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The impact of physical education on the health and well-being of adolescents: The mediating role of self-efficacy

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Abstract

Based on the social cognitive theory, this study explored the mechanism by which physical education (PE) influences the health and well-being (HWB) of middle school students in Heyuan City, China, and verified the mediating role of self-efficacy (SE). Through a questionnaire survey of 540 students from 15 middle schools in Heyuan City, combined with SPSS 27.0 and partial least squares structural equation modeling (PLS-SEM) analysis, the study found that: (1) Physical education not only directly promotes the health and well-being of adolescents (β=0.246, p<0.001), but also indirectly enhances this effect through the improvement of self-efficacy (PE→SE→HWB: β=0.362, p<0.001); (2) Self-efficacy is a core mediating variable, and its psychological mechanisms (such as enhancing confidence in sports and psychological resilience) better explain the improvement of health and well-being than mere physiological improvements; (3) Educational environment (such as teacher support and curriculum design) and individual factors (such as the ability to cope with sports challenges) jointly influence this chain reaction. The research results reveal the "mind-body interaction" function of physical education and provide empirical evidence for school health promotion strategies under the "double reduction" policy. It is suggested that through diversified physical education curriculum design, home-school collaboration mechanisms, and integration of mental health education, the adolescent health intervention plan should be optimized. Future research should expand the sample size and incorporate longitudinal designs to further verify the causal paths and cultural differences.

Keywords: Self-efficacy, Physical education Health and well-being, Mediating effect PLS-SEM, Secondary school adolescents in Heyuan City

Introduction

Adolescence marks the transition from childhood to adulthood and is a crucial stage in individual development. This period is characterized by rapid changes in physical, psychological, and social roles, which profoundly shape adolescents' personalities, self-perception, and lay the foundation for their future career development and social participation. Bandura (1997) emphasized in his social cognitive theory the core role of self-efficacy in adolescent development, defined as an individual's belief in their ability to complete tasks. This is crucial for motivating adolescents to face learning challenges, build social confidence, and enhance their social adaptability (Schunk & Pajares, 2009).

Adolescence is a period of significant change, typically spanning from 10 to 20 years old, and can be further divided into early, middle, and late stages. During this period, adolescents are highly sensitive to environmental stimuli, and their neural plasticity is high, making adolescence an important time for learning and shaping future behavioral patterns (Blakemore & Mills, 2014). The sensitive period theory of social and cultural processing suggests that adolescence is a critical period for long-term impacts of social and cultural experiences on individual development (Pfeifer & Allen, 2015), which is reflected in learning new skills, forming values, establishing social relationships, and identity formation.

To promote adolescents' self-efficacy and overall well-being, families, educators, and policymakers must work together to create a supportive and positive environment. Such an environment will help adolescents build confidence, promote their all-round development, and lay a solid foundation for them to become healthy and capable adults (Tsang et al., 2012). This study focuses on the close relationship between self-efficacy and adolescents' health and well-being, and quantitatively analyzes this relationship among middle school students in Heyuan City, China. Self-efficacy, as an internal psychological resource, is crucial for adolescents' all-round development. It not only encourages adolescents to adopt positive health behaviors but

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also helps them manage emotional fluctuations better, maintain emotional stability, and mental health (Mudayat & Mualip, 2024).

Bandura's social cognitive theory further suggests that confident adolescents are more likely to acquire new behavioral patterns through imitation, practice, and feedback, which is essential for their personal growth. Moreover, the enhancement of self-efficacy significantly influences adolescents' active participation in social activities, the establishment of healthy interpersonal relationships, the formation of strong social support networks, and effective coping with life stress and challenges. This study aims to provide empirical evidence for the cultivation of adolescents' self-efficacy and the promotion of their health and well-being, and contribute new theoretical and practical insights to related fields.

Existing research indicates that self-efficacy is closely related to an individual's social skills, self-concept, social adaptation, and mental health (Stajkovic & Luthans, 2003). Specifically for the adolescent group, self-efficacy has an undeniable connection with their healthy physical habits, emotional management abilities, and social adaptability. This study aims to fill the existing research gap, especially among middle school students in Heyuan City, China, by exploring the interaction between physical education, self-efficacy, and health and well-being, and providing a scientific basis for the formulation of effective health promotion strategies. Through quantitative analysis, this study will reveal the specific impact of self-efficacy on adolescents' health and well-being and identify key influencing factors.

