

ORIGINAL RESEARCH

The relationship between autonomy support from parents and exercise adherence among male Korean adolescents: the multiple mediating effects of resilience and coping style

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(Zhenhua Shi)**Abstract**

The purpose of this study was to investigate the effect of parental autonomy support on adolescents' exercise adherence and the combined mediating effects of psychological resilience and coping style. A total of 478 male adolescents were evaluated using the Parental Autonomy Support Scale (PASS), the Connor-Davidson Resilience Scale (CD-RISC), the Coping Inventory for Competitive Sport (CICS), and the Scale of Exercise Adherence (SEA). The combined mediating effects of resilience and coping style were validated through hierarchical regression and bootstrap analysis. The results showed that: (1) parental autonomy support had a significant positive effect on exercise adherence in adolescents; (2) resilience and coping style mediated the relationship between parental autonomy support and exercise adherence. Parental autonomy support can not only directly promote exercise adherence in adolescents, but also indirectly promote it through the combined mediating effects of resilience and coping style. The mediating effect model constructed in this study demonstrates the internal mechanism through which parental autonomous support can have a positive influence on exercise adherence. It provides valuable information that can be used to promote exercise adherence among male Korean adolescents.

Keywords

Autonomous support; Resilience; Coping style; Exercise adherence; Multiple mediation

1. Introduction

1.1 Study objectives

Long term, consistent physical exercise is necessary in order to obtain ideal exercise results, and it is also essential to the practice of "lifelong sports" [1]. Adherence to exercise requires a strong will, perseverance and patience [2], which are characteristics of people who are persistent, stable, resolute and consistently striving toward the achievement of their goal [3]. A consensus has not yet been reached among academic circles as to the definition and connotation of "exercise adherence". Wang Shen *et al.* [4] consider the term, "physical exercise adherence", as referring to the tendency of an individual to stick to long-term, consistent physical exercise. It is believed that this psychological trait can be promoted, in order to improve physical activity levels, quality of life, sports psychology, and organizational behavior in adolescents, making this an important research topic [5]. There have been several relevant studies on the trait of adherence to exercise in adolescents, but most of these studies were focused on obese children, diabetic children [6], children with musculoskeletal diseases [7], and on children with other specific problems.

There have been relatively few studies on the trait of adherence to exercise in adolescents in the public domain.

No single variable can explain and predict an adolescent's tendency (or lack of tendency) toward exercise adherence [8]. At present, it is generally considered that external support and individual exercise psychology are the two main predictors of adherence to exercise in adolescents [9]. However, if only the direct prediction of exercise adherence based on external or internal factors is discussed, this can lead to misunderstandings such as attributing exercise adherence to environmental determinism or voluntarism. The combination of external support and internal autonomy and the search for effective ways of promoting exercise adherence in adolescents can lead to benefits such as positive exercise psychology and healthy behavior in adolescents, and it can also be conducive to the establishment of a healthy lifestyle for adolescents. Therefore, it is considered an important topic that should be immediately addressed and applied in school sports programs.

According to extensive previous discussions on strategies for the improvement of exercise adherence in adolescents, nationally as well as internationally, there is a general agreement that parental autonomy support has a stimulating effect

on adolescent psychology, which results in the improvement of exercise adherence [1]. According to self-determination theory, autonomous motivation is the internal drive to maintain adherence, a trait that is undeniably connected to nourishment from the external environment [10]. That is to say, when people experience autonomy of choice and freedom of will from the external environment, the inner motivation of egocentricity is stimulated, resulting in the improvement of exercise adherence [11]. The state of being autonomous means that one can act in accord with one's own reflective considerations. Thus, autonomous actions are those that can be self-endorsed and for which one takes responsibility. We further distinguish autonomy from the ideas of independence (or non-reliance) and freedom (or lack of constraints) [12]. Studies have shown that parental autonomy support can have a positive influence on the development of an adolescent's cognition. Parents who practice a high level of autonomy support tend to think from the perspectives of their children and seek to provide opportunities and conditions for their children to grow up independently, in order to stimulate the adolescent's ability to make their own decisions, as well as to promote volitional function and positive qualities, and improve exercise adherence and initiative [13]. Parental autonomy support acts as a protection field under which healthy adolescent behaviors can be encouraged [14]. Parents who practice high level autonomous support can encourage an adolescent's self-control ability when the adolescent's subjective vitality has been lowered, and can thus promote perseverance and willpower. Parental autonomy support can enrich the emotional elements of an adolescent's experience [15], thus improving the adolescent's exercise habits and enhancing their experience and feelings of happiness during exercise [16, 17]. It can be seen that as a parenting style, parental autonomy support is an exogenous force that can improve the will power and behavior of adolescents.

However, the internal psychological mechanisms involved in parental autonomy support for exercise adherence, as well as the relationships between these mechanisms and the resulting improvement in exercise adherence are still unclear. According to self-determination theory, parental autonomy support, as an external factor, can play a role in affecting an adolescent's tendency toward exercise adherence by influencing some internal factors. Positive psychology focuses on the positive aspects of human beings. It suggests that psychology should start from the inherent, actual and potential strength, virtue and kindness of human beings, and promotes a new more positive interpretation of many psychological phenomena (including psychological problems), so as to stimulate the positive strengths and excellent qualities of human beings in order to obtain a high quality of life. Therefore, mental resilience, an important positive internal psychology variable, has been taken into our consideration when studying the relationship between parental autonomy support and exercise adherence. Studies have shown that mental resilience positively predicts sports engagement and adherence, and negatively predicts sports burnout [18–20].

Windle [21] offers a recent definition of resilience as “*the process of effectively negotiating, adapting to, or managing significant sources of stress or trauma*”. Resilience is a mental construct that is notably similar to mental toughness [22].

