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# Impact of Exercise Atmosphere on Adolescents' Exercise Behavior: Chain Mediating Effect of Exercise Identity and Exercise Habit

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## ABSTRACT

Appropriate physical exercise has a positive impact on adolescents' physical and mental health, but there is a serious lack of physical exercise among Chinese adolescents. How to shape their exercise behavior (EB) has become an important task in promoting their development. A questionnaire survey was conducted using stratified cluster random sampling on three middle schools by class in Zhejiang Province, China to investigate the impact of exercise atmosphere (EA) on adolescents' exercise behavior and the mediating role of exercise identity (EI) and exercise habit (EH). 806 adolescents were investigated by the Exercise Atmosphere Scale (EAS), Exercise-Identity Scale (EIS), Self-Report Habit Index (SRHI), and Physical Activity Rating Scale (PARS-3). The results show that: There is a significant positive correlation between each two of exercise atmosphere, exercise identity, exercise habit, and exercise behavior ( $p < 0.05$ ). Exercise atmosphere could not only directly affect adolescents' physical exercise behavior but can also indirectly affect their physical exercise behavior through the mediating effect of exercise identity and exercise habit, involving three mediating pathways, namely, the mediating path through exercise identity, the mediating pathway through exercise habit and the chain mediating pathway through exercise identity and exercise habit. The direct effect of exercise atmosphere on exercise behavior was 0.459 ( $p < 0.01$ ), accounting for 62.62% of the total effect of 0.733, and its indirect effect was 0.274, accounting for 37.28% of the total effect. To a certain extent, the mediating effect model reveals the mechanism of exercise atmosphere affecting exercise behavior and has a certain reference value for promoting adolescents' exercise behavior. We should start by creating an exercise atmosphere, cultivating exercise identity, and enhancing exercise habits to help teenagers form active physical exercise behaviors.

## KEYWORDS

Exercise atmosphere; exercise identity; exercise habit; exercise behavior

## Introduction

On 25 November, 2020, World Health Organization (WHO) released the latest "WHO Guidelines on Physical Activity and Sedentary Behavior", which emphasizes that each individual, regardless of age and ability, can and should engage in physical activity. Physical exercise of any style is useful [1].

Adolescents are in a critical period of personal development, during which physical exercise is significant. Appropriate physical exercise is not only conducive to maintaining adolescents' physical health, but also has a positive impact on their mental health. Studies have shown that physical exercise can relieve stress and enhance sense of happiness [2,3]. In addition, adolescents who regularly participate in



physical exercise are more likely to perform better [3] both academically and socially [4]. Therefore, promoting exercise behavior (EB) among adolescents has become an important way to optimize their development.

A positive physical exercise atmosphere (EA) can motivate adolescents to engage in physical exercise. Firstly, a positive exercise atmosphere can enhance adolescents' interest in and motivation for physical exercise. In a positive exercise atmosphere, they are more easily influenced by other people around them, thus developing an interest and motivation for physical exercise [5]. When adolescents see their classmates actively taking part in physical exercise, they are also more likely to seek participation. Secondly, a positive exercise atmosphere can provide adolescents with social support and encouragement. It can enable them to overcome difficulties and persist in physical exercise [4,5]. Support and encouragement from friends, family members, and teachers can help adolescents cope with difficulties and continue to persevere when encountering troubles in physical exercise. Hence, the following research hypothesis was proposed in this study: H1: Exercise atmosphere significantly positively predicts adolescents' exercise behavior.

Exercise identity (EI) refers to an individual's affirmation and recognition, gradually formed through physical exercise, of his own body, athletic ability and exercise value [6]. It is a positive self-awareness and self-evaluation eventually generated in the individual through constantly challenging the self, achieving self-transcendence and deepening the understanding of his body control, athletic ability, and exercise value during physical exercise [6]. On the one hand, exercise atmosphere plays an important role in enhancing one's sense of exercise identity. Firstly, a positive exercise atmosphere can stimulate adolescents' interest in and enthusiasm for exercise, motivating them to actively participate in physical exercise [7]. Secondly, a positive exercise atmosphere can offer adolescents social support and encouragement, enabling them to overcome difficulties and persist in physical exercise [4,5]. In case of hardship in physical exercise, support and encouragement from friends, family members, and teachers allow individuals to overcome difficulties and continue to persevere. On the other hand, exercise identity has a significant promoting effect on exercise behavior [8]. Exercise identity can enhance exercise willingness and reinforce exercise persistence [8,9]. On this basis, the following research hypothesis was proposed: H2: Exercise identity plays a mediating role in the relationship between exercise atmosphere and adolescents' exercise behavior.

