YANG, Yi, DU, Rui and LUO, Jiong. The Impact of Physical Activity on Adolescents' Social adaptation: The Mediating Role of Self-Esteem. Pedagogy and Psychology of Sport. 2025;27:66974. elSSN 2450-6605.
https://doi.org/10.12775/PPS.2025.27.66974
https://apcz.umk.pl/PPS/article/view/66974

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 25.10.2025. Revised: 29.11.2025. Accepted: 29.11.2025. Published: 30.11.2025.

The Impact of Physical Activity on Adolescents' Social adaptation: The Mediating Role of Self-Esteem

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Abstract

Objective: This study aimed to examine the impact of physical activity on adolescents' social adaptation and the potential mediating role of self-esteem, to inform strategies for promoting healthy adolescent development. **Methods:** A cross-sectional survey was conducted with 897 adolescents using the Physical Activity Level Scale, the Social Adaptation Scale, and the Self-Esteem Scale. Results: 1) Both physical activity and self-esteem were significantly and positively correlated with social adaptation ($p < 0.01$). A significant positive correlation was also found between physical activity and self-esteem ($p < 0.01$). 2) Physical activity was a significant positive predictor of social adaptation levels ($\beta = 0.267$, $p < 0.001$). 3) Self-esteem partially mediated the relationship between physical activity and social adaptation. The mediation effect was 0.117, accounting for 43.82% of the total effect. **Conclusion:** Physical activity not only directly enhances adolescents' social adaptation but also exerts an indirect influence through the pathway of self-esteem. Therefore, incorporating more physical activity into school-based mental health programs and daily routines can serve to elevate adolescents' self-esteem and, in turn, strengthen their social adaptation capabilities.

Keywords: Physical activity; Social adaptation; Self-esteem; Mediating effect; Mental health

Introduction

With the rapid advancement of technology and the increasing prominence of cultural diversity, the social adaptability of adolescents has become a significant societal concern. As a critical factor bridging academic achievement and career development, social adaptability profoundly influences youth development. Social adaptation refers to the process wherein individuals proactively adjust their behaviour and attitudes according to their social environment to achieve a harmonious relationship with it [1]. Consequently, both school education and family upbringing should encourage adolescents to participate in diverse physical and recreational activities to enhance their physical and mental fortitude [2]. Furthermore, young people must develop essential life skills to understand and adapt to society actively. As the future reserve force of society, adolescents must effectively integrate into social life and meet its demands. Engaging in physical activity can help alleviate anxiety and stress while improving self-control and fostering social support.

Physical activity comprises structured exercises that improve physical fitness, health, and mental well-being. Typically pursued during leisure time for health purposes, it is characterized by specific intensity, frequency, and duration [3]. Its low-cost nature, strong adaptability, high safety, and beneficial effects on the physical and mental health of adolescents are widely acknowledged [4]. Grounded in embodied cognition theory, an individual's physical condition directly influences cognitive processes; physical training and interactions with the external environment also exert direct effects on cognition [5]. Consequently, individuals can optimize bodily functions through exercise and actively engage with their environment, thereby fostering positive cognitive outcomes. Social adaptation refers to an individual's level of adjustment to their social environment. It is a process of achieving dynamic equilibrium and harmonious coexistence through self-regulation, adaptation to environmental demands, or proactive environmental modification [6]. This concept reflects an individual's psychological adjustment capacity and the coordination of their social relationships, illustrating the state of subject-object interaction [7]. It also encompasses the ability to adjust behaviors for interpersonal adaptation, including social skills, coping strategies, and communication skills [1].Individuals with high levels of physical activity may possess superior social adaptation capabilities. Research demonstrates that exercise interventions effectively enhance these capabilities [8]. Regular physical activity improves physical fitness, builds character, and allows adolescents to cultivate interpersonal communication, coping, and problem-solving skills [1]. Consequently, it contributes to overall improvements in social interaction, coping strategies, and interpersonal relationships, while also reducing externalizing problem behaviors. Grounded in theories of social adaptation and comprehensive adaptive development, which posit that social adaptability evolves through continuous learning and life experiences [9], moderate physical activity is recognized as a key enhancer of adolescent social adaptability. Outdoor recreational sports, in particular, are effective, and maintaining activity of appropriate duration and intensity is crucial

for this benefit [10]. Therefore, Hypothesis 1 is proposed: Physical activity is positively correlated with adolescents' social adaptation.

