

The impact of moderate-intensity basketball intervention on the physical self-esteem and school adjustment of first-year high school students

Wenting Wei^{1,*}, Ruirui Duan^{2,*}, Fulei Han³ and Qiulin Wang⁴

¹ Kunming University, Kunming, Yunnan, China

² Changzhou Foreign Languages School, Changzhou, Jiangsu, China

³ Kunshan No. 1 Vocational School in Jiangsu Province, Kunshan, Jiangsu, China

⁴ Yangzhou University, Yangzhou, Jiangsu, China

* These authors contributed equally to this work.

ABSTRACT

Object. This study conducted an 8-week experiment with the basketball sports intervention program to explore the relationship between the basketball sports intervention program and the physical self-esteem and school adjustment of first-year high school students, providing references for first-year high school students' school adjustment and related research.

Methods. Using convenient sampling, 88 students in two classes of grade one in a senior high school in Changzhou were selected as the experimental research objects and were randomly divided into experimental groups (basketball) 44 people (20 male and 24 female; control group routine physical education) 44 people (23 male and 21 female). The exercise intervention lasted 8-week, 3-times-a-week with about 30 minutes of moderate-intensity exercise each time. The control group had normal sports activities, and the exercise intensity was not monitored. The Physical Self-esteem Scale and the School Adaptation Scale were used to measure the data in a group manner before and after the experiment. All data were statistically analyzed with SPSS26.0.

Results. (1) After 8 weeks of basketball intervention, the post-test level of school adaptation of first-year high school students was significantly higher than the pre-test ($p < 0.01$), and the post-test level of physical self-esteem was significantly higher than the pre-test ($p < 0.01$). (2) Basketball intervention can directly affect the school adaptation of first-year high school students and indirectly affect the school adaptation through physical self-esteem. The direct effect was 86.79%, and the indirect effect was 13.21%.

Conclusion. (1) Intervention of moderate intensity basketball can improve first-year high school students' school adaptation and physical self-esteem. (2) Intervention of moderate intensity basketball can directly improve first-year high school students' and school adaptation by improving individual physical self-esteem. Physical self-esteem plays a partial intermediary role between basketball and school adaptation.

Submitted 8 May 2024
Accepted 28 July 2024
Published 18 September 2024

Corresponding author
Qiulin Wang, wangql@yzu.edu.cn

Academic editor
Astrid Zech

Additional Information and
Declarations can be found on
page 13

DOI 10.7717/peerj.17941

© Copyright
2024 Wei et al.

Distributed under
Creative Commons CC-BY 4.0

OPEN ACCESS

Subjects Kinesiology, Mental Health

Keywords Exercise intervention, First-year high school students, School adaptation, Physical self-esteem, Intermediary effect

INTRODUCTION

In 2018, General Secretary Xi said at the National Education Conference: “We should adhere to the education concept of “health first”, offer a variety of physical education classes, help students enjoy the fun of physical exercise, sharpen their will and strengthen their physical fitness”. This points out the direction for the development of school sports in the future ([Shi, 2018](#)), the implementation of the improvement of students’ physical and mental health, and the promotion of students’ all-round development ([Ji, 2020](#)).

High school students are the future pillars of the motherland, and the high school period is also a critical stage in cultivating students’ independence. In the process of development, puberty, the pressure of further education and academic pressure, and many other problems make high school students’ mental health a broad concern for all walks of life ([Yang, 2018](#)). Under the present system in China, schools unilaterally pursue a high rate of advancement, parents’ excessive expectations, overly focus on academic performance, and neglect the physical and mental health of high school students, especially the first year of high school students, which is highly unfavorable to their healthy growth ([Chen & Ji, 2006](#)). The natural social environment in high school is mainly the school environment, high-pressure classroom learning environment, and the external environment of students, teachers, and other groups, especially in the first year of high school, to the real world shows our school adaptation ([Song, 2017](#)). School is an essential place of learning for first-year high school students; therefore, good school adaptation benefits senior students’ development. However, maladaptation will not only lead to communication difficulties, loneliness, depression, and a decline in academic performance; it will also significantly impact the future of work, marriage, and family ([Jiang, 2015](#)). Therefore, studying the school adaptation of first-year high school students is of far-reaching practical significance.

Preparing students for early integration into school life and enhancing school adjustment is one of the essential aims of education. Physical education as a part of education also has that role. Kim found that students who exercised regularly produced higher self-esteem levels, and achievement positively affected school adjustment ([Kim, Jang & Cho, 2020](#)). [Fitzgerald, Fitzgerald & Aherne \(2012\)](#) found that increased self-esteem through physical activity improved adjustment in adolescent girls. Other scholars found that moderate-intensity and higher-intensity exercise helped reduce symptoms related to school adjustment more than low-intensity exercise ([Conradsson et al., 2010](#)). Domestic scholars Peng Yeren and Chen Huina concluded that first-year college students’s adjustment to school was significantly related to physical activity level and that students with a higher propensity to be physically active were more sensitive to the school life environment and interpersonal relationships compared with those with a lower propensity to be physically active ([Peng & Chen, 2007](#)). Through her study, [Cao et al. \(2018\)](#) found that physical activity can improve adolescents’ school adjustment. However, research on exercise interventions and school adjustment has focused more on junior high school and college students, and there needs to be more research on exercise interventions for first-year high school students.