Some researchers have also noticed the mediating role of exercise habits (EH) in the relationship between exercise atmosphere and exercise behavior. On the one hand, an exercise atmosphere promotes the formation of exercise habits by providing social support, motivation, emotional support, a sense of belonging, and a role model effect. Firstly, a positive exercise atmosphere can give rise to social support and motivation, encouraging adolescents to persist in participating in physical exercise. In such an atmosphere, individuals can perceive the support and encouragement from coaches, peers, and family members, thereby obtaining higher confidence and motivation in physical exercise, so

that they are more likely to form exercise habits [10]. Secondly, a favorable exercise atmosphere can cultivate individuals' emotional engagement in physical exercise and a sense of belonging. By taking part in team exercise or community exercise activities, individuals can establish close connections with others, perceive the joy of teamwork and a sense of belonging, and thus be more willing to stick to physical exercise. On the other hand, exercise habits can accelerate the formation of exercise behavior [11]. Firstly, exercise habit has functions including reducing the cognitive burden of participating in physical exercise [12]. After the formation of exercise habits, exercise no longer requires additional willpower or decision-making, but becomes a natural behavior. This habitual behavior pattern makes it easier for individuals to overcome laziness or other obstacles and to continue participating in physical exercise. Secondly, exercise habits can also improve one's sense of enjoyment obtained from physical exercise. With the establishment of exercise habits, individuals often gradually develop their interest in and love for physical exercise [13]. The enhancement of this interest makes exercise no longer a passive obligation, but a joyful and enjoyable activity that is highly attractive to individuals. Therefore, the following research hypothesis was proposed in this study: H3: Exercise habit plays a mediating role in the relationship between exercise atmosphere and adolescents' exercise behavior.

How exercise atmosphere affects adolescents' exercise behavior remains unresolved. Two mediating pathways, respectively exercise identity and exercise habit, were proposed in this study. Meanwhile, exercise identity and exercise habit have a connection. Social Cognitive Theory emphasizes the importance of self-efficacy in the development of one's behavior and ability [14]. According to Social Cognitive Theory, individuals who have a stronger sense of exercise identity have a firmer belief in their athletic abilities and believe that they are able to overcome difficulties and challenges in physical exercise [6]. Exercise identity may help individuals achieve or develop self-efficacy [15]. Individuals can regulate their motivation and behavior through self-efficacy and expected outcomes during physical exercise, which is beneficial for promoting their exercise behavior [15]. On this basis, the following research hypothesis was proposed in this study: H4: Exercise atmosphere also affects adolescents' exercise behavior through the chain mediating effect of exercise identity and exercise habit.

Hence, a chain mediating model was constructed this study (shown in Fig. 1) to examine the correlations among exercise atmosphere, exercise identity, exercise habit and exercise behavior.

## Methods

### *Participants*

As recommended by van Smeden et al. [16], the sample size should be equivalent to 10–15 times the number of items. In this study, the calculation was performed by following a 15-fold standard. Since the four scales include a total of  $17 + 18 + 12 + 3 = 50$  items, the sample size was set to be 750. A questionnaire survey was conducted on students in three

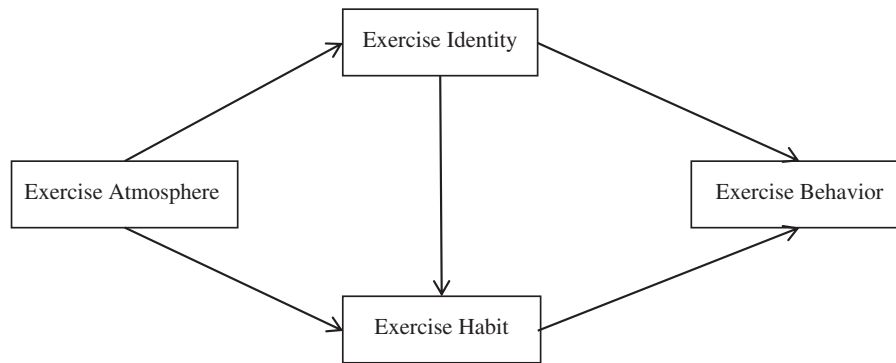


FIGURE 1. Hypothetical model of the relationship between exercise atmosphere and exercise behavior.