2. Research Review

2.1 Overview of social cognitive theory

Social Cognitive Theory (SCT) provides a systematic theoretical framework for understanding the relationship between physical education (PE) and the health and well-being (HWB) of adolescents. This theory, proposed by Bandura (1986; Luszczynska & Schwarzer, 2015), emphasizes the triadic interaction among individuals, behaviors, and environments, with self-efficacy (SE) as the core cognitive mechanism playing a crucial role (Bandura, 1997). In the context of physical education, this theoretical framework can fully explain the mechanism of "PE → SE → HWB": Physical education courses, by offering opportunities for motor skill training and peer observation learning (environmental factors), effectively enhance students' belief in their ability ("I can do it") (individual factors); this enhanced self-efficacy then prompts adolescents to participate more actively in sports activities (behavioral factors), and through dual pathways of improving physical functions (such as enhancing physical fitness) and psychological states (such as relieving stress), ultimately elevating their overall health and well-being levels (McAuley & Blissmer, 2000). This chain of effects fully presents the dynamic interaction process of environmental input, cognitive regulation, and behavioral output in social cognitive theory.

From theoretical application to practical intervention, physical education based on social cognitive theory demonstrates significant value. As a core component of this theory, self-efficacy theory (Bandura, 1997; Bano, Hamzah, & Hafiz, 2025) particularly explains the driving role of ability beliefs in behavioral motivation (Pajares, 2002). Research shows that positive feedback from teachers and peer demonstrations (Schunk & DiBenedetto, 2020) can strengthen students' motor self-efficacy, while progressive skill training can consolidate this behavioral change. Notably, the applicability of this mechanism in different cultural backgrounds and digital educational environments still needs to be verified (Usher & Schunk, 2017). Future research could combine neuroscientific techniques to deeply explore the physiological basis of self-efficacy and how emerging technologies such as virtual reality can optimize the observation learning process in physical education, thereby providing more precise theoretical guidance and practical solutions for promoting adolescent health. Such a research path maintains the integrity of the theory while expanding the possibilities of practice.

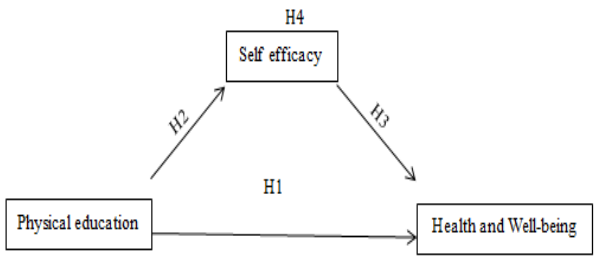

Figure1. Hypothesis model

2.2 Definition and dimensions of health and well-being

Health and well-being are the two main pillars that constitute an individual's overall well-being. Physical health refers to an individual's physiological functions and metabolic state, covering everything from basic physiological functions to the operation of complex physiological systems. According to Stavrinos et al. (2023), Pico et al. (2023), and Shi et al. (2023), lifestyle choices such as sleep, diet, and physical activity play a crucial role in maintaining and improving physical health. These lifestyle factors are essential for improving cardiovascular risk factors and reducing overall mortality. Kochman et al. (2023) further emphasized the importance of physical fitness indicators, including strength, endurance, and flexibility, in adolescent physical health, which can be measured through physical fitness assessments.

Mental health is more complex. According to the World Health Organization (2022), it is not merely the absence of mental disorders but a state that enables individuals to cope with life's stressors, realize their abilities, learn and work effectively, and contribute to their communities. Jimenez Boraita et al. (2024) defined mental health as a state of emotional, psychological, and social well-being and found it to be positively correlated with self-esteem and quality of life. Mental health status is dynamic and is influenced by a wide range of social, biological, and behavioral factors. Martin-Rodriguez et al. (2024) highlighted that this state includes emotional stability, resilience, cognitive function, and effective social skills, which enable individuals to regulate emotions positively, cope with stress, maintain social relationships, and promote mental health recovery when necessary.