Mental toughness is significantly related to resilience and is even used as an interchangeable term for resilience [23]. Like resilience, mental toughness is regarded as a measure of a person's ability to cope with stress and recover from adversity (Bahmani *et al.* [24], 2016). Mental toughness in the field of sports psychology research is considered to be more than this; it is considered to be a genetic or acquired developmental psychological advantage that can enable teenagers to play sports better while under pressure from competition, training and life in general. It can also help them to remain determined, focused and confident, while maintaining self-control in high-pressure situations. This makes mental toughness an excellent psychological advantage [25]. Unlike mental toughness, resilience seems to include a range of influential qualities outside of the self (*e.g.*, perceived social support). Previous studies [26, 27] have shown that psychological resilience also has clearly evident experience-enhancing functions. For example, it can enhance the optimistic tendencies, relaxation, self-determination and motivation of teenagers, and it can even improve the performance of sports. Gucciardi *et al.* [28] (2008) found through qualitative research that adolescents with high psychological resilience not only show improved cognitive abilities applied to individual projects, but also devote themselves to training, competition, and exercise with a more positive attitude. They often exceed in the areas of task focus, positive self-discipline, and perseverance. In addition, Crust *et al.* [26] concluded that autonomous support can play an important role in the formation of a teenager's mental resilience, particularly in unfavorable situations (such as being injured, receiving low grades or losing a match). It can not only improve a teenager's problem-solving strategies, but also reduce their fear factor when faced with adversity, lowering the probability of them collapsing or giving in to frustration, and causing them to act with more courage.

A study by Chen Yan *et al.* [29] showed that autonomous support, as an important social support, is a significant contributing factor in the development of resilience and is positively correlated with mental resilience. In that study, it was demonstrated that teacher autonomy support has a positive predictive effect on children's resilience. Both teachers' autonomous support and resilience can effectively improve autonomous motivation in children. Other research has shown that autonomous support can not only directly predict autonomous motivation in children, but that it can also cause autonomous motivation in children through the mediating effect that it has on the development of resilience. Researchers [30] have also found that teenagers with high psychological resilience demonstrate higher self-control when in stressful situations, tend to evaluate stressors as challenges rather than threats, have higher coping skills and self-efficacy, and are more prone to adopt effective coping strategies rather than focusing on problems. This can improve the overall coping ability of the individual.

Coping refers to the constantly changing cognitive and behavioral efforts of individuals to manage internal and external demands when they believe they have exceeded their limits [31]. In the interaction process between people and their surroundings, the level of impact that stressful events can have on a person's psychology is determined by the person's coping

style [32]. At present, there is no consensus on the best type of coping style. There are many types of coping styles, including cognitive reconstruction, information gathering, problem solving, avoidance, *etc.* Researchers have defined several different types of coping styles based on various theories and measurement models [33]. Lazarus and Folkman [31] differ as to the function of coping styles, and divided them into two types: “problem-focused coping”, which refers to “managing or changing the problem itself that causes distress” and “emotion-focused coping”, which refers to “regulating emotional responses to problems”. Some researchers have further refined the process of investigation and proposed dysfunctional coping styles, describing some maladaptive strategies for coping with stress, including avoidant attitudes and behaviors (such as denial and distraction), self-destructive behaviors (such as alcoholism and drug abuse), and negative emotional behaviors (such as self-blame and venting) [34]. On this basis, Carver *et al.* [34], in 1989, presented the categorization of 13 types of Coping styles, and developed the COPE (Coping Orientation to the Problems Experienced) questionnaire for use as a measuring tool.

Gaudreau *et al.* [35] divided coping styles into three categories: task-oriented coping, distraction-oriented coping, and disengagement-oriented coping. Task-oriented coping refers to strategies that focus on managing internal and external demands during training competitions and exercises; distraction-oriented coping refers to the strategy of diverting one’s attention to factors unrelated to training competitions and exercise; and disengagement-oriented coping refers to an individual’s strategy of disengagement from the process (and struggle) of goal pursuit. It was found that these three types of coping styles have differing predictive effects on various outcome variables (such as goal attainment, coping effectiveness, positive emotions, *etc.*). Compared with distraction and disengagement-oriented coping, task-oriented coping is a more positive and effective coping style [36]. The stress-emotion-performance metamodel holds that coping style is an intermediary factor in determining an adolescent’s reaction to competition pressure, which plays a crucial role in the physical and mental health, as well as the sports and exercise performance level, of adolescents, and the adolescent’s level of reaction to competition pressure can be affected by autonomous support [37]. Generally speaking, adolescents lacking external support tend to adopt negative coping styles such as avoidance and denial when facing stressful events, while those with abundant independent support tend to adopt positive coping styles such as seeking help and solving problems.

Studies have shown that both the parents’ perceptions and the adolescents’ perceptions of autonomy support in the family are important in shaping their respective coping styles [38]. Autonomy support and coping style are closely correlated and coping style is influenced by autonomy support and psychological control [39]. The perceived autonomy support of a family affects children’s ability to cope with stress [40]. The researchers also found that athletes with high levels of autonomous support used more problem-focused strategies such as positive planning and seeking support [40]. Thus, existing studies have confirmed that autonomous support affects the coping styles of adolescents [41], and coping styles affect

exercise adherence [42]. Nicholls *et al.* [43] found that psychological resilience affects the coping style of adolescents and can cause them to show certain tendencies. Psychologically resilient adolescents are more likely to use problem-focused coping styles and less likely to use avoidance coping styles. Researchers generally believe that problem-focused coping styles are more effective than avoidant coping styles in relieving stress, which suggests that psychological resilience can help maintain physical and mental health, promote athletic performance, and improve exercise adherence by encouraging adolescents to adopt more productive coping styles.

Most previous studies on differences in gender, focusing on the above-mentioned variables, showed that there were significant differences in exercise adherence, psychological resilience and coping styles between male and female adolescents, with the scores of males being higher than those of females in exercise adherence [44, 45], psychological resilience [46, 47] and coping styles [48, 49]. Most of the studies showed no significant difference in parental autonomous support between genders [50, 51]. However, some other studies reached opposite conclusions regarding exercise adherence [52], parental autonomous support [53] and resilience [54]. In other words, the conclusions of varying studies were not consistent and the relationships between the above-mentioned variables and gender were not very clear, and we could not find any relevant studies based solely on one gender. In view of this, we opted for male adolescents with relatively higher exercise adherence scores as the research subjects, in order to assess the predictors of exercise adherence in male adolescents, and we expect that the findings will provide comprehensive knowledge applicable in developing strategies for intervention and improvement of adolescent exercise adherence.