Self-esteem is at the core of mental health. Physical self-esteem is a specific domain of self-esteem that is effective in predicting the psychological benefits of exercisers (Lou, 2017), and improving physical self-esteem allows upper-level students to evaluate themselves better. Research has shown that students with high levels of physical self-esteem have higher levels of school adjustment than those with low physical self-esteem (Jung, Kim & Kim, 2016). Also, research has shown that exercise interventions can improve physical self-esteem (Yang *et al.*, 2014).

Foreign scholars have found a meaningful correlation between obesity stress, self-esteem, and school adaptation, with physical activity reducing obesity levels and enhancing self-esteem and school adaptation (Young & Young, 2014). Scholars have found that participation in physical activity indirectly improves adolescents' school adjustment by increasing their self-perception (De Moor *et al.*, 2006). Studies have also found that students who exercise regularly produce higher levels of self-esteem and achievement that positively impact school adjustment (Kim, Jang & Cho, 2020). Fitzgerald, Fitzgerald & Aherne (2012) found that increasing self-esteem through physical activity improved adjustment in adolescent girls. In conclusion, elevated levels of physical self-esteem enhance school adjustment, whereas decreased physical self-esteem increases the incidence of school adjustment distress. Therefore, physical activity improves school adjustment, possibly through improved physical self-esteem.

Basketball is a physically antagonistic sport that includes basketball technique and tactics, physical fitness, and quality (Dong, 2017), which is carried out exceptionally widely in China and is popular among high school students (Zhu & Tang, 2021). Studies have shown that basketball effectively promotes physical and mental health development and improves students' psychological quality. Basketball has been found to improve individual motor abilities, especially strength qualities and bouncing power, thus promoting health. (Liu, 2017). The combination of moderate-intensity basketball and figure skipping can indirectly enhance the self-confidence of upper primary school students by improving physical self-esteem (Yan *et al.*, 2019). A study has found that basketball has an impact on students' school adjustment, improving their self-awareness as well as good interpersonal relationships at school in the process (Liu, 2017). Based on the above analyses, we take basketball as an experimental sport.

In summary, there are significant correlations between sports interventions and body self-esteem, sports interventions and school adjustment, and body self-esteem and school adjustment. However, studies have yet to find precisely how the three are related. Therefore, this study investigated whether body self-esteem plays a mediating variable in basketball sports intervention for school adjustment of first-year high school students.

A total of the following hypotheses were formulated in this study: (1) a moderate-intensity basketball intervention can improve school adjustment for first-year high school students; (2) a moderate-intensity basketball intervention can improve physical self-esteem for first-year high school students; (3) a moderate-intensity basketball intervention can indirectly improve school adjustment for first-year high school students by increasing the level of physical self-esteem.

RESEARCH OBJECTS AND METHODS

Respondents

The survey was conducted in a senior high school in Changzhou City, Jiangsu Province, where two classes were selected by convenience sampling method and randomly divided into experimental and control classes. An informed consent form was distributed to the respondents before the survey to obtain their understanding of and consent to complete the questionnaire. The ethics committee of the medical school of Yangzhou University approved the study (YXYLL-2023-153). A psychometric paper-and-pencil test was used, and uniform instruction was used to guide the subjects to fill out the questionnaire according to their situation. The questionnaires were collected on the spot. The sample size was estimated by F test using G*power 3.1 software. After calculation, a total sample size of 66 cases was required for both groups, and based on a 20% attrition rate, 79.2 cases were required for both groups, and 39.6 cases were required for each group. The sample size of this study was following the estimation. Each student completed the Physical Self-Esteem Scale and the School Adjustment Questionnaire. A total of 88 people agreed to fill out the questionnaires, and there were no invalid questionnaires, giving a valid sample of 88. The validity rate was 100 percent. The criteria for screening the questionnaire were: (1) complete information; (2) no multi-choice situation for one question; (3) no missed answers.

Experimental method

Convenient sampling was used to extract students from a high school senior class in Changzhou City as experimental subjects, who were randomly divided into an experimental class and a control class. The students in the experimental group and the control group were all from senior one with an average age of 16.07 years. The experimental class was taught basketball according to the designed 8-week, three-times-a-week (Monday, Wednesday and Friday) basketball program; the control group was taught the 8-week, three-times-a-week (Monday, Wednesday and Friday) routine. According to the course standard, the experimental group set up ball practice, dribble, pass (including Quadrangle Pass), shoot, tactical cooperation, game and other content. The control group set up the main teaching contents of track and field, including hurdle, long jump, throwing. Based on the high school student's curriculum syllabus and the observation results of favorite sports, combined with the actual situation of the school stadium, basketball is chosen as the content of the sports program. The experimental project is basketball, based on the general high school "physical education and health" curriculum standards; basketball characteristics require fast and powerful passing and catching, high accuracy, effortless control, dribbling sophisticated and skillful, stable shooting, and easy to combine with other actions. Skilled mastery of dribbling with different strengths and different speeds, different distances and different arcs of the pass and catch, and with shooting, can develop students' coordination ability, develop physical fitness to cultivate solidarity and cooperation between students, and joint development of physical fitness, enhance the purpose of the technology, and cultivate the students' courageous, decisive and good qualities. First-year high school students are strong in sensitivity and flexibility but poor in strength, quickly produce a sense of fatigue,

are lively and active, and are competitive. Therefore, in the design of teaching content, to achieve the objectives of this experiment to preset, with games and competitions to carry out a variety of teaching means, with a moderate amount of movement ball activities, and according to the situation of men and women and proficiency, set up learning group (teacher and apprentice grouping or male and female cooperation grouping), to achieve the purpose of the overall development of the student's physical fitness. Five randomly selected first-year high school students wore heart rate monitors and were monitored by assistants to ensure moderate exercise intensity. Quiet heart rate measurements were taken prior to the intervention, and subject heart rates were read according to time points and recorded throughout. Without avoiding the Hawthorne effect, this study adopted a single-masked experimental method, where the subjects in the experimental group were taught without knowledge of the experiment. In contrast, the control group was strictly controlled not to perform any physical activity related to basketball and the system.

