

# Effect of physical activity volume on active coping style among martial arts practicing adolescents: the mediating role of self-efficacy and positive affect

## Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation
- E Funds Collection

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## Abstract

### Background and Study Aim:

Coping style is an important psychological factor for adolescents. Martial arts, as forms of physical activity (PA), have a positive effect on the physical and psychological growth of adolescents. However, the internal mechanisms underlying the impact of physical activity volume (PAV) on the coping styles of adolescents are still unclear. Therefore, the aim of the current study was the knowledge about the intrinsic links between PAV and active coping style (ACS) among martial arts practicing adolescents and the possible mechanisms involved.

### Material and Methods:

This study included 403 Chinese adolescent practitioners of martial arts (mean age 13.66 ± 1.14 years, mean duration of practice 1.36 ± 1.33 years), and we analyzed the questionnaires designed to assess their PAV, general self-efficacy, positive affect, and (ACS).

### Results:

Different physical activity levels had significant effects on self-efficacy, positive affect, and ACS in martial arts practicing adolescents. PAV was positively correlated with self-efficacy, positive affect, and ACS; self-efficacy was positively correlated with positive affect and ACS; and positive affect was positively correlated with ACS. The structural equation model revealed that self-efficacy and positive affect played mediating effects between PAV and ACS in martial arts practicing adolescents.

### Conclusions:

We suggest that primary and secondary schools should encourage students to take part in moderate- to high-intensity physical activity to enhance self-efficacy and positive affect, thereby improving their coping style.

### Keywords:

General Self-Efficacy Scale • mediating effect • Physical Activity Ranking Scale (PARS-3) • Positive Affect Scale • sports psychology

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**Physical activity volume** – *noun* refers to the amount of exercise examined in three aspects: intensity, time, and frequency of exercise [33].

**Active coping style** – *noun* the active cognition and behavior that an individual makes when facing pressure to reduce its negative effects [36].

**Self-efficacy** – *noun* refers to people's control and dominance of their own behavior, and reflects the belief that individuals can take appropriate behaviors to face environmental challenges [34].

**Positive affect** – *noun* as is an important psychological factor in the process of coping with stress and it may predict individual active behavior [22].

**Mediating effect** – *noun* in statistics, a mediation model seeks to identify and explain the mechanism or process that underlies an observed relationship between an independent variable and a dependent variable via the inclusion of a third hypothetical variable, known as a mediator variable (also a intermediary variable, or intervening variable).

**Physical activity** – *noun* exercise and general movement that a person carries out as part of their day [55].

**Sports psychology** – *noun* the scientific study of the mental state of sportspeople, looking at issues such as motivation, concentration, stress and self-confidence [55].

## INTRODUCTION

In recent years, the incidence of psychological and behavioral problems and the prevalence of mental disorders have been gradually increasing in adolescents. These are becoming important public health problems and are of concern to society in general. Coping style has been shown to have a significant impact on social adjustment and the mental health of adolescents [1]. Coping style is the process by which an individual deals with stressful situations through emotion, cognition or behavior [2]. According to the theory of resilience, active coping style (ACS) is a protective factor to reduce an individual's psychological distress [3]. Adolescents are at a critical period of rapid growth, and they are faced with multiple challenges, such as their academic and social progress. Different coping styles have different effects on their physical and mental development. Traditional coping theory states that active coping strategies can improve the resilience of adolescents [4], and the adoption of ACS can prevent the exhibition of negative behaviors, such as drug use and internet addiction, among adolescents [5, 6]. However, the use of passive coping styles, such as avoidant coping, can hinder the physical and mental development of adolescents [7].