middle schools in Zhejiang Province of China from 10 September to 20 October, 2023, using stratified cluster random sampling. A total of 810 copies of the questionnaire were distributed. 34 invalid copies were removed, and 776 valid copies were collected. The effective response rate was 95.80%. The participants included 392 boys and 384 girls. Their age ranged from 12 to 18 (*Mean* = 15.23, *Standard Deviation* = 2.07). Before the investigation, the participants, guardians, and teachers were informed of the significance, methods, and precautions of this survey. Permission was obtained from the participants and their guardians, ensuring that they participated in this survey voluntarily. The study was approved by Ethics Committee of Zhejiang College of Zhejiang University of Technology (No. 2023008).

Inclusion criteria: (1) Middle school students aged 12–18; (2) Students who participated in this study voluntarily and were aware of the purpose and significance of this study; (3) Students who had normal reading and writing functions and without communication barriers. Exclusion criteria: (1) Students who took a leave of absence or transfer for some reason; (2) Students who could not understand the questionnaire or gave obviously regular responses in the questionnaire; (3) Students who had abnormal reading and writing functions and communication barriers due to special reasons.

#### Measures

(1) Exercise Atmosphere Scale (EAS) [17]. Referring to Liu et al. research, five measurement dimensions were formed: interpersonal correlation, natural correlation, information acquisition, interpersonal barriers, and conditional barriers [17]. This questionnaire includes 17 items (e.g., “None of my friends participate in physical exercise”). Scores on the scale are calculated using the Likert 5-point scale. 1 represents “nonconformity”; 5 represents “conformity”. The total score range of this scale is between 17 and 85. Cronbach’s of this scale in this study  $\alpha$  the coefficient is 0.857.

(2) Exercise Identity Scale (EIS) [18]. Role identity, ability identity, and behavioral identity were included with reference to Dong’s study. This scale includes 18 items (e.g., “I think I am an exercise enthusiast” and “Others think I am a person who regularly participates in exercise”). It contains 2 reverse items (e.g., “In fact, my exercise skills are not very good, which makes me unable to perform well in the exercise I love”). The total score can be used to measure

each participant’s level of exercise identity. Scores on the scale is calculated using the Likert 5-point scale. 1 represents “completely disagree”; 5 represents “completely agree”. The total score range of this scale are between 18 and 90. In this study, the Cronbach’s  $\alpha$  coefficient of this scale is 0.892.

(3) Self-Report Habit Index (SRHI) [19]. Self-Report Habit Index is an internationally recognized self-report tool used to assess habit intensity. The exercise habit scale used in this study includes three dimensions: lack of consciousness and conscious intention, lack of control, and efficiency and self-identity. It contains a total of 12 items (e.g., “I would naturally engage in physical exercise”). In this study, the Cronbach’s  $\alpha$  coefficient of this scale is 0.933. The total score range of this scale is between 12 and 60. It is a more accurate and reliable tool for assessing habit intensity.

(4) Physical Activity Rating Scale (PARS-3) [20]. The measurement of exercise behavior was conducted using PARS-3 created by Liang [20]. This scale includes 3 questions (i.e., “What is the intensity of your physical exercise?”, “How many minutes do you engage in the physical exercise activity of the intensity rated above each time?”, “How many times do you engage in the physical exercise activity of the intensity rated above each month?”) to examine the participant’s exercise intensity, time and frequency. Exercise grade = intensity  $\times$  time  $\times$  frequency. Intensity and frequency are divided into 5 grades. The score ranges from 1 to 5; time is divided into 1 to 5 grades. The score ranges from 0 to 4. The score in exercise grade ranges from 0 to 100 points, reflecting the degree of participation in different physical exercise activities. Exercise grade can be divided by the score into low-level exercise grade ( $\leq 19$  points), medium-level exercise grade (20–42 points), and high-level exercise ( $\geq 43$  points). In this study, the Cronbach’s  $\alpha$  coefficient of this scale is 0.985.