Physical self-esteem scale

The physical Self-Esteem Scale, compiled by [Xu & Yao \(2001\)](#), is divided into five parts: motor skills, physical condition, physical attractiveness, physical fitness, and sense of self-worth. It has 30 questions, and the higher the score, the higher the level of physical self-esteem. In this study, Cronbach's alpha of the questionnaire was 0.9, Cronbach's alpha of the motor skills was 0.859, Cronbach's alpha of the Physical condition was 0.822, Cronbach's alpha of the physical attractiveness was 0.858, Cronbach's alpha of the physical quality was 0.848, Cronbach's alpha of the self worth was 0.850.

School adaptation questionnaire

The School Adaptation Questionnaire, compiled by [Cui \(2008\)](#), is divided into five parts: routine adaptation, learning adaptation, peer relationship, teacher-student relationship, and school attitude. It has 27 questions, and the higher the score, the higher the level of school adaptation. In this study, Cronbach's alpha of the questionnaire was 0.93, Cronbach's alpha of the School attitude was 0.851, Cronbach's alpha of the peer relationships was 0.870, Cronbach's alpha of the teacher-student relationship was 0.819, Cronbach's alpha of the academic adaptation was 0.871, Cronbach's alpha of the conventional adaptation was 0.871.

Statistical methods

Statistical analyses were conducted using the social statistical analysis software SPSS 26.0, including homogeneity tests, repeated measures ANOVA, and path analysis mediation role modeling. Furthermore, $P < 0.05$ was considered statistically significant.

RESULTS

Control and inspection of standard method deviations

The Harman univariate test method was used to test whether a standard method bias existed in all project data. The results revealed that there were 15 factors with eigenvalues greater than 1, the maximum factor variance interpretation rate was 19.82%(<40%), and

Table 1 Test of homogeneity between physical self-esteem and school adaptation.

Dimension	Control Group (N = 44)	Experimental Group (N = 44)	t	p
School attitude	23.45 ± 6.673	24.77 ± 3.796	-1.139	0.258
Peer relationships	24.55 ± 5.232	25.45 ± 3.682	-0.943	0.349
Teacher-student relationship	16.91 ± 4.584	17.73 ± 2.790	-1.011	0.315
Academic adaptation	16.14 ± 3.254	16.80 ± 2.882	-1.006	0.317
Conventional adaptation	14.95 ± 3.457	15.27 ± 2.564	-0.490	0.625
School adaptation total score	96.00 ± 17.337	100.02 ± 10.881	-1.304	0.196
Motor skills	12.45 ± 4.184	12.68 ± 4.821	-0.236	0.814
Physical condition	13.70 ± 4.787	13.75 ± 4.591	-0.045	0.964
Physical attractiveness	13.05 ± 4.253	12.57 ± 3.631	0.566	0.573
Physical quality	13.11 ± 3.919	13.89 ± 4.566	-0.852	0.397
Self worth	12.77 ± 3.595	12.80 ± 4.289	-0.027	0.979
Physical self-esteem Total score	65.09 ± 15.413	65.68 ± 18.125	-0.165	0.870

no factors with excessive explanatory power. Thus, no standard severe method deviation problem existed in the data used in this study.

Test of homogeneity between physical self-esteem and school adaptation

Homogeneity was tested using an independent samples *t*-test, which showed that the difference between physical self-esteem and school adjustment between the test and control groups was not statistically significant (Table 1).

The effects of an exercise intervention on physical self-esteem and school adjustment in first-year high school students

In order to explore the effects of different time and group factors on the school adjustment of first-year high school students, this study adopted a two-factor repeated-measures ANOVA to analyze the data before and after the experiment. The results of the study showed (Table 2) that there was a main effect of the time factor [$F_{(1,86)} = 47.809, p < 0.01, \eta_p^2 = 0.526$], a main effect of the group factor [$F_{(1,86)} = 11.409, p < 0.01, \eta_p^2 = 0.210$], and an interaction between the time factor and the group factor [$F_{(1,86)} = 98.210, p < 0.01, \eta_p^2 = 0.695$]. Simple effects analyses showed (Table 3) that at the pre-test, the difference between the total school adjustment scores of first-year high school students in the basketball group (100.02 ± 10.881 points) and the control group of seniors (96.00 ± 17.337 points) was not statistically significant, $p = 0.196$. At the post-test, the total school adjustment scores of the seniors in the basketball group were higher than that of the control group of seniors, and the difference was statistically significant, $p < 0.01$; in the control group, the difference between the total school adjustment scores of first-year high school students (94.80 ± 17.949) and the pre-test (96.00 ± 17.337) was not statistically significant, $p = 0.750$; in the basketball intervention group, the total school adjustment scores of first-year high school students (112.57 ± 15.001) were higher than that of the pre-test (100.02 ± 10.881), with a statistically significant difference. The difference between

Table 2 Repeated measures analysis of variance for the impact of basketball intervention on school adjustment in first-year high school students.