Within the discipline of exercise psychology, physical activity (PA) has a positive effect on coping style. PA can provide emotional regulation, eliminate or alleviate adverse stress reactions, and improve an individual's mental health. Adolescents can improve their self-cognition and reduce stress reactions after PA, thereby eliciting more mature strategies for dealing with stressful events [8]. In China, martial arts, as a mainstream sport, is loved by adolescents and valued by the country's population in general. In the field of sports psychology, martial arts practice has gradually become a popular active coping strategy and has been successfully used to help adolescents improve their coping style. Specifically, a randomized controlled trial found that individuals who participated in martial arts training had higher self-esteem, higher self-efficacy and lower aggression [9].

Martial arts athletes develop higher levels of confidence than track and field athletes and adopt more effective strategies to cope with stressful events, such as using task-oriented coping [10]. According to existing reports, young people who engage in martial arts practice can apply the coping styles used in training to other aspects of their lives, allowing them to cope more effectively in the face of stressful events. Most studies have found

that the amount of PA can affect the ACS of young people, but there has been little study exploring the intrinsic mechanisms between the PAV of martial arts practicing adolescents and ACS. Therefore, this study further explored the impact of PAV on the ACS of martial arts practicing adolescents.

PA plays a vital role in improving self-efficacy. Most studies have revealed that self-efficacy positively correlates with PA and this association varies with PAV [11, 12]. Low self-efficacy positively correlates with a lower PAV; adolescents with higher self-efficacies engage in more vigorous PA [13]. Researchers have reported that individuals' self-efficacy and adaptability are improved after adoption of martial arts intervention [14]. Self-efficacy is the core concept of Bandura's social cognition theory, reflecting the ability of individuals to take appropriate actions in the face of environmental challenges and influencing individual behavior [15]. Coping style is an expression of individual behavior and is affected by a person's psychology, and it is directly subject to a person's sense of self-efficacy [16].

Previous studies revealed that self-efficacy was positively correlated with coping style. Individuals with high self-efficacy score are more confident of adopting active coping strategies to solve problems, while individuals with low self-efficacy tend to choose negative coping strategies when faced with stress [17, 18]. Furthermore, scholars often add some mediating factors to explore the mechanisms behind the effect of PA on mental health [19], and studies have shown that self-efficacy may be an important mediator between physical exercise and ACS in adolescents [20]. Wang et al. [21] believe that physical exercise has a significant impact on an individual's sense of self-efficacy; the relationship between moderate- and high-intensity physical exercise and parental support is realized through self-efficacy.

Positive affect is an important psychological factor in the process of coping with stress and it may predict individual active behavior [22]. Folkman and Moskowitz [23] provided evidence that positive affect is very effective for relieving stress and improving coping capacity, and it has a considerable impact on an individual's ACS when they are faced with stressful events. As part of a healthy lifestyle, physical exercise can prevent disease and improve an individual's mental health by providing positive emotional experiences [24]. Studies on middle-school students showed that PA not

only promoted their positive emotion directly but also indirectly by improving their physical self-esteem [25]. Guo [26] found that the frequency and duration of physical activities are positively correlated with positive affect: the longer the PA, the higher the positive affect will be. Furthermore, individuals find it easier to produce positive affect during the process of physical exercise [27]. Positive affect can relieve stress, thus promoting the adoption of ACS [28]. In addition, previous studies have suggested gender differences in the PAV of male and female students. The PAV of male students was significantly higher than that of female students [29]. Therefore, gender is one of the most important factors influencing the PA.

In summary, studies have suggested that PA, self-efficacy, positive affect, and ACS are positively correlated, and improvement in self-efficacy conduces to a person being better able to cope with stressful events [12, 30]. Individuals with high self-efficacy can effectively control their negative affect and show more positive affect and coping strategies [31]. Studies have shown that sports can improve college's emotional intelligence, allowing them to adopt more effective coping styles towards stressors [32]. In conclusion, few studies have investigated the internal mechanisms linking the PA volume and ACS of martial arts practicing adolescents.

Therefore, the aim of the current study was the knowledge about the intrinsic links between PAV and ACS among martial arts practicing adolescents and the possible mechanisms involved.