1.2 Hypothesis

In order to verify the relationship between variables and further explore the interaction mechanism between variables, this study puts forth the following hypotheses: (H1) parental autonomous support positively predicts exercise adherence; (H2) resilience positively predicts exercise adherence; (H3) different coping styles have different predictive effects on exercise adherence; (H4) resilience and coping style have combined mediating effects on the relationship between parental autonomy support and exercise adherence. Based on these assumptions, a multiple mediation hypothesis model was constructed (see Fig. 1). The purpose of this study is to obtain results-based comprehension of adolescent physical exercise behavior, and provide a reference that can help relevant departments to make decisions.

2. Research methods

2.1 Participants

In the field of exercise physiology, adolescence is defined as 11–15 years old, and youth is defined as 15–adult. Adolescent psychology defines adolescence as 13–25 years old [55]. This study applies Wang Ruiyuan’s [56] definition of adolescence, integrating the development characteristics of individual psychology and physiology. People from 12–18

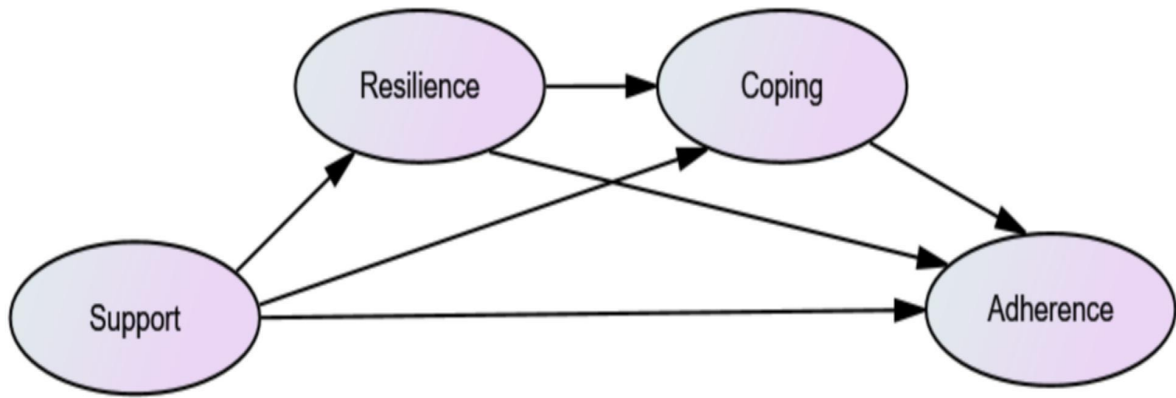


FIGURE 1. Hypothesis model of the serial mediation of resilience and coping style between autonomy support and exercise adherence.

years of age, students in either middle school or high school, were selected as the research subjects. A total of 500 male students were randomly selected from six schools in North Jeolla Province, South Korea, including three middle schools and three high schools. 478 valid data points were collected with an effectivity rate of 95.6%. The average age of the subjects was (14.976 ± 2.767) years old; 222 of the subjects were junior high school students and 256 were high school students.

2.2 Measures

All English and Chinese scales were translated into Korean using a typical cross-translation procedure. First, each item was translated into Korean by a linguist who was proficient in English and Chinese. Second, the translation was reviewed and corrected by two experts in sports psychology who were also proficient in English and Chinese. Then, two foreign teachers who had not seen the original scale translated the items back into English and Chinese. Finally, the above 3 steps were repeated until all the Chinese, English and Korean items were correctly translated, in terms of semantics, expression, and connotation.

2.2.1 Parental autonomy support scale

The Parental Autonomy Support Scale (PASS) was adapted from the Parental Autonomy support subscale of the Parental Involvement and Autonomy Support Scale of Robbins [57] which was revised by Wang *et al.* [58] in 2007. This scale was shown to have good reliability and validity in studies of He Jiao: $\chi^2/DF = 4.83$, RMSEA (root mean square error of approximation) = 0.08, SRMR (Standardized Root Mean Square Residual) = 0.06, GFI (goodness of fit index) = 0.92, NFI (normed fit index) = 0.93 [59]. There are 12 items in the scale. When revising the scale in this study, core words such as “physical exercise” or “exercise” were added to set the question-and-answer situation, such as: My parents encouraged me to schedule my exercise in the way I was used

to. The scale used a 5-point score (1 = very inconsistent, 5 = very consistent), and the average of the items was taken. The higher the score, the higher the level of parental autonomy support perceived by the adolescents. The Cronbach’s α coefficient of this scale was 0.839. The confirmatory factor analysis results showed that χ^2/DF was 3.12, RMSEA was 0.068, SRMR was 0.051, GFI was 0.90, NFI was 0.92, CFI (comparative fit index) was 0.95, IFI (incremental fit index) was 0.92. According to the structural equation fitting index criterion of Wen Zhonglin, Hou Jietai [60]: $\chi^2/DF < 5.00$, RMSEA < 0.08 , SRMR < 0.08 , GFI > 0.90 , NFI > 0.90 , these indices were all within the threshold of recommended values.

2.2.2 Resilience scale

The Chinese version of the Connor-Davidson Resilience scale (CD-RISC) [61] was adopted for this study. This resilience scale contained three dimensions and 25 items, including enjoyment, self-improvement, and resilience. A 5-point score was used to rate each item, indicating “not at all”, “rarely”, “sometimes”, “often” or “almost always”. The average of the items was taken, with higher scores indicating stronger resilience. The predictive efficacy of the CD-RISC on psychological resilience is widely recognized, and it is known for its good reliability and validity when tested in different populations. The Cronbach’s α coefficient of this scale was 0.902, which in line with 0.89 of previous research [48]. The confirmatory factor analysis results showed that χ^2/DF was 2.38, RMSEA was 0.061, SRMR was 0.057, GFI was 0.91, NFI was 0.90, CFI was 0.95 and IFI was 0.92. According to the structural equation fitting index criterion of Wen Zhonglin, Hou Jietai [60]: $\chi^2/DF < 5.00$, RMSEA < 0.08 , SRMR < 0.08 , GFI > 0.90 , NFI > 0.90 , these indices were all within the threshold of recommended values.