Dependent variable	Source of variation	F	p	η_p^2
School adaptation total score	Group	47.809	0.000	0.526
	Time	11.409	0.002	0.210
	Group × Time	98.210	0.000	0.695
School attitude	Group	18.664	0.000	0.303
	Time	9.635	0.003	0.183
	Group × Time	20.020	0.000	0.318
Peer relationships	Group	0.113	0.739	0.003
	Time	8.012	0.007	0.157
	Group × Time	13.650	0.001	0.241
Teacher-student relationship	Group	15.735	0.000	0.268
	Time	9.053	0.004	0.174
	Group × Time	16.148	0.000	0.273
Academic adaptation	Group	1.884	0.177	0.042
	Time	9.924	0.003	0.188
	Group × Time	13.125	0.001	0.234
Conventional adaptation	Group	9.155	0.004	0.176
	Time	4.756	0.035	0.100
	Group × Time	6.368	0.015	0.129

the scores was statistically significant, $p < 0.01$. The results showed that school adjustment of first-year high school students improved significantly after eight weeks of basketball lessons three times a week.

In order to explore the effects of different time and group factors on the physical self-esteem of first-year high school students, this study adopted a two-factor repeated measures ANOVA to analyze the data before and after the experiment. The results of the study showed (Table 4) that there was a main effect of the time factor [$F_{(1,86)} = 214.599$, $p < 0.01$, $\eta_p^2 = 0.833$], there was no main effect of the group factor [$F_{(1,86)} = 2.372$, $p = 0.131$, $\eta_p^2 = 0.052$], and there was an interaction between the time factor and the group factor [$F_{(1,86)} = 47.290$, $p < 0.01$, $\eta_p^2 = 0.524$], and a simple effects analysis showed (Table 5) that at the pre-test, there was no statistically significant difference between the total physical self-esteem scores of first-year high school students in the basketball group (65.68 ± 18.125) and the control group of seniors (65.09 ± 15.413) with a $p = 0.870$; and at the post-test, the total physical self-esteem scores of seniors in the basketball group were higher than the total physical self-esteem scores of first-year high school students in the control group and the difference was statistically significant, $p < 0.01$; in the control group there was no statistically significant difference between the total physical self-esteem scores of first-year high school students (70.00 ± 15.832) and the pre-test (65.09 ± 15.413), $p = 0.144$; in the basketball exercise intervention group, the total physical self-esteem scores of first-year high school students (80.48 ± 16.145) were higher than the The difference between the pre-test (65.68 ± 18.125 points) was statistically significant, $p < 0.01$. The results showed

Table 3 Pre and post-intervention values of school adaptation in first-year high school students for the experimental group and control group ($M \pm SD$).

Dependent Variable	Experimental Group (N=44)		Control Group (N=44)		Pre- <i>P</i>	Post- <i>P</i>
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention		
School adaptation total score	100.02 \pm 10.881	112.57 \pm 15.001	96.00 \pm 17.337	94.80 \pm 17.949	0.196	<0.01
School attitude	24.77 \pm 3.796	28.95 \pm 4.951	23.45 \pm 6.673	23.68 \pm 5.790	0.258	<0.01
Peer relationships	25.45 \pm 3.682	27.02 \pm 3.358	24.55 \pm 5.232	23.32 \pm 5.148	0.349	<0.01
Teacher-student relationship	17.73 \pm 2.790	20.86 \pm 3.508	16.91 \pm 4.584	17.23 \pm 4.812	0.315	<0.01
Academic adaptation	16.80 \pm 2.882	18.50 \pm 3.638	16.14 \pm 3.254	15.43 \pm 3.399	0.317	<0.01
Conventional adaptation	15.27 \pm 2.564	17.23 \pm 2.932	14.95 \pm 3.457	15.14 \pm 3.203	0.625	<0.01

that the physical self-esteem of first-year high school students improved significantly after eight weeks of basketball lessons three times a week.

Modeling the effects of a basketball intervention on school adjustment in first-year high school students

Regression analysis was carried out with the post-experimental measurements of school adaptation of senior students as the dependent variable and different groups as the independent variables, $F_{(1,86)} = 25.399$, $P < 0.01$, $R = 0.477$, $R^2 = 0.228$, $\Delta R^2 = 0.219$, which indicated that the regression equation was significant and that the basketball intervention had a highly significant effect on school adaptation of senior students.

Taking the scores of senior students' physical self-esteem post-experiment measurements as the dependent variable and different groups as the independent variable, regression analysis was conducted, $F_{(1,86)} = 9.446$, $P < 0.01$, $R = 0.315$, $R^2 = 0.099$, $\Delta R^2 = 0.088$, indicating that the regression equation is significant. The basketball intervention has a very significant effect on the physical self-esteem of senior students.

The regression analysis was carried out with the scores measured after the experiment on school adaptation of senior students as the dependent variable and with the scores measured after the experiment on physical self-esteem of different groups as the independent variable, and the regression analyses were carried out, and the results of $F_{(2,85)} = 4.153$, $P < 0.05$, $R = 0.514$, $R^2 = 0.264$, $\Delta R^2 = 0.247$ indicated that the regression equation was significant, and that the effect of basketball sports intervention on the physical self-esteem and school adaptation of senior students was very significant.

In summary, the mediating effect of body esteem was significant (Table 6). The mediating effect model is shown in Fig. 1. It shows that basketball sports intervention has a direct effect on senior students' school adjustment; on the other hand, basketball sports intervention has an indirect effect on senior students' school adjustment through body self-esteem. The mediating effect of body esteem as a percentage of the total effect was $0.315 \times 0.200/(0.477 \times 100\%) = 13.21\%$.