#### Procedure

This questionnaire survey was conducted through on-site filling. After obtaining consent from the school and students, the research team implemented collective questionnaire-filling in each class. Before the participants filled out the questionnaire, the teacher or researcher explained the specific requirements for filling out the questionnaire, read out the instruction, emphasized that no right or wrong answer existed, and required the participants to fill out all items quietly and independently. After the

participants finished answering, their copies of the questionnaire were immediately collected and checked. After the survey was completed, statistical software was used to perform inputting, summarizing, analysis and model-based testing of the data. According to the principle of anonymity, the participants only needed to express their own ideas without a distinction between the right and the wrong. The time for filling out the questionnaire was approximately 10–20 min.

#### Data analysis

SPSS 26.0 and Process statistical software were used in this study for data analysis. Harman univariate test was used to analyze common method bias. Pearson correlation was used to examine the correlation between the variables. The distribution was tested. The standard commonly used in academia for conducting normal distribution tests on data is that the absolute value of skewness is less than 3 and the absolute value of kurtosis is less than 8. Based on the analysis results, it can be concluded that the survey data conform to normal distribution and can be further analyzed. Regression analysis was used to examine the relationship between exercise atmosphere and exercise behavior. The standardized regression coefficient  $\beta$  represents the magnitude of the relationship between them. Model 6 from plugin Process 3.5 was used to test the chain mediating effect, and Bootstrap sampling was conducted 500 times to examine the magnitude of the mediating effect. A difference with  $p < 0.05$  was considered statistically significant.

## Results

#### Common method bias test

To reduce the common method bias caused by the self-report method, program control including emphasizing anonymity and confidentiality was implemented during the data collection process. Harman univariate test was used to test the effectiveness of program control. The four variables were

integrated into an exploratory factor analysis. The results (shown in Table 1) reveal 7 factors with eigenvalues greater than 1. The explanatory rate of the first factor is 28.36%, less than 40%. This suggests that the degree of variation of the common method in this study is within an acceptable range [21].

#### Correlation analysis

Pearson correlation analysis was conducted to examine exercise atmosphere, exercise identity, exercise habit, and exercise behavior. The results (shown in Table 2) indicate that there was a positive correlation between each two of exercise atmosphere, exercise identity, exercise habits, and exercise behavior ( $p < 0.01$ ).

According to statistics, 421 adolescents (49.1%) had a relatively low level of physical activity; 246 adolescents (28.7%) were at a moderate level of physical activity; Only 190 adolescents (22.2%) were at a high level of physical activity.

#### Hypothesis validation

Regression analysis was conducted using hierarchical regression on the relationship between exercise atmosphere and exercise behavior. The results show that exercise atmosphere can significantly positively predict exercise behavior ( $\beta = 0.608$ ,  $t = 22.377$ ,  $p < 0.001$ ). Thus, H1 was validated.

The correlation analysis results above indicate a significant positive predictive relationship between exercise atmosphere and exercise behavior. To further verify the relationship between these two variables, Model 6 in the Process program was used in this study to test the mediating effect of exercise identity and exercise habit on exercise atmosphere and exercise behavior. Exercise behavior was taken as the outcome variable; exercise atmosphere was taken as the independent variable; exercise identity and exercise habits were taken as the mediating variables. The results are shown in Table 3.

TABLE 1

#### Harman univariate test

Component	Initial feature value			Extracted sum of squared loads		
	Total	Variance%	Cumulative%	Total	Variance%	Cumulative%
1	16.73	28.36	28.36	16.73	28.36	28.36
2	7.36	12.48	40.84	7.36	12.48	40.84
3	5.25	8.89	49.73	5.25	8.89	49.73
4	5.07	8.59	58.31	5.07	8.59	58.31
5	4.48	7.59	65.90	4.48	7.59	65.90
6	2.49	4.23	70.13	2.49	4.23	70.13
7	1.08	1.83	71.96	1.08	1.83	71.96
8	0.56	0.95	72.90			
9	0.54	0.92	73.82			
10	0.49	0.84	74.66			

TABLE 2

Statistical description and correlation coefficient matrix of exercise atmosphere, exercise identity, exercise habit, and exercise behavior

Variable	M	SD	Score range	1	2	3	4
1 EA	54.741	16.885	17–85	1			
2 EI	47.753	18.581	18–90	0.459**	1		
3 EH	34.251	9.685	12–60	0.434**	0.395**	1	
4 EB	28.914	12.835	0–100	0.608**	0.484**	0.698**	1

Note: \*\* $p < 0.01$ , EA = Exercise atmosphere, EI = Exercise identity, EH = Exercise habit, EB = Exercise behavior, SD = Standard deviation, M = Mean.

