

The effects of cumulative ecological risk on college students' exercise adherence: mediated by exercise motivation and atmosphere

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This study will explore the effects of cumulative ecological risk on college students' exercise adherence and analyze the mediating effects of exercise motivation and atmosphere. The purpose is to provide a theoretical basis for more college students to persist in participating in sports and to help them develop a healthy lifestyle. The [Cumulative Ecological Risk Scale], [College Students' Exercise Adherence Scale], [College Students' Exercise Motivation Scale], and [College Students' Exercise Atmosphere Scale] adapted from the mature scale were used to survey 919 college students from six colleges and universities in Guizhou Province. The collected data were analyzed by using the correlation analysis method, the multiple regression analysis method, and the Bootstrap test method. The results showed that there were significant correlations among the four components of cumulative ecological risk, exercise motivation, exercise atmosphere, and college students' exercise adherence ($P < 0.01$); multiple regression analysis showed that cumulative ecological risk could significantly negatively predict college students' exercise adherence ($\beta = -0.692$; $P < 0.01$); significantly negatively predict exercise motivation ($\beta = -0.179$; $P < 0.01$); and could significantly negatively predict exercise atmosphere ($\beta = -0.289$; $P < 0.01$); and both exercise motivation and exercise atmosphere positively and significantly predicted college student exercise adherence ($\beta = 0.387, 0.193$; $P < 0.01$). The results of the Bootstrap test method showed that cumulative ecological risk significantly and negatively predicted college student exercise adherence with a direct effect of -0.629 , with a direct effect of 83.4% ; cumulative ecological risk can indirectly affect college students' exercise adherence through exercise motivation and exercise atmosphere, with a total indirect effect of -0.175 , with an indirect effect of 19.5% . It is concluded that cumulative ecological risk can directly or indirectly affect college students' exercise adherence through exercise motivation and exercise atmosphere. Focusing on improving college students' exercise motivation and creating a positive exercise atmosphere can promote college students' adherence to exercise and form regular exercise habits and healthy lifestyles.

KEY WORDS: Cumulative ecological risk; Exercise motivation; Exercise atmosphere; exercise adherence

1. Introduction

College students' physical and mental health development has always been the focus of scholars' attention and research. However, with the continuous development of the economy and science and technology, college students' physical and mental health is not optimistic. (Savage et al., 2020). China's long-term education reform problems have led to the one-sided pursuit of students' academic performance and school employment rates. Students have to bear multiple pressures from academics, family, and society, thus neglecting sports development. The atmosphere of sports is diffuse, and college students' physical and mental quality is declining. (Linxia, 2014). Also, with the rapid development of science and technology, people's physical labor is slowly replaced by some high-tech, and some of the human body's functions gradually deteriorate. In their leisure time, many college students are unwilling to participate in sports, addicted to cell phones and computer games, and even eat meals are ordering takeout; the willingness to participate in sports is extremely low, which seriously affects the physical and mental health development of college students. Statistics show that more than 90% of college students have had outdoor sports experience, but 70% of them have interrupted or quit participating in outdoor sports, making them miss the many health benefits of outdoor sports and affecting their positive health. The development of healthy behaviors and increased potential health risks (Ting, Chien, Dhir, & Chen, 2019). The key to solving this problem is identifying the factors affecting college students' exercise adherence and making relevant suggestions. This study will explore the effects on college students' exercise adherence from the comprehensive perspective of cumulative ecological risks of family, school, community, and network and verify the mediating roles of exercise motivation and atmosphere.

1.1 CUMULATIVE ECOLOGICAL RISK AND EXERCISE ADHERENCE

The social-ecological theory recognizes cumulative ecological risk as the accumulation of disadvantages and stressors that individuals face in the environment in which they live. It emphasizes the impact of the ecological environment in which an individual lives on their overall health and argues that accumulating these factors can lead to adverse outcomes. Cumulative ecological risks include a variety of possible stressors and disadvantages, such as low socio-economic status, poverty, social exclusion, family conflict, violence, crime, environmental pollution, interpersonal problems, unhealthy diets, and poor living conditions. Individual risk factors may have a limited impact on an individual. However,

when multiple risk factors coexist and accumulate, they may interact and have a stacking effect, increasing the likelihood of adverse outcomes for the individual (Dongping et al., 2016). Therefore, in recent years, scholars have begun to explore the impact of cumulative ecological risk on individual behavior and agree that cumulative ecological risk is more in line with the reality of college students' lives and adversely affects the individual's healthy behavioral style.