Self-esteem, a core element in personality psychology, constitutes the affective evaluation individuals form based on their physiological traits, personality, and value systems [11]. This psychological construct significantly influences an individual's mental health and plays a vital role in shaping their personality and psychological characteristics. Extensive research demonstrates that physical activity positively affects self-esteem in adolescents [12, 13]. For instance, a 14-week folk sports intervention was found to significantly enhance elementary students' self-awareness and global self-esteem, thereby promoting healthy personality development. This intervention also revealed significant gender differences in certain indicators, further corroborating its positive impact on psychological development [13]. Moreover, the level of physical activity is positively correlated with self-esteem, indicating that increased participation improves self-esteem levels [14]. Self-esteem is also closely linked to social adaptation. Studies show that self-esteem is strongly associated with adolescents' social adaptation abilities, where higher self-esteem helps them better cope with challenges across various domains [15]. Furthermore, external support from family, peers, and school is crucial for enhancing both self-esteem and adaptive capacities [16]. Therefore, Hypothesis 2 is proposed: Self-esteem mediates the relationship between physical activity and social adaptation.

Current research on the relationship between physical activity and social adaptation remains limited, particularly concerning adolescents. This study employs structural equation modeling to analyze the mechanism by which physical activity influences social adaptation in this demographic. It specifically investigates the mediating role of self-esteem in this relationship. The research aims to elucidate the multifaceted role of physical activity in health promotion, thereby providing a theoretical foundation for developing scientific physical activity interventions to enhance adolescents' physical and mental well-being.

1. Methods

1. 1. Study Subjects

This study utilized a cross-sectional survey design and was conducted among junior high school students from selected middle schools in Chongqing. A total of 1,000 questionnaires were distributed, yielding 947 valid responses. The valid response rate was 94.7%. The participants had a mean age of 13.79 ± 1.53 years. The sample comprised 453 (47.8%) male and 497 (52.5%) female students. Regarding grade distribution, 324 students (34.2%) were in Grade 7, 385 (40.6%) in Grade 8, and 241 (25.4%) in Grade 9.

1.2. Research Tools

1.1.1. Physical Activity Scale

This study utilized the Physical Activity Level Scale developed by Liang Deqing [17]. The scale evaluates physical activity levels across three dimensions: intensity, frequency, and duration. A 5-point Likert scale was used for scoring. Intensity and frequency were rated from 1 (lowest) to 5 (highest), while duration was scored from 0 to 4 across five levels. The total

exercise volume was calculated using the formula “Exercise Intensity × Exercise Duration × Exercise Frequency,” producing a score ranging from 0 to 100, with higher scores indicating a greater volume of exercise. Based on this score, exercise volume was categorized as low (≤19 points), moderate (20–42 points), or high (≥43 points). In this study, the scale demonstrated good internal consistency, with a Cronbach's alpha of 0.84.

1.1.2. Social Adaptation Scale

This study utilized the Adolescent Social Adaptation Scale, revised by Guo Cheng's team [18]. The scale contains 32 items across four dimensions: interpersonal harmony, academic autonomy, environmental identification, and life independence. Responses were recorded on a five-point Likert scale, ranging from 1 ("completely disagree") to 5 ("completely agree"). A composite total score, calculated by weighting the dimension scores, was used as the measure. This total score is positively correlated with social adaptation levels, meaning that higher scores indicate stronger adaptation abilities. In this study, the scale demonstrated high internal consistency, with a Cronbach's alpha of 0.93.

1.1.3. Self-Esteem Scale

This study employed the Chinese version of Rosenberg's (1965) Self-Esteem Scale, which was introduced and localized by Wang Ping and Gao Hua (1998) to create a standardized instrument suitable for the Chinese context [19]. The scale consists of 10 items rated on a 4-point Likert scale ranging from 1 ("strongly disagree") to 4 ("strongly agree"). It primarily assesses adolescents' sense of self-worth and self-acceptance. In the present sample, the scale demonstrated good reliability, with a Cronbach's alpha coefficient of 0.86.