TABLE 3

Testing of different models for regression analysis among exercise atmosphere, exercise identity, exercise habit, and exercise behavior

Model	Variable	NSC	SE	$\beta$	$t$	$p$	CS		$R$	$R^2$	$F$
							Tolerance	VIF			
1 (PV: EI)	EA	0.505	0.033	0.459	15.104	0.000	1	1	0.459	0.211	228.129
2 (PV: EH)	EI	0.129	0.018	0.248	7.377	0.000	0.789	1.267	0.486	0.237	132.321
	EA	0.183	0.019	0.320	9.497	0.000	0.789	1.267			
3 (EB)	EH	1.358	0.069	0.490	19.669	0.000	0.763	1.31	0.595	0.594	418.388
	EI	0.194	0.037	0.135	5.323	0.000	0.742	1.348			
	EA	0.518	0.041	0.326	12.637	0.000	0.714	1.401			

Note: SE = Standard error,  $\beta$  = Standardized coefficient, NSC = Non-standardized coefficient, CS = Collinearity statistics, EA = Exercise atmosphere, EI = Exercise identity, EH = Exercise habit, EB = Exercise behavior, PV = Predictive variable, VIF = Variance inflation factor.

According to Table 3, regression analysis was conducted under Model 1. Exercise atmosphere is the independent variable; exercise identity is the dependent variable. The regression coefficient is significant ( $\beta = 0.459$ ,  $t = 15.104$ ,  $p < 0.001$ ).

Regression analysis was conducted under Model 2. Exercise habit is the dependent variable; exercise identity and exercise atmosphere are the independent variables. According to the results, exercise atmosphere and exercise identity can significantly positively predict physical exercise habits ( $p < 0.001$ ).

Regression analysis was conducted under Model 3. Exercise behavior is the dependent variable; exercise habit, exercise identity and exercise atmosphere are the independent variables. According to the results, exercise

habit, exercise identity and exercise atmosphere all can positively predict exercise behavior ( $p < 0.001$ ).

Afterwards, a bootstrapping sample with a capacity of 5000 was generated to conduct 95% confidence interval test. The results are shown in Table 4. The mediating effect of Mediating Pathway 1 is 0.062. It is significant with a Percentile 95% CI of [0.041, 0.085]. This indicates that exercise identity plays a mediating role in the relationship between exercise atmosphere and exercise behavior. H2 can thereby be validated. The mediating effect of Mediating Pathway 2 is 0.157. It is significant with a Percentile 95% CI of [0.124, 0.191]. This indicates that exercise habit plays a mediating role in the relationship between exercise atmosphere and exercise behavior. H3 can thereby be validated. The mediating effect of Mediating Pathway 3 is

TABLE 4

Bootstrap analysis of the mediating effect of exercise identity and exercise habit

Influencing pathway	Effect value	Effect ratio	Boot standard error	Boot CI lower limit	Boot CI upper limit
Total effect	0.733			0.868	0.930
Direct effect	0.459	62.62%	0.033	0.437	0.598
Total indirect effect	0.274	37.28%	0.019	0.239	0.312
Mediating Pathway 1: EA -> EI -> EB	0.062	8.46%	0.011	0.041	0.085
Mediating Pathway 2: EA -> EH -> EB	0.157	21.42%	0.017	0.124	0.191
Mediating Pathway 3: EA -> EI -> EH -> EB	0.056	7.64%	0.008	0.041	0.072

Note: EA = Exercise atmosphere, EI = Exercise identity, EH = Exercise habit, EB = Exercise behavior.