In summary, health and well-being require individuals to be in good emotional, cognitive, and social adjustment. Through physical exercise, social support, cultural understanding, technology application, and the formulation of public health policies, mental health status can be effectively promoted. At the same time, we must also be aware of the ethical and social challenges that may arise in specific contexts and with the application of new technologies. Health and well-being are multi-dimensional concepts that encompass physical, mental, social environment, and cultural background.

The dimensions of physical health include body composition, physical activity levels, sleep, and nutritional status, all of which have a positive impact on adolescents' mental health and self-esteem (Benitez-Sillero et al., 2024). For instance, Boat et al. (2024) emphasized the importance of self-control for adolescents' physical health and physical activity, which is not only related to physical health but may also have a positive effect on reducing obesity. Additionally, Xu et al. (2024) evaluated the sleep time, physical activity time, screen time, and nutritional literacy of adolescents in Chongqing, China, and found that these factors significantly affected their physical health.

The dimensions of mental health are more complex. They not only include personal psychological and biological factors such as emotional skills, substance use, and genetic predispositions but also social economic environments, geopolitical, and environmental factors such as poverty, violence, inequality, and environmental deprivation (WHO, 2022). Sherif et al. (2024) conducted an online life skills intervention to improve the mental health of 14 to 18-year-old Arab adolescents in Malaysia, covering major mental health outcomes such as anxiety, depression, and stress, and used the Depression Anxiety Stress Scales-21 (DASS-21) for assessment. In addition, factors such as family environment (Xia et al., 2023), community environment (Perez-Sastre et al., 2024), substance use behavior (Mattingly et al., 2024), and access to mental health treatment (Subotic-Kerry et al., 2023) also have a significant impact on the mental health of adolescents. For instance, the mental health status of parents in the family environment has a significant influence on the mental health of adolescents. Parents' anxiety and depression symptoms are associated with non-suicidal self-injury behaviors in adolescents.

The disorder and violence in the community environment directly affect the psychological distress of Mexican adolescents, even without considering personal victimization experiences. Moreover, there is a close connection between substance use and mental health, and mental health issues need to be addressed in the context of adolescent substance use. In summary, the dimensions of health and well-being include physical health, mental state, social environment, and cultural background. By improving these dimensions, the physical health of can be

promoted (Seque-Dominguez et al., 2024; Kochman et al., 2023; Ortiz et al., 2024).

2.3 The relationship between self-efficacy and health and well-being

Self-efficacy, as an individual's core belief in their ability to complete specific tasks, plays a multi-level role in promoting the health and well-being of adolescents. Research indicates that self-efficacy not only directly and positively predicts the mental health status of adolescents (Dzeidee Schaff et al., 2024; Sherif et al., 2024), but also systematically influences their overall well-being through intermediary mechanisms such as promoting healthy behaviors (Bandura & Wessels, 1997), enhancing academic performance (Zimmerman, 2000), and improving social adaptability (Thasleema et al., 2024).

Specifically, adolescents with high self-efficacy are more likely to adopt positive health management strategies (Dong et al., 2023), exhibit greater persistence in the face of academic challenges, and employ constructive coping strategies in interpersonal interactions (Bandura & Wessels, 1997; Garcia, 1990).

This effect is particularly pronounced in the family environment, where parents' self-efficacy, through warm and supervisory parenting behaviors, not only reduces children's emotional and behavioral problems but also significantly enhances their social skills (Dzeidee Schaff et al., 2024).

Moreover, as a key component of psychological resilience (As, 2014), self-efficacy enables adolescents to effectively mobilize resources to cope with adversity, while participation in physical education and social support from family, peers, and educators further enhance subjective well-being by strengthening self-efficacy (Thasleema et al., 2024), creating a virtuous cycle of healthy development.

These findings collectively suggest that self-efficacy is a multi-dimensional protective factor that profoundly influences the physical and mental health and long-term well-being of adolescents through the interaction of individual, family, and social systems.