1. 2. Statistical Analysis

Data analysis in this study employed descriptive analysis using SPSS 23.0 software. To validate the mediating effect, the PROCESS v4.1 plugin developed by Hayes A F was implemented [20], specifically utilizing the Bootstrap nonparametric test for effect estimation: the confidence interval for the effect value was calculated through 5000 repeated samples, with a 95% confidence interval selected as the statistical inference criterion. The significance threshold for all indicators was set at $P < 0.05$.

2. Results

2. 1. Common Method Bias Test

Common method bias was examined using Harman's single-factor test [21]. An unrotated factor analysis including all measurement items revealed eight factors with eigenvalues greater than 1. The first factor accounted for 30.62% of the variance, which is below the 40% critical threshold. Therefore, it can be concluded that common method bias is not a significant concern in this study.

2.2. Testing Differences in Adolescent Demographic Variables

This study assessed demographic variables (gender, grade level) and scores for physical activity, self-esteem, and social adaptation using one-way ANOVA and independent samples t-tests. As presented in Table 1, physical activity scores differed significantly between genders ($P < 0.001$), with male adolescents scoring higher on average than their female counterparts. No significant gender differences were found for self-esteem or social adaptation. Furthermore, significant differences emerged across grade levels for physical activity ($F=54.57$, $P<0.001$), self-esteem ($F=27.78$, $P<0.001$), and social adaptation ($F=204.29$, $P<0.001$).

Table 1. Differences in Scores for Physical Activity, Self-Esteem, and Social Adaptation Among Adolescents by Demographic Variables (M±SD)

Project	Total sample size (n=947)		Physical activity	Self-esteem	Social Adaptation
Gender	Male	453	25.75±25.87	26.03±3.45	114.31±20.98
	Female	497	15.32±16.79	25.89±3.00	113.18±19.14
	t		12.99***	1.09	1.50
Grade	Eighth Grade	324	30.29±27.22	26.75±4.91	113.73±20.08
	Eighth Grade	385	19.82±20.62	26.07±2.42	111.98±15.88
	Ninth Grade	241	17.89±21.00	25.44±3.23	130.24±25.47
	F		54.57***	27.78***	204.29***
	LSD		1>2, 1>3, 2>3	1<2, 1<3, 2<3	1>2, 1<3, 2<3

Note: *P < 0.05, **P < 0.01, ***P < 0.001; t: value from independent samples t-test; F: value from one-way ANOVA.

2.3. Correlation Analysis of Physical Activity, Self-Esteem, and Social Adaptation

The results of the correlation analysis are presented in Table 2. Both physical activity and self-esteem were significantly positively correlated with social adaptation ($p < 0.001$). A significant positive correlation was also observed between physical activity and self-esteem ($p < 0.001$). These significant intercorrelations support the subsequent testing of a mediation model.

Table 2. Correlation Coefficients for Physical Activity, Self-Esteem, and Social Adaptation

Variable	M±SD	Physical Activity	Self-Esteem	Social Adaptation
Physical Activity	67.56±15.41	1		
Self-Esteem	67.56±15.49	0.77***	1	
Social Adaptation	91.42±14.64	0.177***	0.186***	1

Note: * indicates P < 0.05, ** indicates P < 0.01, *** indicates P < 0.001

2. 4. The Impact of Physical Activity on Social Adaptation: An Analysis of the Mediating Effect of Self-Esteem

Based on a review of the literature, this study constructed a theoretical model in which self-esteem mediates the relationship between physical activity and social adaptation. To test this model, a mediation analysis was performed using Model 4 of the Hayes PROCESS macro. This analysis aimed to examine the proposed mediating role of self-esteem in the effect of physical activity on social adaptation.

Research findings indicate that physical activity significantly promotes social adaptation in adolescents (β = 0.148, *p* < .001). A path model incorporating self-esteem as a mediator further revealed that physical activity influences social adaptation both directly (β = 0.012, *p* < .001) and indirectly by enhancing self-esteem (β = 0.011, *p* < .001), which in turn strengthens social adaptation (β = 1.074, *p* < .001). This establishes a complete mediating pathway: "physical activity → self-esteem → social adaptation." Decomposition of the total effect (0.160) showed that the direct effect accounted for 91.87% (0.148), while the mediating effect of self-esteem accounted for 8.13% (0.012). Bootstrap testing (95% CI) confirmed the statistical significance of the total (CI: 0.016–0.128), direct (CI: 0.015–0.116), and mediating (CI: 0.004–0.005) effects, as all confidence intervals excluded zero. These results confirm that physical activity directly influences social adaptation and also operates through the mediating mechanism of self-esteem, supporting the theoretical hypothesis of a partial mediation model. Consequently, both Hypothesis 1 (physical activity positively influences social adaptation) and Hypothesis 2 (self-esteem partially mediates this relationship) are empirically supported (see Tables 3 and 4, and Figure 1).