Exercise is based on physical activity skills to improve the quality of physical functioning and performance (Yongsheng & Stenden, 2013). Exercise adherence refers to the long-term continuity of athletes taking the initiative to join the regularity of the psychological state of physical exercise, which to achieve exercise adherence, you need to overcome the process of exercise in the external environment and their unfavorable factors, regular exercise to the end! (Rodrigues, Teixeira, Neiva, Cid, & Monteiro, 2020). In the family, parental involvement in exercise habits, parental support, and family upbringing styles impact college students' perceptions of exercise and may influence their adherence to exercise behaviors. The physical exercise environment at school, the community exercise environment, the exercise atmosphere, and peer supervision may also influence college students' adherence to exercise behaviors (Jinjing et al., 2017). However, most of the previous studies have focused on the impact of a single risk factor on individual development, and few researchers have explored it from a more comprehensive perspective, which has led to our inability to analyze the influencing factors of college students' exercise adherence in a more comprehensive manner. Social cognitive theory suggests that both internal and external factors influence individual behavioral outcomes and that the individual (exercise motivation) and the environment (exercise atmosphere) will change with the gradual accumulation of risk factors in the ecological field (Schunk & DiBenedetto, 2020). When these risk factors, such as family, school, community, and peers, are cumulated together, they may have a significant predictive effect on college students' participation in sports; therefore, there is a need to examine the effects of cumulative ecological risk on college students' exercise adherence. Based on this, the following research hypotheses are proposed:

H1: Cumulative ecological risk significantly and negatively predicts college student exercise adherence.

1.2 THE MEDIATING ROLE OF EXERCISE MOTIVATION

Motivation is the driving force behind an individual's participation in sport. Sports psychologists have developed theories of exercise motivation

over a long period. Kenyon argues that people are motivated to participate in sport for various reasons, not just to prove their ability (Martindale, Devlin, & Vyse, 1990). According to Butt, biological motivation and reinforcement from physical activity experiences motivate people to participate in sport. (Butt, Weinberg, Breckon, & Claytor, 2011). Chatterton's study of young participants' motivations for participation found that. Motivations for deciding to participate usually contain several of these dimensions rather than a single motivation. Participation motivation often varies depending on gender, age, culture, experience level, and skill type (Chatterton, 2016). Therefore, sports motivation is the driving force for college students to participate in sports, guiding the individual's sports behavior. It also has the property that it will make the individual's sports behavior continue to be maintained after reaching a certain intensity. That is, the stronger the motivation of individuals, the higher their motivation to participate in sports activities, the more focused their attention will be, and the time they persist in sports will be longer on the contrary, the weaker the motivation of individuals, the shorter the time they spend in sports, and they will probably give up sports in the end (Weina, Chenglin, & Jun, 2011). Communities, families, and schools provide individuals with suitable exercise environments, which help to enhance their motivation to exercise and thus form regularized exercise habits. It was found that when the cumulative ecological risk was small, college students' participation in sports was supported by their families and peers. The attitude of physical education teachers, the quality of physical education classes, the arrangement of extracurricular activities, and the adequacy and convenience of school sports venues reached a good state, which deepened students' understanding of the value of sports and could significantly increase college students' motivation to exercise, and thus promote individuals' persistent exercise behaviors. Based on the above, the following hypotheses are proposed:

H2: Cumulative ecological risk is a negative predictor of exercise motivation;

H3: Exercise motivation has a significant positive predictive effect on college students' exercise adherence;

H4: Exercise motivation mediates the relationship between cumulative ecological risk and college student exercise adherence.