3. Research Methods

3.1 Research sample

In this study, students from 15 middle schools in southern China were selected as the sample group. The reasons are as follows: (1) The students of these 15 schools have abundant resources and opportunities for physical education and health education, thus having rich educational experiences. (2) Middle school students are at a critical stage for the formation of self-efficacy, and their health behaviors and psychological resilience have significant impacts on the cultivation of future social service capabilities. Therefore, exploring the health and well-being of middle school students is forward-looking for enhancing their sense of social responsibility and practical abilities. It is evident that using middle school students as a sample to investigate the influencing factors of health and well-being is representative. In 2024, a total of 30,118 students were enrolled in these 15 schools. Through recruitment, 540 students participated in this study.

3.2 Survey

Questionnaires were distributed and collected both online and offline in 2024. A total of 540 questionnaires were distributed, with a 100% recovery rate and 540 valid questionnaires, resulting in a 100% valid recovery rate. The criterion for determining an invalid questionnaire was that the respondent was not a student from within the 15 schools in Heyuan City.

3.3 Instruments and measurements

The health and well-being of middle school adolescents were measured through a scale. The first part of the scale collected basic background information of the respondents (gender, age, school, grade, family background, and whether they are an only child). The second part evaluated students' participation in physical education, assessing their classroom participation, extracurricular self-exercise, curriculum design, teacher support, and enjoyment of activities through five questions, drawing on the research of Standage et al. (2012) and Lu et al. (2017). The third part assessed students' self-efficacy through six questions, covering learning new skills, improving performance, overcoming

difficulties, stress management, peer comparison, and time management, based on the studies of Bandura (2006) and Babkes & Weiss (1999). The fourth part evaluated students' health and well-being through six questions, including physical support, healthy habits, emotional stability, stress regulation, social relationships, and self-assessment of health, drawing on the research of WHO (2019) and Zheng et al. (2023). After the initial draft of the questionnaire was completed, relevant experts were invited to review the applicability and accuracy of the questionnaire items. The questionnaire was revised based on the experts' opinions. The second and third parts were measured using a 1 to 5 Likert scale, ranging from "1 = Strongly Disagree" to "5 = Strongly Agree".

Table1. Instrument

Variables	Items	Reference
Physical education (PE)	PE1：I take part in every PE class arranged by the school seriously. PE2：I will take the initiative to do physical exercises (such as running, playing ball games, etc.) in my spare time. PE3：I think the physical education curriculum design of the school can enhance my athletic ability. PE4：The PE teacher will encourage us to try different sports. PE5：I often feel happy and fulfilled in sports activities.	Standage et al., (2012)、Chen et al., (2020)、Lu et al.,(2017)
Self-efficacy (SE)	SE1: I believe I can master the new sports skills I have learned. SE2: Even if I encounter difficulties during exercise, I can still persist and finish it. SE3: In sports competitions, I can deal with pressure calmly. SE4: I can improve my sports performance through practice. SE5: I can balance the time for physical training and cultural studies well. SE6: My sports ability is no worse than that of other classmates.	Bandura, (2006)、Bandura & Locke, (2003)、Babkes & Weiss, (1999)
Health and well-being (HWB)	HWB1: My physical condition can support my daily study and activities. HWB2: Most of the time, I feel emotionally stable and happy. HWB3: I have a regular schedule and healthy eating habits. HWB4: I can effectively relieve stress through exercise. HWB5: I am satisfied with my health condition. HWB6: I often feel the support of my family and friends.	WHO, (2019)、Kyle et al., (2016)、Zheng et al., (2023)

3.4 Data analysis

The data analysis was conducted using SPSS 27 software, covering descriptive statistical analysis to summarize the basic characteristics of the sample; correlation analysis to explore the relationships among different variables; and regression analysis through smart PLS software to evaluate the predictive effects of sports education participation and self-efficacy on health and well-being. The questionnaire results will provide data support for understanding individual self-perception and behavioral patterns.