2.2.3 Coping style scale

The Coping Inventory for Competitive Sport (CICS) was compiled by Gaudreau *et al.* [35] and revised by Yuan Lijun [62]. The questionnaire has 39 items, including 3 higher-order

dimensions: task-oriented coping, distraction-oriented coping, and disengagement-oriented coping. Task-oriented coping included six sub-dimensions: thought control, mental representation, relaxation, effort, logical analysis and support seeking. Distraction-oriented coping included two subdimensions: alienation and distraction. Disengagement-oriented coping included two subdimensions: submission and release of unpleasant emotions. A scale of 1 to 5 was used, with 1 to 5 representing “never” to “always”. The higher the score, the more likely the individual was to adopt the coping style. In this study, the Cronbach’s α coefficients of the subdimensions were 0.83 (task-oriented coping), 0.77 (disengagement-oriented coping) and 0.68 (distraction-oriented coping). The confirmatory factor analysis results showed that χ^2/DF was 2.86, RMSEA was 0.069, SRMR was 0.057, GFI was 0.91, NFI was 0.90, CFI was 0.96 and IFI was 0.95, which was consistent with the previous study by Wang Bin [20]: Cronbach’s α coefficients = 0.84 (task-oriented coping), 0.80 (disengagement-oriented coping), and 0.67 (distraction-oriented coping), $\chi^2/DF = 2.61$, RMSEA = 0.06, SRMR = 0.05, GFI = 0.94, NFI = 0.90, CFI = 0.92, IFI = 0.93. According to the structural equation fitting index criterion of Wen Zhonglin, Hou Jietai [60]: $\chi^2/DF < 5.00$, RMSEA < 0.08 , SRMR < 0.08 , GFI > 0.90 , NFI > 0.90 , these indices were all within the threshold of recommended values.

2.2.4 Exercise adherence scale for adolescents

The Scale of Exercise Adherence (SEA) was revised from the Scale of Outdoor Exercise Adherence for Adolescents developed by Liu Weina *et al.* [63] (6 questions). The Likert 5-point method was used to score from “completely disagree” (1) to “completely agree” (5), and the total score represented the exercise adherence level of the subject. In the revision, the core words such as “outdoor exercise” and “sports” were revised into “physical exercise” (*e.g.*, participating in exercise has become a habit of mine), and at the same time, the reverse answer was designed (*e.g.*, to me, it doesn’t matter if I give up physical exercise). Cronbach’s α coefficient was 0.880. The confirmatory factor analysis results showed that χ^2/DF was 2.91, RMSEA was 0.066, SRMR was 0.056, GFI was 0.91, NFI was 0.90, CFI was 0.963 and IFI was 0.92, which is consistent with the previous research of Dong Baolin: Cronbach’s α coefficient was 0.880. The confirmatory factor analysis results showed that χ^2/DF was 2.59, RMSEA was 0.072, SRMR was 0.047, GFI was 0.95, NFI was 0.93, CFI was 0.94 and IFI was 0.94. According to the structural equation fitting index criterion of Wen Zhonglin, Hou Jietai [60]: $\chi^2/DF < 5.00$, RMSEA < 0.08 , SRMR < 0.08 , GFI > 0.90 , NFI > 0.90 , these indices were all within the threshold of recommended values.

2.2.5 Reliability and validity test

This study used Cronbach’s α coefficient and confirmatory factor analysis to test the reliability and validity of the scales. The Cronbach’s α coefficient of the scales, as discussed above, were both over 0.8, which indicates a high level of internal consistency reliability. Confirmatory factor analysis was also performed to test the measuring model and ensure that the measured variables reliably reflected the underlying variables before mediating effects testing. The results of the confirmatory factor analysis were all within the threshold of recom-

mended values. All the standard loadings of the measuring model were over 0.7 and were significant at the 5% level, showing that there was a good correspondence between factors and measurement items. The composite reliability (CR) results (Parental Autonomy Support: 0.827; resilience: 0.798, 0.827, 0.879; coping style: 0.901, 0.833, 0.789; exercise adherence: 0.814) were over 0.7, showing good composite reliability of these scales. The average variances extracted (AVE) (Parental Autonomy Support: 0.668; resilience: 0.589, 0.647, 0.691; coping style: 0.821, 0.623, 0.661; exercise adherence: 0.753) were all over 0.5, indicating that the scales have good convergent validity. All square roots of the AVEs were bigger than the correlation coefficients with other constructs, which demonstrates good discriminant validity [64].

2.3 Test program and common method bias test

The test was carried out in a unified manner by the class, and the data was collected. Before the test, the tester spoke to the subjects, emphasizing the confidentiality principle of the questionnaire. The subjects answered the questions in turn in the PASS, the CD-RISC, the CICS and the SEA, after reading the questionnaire guidebook and signing the informed consent letter, and the questionnaire was then collected, with the whole process taking about 10–20 minutes. SPSS (24.0, IBM SPSS Inc., Chicago, IL, USA) and AMOS (24.0, IBM-International Business Machines Corporation, Armonk, NY, USA) were used for data entry and analysis in this study.

In this study, the data were all self-evaluated by the subjects. In order to ensure the rigor of the study, the common method bias test was carried out. According to the introduction to common method bias by Zhou Hao and Long Lirong (2004), a Harman single factor test was carried out on the collected data, and a factor analysis was conducted on all questions in the questionnaire. The final results showed that there were a total of 5 factors with characteristic roots greater than 1, and the variance interpretation rate of the largest factor was 36.03% (less than 40%), so there was no significant common method bias in this study.