We verify the following hypotheses: H1: PAV positively correlated with self-efficacy, positive affect, and ACS among martial arts practicing adolescents; H2: Self-efficacy was positively correlated with positive affect and ACS, positive affect positively correlated with and ACS among martial arts practicing adolescents; H3: self-efficacy plays a mediating effect between PAV and ACS among martial arts practicing adolescents; H4: positive affect plays a mediating effect between PAV and ACS among martial arts practicing adolescents.

## MATERIAL AND METHODS

### Sample

This study distributed 430 questionnaires in China, and a total of 403 valid ones were returned, with a response rate of 93.7%. Participants were 403

martial arts practicing adolescents (351 males, 52 females) from two middle schools. The sample consisted of 64 sixth graders, 117 seventh graders, 138 eighth graders and 84 ninth graders. Participants' ages ranged from 12 to 18 years (mean  $13.66 \pm 1.14$ ). All participants practiced martial arts, and their mean duration of practice was  $1.36 \pm 1.33$  years). In this study, 384 participants under 16 years of age and have obtained written informed consent from the parents/legal guardians.

### Procedure

This study adopted a cluster sampling method to identify subjects. A total of 403 martial arts practicing adolescents from two middle schools of Guizhou and Guangxi province were invited to engage in our survey. The survey was implemented in classrooms, and approvals were acquired from the schools and parents of the students. Before administering the questionnaire, participants read information on the study and consented to their participation. This study emphasized the information of participants was completely voluntary and anonymous. All questionnaires took approximately 20 minutes to complete.

The design of this study was permitted by the Southwest University's Human Research Ethics Committee. Prior to initiation of the study, all participants acquired written informed consent in accordance with the Declaration of Helsinki.

### Measures

#### *Physical activity ranking scale*

We adopted the Chinese version of the Physical Activity Ranking Scale (PARS-3) modified by Liang [33], which gathers information on intensity, time, and frequency of PA to assess the PAV of martial arts practicing adolescents.

The questionnaire contained three aspects in total. One question focused on physical activity intensity, (e.g., "How your physical activity intensity each time?", answer: 1 = less than 10 minutes, 2 = 11 to 20 minutes, 3 = 21 to 30 minutes, 4 = 31 to 59 minutes, 5 = more than 60 minutes); second question focused on physical activity time, (e.g., "How many minutes do you spend on physical activity at a time?", answer: 1 = less than once a month, 2 = 2-3 times a month, 3 = 1-2 times a week, 4 = 3-5 times a week, 5 = approximately 1 time a day); and third question focused on physical activity frequency, (e.g., "How many times did you participate in physical activity?", answer: 1 = no feeling, 2 = slightly hot

all over, 3 = slightly sweating, 4 = moderate sweating, 5 = sweating profusely). The PAV was calculated by  $\text{strength} \times (\text{time}^{-1}) \times \text{frequency}$ , and every index was divided into five ranks. PAV ranged from 0 point (low) to 100 points (high). According to the PA score, PAV was divided into low, moderate, and high categories: low PA intensity  $\leq 19$  points, moderate PA intensity 20–42 points, and high PA intensity  $\geq 43$  points. The questionnaire's retest reliability was  $\alpha = 0.82$  [33].

### **General self-efficacy scale**

A modified Chinese version of the General Self-Efficacy Scale was adapted to evaluate the sense of self-efficacy of martial arts practicing adolescents [34]. Ten items were presented to the participants, such as “when I have a problem, I always find a solution”. Each item had to be answered on a scale of 1 (completely incorrect) to 4 (completely correct). Cronbach's  $\alpha$  of the self-efficacy scale was 0.64 in our sample. The results of confirmatory factor analysis for self-efficacy scale showed (CFA):  $\chi^2/df = 1.18$ , standardized root mean square residual (SRMR) = 0.03, root mean square error of approximation (RMSEA) = 0.02, goodness of fit index (GFI) = 0.98, Tucker-Lewis index (TLI) = 0.97, comparative fit index (CFI) = 0.98, incremental fit index (IFI) = 0.98, normed fit index (NFI) = 0.90, indicating that the questionnaire had good model fit.