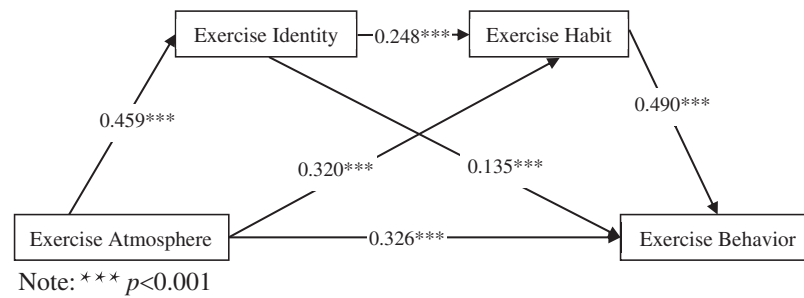


FIGURE 2. Chain mediating model.

0.056. It is significant with a Percentile 95% CI of [0.041, 0.072]. This indicates that exercise identity and exercise habit play a significant chain mediating role in the relationship between exercise atmosphere and exercise behavior. Thus, H4 can be validated. The details are shown in Fig. 2.

## Discussion

The objective of this study was to explore the impact of exercise atmosphere on adolescents' exercise behavior, as well as the mediating role of exercise identity and exercise habit. A survey was conducted on 806 Chinese adolescents using relevant measurement scales. The results show that exercise atmosphere not only directly affects adolescents' exercise behavior, but also indirectly affects their exercise behavior through the mediating effect of exercise identity and exercise habit. There are three mediating pathways: the mediating pathway through exercise identity, the mediating pathway through exercise habit, and the chain mediating pathway through exercise identity and exercise habit.

### *The relationship between exercise atmosphere and adolescents' exercise behavior*

It was found in this study that 49.1% of adolescents had relatively low levels of physical grade, which means that nearly half of them had low-level physical grade. This research result is consistent with the result reported by Zhang et al. [22]. The lack of physical exercise among adolescents has become an urgent problem to be solved, because it may have a negative impact on adolescents' physical health. It was also found that exercise atmosphere has a direct predictive effect on adolescents' exercise behavior. It means that a more favorable exercise atmosphere is more likely to promote adolescents' exercise behavior. This is consistent with previous research findings [23,24]. Empirical studies have shown that parental support [23] and school atmosphere [25], as important exercise atmospheres, can positively predict adolescents' exercise behavior. This suggests that schools need to take more measures. For example, schools can optimize the ways of organizing physical exercise activities, actively carry out fun sports, sports competitions and other activities, and create a good exercise atmosphere, thereby cultivating adolescents' exercise awareness and increasing their physical exercise. Meanwhile, parents should actively motivate their children to engage in physical exercise, encourage them to master more exercise skills, and cultivate their interest in sports.

Firstly, according to Bandura's Social Cognitive Theory, a positive and dense exercise atmosphere can stimulate adolescents' interest and enthusiasm to participate in exercise activities [25]. In a favorable exercise atmosphere, adolescents are more likely to see their peers actively taking part in physical exercise and gaining pleasure and a sense of achievement from it, thus having a desire to imitate and participate. Secondly, a well-established exercise atmosphere is often accompanied by sufficient exercise resources, facilities, and options, which can provide adolescents with convenient exercise conditions and further promote their exercise behavior [26]. Thirdly, a positive exercise atmosphere is conducive to establishing long-term exercise culture. The creation of a positive exercise atmosphere should focus on the construction of long-term exercise culture. It can make exercise behavior a habit and way of life in society. With the continuous dissemination of exercise concepts, cultivation of exercise awareness, and sustained provision of exercise opportunities and resources, individuals can gradually form a more positive exercise behavior, thereby contributing to the healthy development of the entire society.

According to the discussion above, the creation of a positive exercise atmosphere has a significant direct predictive effect on the cultivation of exercise behavior among adolescents. Therefore, attention should be paid to constructing and optimizing the exercise environment from multiple dimensions. Efforts are needed to guide and motivate adolescent to actively participate in physical exercise during their growth, thus ensuring their physical and mental health.

### *Analysis of the mediating effect of exercise identity*

It was found in this study that exercise identity mediated the predictive effect of exercise atmosphere on exercise behavior. This indicates that the significant positive predictive effect of exercise atmosphere on adolescents' exercise behavior is mediated by exercise identity to some extent. Adolescents with a stronger sense of exercise identity are more willing to engage in physical exercise. This is consistent with previous research findings [27-29].