Table 4 Repeated measures analysis of variance for the impact of basketball intervention on physical self-esteem in first-year high school students.

Dependent variable	Source of variation	F	p	η^2_p
Physical self-esteem total score	Group	214.599	0.000	0.833
	Time	2.372	0.131	0.052
	Group \times Time	47.290	0.000	0.524
Motor skills	Group	42.865	0.000	0.499
	Time	2.249	0.141	0.050
	Group \times Time	11.219	0.002	0.207
Physical condition	Group	23.354	0.000	0.352
	Time	1.646	0.206	0.037
	Group \times Time	10.868	0.002	0.202
Physical attractiveness	Group	19.728	0.000	0.315
	Time	1.089	0.303	0.025
	Group \times Time	9.954	0.003	0.188
Physical quality	Group	46.407	0.000	0.519
	Time	2.528	0.119	0.056
	Group \times Time	1.151	0.289	0.026
Self worth	Group	47.543	0.000	0.525
	Time	1.539	0.222	0.035
	Group \times Time	9.496	0.004	0.181

Table 5 Pre- and post-intervention values of physical self-esteem in first-year high school students for the experimental group and control group ($M \pm SD$).

Dependent Variable	Experimental Group (N=44)		Control Group (N=44)		Pre-P	Post-P
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention		
Physical self-esteem total score	65.68 \pm 18.125	80.48 \pm 16.145	65.09 \pm 15.413	70.00 \pm 15.832	0.870	<0.01
Motor skills	12.68 \pm 4.821	15.93 \pm 4.283	12.45 \pm 4.184	13.34 \pm 4.126	0.814	<0.05
Physical condition	13.75 \pm 4.591	16.70 \pm 4.354	13.70 \pm 4.787	14.34 \pm 4.092	0.964	<0.05
Physical attractiveness	12.57 \pm 3.631	15.30 \pm 3.400	13.05 \pm 4.253	13.39 \pm 3.823	0.573	<0.05
Physical quality	13.89 \pm 4.566	14.98 \pm 3.593	13.11 \pm 3.919	16.59 \pm 3.775	0.397	<0.05
Self worth	12.80 \pm 4.289	15.95 \pm 3.754	12.77 \pm 3.595	13.95 \pm 3.935	0.979	<0.05

Table 6 Mediation analysis.

Step	Standardized regression equation	Regression coefficient test
Step 1	$Y = 0.477x$	SE = 3.527, $t = 5.040^{**}$
Step 2	$Y = 0.315x$	SE = 3.409, $t = 3.073^{**}$
Step 3	$Y = 0.415x + 0.200z$	SE = 3.649, $t = 4.230^{**}$ SE = 0.110, $t = 2.038^*$

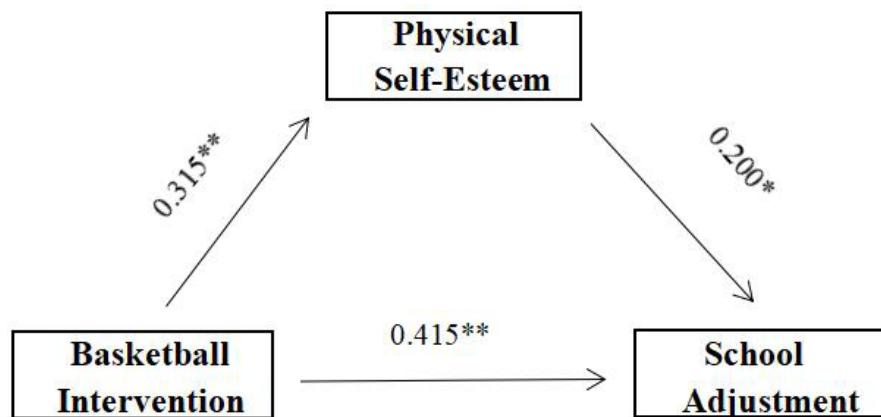


Figure 1 Diagram of the mediation model.

Full-size DOI: [10.7717/peerj.17941/fig-1](https://doi.org/10.7717/peerj.17941/fig-1)

DISCUSSION

The effects of a basketball intervention on upper-level students's school adjustment

The results of this study showed that after eight weeks of basketball exercise, the overall school adjustment of first-year high school students in the basketball exercise intervention group improved significantly. Likewise, the dimensions of school adjustment changed in a positive direction. Regarding school attitudes (Tables 2 and 3), first-year high school students continued to familiarise themselves with the school and adapt to the school environment during practice, thus increasing their sense of belonging and reliance on the school. Regarding peer relationships (Tables 2 and 3), basketball can increase communication between classmates and promote emotional warming. Good peer relationships can create positive emotional attitudes toward school among first-year high school students. At the same time, basketball can cultivate a sense of cooperation and teamwork among first-year high school students and promote positive emotional relationships among peers. In terms of teacher-student relationships (Tables 2 and 3), after eight weeks of living together, students and teachers have established deep friendships with each other, which promotes good teacher-student relationships, and first-year high school students can actively participate in class and school activities, which further promotes students' classroom performance in class, and enables them to learn basketball skills more quickly. Regarding academic adjustment (Tables 2 and 3), good interpersonal relationships, especially teacher-student relationships, can promote students' academic growth and active learning. In routine adaptation (Tables 2 and 3), first-year high school students could adapt quickly to returning to school after the epidemic and were fully engaged in their academic life. The study found that basketball is a collective sport, which can strengthen the cooperation and communication between students and require synergistic cooperation between individuals, and the passing and receiving, cover cooperation, and blocking techniques in basketball requires tacit cooperation between individuals and the ability to think differently from each other, which can strengthen the interaction and communication