### **The positive affect scale**

This study adopted the Positive Affect Scale [35]. The scale included 10 items and was used to investigate the positive affect experience of martial arts practicing adolescents. Each item had to be answered on a scale of 1 (scarcely) to 5 (very much). Cronbach's  $\alpha$  of the positive affect scale was 0.75 in our sample. The confirmatory factor analysis results for positive affect scale showed (CFA):  $\chi^2/df = 1.26$ , SRMR = 0.04, RMSEA = 0.03, GFI = 0.98, TLI = 0.98, CFI = 0.99, IFI = 0.99, NFI = 0.94, indicating that the questionnaire had good model fit.

### **Active coping style scale**

This study adopted the Active Coping Style (ACS) scale by Huang et al. [36]. The scale mainly examined the active coping ability of martial arts practicing adolescents, which included problem solving (eight items) and asking for help (seven items). Each item had to be answered on a scale of 1 (never) to 5 (always). The Cronbach's  $\alpha$  of problem solving subscale was 0.76 and asking for help subscale was 0.73 in our sample. The

confirmatory factor analysis results for the ACS scale showed good model fit (CFA):  $\chi^2/df = 1.25$ , SRMR = 0.04, RMSEA = 0.02, GFI = 0.97, TLI = 0.97, CFI = 0.98, IFI = 0.98, NFI = 0.93, indicating that the scale had good structural validity. Cronbach's  $\alpha$  of the total scale was 0.84 in our sample, with high reliability.

### **Testing for common method bias**

This study collected data through using questionnaires, which may exist common method bias. To combat this, we study applied the method recommended by previous scholars to control for common method bias [37]. Harman's single factor test was implemented to prove for common method bias.

## **STATISTICAL ANALYSIS**

In this study, SPSS 22.0 was used for statistical analyses (including reliability and validity test, descriptive statistics, an independent sample t-test, one-way ANOVA, and Pearson correlation analysis). AMOS21.0 was adopted when establishing the structural model, based mainly on the mediation effect test by Wen and Ye [38]. Prior to the establishment of the structural equation model, confirmatory factor analysis was performed to evaluate the goodness-of-fit of the measurement model with AMOS21.0. To test the adequacy of the estimated model, we used  $\chi^2/df$ , RMSEA, GFI, TLI, CFI, IFI, NFI, and the standardized root mean square residual (SRMR). Good model fit was defined by a  $\chi^2/df$  value range from 1 to 3; TLI, IFI, and NFI greater than 0.9 [38]; and GFI and CFI greater than 0.9, as recommended by Salisbury et al. (2002) [39]. For the RMSEA and SRMR, effect values less than 0.08 represented an acceptable fit and less than 0.05 suggested a good fit [40].

According to existing studies and the relationships between variables, structural equation modeling was applied to examine the intrinsic mechanisms among the variables with PA volume as the exogenous (“independent”) variable and ACS as the endogenous (“dependent”) variable after controlling for gender and years of exercise. In this study 2,000 samples were repeatedly selected by a percentile bootstrap method for mediating effect test. If the 95% CI of the mediating effect did not include 0, the mediating effect was significant; otherwise, the mediating effect was not significant. Based on the procedure for

mediating effects test [38], at first, this study test the direct effect of PAV on ACS, followed by the fitness of the model and the significance of each path effect after adding the mediating variable.

The estimation of the results is based on the following indicators: mean (M); standard deviation (SD or  $\pm$ ); correlation coefficient, empirical (*r*); distribution, F-Snedecor statistics, result of the analysis of variance (*F*); significance level, probability (*p*); chi-squared test ( $\chi^2$ ); degrees of freedom (*df*); the significance level  $\alpha$  is the threshold for *p* below which the null hypothesis is rejected even though by assumption it were true, and something else is going on ( $\alpha$ ); type II error, false negative (probability =  $\beta$ ); confidence interval (CI).