4. Results

4.1 Demographic profile and family background of respondents

The 540 middle school students participating in this study presented a balanced demographic distribution, with the sample being well-representative and homogeneous. The data indicated that the respondents were evenly split by gender (50.0% male and 50.0% female), with the majority aged between 12 and 15 years, with 14-year-olds accounting for the highest proportion (35.0%), which aligns with the typical age range of junior high school students. The grade distribution was also even (7th grade: 33.3%, 8th grade: 35.0%, and 9th grade: 31.7%), suggesting the potential feasibility of longitudinal tracking studies. Notably, the respondents were predominantly from urban areas (87.6%), and non-only children constituted the vast majority (90.0%). This reflects the characteristics of educational resource allocation during the urbanization process in Heyuan City and also conforms to the population structure changes following the implementation of the "universal two-child" policy in Guangdong Province (Azzoni, 2020). Although this highly homogeneous sample structure may limit the generalizability of the research conclusions to rural students, it provides ideal

conditions for controlling the interference of the variable of family residence on the acquisition of sports education resources, facilitating a clearer understanding of the intrinsic mechanisms between self-efficacy and health and well-being. Future research could consider stratified sampling to enhance ecological validity, especially in the context of significant educational disparities between urban and rural areas.

Table 2. Respondents demographic profile and family background (N = 540)

Characteristics		Frequency	Peentage
Gender	Male Female	270 270	50.0 50.0
Age	12 13 14 15	32 147 189 172	5.9 27.2 35.0 31.9
Grade	Grade 7 Grade 8 Grade 9	180 189 171	33.3 35.0 31.7
Family background	Urban Towns Rural	473 67 0	87.6 12.4 0.0
Only child	Yes No	54 486	10.0 90.0

4.2 Assessment of the measurement model

4.2.1 Reliability of the measurement model

The data in Table 3 demonstrate that the structure (physical education, self-efficacy, and health and well-being) has strong reliability and validity, as all item indicator loadings are greater than 0.7, the Cronbach's alpha and CR values of the constructs are over 0.8, and the AVE is greater than 0.5. All values meet the thresholds proposed by Fornell and Larcker (1981) and Hair et al. (2010), and the VIF values are below the common cutoff value of 5 (Hair et al., 2014). Therefore, no items were deleted, which indicates good internal consistency.

Table 3. Results of reliability loading, CR and VIF for constructs

Variables	Items	Cronbach's alpha	CR	AVE	Loading	VIF
Physical education(PE)	PE1 PE2 PE3 PE4 PE5	0.836	0.84	0.604	0.742 0.765 0.742 0.822 0.811	1.574 1.662 1.576 1.957 1.811
Self-efficacy(SE)	SE1 SE2 SE3 SE4 SE5 SE6	0.88	0.884	0.627	0.833 0.737 0.81 0.788 0.763 0.815	2.207 1.663 2.104 1.912 1.848 2.099
Health and well-being(HWB)	HWB1 HWB2 HWB3 HWB4 HWB5 HWB6	0.859	0.86	0.587	0.78 0.807 0.741 0.767 0.751 0.749	1.843 1.992 1.63 1.796 1.728 1.657

Note: CR= composite reliability ; AVE= average variance extracted; VIF=Variance Inflation Factor

4.2.2 Validity of the measurement approach

This measurement model demonstrated satisfactory convergent validity and discriminant validity through multiple evaluation criteria. The average variance extracted (AVE) exceeded the threshold of 0.50 (Fornell & Larcker, 1981), confirming its robust convergent validity. Discriminant validity was supported by three methods: (1) Cross-loadings analysis (Table 4) indicated that each item had a higher loading on its expected construct than on other constructs (Hair et al., 2017); (2) The Fornell-Larcker criterion (Table 5) showed that the AVE was greater than 0.5 and its square root was greater than the correlations between constructs (Fornell & Larcker, 1981); (3) All heterotrait-monotrait ratio (HTMT) values were below the benchmark of 0.85 (Table 6), meeting the standards proposed by (Henseler et al., 2014; Franke & Sarstedt, 2019). These results collectively confirmed that the discriminant validity of the model was satisfactory.

Table 4. Results of cross-loadings

Items	HWB	PE	SE
HWB1	0.780	0.467	0.533
HWB2	0.807	0.480	0.561
HWB3	0.741	0.427	0.528
HWB4	0.767	0.461	0.514
HWB5	0.751	0.460	0.499
HWB6	0.749	0.493	0.556
PE1	0.443	0.742	0.490
PE2	0.432	0.765	0.551
PE3	0.449	0.742	0.490
PE4	0.490	0.822	0.554
PE5	0.539	0.811	0.581
SE1	0.612	0.570	0.833
SE2	0.510	0.490	0.737
SE3	0.508	0.528	0.810
SE4	0.561	0.567	0.788
SE5	0.507	0.506	0.763
SE6	0.589	0.596	0.815

Note: PE=physical education; SE=self-efficacy; HWB=health and well-being.