between students and teachers, and can enhance the degree of intimacy between students and teachers. The study also found that good inter-school interpersonal relationships can promote school adaptation, including teacher-student relationships, school attitudes, and other aspects so that students deepen their emotions towards the school, which is conducive to better school adaptation (Chen *et al.*, 2019; Harris, Altekruze & Engels, 2003; Kliziene *et al.*, 2018; Ren *et al.*, 2017; Xiong, Liu & Zhang, 2020). Compared with other studies, the results of this study are consistent with the performance of basketball team events in peer relationship, teacher-student relationship and school attitude dimensions, and the performance of this study is more obvious, the effects on academic adaptation and routine adaptation are less pronounced. Overall, performing basketball practice significantly affects students' school adjustment. Thus, hypothesis H1 is verified. And there is no main effect of time for the two dimensions of peer relationship and school adjustment, which indicates that peer relationship and school adjustment do not change much over time, and the scores of the pos *t*-test are lower than those of the pre-test (Tables 2 and 3), which may be due to the following reasons: firstly, the current intervention was opened after the improvement of the epidemic, and the students met each other more on the computer, with very little communication, coupled with the limited time of the intervention, which led to the existence of some; Secondly, as students who just entered high school from junior high school, their personalities changed compared to junior high school, and they paid more attention to themselves, with little communication among peers, and under the influence of the epidemic, communication among classmates was even more rare; then, under the influence of the epidemic, the time and place of students' classes were highly irregular, and they faced computers in class at any time, which led to unstable classes and affected their academic performance; finally, the regular physical education classes were slightly unstable. Finally, regular physical education classes could be more exciting. During the pandemic, students are asked to keep their distance and lack communication, which is different from the cooperative communication of basketball in the experimental group, in which many exercises require cooperation between two or more people, which is conducive to communication between each other.

The effects of a basketball intervention on upper school students' physical self-esteem

The results of this study show that after eight weeks of basketball, the overall condition of physical self-esteem of first-year high school students in the basketball intervention group was significantly improved, which verified our initial research hypothesis and was also supported by related studies that physical education and sports have the effect of promoting the physical and mental health of senior students, and that some of the indicators of physical and mental health have a close correlation with the occurrence of physical self-esteem (Bai, 2022), and that similarly, physical self-esteem dimensions also changed in a positive direction, specifically in the four dimensions of motor skills, physical condition, physical attractiveness, and sense of self-worth, with a slight improvement in the physical fitness dimension, and a non-significant main effect of the group factor, suggesting that the differences between the different intervention groups were not significant. Regarding

motor skills (Tables 4 and 5), the ratings of the ability to learn new skills and the level of self-confidence were included. In basketball learning, there are strict requirements for first-year high school students' strength, coordination, speed, *etc.*; they need to maintain good body posture and control their core in the practice process. After eight weeks of basketball learning, first-year high school students' ability and skills in all sports were improved, and they could use their basketball skills, which stimulated the students' interest in sports and helped them to improve their self-confidence. In terms of physical fitness (Tables 4 and 5), first-year high school students improved their muscular, respiratory, and physical fitness levels through the coordinated development of their upper and lower limbs to complete basketball exercises. In terms of physical attractiveness (Tables 4 and 5), first-year high school students can discover their changes through this process of change, which can cultivate the beauty of healthy, positive, and optimistic physical form of senior students, thus promoting the improvement of self-confidence. In terms of physical self-worth (Tables 4 and 5), through continuous practice, first-year students continue to gain physical and psychological satisfaction, which promotes their appreciation of their bodies and enhances their confidence in their appearance, making them appreciate themselves more in life. Therefore, after eight weeks of basketball practice, physical self-worth has a positive impact. In terms of physical fitness (Tables 4 and 5), the duration of the training cycle needed to be longer, which led to less pronounced improvement and slower progress for the students. Compared with other studies, the results of this study are consistent with the performance of basketball team events in terms of motor skills, physical status, physical attractiveness and self-worth; however, there was only a small improvement in the fitness dimension, perhaps because of the short duration compared with other studies. Overall, conducting basketball practice has a significant effect on students' physical self-esteem. Thus, hypothesis H2 is verified. Practicing in basketball class makes students focus on their self-perception and identification of their sense of self-worth, especially students' improvement in motor skills, physical condition, physical attractiveness, and sense of self-worth is more prominent. The analysis of the experimental data (Tables 4 and 5) showed that the students' self-confidence in the experimental group increased significantly, and their interest in learning basketball increased. The recognition of basketball is high. This shows that basketball teaching has a positive effect on physical self-esteem and, even more so, on psychological benefits. At the same time, teachers were instructed to carry out targeted educational activities to dig deeper into the potential of students' basketball in the teaching process, personalize the teaching, and improve students' lifelong sports awareness.