## RESULTS

### Demographic differences among variables

There was a significant gender difference for PAV ( $t = -1.20, p < 0.05$ ), with boys' PAV (M = 32.43, SD = 1.73) being higher than girls (M = 24.97, SD = 3.46). This study found no statistical differences for self-efficacy, positive affect, and ACS.

An ANOVA of the different PAV with regards to self-efficacy, positive affect, and ACS among

martial arts practicing adolescents indicated significant results. There were significant differences among (1) self-efficacy scores ( $F = 6.02, p < 0.01$ ; i.e., high PA intensity > moderate PA intensity and high PA intensity > low PA intensity); (2) positive affect scores ( $F = 5.94, p < 0.01$ ; i.e., high PA intensity > moderate PA intensity); and (3) ACS scores ( $F = 8.07, p < 0.001$ ; i.e., high PA intensity > moderate PA intensity and high PA intensity > low PA intensity) (Table 1).

### Correlation analysis

PAV was positively correlated with self-efficacy ( $r = 0.13$ ), positive affect ( $r = 0.15$ ), and ACS ( $r = 0.16$ ). In addition, self-efficacy was positively correlated with positive affect ( $r = 0.29$ ) and ACS ( $r = 0.44$ ); and positive affect was positively correlated with ACS ( $r = 0.43$ ). Moreover, gender was positively correlated with PAV ( $r = -0.11$ ) (Table 2). Therefore, H1 and H2 were confirmed.

### The mediating effects of positive affect and self-efficacy

The fitness indicators of the SEM direct effect analyses results were as follows:  $\chi^2/df = 1.26$ , SRMR = 0.01, RMSEA = 0.02, GFI = 0.99, TLI = 0.94, CFI = 0.98, IFI = 0.98, NFI = 0.92. The direct path effect value of PAV on ACS was significant ( $\beta = 0.15, p < 0.01$ ).

**Table 1.** Differences in self-efficacy, positive affect and ACS among martial arts practicing adolescents (n = 403) with different PAV

Variable	Low PA intensity (a)	Moderate PA intensity (b)	High PA intensity (c)	F	p	Multiple comparison
	M, SD	M, SD	M, SD			
Self-efficacy	2.35 ± 0.41	2.37 ± 0.43	2.52 ± 0.44	6.02**	0.003	>a, >b
Positive affect	2.87 ± 0.59	2.79 ± 0.67	3.05 ± 0.65	5.94**	0.003	>b
ACS	2.66 ± 0.67	2.82 ± 0.68	3.01 ± 0.60	8.07***	0.000	>a, >b

Note: **PA**: physical activity; **ACS**: active coping style; statistically significant: \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

**Table 2.** Descriptive statistics and correlations between variables (n = 403).

Variable	1	2	3	4	5
1. Gender	1				
2. Physical activity volume	-0.11*	1			
3. Self-efficacy	-0.01	0.13**	1		
4. Positive affect	0.01	0.15**	0.29**	1	
5. Active coping style	0.06	0.16**	0.44**	0.43**	1
M	1.13	55.68	2.46	2.97	2.92
SD	0.33	31.74	0.44	0.66	0.64

Note: statistically significant: \* $p < 0.05$ ; \*\* $p < 0.01$ .

