatory self-efficacy have distinct associations with negative affective outcomes, indicating that believing one can regulate emotions is itself an important psychological factor for understanding anxiety differences [29]. Thus, including RESE in the cross-sectional association framework for junior high school students' SA helps move beyond a general "emotion regulation difficulty–social anxiety" account and further highlights the relevance of emotion-regulation beliefs and perceived emotional controllability to SA-related functioning. From a school-context perspective, this finding suggests that attention to students' SA-related difficulties should also include their subjective confidence in regulating emotions, particularly their confidence in recognizing, expressing, and managing tension and worry in socially evaluative situations.

In addition to social avoidance and emotion-regulation beliefs, PE, as a modifiable everyday context of physical activity participation, was also significantly associated with SA-related functioning among junior high school students. The results showed that PE was negatively associated with SA, and this association remained significant after RESE and SAV were simultaneously included and basic demographic variables were adjusted. Recent studies among Chinese middle school students have similarly shown that physical exercise is closely related to social adaptation, peer relationships, and SA. For example, one study of 1,056 middle school students found that physical exercise was significantly associated with social adaptability, with SA playing an important role in the relationship between

physical exercise and social adaptability [54]. Another study further suggested that the association between physical exercise and SA among middle school students should be understood in relation to peer relationships and flow experiences in exercise, both of which are embedded in school-based social contexts [55]. These findings suggest that the PE–SA association may not simply reflect a general emotional-buffering pattern; it may also be connected to the peer contact, rule-based participation, cooperative tasks, and bodily performance contexts provided by physical activities. Recent research on adolescent physical activity and mental health has also indicated that physical activity is related to adolescents' mental health status, school adaptation, and social functioning [56, 57]. In addition, research among adolescents participating in sports found that higher SA was associated with weaker effective communication skills, further suggesting that SA in sport contexts should not be understood only in relation to exercise volume, but also in relation to adolescents' expressive ability, interaction experiences, and social-evaluative pressure [58]. Accordingly, the negative association between PE and SA observed in this study should be interpreted as a cross-sectional statistical association rather than evidence of a confirmed protective effect or intervention effect. By examining PE together with RESE and SAV, this study helps reposition physical activity beyond a simple indicator of "exercise amount" and instead frames it as an everyday participation context through which school life, peer interaction, and social-emotional adjustment can be understood.

More broadly, PE, RESE, and SAV are not isolated variables; rather, they reflect three interrelated layers of SA-related functioning among junior high school students: everyday behavioral participation, emotion-regulation beliefs, and social avoidance tendencies. Psychopathology research has suggested that adolescent mental health problems are rarely determined by a single linear factor, but may instead involve complex interconnections among emotional, cognitive, and behavioral components [59]. Network analysis among adolescents has similarly shown close connections among emotion-regulation difficulties, anxiety, and depressive symptoms, with access to emotion-regulation strategies potentially occupying an important position within symptom networks [60]. Focusing more specifically on SA-related symptoms, recent network research among high school students has found that self-concealment in social interaction and concerns about one's true self being perceived by others may constitute important components of the SA symptom network [61]. At the same time, adolescent SA is closely linked to avoidant decision-making and risk-avoidance responses, suggesting that SA involves not only subjective anxiety experiences but also whether individuals enter or avoid situations characterized by uncertainty and social evaluation [62]. Within school life, physical activity has also been associated with peer attachment and social-emotional competence, indicating that physical activity may represent not only a behavioral activity indicator but also a context in which students accumulate interaction experiences and develop social-emotional capacities [63]. Against this background, integrating PE, RESE, SAV, and SA within the same cross-sectional association framework helps situate junior high school students' SA within the intersecting contexts of physical activity participation, emotion-regulation beliefs, and social avoidance tendencies.