2.4 Data analysis

The data were imported into SPSS 24.0, AMOS 24.0 and MPLUS (6.0, Linda Muthén & Bengt Muthén, UCLA, LA, USA) software for analysis. Effective data were processed by centralization and reverse questions. Confirmatory factor analysis and descriptive statistics were used to describe the data and test the reliability and validity of the scale. And Correlation analysis, regression analysis and other methods were used to investigate the direct impact of parental autonomy support, mental resilience and coping styles on exercise adherence. According to Fang Jie *et al.* [65], the Bootstrap method was used to analyze the indirect effect of parental autonomy support on exercise adherence. The plugin programming process designed by Preacher *et al.* [66] was used to select the independent variable (X), dependent variable (Y), mediating variable (M), mediating variable (W), and mediating variable (V) into corresponding option boxes. The Bootstrap Samples = 5000 were set (sample size = 5000), the sampling method

was set as Bias Corrected (non-parametric percentile method with deviation correction), and the confidence interval was set as 95%. The grouping conditions were Mean and \pm SD from Mean (*i.e.*, mean and mean plus or minus 1 standard deviation). The analysis of complex models using the Bootstrap plugin process has recently been widely applied by scholars in the fields of psychology and organizational behavior.

3. Results

3.1 Correlation analysis

Descriptive statistics on the study variables and correlation analysis of the variables were used to analyze the correlation coefficients between autonomous support, psychological resilience, three types of coping styles, and exercise adherence by Pearson correlation analysis (Table 1). Autonomy support, resilience and task-oriented coping were significantly positively correlated with exercise adherence, while disengagement-oriented coping was significantly negatively correlated with exercise adherence. Autonomy support and resilience were positively correlated with task-oriented coping, and resilience was negatively correlated with disengagement-oriented coping. Autonomy support was positively correlated with resilience. The significant correlation between the study variables provides a good basis for subsequent regression analysis and mediation effect testing.

3.2 Hypothesis testing and significance test of the mediating effect

Using the latest mediating effect test procedure proposed by Wen Zhonglin *et al.* [67], the combined mediating effects of psychological resilience and coping style on the relationship between autonomy support and exercise adherence was tested.

3.2.1 Testing the predictive effect of independent variables on dependent variables

Hierarchical regression analysis was conducted with demographic variables (age) and parental autonomy support as independent variables and exercise adherence as a dependent variable. The results (Table 2) showed that after controlling for demographic variables, autonomous support had a significant positive predictive effect on exercise adherence ($\beta = 0.43$, $p < 0.001$), which can explain 16% of the variation in exercise adherence. Thus, H1 is verified.

3.2.2 Testing the predictive effect of independent variables on mediating variables

A hierarchical regression analysis was conducted with demographic variables, autonomy support, and resilience as independent variables, and task-oriented coping, distraction-oriented coping, and disengagement-oriented coping as dependent variables. The results are shown in Table 3. After controlling for demographic variables, parental autonomy support had a significant positive predictive effect on task-oriented coping ($\beta = 0.43$, $p < 0.001$) but had no significant predictive effect on distraction-oriented coping ($\beta = 0.03$, $p > 0.05$), it was also had no significant predictive effect on disengagement-oriented coping ($\beta = -0.04$, $p > 0.05$). After controlling for de-

mographic variables and autonomy support, resilience was shown to have a significant positive predictive effect on task-oriented coping ($\beta = 0.32$, $p < 0.001$) and a significant negative predictive effect on distraction-oriented coping ($\beta = -0.15$, $p < 0.01$). However, it had a significant negative predictive effect on disengagement-oriented coping ($\beta = -0.47$, $p < 0.001$). Then, hierarchical regression analysis was conducted with demographic variables and autonomy support as independent variables and psychological resilience as a dependent variable. The results showed that autonomy support had a significant positive predictive effect on resilience after controlling for demographic variables ($\beta = 0.27$, $p < 0.001$).

3.2.3 Testing the predictive effect of a mediating variable on a dependent variable

Demographic variables, parental autonomy support, mental resilience, task-oriented coping, distraction-oriented coping, and disengagement-oriented coping were used as independent variables, and exercise adherence was used as a dependent variable. The results are shown in Table 2. It was found that after controlling for demographic variables and parental autonomy support, psychological resilience had a significant positive predictive effect on exercise adherence ($\beta = 0.44$, $p < 0.001$). After controlling for demographic variables, parental autonomy support and psychological resilience, task-oriented coping had a significant positive effect on exercise adherence ($\beta = 0.48$, $p < 0.001$), while distraction-oriented coping had no significant effect on exercise adherence ($\beta = 0.03$, $p > 0.05$). Disorientation coping had a significant negative predictive effect on exercise adherence ($\beta = -0.14$, $p < 0.001$). Thus, H2 and H3 are verified.

3.2.4 Further exploring the size of the mediating effect

A nonparametric percentile Bootstrap procedure with bias correction using MPLUS 6.0 software was used for analysis. The model 4 was chosen and a total of 5000 samples were taken from 478 subjects as the "parent" and 95% CI (confidence interval) of the mediating effect was estimated according to the 5000 samples. If the 95% CI of the mediating effect did not include 0, it indicated that the mediating effect was significant. If the mediating effect did include 0, it indicated that the mediating effect was not significant. As can be seen from Table 4, the total effect of parental autonomy support on exercise adherence is 0.45, the direct effect is 0.17, and the total indirect effect is 0.28, all of which are significant. The effect size was the effect value divided by the total effect, and the effect size of the total indirect effect was 62.2%. There were four significant mediating pathways in this study: (1) the mediating path through resilience (effect value was 0.054, effect size was 12.0%); (2) the mediating path through task-oriented coping (effect value was 0.163, effect size was 36.2%); (3) the serial mediating path through the sequence of resilience and task-oriented coping (response value: 0.041, effect size: 9.1%); (4) the serial mediating path through resilience and disengagement-oriented coping (effect value: 0.021, effect size: 4.7%). Thus, H4 was confirmed.

TABLE 1. Correlation analysis of research factors.

Factor	M	SD	1	2	3	4	5	6
Autonomy support	3.46	0.77	1.00					
Resilience	3.39	0.57	0.30**	1.00				
Task-oriented coping	3.43	0.59	0.46**	0.47**	1.00			
Distraction-oriented coping	2.31	0.66	0.01	-0.05	0.10*	1.00		
Disengagement-oriented coping	2.26	0.73	-0.05	-0.39**	-0.03	0.48**	1.00	
Exercise adherence	3.97	0.69	0.43**	-0.53**	0.59**	-0.02	0.25**	1.00

* $p < 0.05$; ** $p < 0.01$; *M*: mean; *SD*: standard deviation.