Self-efficacy was taken as mediating variables between PAV and ACS in martial arts practicing adolescents and the fitness results were significant:  $\chi^2/df = 1.57$ , SRMR = 0.01, RMSEA = 0.03, GFI = 0.99, CFI = 0.98, TLI = 0.96, IFI = 0.98, NFI = 0.97. The path effect value between PAV and self-efficacy ( $\beta = 0.13$ ,  $p < 0.01$ ), self-efficacy and ACS ( $\beta = 0.43$ ,  $p < 0.001$ ), PAV and ACS ( $\beta = 0.11$ ,  $p < 0.05$ ), gender and PAV ( $\beta = -0.11$ ,  $p < 0.05$ ). However, after adding the mediating variables of self-efficacy, the path effect between PAV and ACS changed from being significant ( $\beta = 0.15$ ,  $p < 0.01$ ) to non-significant ( $\beta = 0.11$ ,  $p < 0.05$ ), which showed that the mediating effects of PAV → self-efficacy → ACS were significant, the 95% CI was (0.015, 0.104) (Table 3, Figure 1).

Positive affect was taken as mediating variables between PAV and ACS in martial arts practicing adolescents and the fitness results were significant:  $\chi^2/df = 1.31$ , SRMR = 0.01, RMSEA = 0.02, GFI = 0.99, CFI = 0.99, TLI = 0.98, IFI = 0.99,

NFI = 0.97. The path effect value between PAV and positive affect ( $\beta = 0.15$ ,  $p < 0.01$ ), positive affect and ACS ( $\beta = 0.42$ ,  $p < 0.001$ ), PAV and ACS ( $\beta = 0.10$ ,  $p < 0.05$ ), gender and PAV ( $\beta = -0.11$ ,  $p < 0.05$ ). However, after adding the mediating variables of positive affect, the path effect between PAV and ACS changed from being significant ( $\beta = 0.15$ ,  $p < 0.01$ ) to non-significant ( $\beta = 0.10$ ,  $p < 0.05$ ), which showed that the mediating effects of PAV → positive affect → ACS were significant, the 95% CI was (0.024, 0.110). As such, the results showed that positive affect and self-efficacy played partial mediating effects on the link between PAV and ACS among martial arts practicing adolescents (Table 4, Figure 2).

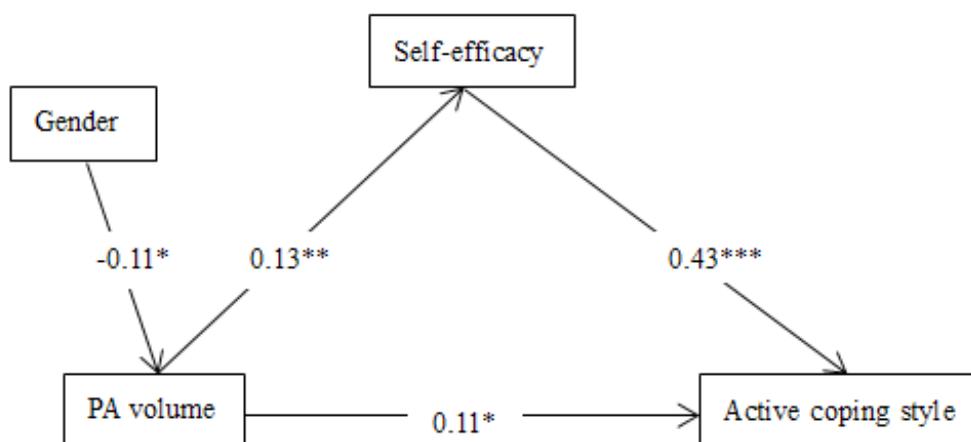
### DISCUSSION

In this study, the significant correlations between the variables laid the foundation for the subsequent mediating effect test. The results showed that there were 11 factors with an eigenvalue

**Table 3.** Path weight coefficient statistics table.

Path	Boot SE	CR	Direct effect	Indirect effect	95% CI
Gender → PAV	0.14	-2.29	-0.11		(-0.193, -0.032)
PAV → SE	0.04	2.67	0.13		(0.034, 0.230)
SE → ACS	0.04	9.50	0.43		(0.342, 0.503)
PAV → ACS	0.04	2.50	0.11		(0.023, 0.197)
PAV → SE → ACS				0.13×0.43 = 0.055	(0.015, 0.104)

Note: **PAV**: physical activity volume; **ACS**: active coping style; **Boot SE**: bootstrap standard error; **CR**: critical ratio.