Table 5. Results of fornell-larcker criterion

Variables	HWB	PE	SE
HWB	0.809		
PE	0.84	0.762	
SE	0.838	0.829	0.852

Note: PE=physical education; SE=self-efficacy; HWB=health and well-being

Table 6. Results of Heterotrait Monotrait Ratio (HTMT)

Variables	HWB	PE	SE
HWB			
PE	0.715		
SE	0.796	0.799	

Note: PE=physical education; SE=self-efficacy; HWB=health and well-being

4.3 Evaluation of structural models

4.3.1 Evaluation of multicollinearity

The structural model was evaluated for multicollinearity using variance inflation factor (VIF) values. Inner model VIFs for all constructs were below the threshold of 5 (Hair et al., 2022), indicating no significant multicollinearity issues.

4.3.2 Interpretive power and model fit evaluation

Experts and scholars believe that the larger the coefficient of determination (R^2), the better the model fit. This structural model demonstrates strong interpretive power(Table 8), with R^2 values of 0.515 for health and well-being (HWB) and 0.474 for self-efficacy (SE) (Table 8), indicating moderate to high predictive accuracy (Cohen, 1992). The adjusted R^2 values (0.513 and 0.473, respectively) confirm the model's robustness. Additionally, the predictive relevance of the model was assessed using Stone-Geisser's Q^2 (Geisser, 1974; Stone, 1974). The Q^2 values for HWB (0.362) and SE (0.470) exceed the threshold of 0, indicating that the model has

predictive relevance for both endogenous constructs. Specifically, Q^2 values between 0.02 and 0.15 suggest small predictive relevance, values between 0.15 and 0.35 indicate medium predictive relevance, and values above 0.35 represent large predictive relevance (Hair et al., 2014). The effect size analysis (Table 7) shows that physical education (PE) has a large effect on self-efficacy (SE) (f^2 = 0.899), and a small to moderate effect on health and well-being (HWB) (PE→HWB: f^2 = 0.066; SE→HWB: f^2 = 0.300) (Cohen, 1992). The model fit is good, with a standardized root mean square residual (SRMR) of 0.053, below the threshold of 0.08 (Hu & Bentler, 1999), and a normed fit index (NFI) of 0.906, exceeding the benchmark of 0.9 (Kline, 2016), jointly indicating a reasonable model construction. All hypothesized paths are statistically significant ($p < 0.001$), with large t-values (> 1.96), supporting direct effects (PE→HWB: β = 0.246; PE→SE: β = 0.688; SE→HWB: β = 0.526) and the mediating path (PE→SE→HWB: β = 0.362) (Heil et al., 2022).

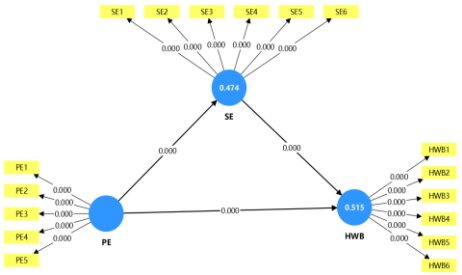

Figure 2. The structural model

Table 7. Results of f-square

Variables	HWB	PE	SE
HWB			
PE	0.066		0.899
SE	0.300		

Note: PE=physical education; SE=self-efficacy; HWB=health and well-being.

Table 8. Coefficient of determination (R2) and (Q2) and model fit (Chi-square-SRMR-NFI)

Variables	R-square	R-square adjusted	Q^2predict
HWB	0.515	0.513	0.362
SE	0.474	0.473	0.470
Model Fit indices	Chi-square	SRMR	NFI
	432.389	0.053	0.906

Note: PE=physical education; SE=self-efficacy; HWB=health and well-being.