1.3 THE MEDIATING ROLE OF THE EXERCISE ATMOSPHERE

Exercise atmosphere is a concept in sport psychology that refers to the participation in sports by people around the individual and the sport-related

media messages the individual is exposed to. In recent years, scholars generally agree that the “atmosphere is an external resource for the emergence, maintenance, and development of autonomous behavior in sport.” (Cuilian, 2020,16). The natural atmosphere is the external demand and motivation of individual exercise practice and is the decision-making basis for people to participate in the exercise consciously. When exercisers perceive that the number and layout of exercise places, accessibility, and accessibility meet expectations or satisfy needs, it will arouse interest, enthusiasm, and desire, stimulate exercise behavior, and easily promote the frequency and duration of participation (Cuiping, 2019). The interpersonal environment determines individual movements' cognition, emotion, choice, and expression. On the one hand, the interpersonal atmosphere created by peer friendships is beneficial for individuals to reduce loneliness and to develop behaviors that are consistent with those of their surrounding peers while building social relationships, i.e., to develop convergent behaviors. As herd psychology explains, adolescents' perceptions and behaviors are guided and pressured by interpersonal relationships to conform to the majority (Tamminen et al., 2019). On the other hand, people perceive the autonomy support of significant others as an emotional boost to their coping with challenging events, which helps individuals to gain enthusiasm for the movement and a sense of identity, and stimulates movement autonomy and self-determination (Burns et al., 2019). As K.C. JUNI-PER suggests, intersubjective structural relationships refine college students' health beliefs and make their physical activity more dynamic. In conclusion, natural and interpersonal atmosphere (friendship, support) are critical external factors motivating university students to engage in sports autonomously and actively.

Nikos Ntoumanis and C. K. John Wang both mentioned that the positive impacts occurred when students had a strong intrinsic desire to exercise, were highly motivated, had a sense of autonomy, and could maintain their beliefs about exercise (Ntoumanis, 2001; Wang, Chatzisarantis, Spray, & Biddle, 2002). Brenton Button mentions that school physical activity environments positively correlate with students' physical health within schools (Button, Trites, & Janssen, 2013). A good exercise atmosphere also promotes college students' emotional communication and social skills enhancement, improving individual exercise motivation. When the cumulative ecological risk is small, the support and encouragement of family, teachers, friends, and elders for college students' exercise is sufficient. The school, family, and community provide an excellent natural environment and supply of space and equipment for college students' exercise, which helps to form a positive exercise atmosphere. The positive exercise atmosphere is conducive to pro-

moting college students’ emotional communication, improving their social skills, treating exercise as a pleasurable physical and mental, and realizing their self-worth. Social activities better motivate students to exercise (Jin et al., 2021). A poor exercise atmosphere can constrain a college student’s desire to exercise and even prevent an individual from exercising consistently. Based on the above, the following hypotheses are proposed:

- H5: Cumulative ecological risk hurts the exercise atmosphere;
- H6: Exercise atmosphere has a significant positive effect on college students’ exercise adherence;
- H7: Exercise atmosphere mediates between cumulative ecological risk and college students’ exercise adherence.

1.4 CHAIN MEDIATION OF EXERCISE MOTIVATION AND EXERCISE ATMOSPHERE

Based on the above theoretical assumptions, the effect of cumulative ecological risk on college students’ exercise adherence is influenced by exercise atmosphere and motivation. There is a comprehensive effect of mutual influence. Cascading between exercise atmosphere and exercise motivation, i.e., exercise atmosphere influences exercise motivation and influences college students’ exercise adherence through exercise motivation. Both are essential factors influencing college students’ exercise adherence, based on which the hypothesis is proposed:

- H8: Exercise atmosphere and motivation are chain-mediated between cumulative ecological risk and college students’ exercise adherence.

A diagram of the hypothetical model is shown in Figure 1.

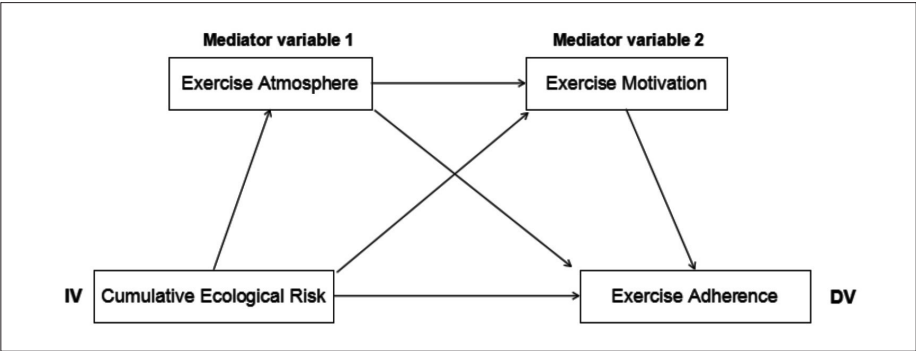


Figure 1. Diagram of the hypothetical model.