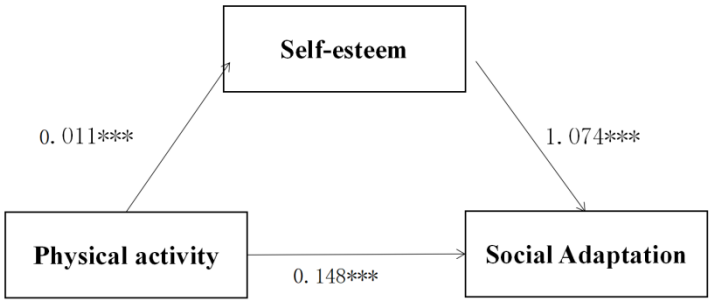

Figure 1: Mediated Effect Model

Table 3. Pathways and Effect Analysis of Physical Activity on Social Adaptation

Steps	Variable	Variable	R	R_sq	F	β	t
1	Physical Activity	Social Adaptation	0.178	0.032	95.22***	0.148	223.35***
2	Physical Activity	Self-esteem	0.076	0.006	17.25***	0.011	28.45***
3	Physical Activity→Self-esteem	Social Adaptation	0.247	0.061	95.45***	0.012	9.14***
						1.074	9.63***

Note: * indicates P < 0.05, ** indicates P < 0.01, *** indicates P < 0.001

Table 4. Decomposition of Total Effect, Direct Effect, and Mediating Effect

Effect relationship	Effect value	BootSE	LLCI	ULCI	Effect Proportion
Overall effect	0.160	0.016	0.128	0.192	
Direct effect	0.148	0.015	0.116	0.179	91.87%
The Mediating Effect of Self-Esteem	0.012	0.004	0.005	0.021	8.13%

3. Discussion

3. 1. Analysis of Differences in Physical Activity, Self-Esteem, and Social Adaptation Among Adolescents of Different Genders and Grade Levels

This study identified significant gender differences solely in physical activity levels, with male adolescents demonstrating higher activity than their female counterparts, a finding consistent with prior research [22]. Consequently, greater attention is warranted concerning the

physical health of female adolescents, with initiatives aimed at increasing their exercise frequency. Across grade levels, significant differences emerged in physical activity, self-esteem, and social adaptation. Physical activity participation declined progressively with higher grades, a trend that may stem from escalating academic pressures, such as the high school entrance exam. Therefore, it is imperative for the "home-school-community" triad to embrace the concept that exercise promotes health. Through physical activity, adolescents can acquire fitness-related knowledge and skills, enhance their physical literacy, cultivate healthy lifestyles, and improve their emotional and social adaptation abilities [23]. Regular physical exercise does not impair academic performance; on the contrary, it positively influences academic motivation, self-efficacy, cognitive function, and health-related fitness [24]. Self-esteem also showed a tendency to decrease with advancing grade levels, highlighting a need for increased focus on the mental health of senior students. Finally, social adaptation improved with age, likely due to the expansion of social experience and knowledge.

3.2. The Direct Impact of Physical Activity on Adolescents' Social Adaptation

This study identified a positive correlation between physical activity and social adaptation, with physical activity exerting a direct and positive influence on social adaptation levels—a finding consistent with previous research [1, 8, 25]. Adolescence is a critical period for brain development, which plays a crucial role in future cognitive and social development. Increasing physical activity to improve adolescents' mental health is therefore an effective strategy for enhancing their social adaptation [25]. The results demonstrate that physical activity significantly promotes psychological adaptation [10]. From the perspective of positive adaptation, its most pronounced effect is on enhancing task efficiency, followed by strengthening positive coping strategies, self-affirmation, and prosocial tendencies. Regarding the mitigation of maladaptive behaviors, physical activity is most effective in reducing interpersonal alienation, and it also alleviates negative withdrawal behaviors and self-disturbance tendencies. In summary, physical activity directly influences social adaptation, which aligns with the findings of this study. It can be concluded that physical activity is a significant predictor of social adaptation; higher levels of physical activity among adolescents strengthen their interpersonal communication, teamwork, and fair competition competencies, thereby enhancing their overall social adaptation.