4.3.3 Hypothesis testing

This study tested the hypotheses of the structural model through 5,000 Bootstrap samplings (Edeh et al., 2023). As shown in Table 9, all hypotheses were statistically supported: Physical Education (PE) has a significant positive impact on Health and Well-being (HWB) (H1: β=0.246, t=4.519, p<0.001); the effect of PE on Self-efficacy (SE) is particularly significant (H2: β=0.688, t=23.408, p<0.001); the promoting effect of SE on HWB was also verified (H3: β=0.526, t=12.164, p<0.001). More importantly, the mediation effect test showed that the indirect path of PE influencing HWB through SE was significant (H4: β=0.362, t=11.756, p<0.001), which is consistent with the latest research conclusions in the field of health behavior (Buecker et al., 2023). All t-values were greater than the critical value of 1.96, and p-values were less than 0.001, indicating that the research results are highly robust (Kline, 2016).

Table 9. Results of hypothesis test

Hypothesis	Path coefficients	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Outcome
H1: PE -> HWB	0.246	0.247	0.054	4.519	0.000	Support
H2: PE -> SE	0.688	0.689	0.029	23.408	0.000	Support
H3: SE -> HWB	0.526	0.527	0.043	12.164	0.000	Support
H4: PE->SE -> HWB	0.362	0.363	0.031	11.756	0.000	Support

Note: All path coefficients are statistically significant with p<0.001 and T>1.96.

5. Discussion and Implications

This study explored the impact of physical education (PE) on the health and well-being (HWB) of adolescents in middle schools in Heyuan City, China, and verified the mediating role of self-efficacy (SE). The research findings indicated that physical education not only directly promotes the health and well-being of adolescents (HWB: $\beta=0.246$, $p<0.001$), but also indirectly enhances this effect through the improvement of self-efficacy (PE→SE→HWB: $\beta=0.362$, $p<0.001$). This discovery aligns with the social cognitive theory proposed by Mudayat & Mualip (2024), which posits that self-efficacy is a key driver of individual health behaviors. Specifically, participation in physical education enhances adolescents' physical abilities and psychological resilience, thereby boosting their sense of self-efficacy and ultimately leading to a more positive state of physical and mental health.

Compared with existing literature, this study further refines the relationship among physical education, self-efficacy, and health in the adolescent population. Physical education directly influences health by increasing physical activity levels and emphasizes the bridging role of psychological factors such as self-efficacy, which echoes the integrated model proposed by Buecker et al. (2023). However, the study has certain limitations: the sample is limited to middle school students in Heyuan City, which may restrict the generalizability of the conclusions; in addition, potential influencing variables such as family support and school environment were not considered. Future research could expand the sample size, incorporate multi-level influencing factors, and adopt a longitudinal design to track the long-term effects of physical education, in order to more comprehensively reveal its health promotion mechanisms.

Based on the research results, the education department and school administrators in Heyuan City should attach importance to the dual functions of physical education, which not only enhance physical fitness but also cultivate psychological capital. Specific suggestions include: 1) Designing diverse physical education courses to strengthen students' sense of success and thereby enhance self-efficacy; 2) Integrating mental health education into physical activities, such as enhancing adolescents' psychological resilience through team cooperation tasks; 3) Establishing a home-school collaboration mechanism to encourage family support for adolescents' participation in physical activities. These measures not only contribute to improving the health of adolescents but also provide a theoretical basis for formulating precise school health policies.

6. Limitations and suggestions for future research

Although this study has revealed the promoting effect of physical education (PE) on adolescents' health and well-being (HWB) through self-efficacy (SE) (PE→HWB: $\beta=0.246$; PE→SE→HWB: $\beta=0.362$), there are still several limitations: Firstly, the sample only includes middle school students in Heyuan City, which may limit the generalizability of the conclusions; secondly, the cross-sectional design cannot infer causal relationships; finally, the role of contextual factors such as family support and school environment was not examined. Based on the main findings, it is suggested that educational practitioners design physical education courses as an "intervention platform for mind-body integration", for instance, by strengthening self-efficacy through task challenges. Meanwhile, policymakers should establish a home-school collaboration mechanism and incorporate physical activities into the regular assessment system for promoting adolescent health. Future research could adopt longitudinal tracking or multi-center sampling, combined with mixed methods (such as physiological indicators and interviews) to reveal the dynamic mechanism of the PE-SE-HWB chain reaction and explore the influence of cultural differences on this model, with the aim of providing a more comprehensive scientific basis for the precision of adolescent health policies.

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