TABLE 2. Hierarchical regression analysis of autonomy support, resilience and coping style on exercise adherence.

Variables	Exercise adherence							
	The first step		The second step		The third step		The fourth step	
	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>
Age	0.21	3.92**	0.17	3.61**	0.09	1.94	0.05	1.33
Autonomy support			0.43	10.09**	0.29	7.78**	0.17	4.52**
Resilience					0.44	10.06**	0.21	4.81**
Task-oriented coping							0.48	12.06**
Distraction-oriented coping							0.03	0.73
Disengagement-oriented coping							-0.14	-3.91**
<i>F</i>	12.67**		33.32**		51.03**		60.12**	
R^2	0.09		0.25		0.39		0.53	
ΔR^2	0.09		0.16		0.14		0.14	

** $p < 0.01$.

TABLE 3. Hierarchical regression analysis of autonomy support and resilience on copying styles.

variables	Task-oriented coping				Distraction-oriented coping				Disengagement-oriented coping			
	First		Second		First		Second		First		Second	
	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>
Autonomy support	0.43	9.98**	0.34	8.11**	0.03	-0.10	0.04	0.72	-0.04	-0.90	0.08	1.75
Resilience			0.32	7.35**			-0.15	-2.97**			-0.47	-9.73**
<i>F</i>	29.17**		35.08**		3.77		4.45**		1.99		18.81**	
R^2	0.24		0.31		0.03		0.05		0.03		0.18	
ΔR^2	0.17		0.07		0.01		0.02		0.01		0.15	

** $p < 0.01$.

4. Discussion

In order to verify the relationships between parental autonomy support, resilience, coping style and exercise adherence, as well as to explore the internal psychological mechanism of the relationship between parental autonomy support and adolescent sports adherence, and to further explore the interaction mechanism among variables, a total of 478 male adolescents were tested using the PASS, the CD-RISC, the CICS and the SEA. Parental autonomy support, resilience and coping style showed statistically significant positive and direct effects on adolescents' exercise adherence ($p < 0.01$), which explained 16.08%, 14.16% and 14.09%. In the chain of

influence between parental autonomy support and adolescents' exercise adherence, adolescents' resilience and coping style have partial combined mediating effects, and the combined mediating effects of the two are statistically significant.

4.1 Discussion of direct effect

Correlation analysis and regression analysis of direct effect showed that the higher the level of parental autonomy support, the greater the adolescent's exercise adherence, which is consistent with previous studies [1, 14]. Parental autonomy support can provide adolescents with an independence and self-determination encouraging support field, which encour-

TABLE 4. Bootstrap analysis of significance of the mediating effect.

Path of effect	Standardized effect value	95% CI		Significant
		Lower limit	Upper limit	
The total effect	0.450	0.332	0.490	yes
Direct effect	0.170	0.079	0.248	yes
Indirect effect	0.280	0.187	0.301	yes
Autonomy support → Resilience → Exercise adherence	$0.26 \times 0.21 = 0.054$	0.026	0.087	yes
Autonomy support → Resilience → Task-oriented coping → Exercise adherence	$0.26 \times 0.33 \times 0.48 = 0.041$	0.021	0.061	yes
Autonomy support → Resilience → Distraction-oriented coping → Exercise adherence	$0.26 \times (-0.16) \times 0.04 = -0.002$	-0.005	0.003	no
Autonomy support → Resilience → Disengagement-oriented coping → Exercise adherence	$0.26 \times (-0.48) \times (-0.17) = 0.021$	0.008	0.039	yes
Autonomy support → Task-oriented coping → Exercise adherence	$0.34 \times 0.48 = 0.163$	0.097	0.179	yes
Autonomy support → Distraction-oriented coping → Exercise adherence	$0.03 \times 0.04 = 0.012$	-0.009	0.002	no
Autonomy support → Disengagement-oriented coping → Exercise adherence	$0.08 \times (-0.17) = -0.014$	-0.017	0.011	no

CI: confidence interval.

ages the adolescent to act without hesitation in exercise events, show initiative, and explore their own interests. This support field helps to stimulate positive experiences, enrich sports cognition, and make it possible for adolescents to improve exercise adherence. External situational information helps to expand the subject's cognition and other intellectual factors, and produces guiding effects that can positively influence the subject's behavior and decision-making processes. In other words, parents' support for their children's independent exercise can enrich an adolescent's exercise cognition and encourage them to be more inclined to participate in exercise. Just as E.L. Deci [18] said, autonomous support in a social context can guide individuals toward positive commitment and psychological growth, which can help to ensure the sustainable development of the individual's behavior.

4.2 Discussion on the mediating effects of resilience and coping style

This study not only examined the direct relationship between parental autonomy support and exercise adherence, but also constructed a serial mediation model of parental autonomy support influencing exercise adherence with resilience and coping style as mediating variables. The mediating effect was significant, and the mediating effect size reached 62.2%. With consideration of previous studies that had confirmed the mediating role of goal-orientation [68] and basic psychological

needs [69] in the relationship between autonomy support and exercise adherence, the results of this study indicate that the mediating variable was of great significance in explaining the predicting effect of autonomy support on exercise adherence. Therefore, we encourage parents to view physical exercise activities from the perspective of their children and give young people more exercise autonomy support, which can help adolescents to develop exercise cognition, resilience, and positive coping styles, as an effective strategy to improve the exercise adherence of adolescents.