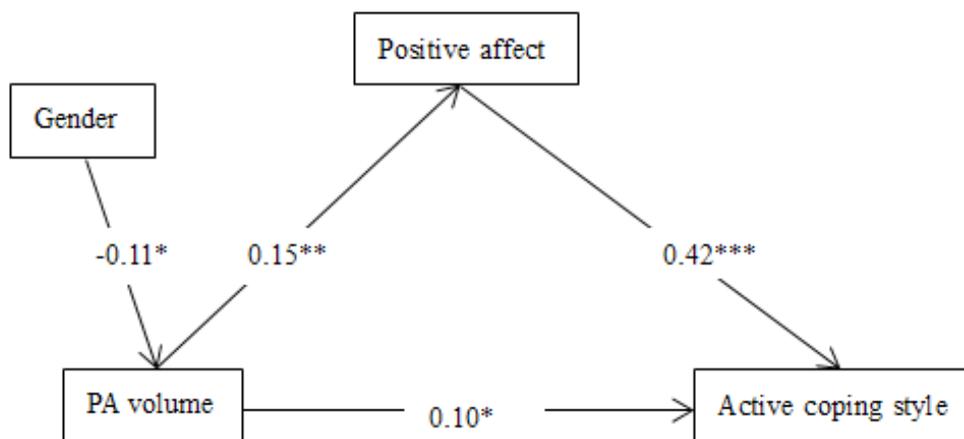


**Figure 1.** Self-efficacy play mediating effects on the link between PAV and active coping style among martial arts practicing adolescents (n = 403) (statistically significant: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ ).

**Table 4.** Path weight coefficient statistics table.

Path	Boot SE	CR	Direct effect	Indirect effect	95% CI
Gender → PAV	0.14	-2.29	-0.11*		(-0.193,-0.032)
PAV → positive affect	0.03	3.10	0.15**		(0.055, 0.247)
Positive affect → ACS	0.06	9.38	0.42***		(0.337, 0.504)
PAV → ACS	0.04	2.30	0.10*		(0.011, 0.193)
PAV → positive affect → ACS				-0.15×0.42 = -0.063	(0.024, 0.110)

Note: **PAV**: physical activity volume; **ACS**: active coping style; **Boot SE**: bootstrap standard error; **CR**: critical ratio; statistically significant: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .



**Figure 2.** Positive affect play mediating effects on the link between physical activity volume and active coping style among martial arts practicing adolescents (n = 403); statistically significant: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

greater than 1, and the first factor had an explanatory variance of 17.6%, which is less than the threshold of 40%. This indicated that the common method bias of this study was not significant.

This study shows that PA volume not only directly affected the ACS of martial arts practicing adolescents, but also indirectly affected ACS through self-efficacy and positive affect, which supports the theoretical hypothesis of this study. Physical exercise as a coping behavior is common, and previous studies found that physical exercise predicts ACS [41] and can strengthen the communication of adolescents' peer relationships, reduce their anxiety levels, and encouraging them to solve problems more actively [42]. After participating in martial arts exercise, people can also improve their self-awareness and respond positively to challenges [43]. In addition, research by Zivin et al. [44] on traditional martial arts interventions also confirmed that the more years of

martial arts practice, the more positive affect individuals produce, the calmer they are in the face of stressful events, and the more ACS they adopt [44]. Therefore, PA exercise, as an ACS, enables adolescents to experience more positive affect, which helps them to alleviate psychological stress and improve their coping ability [41]. This finding is helpful for researchers interested in improving adolescents' attitudes and ways of coping with problems from the perspective of sport intervention.