Physical self-esteem mediates the relationship between basketball intervention and school adjustment in upper school students

Through the analysis of the established structural equation model, it was learned that body self-esteem played a partially mediating role and had a significant effect on basketball sports intervention and school adaptation, indicating that basketball sports intervention could be achieved through the indirect effect of body self-esteem in addition to its direct effect on school adaptation. Research has shown that physical activity reduces obesity and enhances self-esteem and school adjustment (Young & Young, 2014). Scholars have

found that participation in physical activity can indirectly improve adolescents' school adjustment by improving their self-perception (*De Moor et al., 2006*). Studies have also found that physical self-esteem is predictive of school adjustment in high school students (*Angelo Junior et al., 2021; Sung-Hoon & Jong-Hoon, 2017*) and that students who exercise regularly produce higher levels of self-esteem and achievement have a positive impact on school adjustment (*Kim, Jang & Cho, 2020*). *Fitzgerald, Fitzgerald & Aherne (2012)* found that increasing self-esteem through physical activity improves adjustment in adolescent girls. The present study found that increasing students' physical self-esteem may improve school adjustment. In physical education classes, especially basketball, which is a physically confrontational sport, extra attention is paid to physical training and motor skills, and the process of their rising athletic level is bound to be accompanied by an increase in the level of self-esteem of the body, leading to a reasonable school adjustment of the students. Therefore, if we want to improve the school adjustment of first-year high school students, it is essential to improve the body's self-esteem.

Shortcomings of this study and prospects

Due to the impact of the epidemic, the original 12-week experiment was shortened to 8 weeks, which is a relatively short span; in the future, consideration should be given to resuming the 12-week or increasing the intervention time to 16 weeks and adding intermediate measurements in the course of the experiment; the mediator was only considered to be an indicator of self-esteem, but in the future, more indicators can be added to carry out the research; a cross-lagged model can be set up with the three variables of physical exercise, self-esteem, and school adjustment to conduct follow-up studies on the subjects.

CONCLUSION

(1) A moderate-intensity basketball intervention can improve school adjustment for first-year high school students; (2) a moderate-intensity basketball intervention can improve physical self-esteem for first-year high school students; (3) a moderate-intensity basketball intervention can indirectly improve school adjustment for first-year high school students by increasing the level of physical self-esteem.

ADDITIONAL INFORMATION AND DECLARATIONS

Funding

This research was funded by the 2022 Ministry of Education Humanities and Social Research Project (Grant number: 22YJE890001). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Grant Disclosures

The following grant information was disclosed by the authors:

2022 Ministry of Education Humanities and Social Research Project: 22YJE890001.

Competing Interests

The authors declare there are no competing interests.

Author Contributions

- Wenting Wei conceived and designed the experiments, performed the experiments, authored or reviewed drafts of the article, and approved the final draft.
- Ruirui Duan conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, and approved the final draft.
- Fulei Han conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.
- Qiulin Wang analyzed the data, authored or reviewed drafts of the article, and approved the final draft.

Human Ethics

The following information was supplied relating to ethical approvals (*i.e.*, approving body and any reference numbers):

The ethics committee of the medical school of Yangzhou University approved the study (YXYLL-2023-153).

Data Availability

The following information was supplied regarding data availability:

Raw data is available in the [Supplemental Files](#).

Supplemental Information

Supplemental information for this article can be found online at <http://dx.doi.org/10.7717/peerj.17941#supplemental-information>.

REFERENCES

Angelo Junior DSDM, Gil JFL, Caporal GC, Mello JB. 2021. Benefits, risks, and possibilities of strength training in school Physical Education: a brief review. *Sport Sciences for Health* **18**(1):11–20 DOI [10.1007/s11332-021-00847-3](https://doi.org/10.1007/s11332-021-00847-3).

Bai M. 2022. The relationship between physical activity and school adjustment in junior high school students: the chain mediating role of mental toughness and motivation to learn physical education. *Frontiers in Psychology* **13**:977663 DOI [10.3389/fpsyg.2022.977663](https://doi.org/10.3389/fpsyg.2022.977663).

Cao M, Zhang G, Sun Z, Zhang H. 2018. Mediating effects of elementary school students' self-perceptions between physical activity and school adjustment. *Chinese Journal of School Health* **39**:122–123+129 DOI [10.16835/j.cnki.1000-9817.2018.01.039](https://doi.org/10.16835/j.cnki.1000-9817.2018.01.039).

Chen Y, Li Y, Xiao S, Deng Q, Gao Y, Gao F. 2019. The relationship between junior high school students interpersonal relationship and their school adjustment: evidence from multiple mediator models. *Chinese Journal of Special Education* 83–89.

Chen Z, Ji L. 2006. The effect of physical exercise on subjective well-being of senior high school students and their psychological mechanism. *Acta Psychologica Sinica* **38(04)**:562–575.

Conradsson M, Littbrand HK, Lindelof FN, Gustafson Y, Rosendahl E. 2010. Effects of a high-intensity functional exercise program on depressive symptoms and psychological well-being among older people living in residential care facilities: a cluster-randomized controlled trial. *Aging & Mental Health* **14**:565–576 DOI [10.1080/13607860903483078](https://doi.org/10.1080/13607860903483078).

Cui N. 2008. A study on the relationship of school adaptation and self-conception among junior school students. Master's thesis, Southwest University, Chongqing, China.

De Moor MHM, Beem AL, Stubbe JH, Boomsma DI, De Geus EJC. 2006. Regular exercise, anxiety, depression, and personality: a population-based study. *Preventive Medicine* **42(4)**:273–279 DOI [10.1016/j.ypmed.2005.12.002](https://doi.org/10.1016/j.ypmed.2005.12.002).

Dong Z. 2017. An experimental study of the effects of basketball and synchronized rope skipping exercise on college students' physical self-esteem and subjective well-being. Master's thesis, Yangzhou University, Yangzhou, China.