Parental autonomy support can positively predict psychological resilience and exercise adherence, and can also predict exercise adherence through the mediating role of psychological resilience. The study results demonstrating the relationship between autonomy support and resilience were consistent with the research of Wei xin [70]. From the point of view of positive psychology, personality is not completely determined and fixed by innate genetic factors, but is rather formed by physiological mechanisms, external behavior, and social environment [71]. Therefore, positive personality traits can be cultivated through nurturing [72]. Scholars believe that psychological resilience also develops, changes, and is influenced by environmental factors [13]. With parental autonomy support, teenagers can experience trust, respect, and encouragement, and learn to see themselves as valuable individuals, thus forming strong self-efficacy, as well as obtaining inner

resources that can help them to cope with stress, which can in turn help them to overcome setbacks and difficulties, while in the process developing strong character and enhancing mental flexibility. This is consistent with conventional wisdom, which states that caring builds resilience. The results of this study, which demonstrate the relationship between resilience and exercise adherence, are consistent with the research of Shao Lili [73]. Psychological resilience can be described as a combination of positive psychological qualities, such as confidence, firmness and self-control, which reflect an individual's confidence in their own strength, and it can also manifest in personality traits such as the persistent pursuit of one's own ideal and the effective control of personal emotions [73]. These psychological tendencies, having great adaptive significance, help adolescents to form a positive psychological cognitive mode and transform their negative ideas into more positive ideas in time. For example, the temporary negative experience is regarded as "feedback", the setback is regarded as "lastic investment" and the pressure encountered in exercise is regarded as a rare "challenge and growth opportunity" [28]. As a result, teenagers with psychological resilience are able to eliminate negative thoughts, stimulate positive emotions, fully engage in exercise guided by goals, and keep exercise adherence.

Parental autonomy support can positively predict exercise adherence through task-directed coping. Teenagers who receive a high level of autonomy support tend to adopt more task-oriented strategies, apply more control of their own thoughts (accepting themselves, finding their own advantage, *etc.*), apply more mental skill to exercise and strenuous situations, and are more prone to be relaxed under pressure. The practice of positive cognitive and behavioral techniques, such as relieving muscle tension, staying consistent with effort, being aggressive, applying logical analysis (analyzing problems to find solutions), and seeking support (reaching out for help for advice), can help to align the body and mind, bringing out the best of the abilities of the adolescent, thus promoting a high level of adherence during exercise. This is consistent with the research of Liu Dingdong [74]. In reality, when teenagers are exercising, they not only have to bear various external pressures (such as external expectations and established goals), but also face their own inner confusion. As a kind of pressure buffer, parental autonomous support can help give adolescents confidence and the ability to cope with various pressures. These views are consistent with the research of Ruoxuan Li *et al.* [39]. For example, autonomous support can provide a channel for adolescents to obtain support and feedback, which makes it convenient for them to "seek support" and apply "logical analysis". It can provide opportunities for teenagers to receive education and help them to better grasp the concepts of "mental representation" and "relaxation". It can enhance an adolescent's sense of self-worth, as well as promote their "thought control" and "effort". These well-adapted coping styles become fortified after the adolescent repeatedly experiences their effectiveness, and they are then internalized, forming internal resources, which can be flexibly applied in various situations, helping to achieve a dynamic balance between the individual and the environment. This can help adolescents maintain physical and mental health and

better engage in exercise. Therefore, autonomous support cannot completely replace adolescents' "self-sufficiency" and its gain function requires the help of the adolescent's task-oriented coping style to regulate their body and mind, solve problems, and promote exercise adherence.

Autonomy support positively predicts exercise adherence through the mediating effect of resilience, and then through task-oriented coping and disengagement-oriented coping. As mentioned above, autonomy support contributes to the cultivation of psychological resilience in male adolescents. According to the trait coping theory, the improvement of resilience, as a personality trait, leads to changes in individual coping style. This is consistent with the research of Wang bin *et al.* [75]. Greater psychological resilience in teenagers leads to more task-oriented coping, thought control, mental presence, relaxation, willingness to put forth effort, logical analysis and the ability to strategize (including the seeking of support in combination with other tactics). It also stimulates vitality and enthusiasm in adolescents and helps to maintain their interest and self-confidence, while on the other hand it can also prompt adolescents to be less dependent on external guidance and reduce the probability of them giving up and forsaking their efforts, while preventing them from unreasonably expressing their unpleasant emotions, thus strengthening their ideals and beliefs, helping them to maintain physical and mental health, and ultimately promoting exercise adherence. This further verifies the buffer theory hypothesis of autonomy support, that is, as an external factor, autonomy support indirectly affects the stress adaptation ability of the adolescent through the mediating effects of individual internal factors such as personality and coping style [76]. Meanwhile, the results of this study also support the conclusion of Nicholls *et al.* [77], that psychological resilience has a dual mechanism of promoting positive coping styles and inhibiting negative coping styles.

In this study, the mediating effect of distraction-oriented coping was not found to be significant, a finding similar to those of Schellenberg *et al.* [36]. Schellenberg *et al.* [36] explored the mediating effect of coping style between passion and adolescent burnout, and found that the mediating effect of distraction-oriented coping was not significant. They believe that this may be related to the nature of distraction-oriented coping, and that its positive and negative effects depend on whether it is properly fit to the exercise situation, the specific characteristics of the adolescent, and other factors. This is consistent with the conclusions of Lazarus [31]. Some coping styles do not necessarily lead to good results. H González-García *et al.* [78] explored the relationships between coach and athlete, between coping and affective states, and between satisfaction and the attainment of goals, and the results revealed that task-oriented coping marginally mediated the relationship between the coach-athlete dyad and sport satisfaction, but the mediating effect of distraction-oriented coping was not found to be significant either.

A possible reason for this is that more task-oriented coping reflects more effective communication and more support in daily life, which is associated with higher relationship satisfaction. By contrast, individuals with more emotion-oriented or distraction-oriented coping styles have been found to experience more conflict and aggression and less relationship satisfaction.

faction. In addition, distraction-oriented coping has generally been associated with a negative mental state. Ruoxuan Li *et al.* [39] investigated the relationships between autonomy support, coping style, and loneliness, particularly the difference in those relationships between victims and nonvictims of bullying in school. The results indicate that parental autonomy support negatively predicts children's loneliness, and psychological control positively predicts it. Whether for nonvictims or victims, the mediating effects of problem-focused coping between autonomy support and loneliness, and those of emotion-focused coping between psychological control and loneliness were all found to be significant. Distraction-oriented coping, however, was not mentioned in the study on mediating effects. The problem-focused coping styles used in their research were very similar to the task-oriented coping styles used in our research.