The results of structural equation model shows that self-efficacy and positive affect played mediating effects between PA volume and ACS in martial arts practicing adolescents. Self-efficacy has a mediating effect in the link between PA and ACS in adolescents, which is consistent with previous studies [20]. Bandura's [45] social cognitive theory suggests that self-efficacy can affect a person's cognition, emotion and will, and variations in self-efficacy can also affect an individuals'

coping style; the higher the self-efficacy of individuals, the less negative affect occurs and the more likely they will adopt active attitudes to problem-solving.

Therefore, self-efficacy, as an important psychological factor influencing individual behaviors, can effectively predict ACS. Improvement in self-efficacy is conducive to the formation of a positive mentality and, thus, promotes the adoption of ACS among adolescents [46]. A previous study demonstrated that PAV positively correlates with higher self-efficacy [12] and can also positively predict self-efficacy [11]. This indicates that self-efficacy can be improved through physical exercise: the higher the intensity of PA, the higher the self-efficacy [47, 48]. Experimental research has also shown that martial arts intervention can effectively improve self-efficacy and, thereby promote the problem-solving abilities of young people [41]. In addition, studies have shown that physical exercise can indirectly affect the mental health of adolescents through the mediation of self-efficacy [19]. Kostorz et al. [49] also concluded that the longer an individual has practiced martial arts, the higher the level of the individual's self-esteem, which is obtained through their sense of self-efficacy:

Moreover, PA has also been found to promote emotional health. Different levels of PA have different effects on positive emotions, and regular PA prevents aggression and negative moods and promotes positive affect [26]. Overall, adolescents may improve their ability to resist negative emotions and apply ACS to solve problems through PA exercise [50, 28]. Furthermore, studies on Chinese college freshmen found that self-efficacy positively predicted life satisfaction through the mediating role of positive affect [51]. Self-efficacy was positively correlated with positive affect: the higher the self-efficacy, the more positive affect the individuals had [52]. For adolescents, PA exercise has become an important way to improve self-efficacy and release pressure, thereby increasing positive affect. Meanwhile, the positive peer interaction and positive emotions they receive during PA exercise may facilitate the adoption of ACS (e.g., seeking social support) when they deal with problems or face challenges. Therefore, physical exercise should be advocated in the school environment and moderate to high activity intensities should be implemented in school curriculums to improve the physical and mental health of adolescents.

This study also revealed some gender differences in PAV and ACS. For example, the PAV of male martial arts practicing adolescents was significantly higher than that of female martial arts practicing adolescents, which is consistent with previous studies [29, 53]. PAV may be affected by personality traits and motivational variables. Males were more prone to seek stimuli and engage in competitive activities than females. Because of their gentle personality and introversion, females do not actively participate in activities and tend to prefer task-oriented sports [54].

The above viewpoints reveal the possible mechanisms by which PAV affects the ACS of martial arts practicing adolescents. Clearly, PAV not only directly affects ACS but also indirectly affects ACS through self-efficacy and positive affect. Although this study explored some of the mechanisms behind the effects of PAV on the ACS of martial arts practicing adolescents, some limitations should be noted. Firstly, we study applied a cross-sectional design, which made it impossible to get causal relationships. Secondly, this study mainly examine the role of self-efficacy and positive influence in the link between PAV and ACS, but there are still many other important mediating variables that may affect ACS, which need to be explored in future studies. Finally, a longitudinal design and sport intervention should be adopted in future studies to find the intrinsic mechanisms linking PAV and ACS in martial arts practicing adolescents.

## CONCLUSIONS

- (1) Regarding PA volume, male martial arts practicing adolescents had significantly higher scores than female martial arts practicing adolescents. Different PAV have significantly different effects on self-efficacy, positive affect and ACS.
- (2) The PAV of martial arts practicing adolescents was positively correlated with self-efficacy, positive affect, and ACS; self-efficacy was positively correlated with positive affect and ACS; and positive affect was positively correlated with ACS.
- (3) Self-efficacy and positive affect played a partial mediating effect in the link between PA volume and ACS in martial arts practicing adolescents. This study found that PAV can directly and indirectly affect the ACS of martial arts practicing adolescents.

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