On the one hand, exercise atmosphere plays an important role in promoting the formation of exercise identity. First of all, a favorable exercise atmosphere conveys positive and upward social norms and expectations. A positive exercise atmosphere typically views physical exercise as a positive behavior and also as a part of social norms [30]. Under such circumstances, individuals are more likely

to accept and identify with physical exercise in view of its alignment with the expectations and values of the social group they are situated. Secondly, a positive exercise atmosphere shapes individuals' identity recognition and enhances their sense of belonging. Emphasizing values such as teamwork and healthy lifestyles in a positive exercise atmosphere can encourage individuals to incorporate physical exercise into their identity recognition and develop a sense of belonging to exercise [6,31]. This sense of belonging reinforces individuals' sense of identity with physical exercise, which in turn affects their exercise behavior. Finally, in a favorable exercise atmosphere, adolescents have the opportunity to observe how their peers and role models actively participate in physical exercise. They can thereby experience the fun, challenges, and sense of achievement brought by exercise. This intuitive demonstration effect works in stimulating their interest in and identity with physical exercise.

On the other hand, exercise identity has a significant positive promoting effect on individuals' exercise behavior. Firstly, exercise identity can enhance one's motivation and attitude towards participating in exercise behavior. A high level of exercise identity means that individuals have a positive attitude and view of values towards physical exercise. Particularly, they view participating in exercise as an important way to achieve self-realization, ensure health, and improve quality of life. This internal motivation encourages them to actively seek opportunities to participate in and persist in physical exercise in their daily lives. Secondly, exercise identity contributes to behavioral consistency [32]. Individuals with a high level of exercise identity typically behave consistently with their identity. Specifically, they participate more frequently in exercise activities. Driven by their recognition that physical exercise is one of their parts, they work harder to practice this recognition and behave more actively in physical exercise [33,34]. Accordingly, the exercise atmosphere plays a promoting and catalytic role in the formation of exercise identity [32]. It makes adolescents more willing to accept and internalize exercise as a key component of their identity and ultimately transform it into practical action through actively participating in physical exercise.

Based on the discussion above, exercise identity, as a mediating variable, constructs a psychological bridge from cognition to action in the individual. It not only explains how exercise atmosphere indirectly affects exercise behavior, but also reveals an effective pathway to enhance the public's enthusiasm for physical exercise (i.e., cultivating exercise identity).

#### *Analysis of the mediating effect of exercise habit*

It was found in this study that exercise atmosphere predicted exercise behavior through exercise habit. Accordingly, a favorable exercise atmosphere strongly drives adolescents to develop a positive exercise habit; this exercise habit further significantly promotes their exercise behavior. This is consistent with previous research findings [35].

On the one hand, exercise atmosphere, as an important environmental factor, has a shaping and motivating effect on adolescents' exercise behavior. The formation of exercise

habits requires a long-term process, influenced by some internal factors in individuals and the external environment. These internal factors include personal motivation, attitude, self-efficacy, etc., while the external environment involves factors such as family, school, society, etc. [36]. Exercise atmosphere plays an important role in this process. An environment featuring vitality, encouraging participation, and respecting the value of exercise can better stimulate adolescents' enthusiasm and passion for physical exercise, gradually shaping stable exercise habits. In addition, a favorable exercise atmosphere usually provides rich and diverse exercise facilities, activities, and resources, making it easier for individuals to obtain opportunities and conditions for exercise. Schools or communities can create a favorable exercise atmosphere by providing resources such as gyms, exercise venues, and coach guidance, which are conducive to forming and maintaining exercise habits among individuals [34].

On the other hand, exercise habit promotes individuals' exercise behavior by bringing them positive self-perception and identity recognition, self-regulation and goal setting, optimistic emotions and affirmative physical perception. First of all, individuals who have developed exercise habit often view exercise as a part of their lives, and this identity recognition encourages them to participate more frequently in exercise behavior for the purpose of maintaining their image and self-awareness [36]. Secondly, individuals with healthy exercise habit typically have stronger abilities in self-regulation and goal setting [37]. They consciously schedule their time for exercise and set clear exercise goals, thereby having more proactive performance in participating in various exercise activities. Finally, exercise habit drives individuals to experience the positive emotions and physical perception that exercise brings, as well as the pleasure, sense of energy, and physical comfort arising from exercise. These experiences can enhance individuals' positive evaluation of exercise, thereby increasing their participation in exercise behavior. Once adolescents have developed a habit of regular and continuous exercise, this habit will be internalized into a self-driving force. This force would prompt them to actively engage in physical exercise, thereby shaping stable exercise behavior.