Fitzgerald A, Fitzgerald N, Aherne C. 2012. Do peers matter? A review of peer and friends' influence on physical activity among American adolescents. *Journal of Adolescence* **35**:941–958 DOI [10.1016/j.adolescence.2012.01.002](https://doi.org/10.1016/j.adolescence.2012.01.002).

Harris HL, Altekroose MK, Engels DW. 2003. Helping freshman student athletes adjust to college life using psychoeducational groups. *Journal for Specialists in Group Work* **28**:64–81 DOI [10.1177/019339202250079](https://doi.org/10.1177/019339202250079).

Ji L. 2020. Improving students' physical and mental health: the fundament and direction of the development of school physical education in China: Study and implementation of President Xi's important speech at the national education conference. *Journal of Jishou University (Social Sciences)* **41**:28–37 DOI [10.13438/j.cnki.jdxb.2020.01.004](https://doi.org/10.13438/j.cnki.jdxb.2020.01.004).

Jiang Q. 2015. The relationship between shyness, self-identity, and school adjustment among senior high school students. Master's thesis, Shandong Normal University, Shandong, China.

Jung S-B, Kim J-T, Kim E-S. 2016. Structural relationship model among physical competence, self-esteem, sense of community and school adjustment of adolescent. *Journal of the Korean Society for Wellness* **11**:327–343.

Sung-Hoon K, Jong-Hoon S. 2017. An analysis of a causal relationship among basketball players' self encouragement discouragement, self management, self esteem and intention of exercises adherence. *Journal of the Korea Entertainment Industry Association* **11**:123–139 DOI [10.21184/jkeia.2017.01.11.1.123](https://doi.org/10.21184/jkeia.2017.01.11.1.123).

Kim Y-J, Jang J-H, Cho J-H. 2020. High physical self-concept benefits on school adjustment of korean student-athletes. *International Journal of Environmental Research and Public Health* **17**:2653 DOI [10.3390/ijerph17082653](https://doi.org/10.3390/ijerph17082653).

Kliziene I, Klizas S, Cizauskas G, Sipaviciene S. 2018. Effects of a 7-month exercise intervention programme on the psychosocial adjustment and decrease of anxiety among adolescents. *European Journal of Contemporary Education* **7**:127–136.

Liu Y. 2017. Research on the influences of cooperative learning on the social adaptability of middle students in basketball teaching—with the example of Xiaodong District Middle School in Xinglong County. Master's thesis, Hebei Normal University, Hebei, China.

Lou Y. 2017. Research on the correlation of college students' physical fitness and physical self-esteem in the three colleges and universities in Shanghai as an example. Master's thesis, Nanjing Sports Institute, Nanjing, China.

Peng Y, Chen H. 2007. Effects of sports activity on school adaptation of college freshman. *Bulletin of Sport Science & Technology* 45–46.

Ren P, Guo Y, Qin X, Zhang Y, Zhang R. 2017. Classroom ecology and its effects on students' school adaptation. *Journal of Beijing Normal University (Social Sciences)* 31–39.

Shi G. 2018. On Learning and Implementing President Xi's important exposition on education: focus on the first nations education conference in the new era. *Journal of Chinese Youth Social Science* 37:8–16 DOI [10.16034/j.cnki.10-1318/c.2018.06.022](https://doi.org/10.16034/j.cnki.10-1318/c.2018.06.022).

Song T. 2017. The relationship among self-control in learning, school adjustment and learning burnout in senior high school students. Master's thesis, Minnan Normal University, Zhangzhou, China.

Xiong H, Liu K, Zhang J. 2020. The effect of teacher-student relationship on left-behind children's school adjustment: the chain mediating role of mental health and school engagement. *Psychology: Techniques and Applications* 8:1–8 DOI [10.16842/j.cnki.issn2095-5588.2020.01.001](https://doi.org/10.16842/j.cnki.issn2095-5588.2020.01.001).

Xu X, Yao J. 2001. Revision and test of physical self-perception profile for college students. *China Sport Science* 7:8–81.

Yan J, Li Q, Zhang Z, Wang B, Zhu F. 2019. The influence of extracurricular physical exercise on the physical self-esteem and self-confidence of elementary students. *Sports & Science* 40:100–104 DOI [10.13598/j.issn1004-4590.2019.02.012](https://doi.org/10.13598/j.issn1004-4590.2019.02.012).

Yang J, Ji L, Yang W, Jin J. 2014. Research based on the effect of trans-theoretical model intervention of physical exercise on pupil's self-efficacy, self-esteem and weight. *Journal of Tianjin University of Sport* 29:185–189 DOI [10.13297/j.cnki.issn1005-0000.2014.03.007](https://doi.org/10.13297/j.cnki.issn1005-0000.2014.03.007).

Yang Z. 2018. Research on support system of life education—Shanghai demonstration high schools as the case doctor. Master's thesis, East China Normal University, Shanghai, China.

Young SH, Young LD. 2014. A correlational study of obesity stress, self-esteem and adaptation to school life regarding to the obesity index of upper elementary school students. *Journal of the Korean Society of School Health* 27(2):80–89 DOI [10.15434/kssh.2014.27.2.80](https://doi.org/10.15434/kssh.2014.27.2.80).

Zhu S, Tang H. 2021. A study on the behavior characteristics of high school students participating in campus basketball activities. *Bulletin of Sport Science & Technology* 29:137–140+150 DOI [10.19379/j.cnki.issn.1005-0256.2021.07.049](https://doi.org/10.19379/j.cnki.issn.1005-0256.2021.07.049).