In general, task-oriented coping styles are considered to be adaptive, whereas emotion-oriented coping, disengagement-oriented coping and distraction-oriented coping appear to be maladaptive [79]. For example, in the case of basketball players with more pronounced self-confidence, task-oriented coping is more effective and disengagement-oriented coping is less effective [80]. Several studies on heterosexual individuals have examined how maladaptive coping strategies contribute to poor mental health and how adaptive coping strategies can help to buffer stress, reduce psychological problems, and improve relationships and general well-being. For example, Sica *et al.* [81] investigated the intersecting roles of dysfunctional personality traits and coping styles in relation to psychological distress during the Italian national lockdown caused by the COVID-19 pandemic, and the results indicate that during an unprecedentedly stressful time, associations between maladaptive personality traits and psychological distress may be, at least in part, explained by maladaptive coping strategies.

Therefore, in our study, parental autonomy support is described as a type of positive and adaptive social support, which can guide and affect an adolescent's adaptive coping style, that is, it can promote task-oriented coping. It is understandable that distraction-oriented coping, which is a maladaptive coping style, has no significant relationship with parental autonomy support. It is also possible that distraction-oriented coping, as a maladaptive coping style, can negatively predict an adolescent's autonomous support, which is also conceivable. Perhaps under certain circumstances, that is, under the effect of certain moderating variables, its negative mediating effect could be significant, which could be subject matter for our future research.

In addition, this study found that autonomy support had no significant effect on the path of disengagement-oriented coping, which may be because the relationship between them was moderated by adolescent stress. Specifically, when an adolescent's stress level is high, their disengagement-oriented coping tendency becomes more obvious. Parental autonomous support can play the role of "timely assistance" and effectively inhibit an adolescent's disengagement-oriented coping mechanism; when the stress level of an adolescent is low, the probability of disengagement-oriented coping is also low, and the inhibitory effect of autonomous support on disengagement-oriented coping is relatively limited. These possible causes

merit further study.

We conclude that exercise adherence is the result of a combination of external factors (autonomous support) and internal factors (psychological resilience and coping style). It is suggested that both internal and external aspects should be taken into account in order to effectively promote exercise adherence. First of all, it is necessary to build a good autonomous support system in order to increase the probability of exercise adherence. Some adolescents tend to regard seeking help as a sign of "weakness" and are reluctant to speak out when they encounter psychological difficulties, for fear that others will underestimate their psychological endurance. Therefore, in the process of autonomous support system construction, it is necessary to intervene, and seek to make a positive influence in order to counteract the teenager's self-destructive psychology and motivate them to actively express their personal feelings, in order to improve the effectiveness of autonomous support.

Secondly, attention should be paid to the cultivation of young people's mental resilience due to the resilience is not a unique trait of geniuses. There is a seed of resilience in everyone that can be nurtured in many ways. The key step is to encourage teenagers to conduct encouraging self-reflection, which means to search for positive meaning in setbacks and hardships. Finally, the coping styles of adolescents should be influenced by parental intervention. On the one hand, it is necessary to help adolescents master more task-oriented coping styles and reduce disengagement-oriented coping; on the other hand, it is necessary to improve the automation level of adolescents' coping and guide them to flexibly carry out targeted coping techniques according to situational necessity.

4.3 Research limitations and recommendations

This study has certain theoretical and practical significance, but it also has some limitations. First, although cross-sectional studies can provide valuable information, they are not yet able to establish causality. Experimental studies and Longitudinal designs can be used to test the findings of this study in the future. Second, the study used the self-reporting method for data collection. The self-reporting method is prone to inaccuracies, due to some adolescents having a preoccupation with social approval. In the future, data can be collected by combining the self-reporting method with various other methods (such as coach reports and teammate evaluations). Third, the results of this study only concern only the male adolescent population and therefore cannot be generalized beyond this population. Finally, although the mediating effects of resilience and coping style between autonomy support and exercise adherence were examined in this study, other mediating variables, such as self-determination, motivation, perceived stress, and fear of failure, were not sufficiently examined.

4.4 Practical implications

This study explored the internal psychological mechanisms involved in parental autonomy support and its impact on adolescent sports adherence, and further verified the interactional relationships between parental autonomy support, resilience, coping styles and exercise adherence. The results of this study

indicate a link between external support and intrinsic traits, which combine to form the personality and manifest as the behavioral expression of the adolescent. Obtaining greater comprehension of this link between external influence and intrinsic traits can serve to enrich the theoretical framework for future research into exercise adherence and can thus provide useful information, contributing to the general comprehension of exercise adherence.

5. Conclusions

The mediating effects of resilience and coping style were validated through hierarchical regression and Bootstrap analysis. The results showed: (1) parental autonomy support had a significant positive predictive effect on exercise adherence; (2) resilience and coping style mediated the relationship between parental autonomy support and exercise adherence. Parental autonomy support can not only directly promote exercise adherence, but also indirectly promote it through the multiple mediating effects of resilience and coping style. The mediating effect model constructed in this study revealed the internal mechanism through which autonomous support influences exercise adherence to a certain extent. It provides useful information for promoting exercise adherence among male Korean adolescents. The results of this study concern only the male adolescent population of Korean and so it was limited to this population.

AVAILABILITY OF DATA AND MATERIALS

All the data contained in this study can be obtained by contacting the corresponding author. Readers can also inquire part of the original data and the results of data processing in this paper.

AUTHOR CONTRIBUTIONS

HTF—contributed to topic selection, literature consultation, literature review and article drafting. JG—contributed to the manuscripts writing, revision and proofreading. JH—provided help and advice on designing the research. ZHS—contributed to the questionnaire survey, performed the data analyses and wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

There was no unethical behavior in this study, as this study was limited to a questionnaire survey. Since this study did not involve human clinical trials or animal experiments, according to Chinese and Korea laws and regulations and scientific research guidelines, this study does not require ethical approval, and so was orally approved by the scientific research institution of Hebei University of Science and Technology and Jeonbuk National University. In addition, all subjects gave written informed consent in accordance with the Declaration of Helsinki. The subjects of the investigation were ensured the

rights to confidentiality and anonymity. All participation was voluntary. This survey has taken the form of parents' opinions conveyed by the students themselves, or the consent of the parents or guardians has been obtained by calling in advance or on the spot.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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