From a school-context perspective, the present findings suggest that understanding SA-related functioning among junior high school students requires attention not only to anxiety symptoms

themselves, but also to students' social avoidance behaviors, emotion-regulation confidence, and physical activity participation experiences in everyday school life. Existing research indicates that school-based psychological support or intervention can improve anxiety and depressive symptoms among children and adolescents, although effects vary across theoretical approaches and implementation formats [64, 65]. This suggests that school-based support should not remain at the level of general activity provision, but should more specifically address differences in students' social participation, emotion regulation, and activity experiences. In light of the present findings, students with higher SAV may benefit from low-evaluation, low-threat, and gradually scaffolded opportunities for peer interaction, whereas students with lower RESE may require more support in emotion recognition, emotional expression, and confidence in emotion regulation. At the same time, physical activity can be understood as an everyday participation context in school life. Its value should not be reduced to increasing exercise time or intensity; rather, it may lie in supportive feedback, cooperative tasks, activity choice, and safe peer interaction [66, 67]. This school-context-oriented perspective may help integrate physical activity, emotion-regulation education, and social adaptation support in ways that are more closely aligned with adolescents' daily lives and peer-interaction contexts.

Limitations

This study has several limitations. First, the cross-sectional design only allows the identification of statistical associations among PE, RESE, SAV, and SA, and cannot establish temporal ordering or causal directions among these variables. Therefore, the findings should not be interpreted as evidence that PE, RESE, or SAV has a causal effect on SA. Future studies should use longitudinal or experimental designs to examine the dynamic relationships among these variables over time. Second, PE, RESE, SAV, and SA were assessed using self-report measures, which may be subject to recall bias, social desirability bias, and common method bias. Although this study tested for common method bias, future research could further validate these findings by incorporating objective physical activity monitoring, teacher reports, peer reports, or other multi-informant data sources. Finally, the sample was drawn from five junior high schools in Nanyang, Henan Province, using convenience sampling. Although the sample size was relatively large and included students of different sexes, grades, and household registration statuses, caution is needed when generalizing the findings to other regions or school contexts. In addition, this study controlled only for basic demographic variables. Future research could include contextual factors such as peer relationship quality, academic pressure, family socioeconomic status, and school climate to provide a more comprehensive understanding of the developmental background of SA-related functioning among junior high school students.

Conclusions

Using cross-sectional questionnaire data from junior high school students, this study examined the associations of SA with PE, RESE, and SAV. The results showed that higher SA was associated with lower PE, lower RESE, and higher SAV. These associations remained significant after adjusting for sex, grade, and household registration, and the main directions of the associations were broadly consistent

among boys and girls. These findings suggest that SA-related functioning among junior high school students is not an isolated anxiety experience, but is embedded in physical activity participation, emotion-regulation beliefs, and social avoidance tendencies within school life. The main contribution of this study lies in integrating PE, RESE, and SAV within a single cross-sectional association framework, thereby characterizing SA-related functioning in early adolescence from three complementary perspectives: everyday behavioral participation, perceived emotional controllability, and avoidance in peer-interaction contexts. Accordingly, understanding SA among junior high school students requires attention not only to anxiety symptoms themselves, but also to students' activity participation experiences, emotion-regulation confidence, and patterns of social engagement in everyday school contexts.

Abbreviations

PE Physical exercise

SA Social anxiety

RESE Regulatory emotional self-efficacy

SAV Social avoidance

M Mean

SD Standard deviation

Declarations

Ethics Approval and Consent to Participate

First, this study strictly adhered to the principles set out in the Declaration of Helsinki, and all methods were carried out in accordance with relevant guidelines and regulations. Second, this study was approved by the Ethics Committee of the Academic Committee of Capital University of Physical Education and Sports (2026A071). Finally, informed consent was obtained from all junior high school students and their guardians.

Consent for Publication

Not applicable.

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Author Contribution

DYH was responsible for questionnaire distribution, data analysis, and manuscript writing. LMY was responsible for the overall coordination of the study. ZKY and WWB revised the manuscript. All authors have read and approved the final version of the manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no competing interests.

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