Based on the discussion above, exercise habit, as a mediating variable, plays a bridging role between exercise atmosphere and exercise behavior and transforms external environmental impact into internal behavioral motivation. Exercise atmosphere plays an important role in cultivating exercise habit among adolescents; a well-established exercise habit is the key driving force behind their implementation of exercise behavior.

#### *Analysis of the chain mediating effect of exercise identity and exercise habit*

It was found in this study that exercise identity and exercise habit played a chain mediating role in the impact of exercise atmosphere on adolescents' exercise behavior. This indicates that exercise atmosphere can significantly positively predict adolescents' exercise behavior through the single mediating effect of exercise identity and exercise habit. It may also affect adolescents' exercise behavior through the joint chain

mediating effect of exercise identity and exercise habit. Studies both in China and internationally have shown that the exercise atmosphere plays an important role in promoting adolescents' exercise identity and exercise habits [5,38]. They are all factors that contribute to exercise behavior. This conclusion can be enriched by the finding of this study that an exercise atmosphere ultimately promotes exercise behavior among adolescents through exercise identity and exercise habit. A positive exercise atmosphere can give rise to exercise identity. Meanwhile, when individuals have acquired a strong sense of exercise identity, they are more likely to integrate physical exercise into their daily lives, turning it into a regular habit. Besides, long-term stable exercise habit is undoubtedly a key factor which functions in maintaining and improving physical health. This finding enriches the current understanding of the determinants of adolescents' exercise behavior and provides a theoretical basis to formulate more scientific and effective intervention strategies aiming to ensure adolescents' active participation in physical exercise.

#### *Strengths and limitations*

Despite the pursuit of preciseness and objectivity in the research process, this study still has some limitations. Firstly, the questionnaire survey method used in this study belongs to a design involved in cross-sectional studies, which has certain limitations. Longitudinal studies or clever experiments can be used in future research to explore the causal relationship between exercise atmosphere and adolescents' exercise behavior. Secondly, although the results of this study show that exercise atmosphere has a significant predictive effect on adolescents' exercise behavior, the significance of exercise atmosphere as an important external environment for adolescents' quality development is not confined to this conclusion. At last, only self-report measures were used, which has certain limitations. It may lead to poor objectivity of the data, in that people may overestimate their exercise identity or habit. Therefore, more attention should be paid in future research to examine the positive impact of exercise atmosphere and explore more diverse and effective ways to promote adolescents' full-range development.

The findings of this study indicate three recommendations to promote adolescents' exercise behavior. Firstly, efforts should be made to establish a positive exercise atmosphere. The school, community, and family should work together to create a positive exercise atmosphere. The school is advised to increase the diversity of physical education and encourage students to participate in on-campus exercise activities. The community can provide various exercise clubs and outdoor exercise programs. Family members can participate in exercise activities together and become exercise role models for children. Secondly, it is important to cultivate exercise identity among adolescents, encourage them to establish a sense of identity-related to exercise, and bring them a healthy and positive perception towards participating in exercise activities. Their exercise identity can be strengthened by highlighting their exercise achievements, encouraging them to try new exercise programs, and sharing

their exercise experience with others. Thirdly, it is necessary to cultivate healthy exercise habits. Adolescents should be assisted in developing the habit of continuous exercise through formulating exercise plans, offering regular supervision and encouragement, and establishing inspiring self-motivation mechanisms.

#### **Conclusions**

A quantitative research method was adopted for the questionnaire survey in this study to explore the impact of exercise atmosphere on adolescents' exercise behavior and the corresponding mechanism. The results of this study show that exercise atmosphere not only directly affects adolescents' exercise behavior, but also indirectly affects their exercise behavior through the mediating effect of exercise identity and exercise habit, including three mediating pathways, namely, the mediating pathway through exercise identity, the mediating pathway through exercise habit and the chain mediating pathway through exercise identity and exercise habit.

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**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.

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