This study confirms a significant positive correlation between self-esteem levels and social adaptation abilities, which aligns with previous research [1, 16]. From a psychological development perspective, an individual's self-esteem level often partially reflects their mental health status, while the perception of life meaning is a critical factor influencing psychological well-being. Within the adolescent population, varying levels of self-esteem lead to distinct psychological and behavioral patterns. Adolescents with lower self-esteem are more susceptible to developing negative life attitudes. The persistent accumulation of negative emotions, such as inferiority and helplessness, undermines their psychological resilience in coping with academic and life challenges. In contrast, adolescents with high self-esteem typically establish positive psychological feedback mechanisms. These mechanisms provide positive emotional resources that help them maintain a confident and optimistic attitude when confronting difficulties.

This study identified a significant positive correlation between physical activity levels and self-esteem in adolescents, a finding consistent with existing literature [26]. Regarding the underlying mechanisms, regular physical activity not only bolsters self-esteem but also fosters social development through multiple pathways. For instance, participation in activities such as team sports or outdoor hiking provides adolescents with a means for positive psychological and physical adjustment, buffering the effects of academic stress. This stress-buffering effect enhances emotional regulation and facilitates the establishment of positive social interaction patterns. Furthermore, the inherently social nature of many physical activities creates opportunities for adolescents to expand their interpersonal networks. In team-based settings, individuals naturally develop communication and coordination skills, as well as a sense of collective awareness. This accumulation of social capital, in turn, enhances overall adaptability. From a developmental psychology perspective, this synergistic process of physical and mental development supports the formation of healthy personalities and positive values in adolescents, offering a crucial practical arena for their socialization [27].

3.3. The Mediating Role of Self-Esteem Between Physical Activity and Social Adaptation

This study found that self-esteem partially mediates the relationship between social adaptation and physical activity. Specifically, physical activity not only directly enhances social adaptation but also indirectly improves it by elevating self-esteem. Adolescence represents a critical period for personality and identity formation, where physical and mental health serve as fundamental prerequisites for holistic development. Confronted with challenges such as parental pressure, academic criticism, and peer conflict, adolescents require both physical resilience and psychological fortitude to overcome such adversities. Furthermore, prevalent issues including adolescent obesity and psychological disorders necessitate greater attention. Therefore, physical activity can be leveraged as a key intervention to improve adolescents' self-esteem and social adaptation.

4. Limitations

This study is subject to several limitations. First, the analysis was restricted to the relationship between physical activity and self-esteem and social adaptation; future research should incorporate additional variables to explore more complex interactions. Second, the cross-sectional design constrains the interpretation of the findings. The lack of longitudinal data precludes analysis of changes over time. Consequently, subsequent studies are encouraged to adopt a longitudinal approach to establish temporal precedence and enhance causal inference.

5. Conclusions

Physical activity is a positive predictor of social adaptation and has a direct, beneficial effect on it. Furthermore, self-esteem serves as a partial mediator in the relationship between physical activity and social adaptation, thereby playing a crucial role in enhancing adolescents' capabilities in this domain. Therefore, in the context of adolescent mental health management, implementing structured physical activities can effectively increase physical activity levels. This strategy, in turn, can bolster self-esteem and social adaptation, ultimately promoting healthy and positive development.

Author Contributions: This article is written by Yi Yang and Rui Du, Luo Jiong is the manager of the project and has approved the author and corresponding author of this study. All authors have read and agreed with the published version of the manuscript.

Authorship declaration: All authors of the article declare that there are no conflicts of interest during the research and writing process of the article.

Ethics Statement： The studies involving human participants were reviewed and approved by Ethics Committee of Southwest University Hospital. The patients/participants provided their written informed consent to participate in this study.

Data Availability Statement：The data presented in this study is available upon request from the corresponding author.

Funding：This research received no project funding support.

Conflict of interest：The authors deny any conflict of interest.

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