2 Research Objects And Methods

2.1 RESEARCH OBJECTS

A random sampling method was used to survey six colleges and universities in Guizhou Province. Before the survey, the purpose of the study was explained to the subjects, and the contents of the student's answers were kept strictly confidential. The questionnaire requirements were explained to the students, and the questionnaires were uniformly collected and screened on-site. From April to June 2023, the research group distributed 1,000 questionnaires, 986 were collected, 67 invalid questionnaires were excluded, and 919 valid questionnaires (93.2%) were finally identified. Among them, 407 are male, and 512 are female.

2.2 RESEARCH METHODOLOGY

2.2.1 *Research tools*

All constructed measurement scales applied in this empirical study drew on well-established scales used by previous scholars and were appropriately modified for the college students in this study.

[Cumulative Ecological Risk Scale] The scale revised by Dongping Li 2016 et al. was used, which contains five subscales, i.e., Family Risk, School Risk, Community Risk, Peer Risk, and Internet Risk, with a total of 42 question items. Respondents were asked to answer each question item on a 5-point Likert scale, with 1=disagree ultimately, 2=disagree, 3=don't know, 4=agree basically, and 5=agree strongly. Higher total scores indicate higher risk experienced by college students. The Cronbach's alpha coefficient for this questionnaire in this measurement was 0.903.

[College Student Exercise Motivation Scale] The scale revised by Weina Liu et al. in 2011 contained four subscales: self-breakthrough, competence, independent choice, and personal commitment, totaling 16 items. Respondents were asked to answer each statement on a 5-point Likert scale ranging from "1" not at all to "5" very strongly. The higher the score, the stronger the motivation of the university students and the Cronbach's alpha coefficient of this questionnaire was 0.928 in this measurement.

[College Students' Exercise Atmosphere Scale] Developed by Liu Weina and Zhou Chenglin et al. in 2011, the scale was tested for good validity and can be effectively used as a valid measurement tool for exercise atmosphere. The scale contains five subscales, namely interpersonal association, natural association, information access, interpersonal hindrance, and conditional hindrance, with 17 items, and subjects are required to answer each statement. The scale is based on a 5-point Likert scale from "1" disagree entirely to "5" strongly agree. The Cronbach's alpha coefficient of the questionnaire was 0.912 for this measurement.

[Exercise Adherence Scale for College Students] The revised scale of Wang Shen et al. 2016 was used. Containing three subscales, i.e., effort engagement, emotional experience, and behavioral habits, with 14 question items, it was scored on a 5-point Likert scale from "1" completely disagree to "5" strongly agree. The model fit index was $\chi^2/DF=2.896$, CFI=0.945, TLI=0.932, NFI=0.919, RFI=0.900, IFI=0.945, NCP=140.298, RMSEA=0.08, and the coeffi-

cient of internal consistency of the total questionnaire was 0.941, which was of good reliability, and the scoring method was the total score at the end of the statistics. The higher the score, the stronger the exercise adherence.

2.2.2 Common method bias test

In this paper, we trained the principal examiners before questionnaire distribution. We used standardized instructions, strict control of filling time, mixed distribution of positive and negative questions, and control of demographic variables to minimize the impact of common method bias on the research results. Meanwhile, the Harman one-way test was used to conduct an exploratory factor analysis with all the question items included in the study variables: cumulative ecological risk, exercise atmosphere, motivation, and adherence. There were 16 factors with eigenvalues greater than 1 when the factors were not rotated, and the amount of variance explained by the first factor was 22%, which did not reach the specified critical level of 40%. Therefore, there is no standard method bias in this stressing.

2.2.3 Data proessing study

Reliability analysis, correlation analysis, and regression analysis were performed sequentially on the research variables through SPSS27 software; with the help of the Bootstrap method, a model was fitted to the potential relationship between cumulative ecological risk, exercise motivation, exercise atmosphere, and college students' exercise adherence to validate the chain mediation effect of exercise motivation and exercise atmosphere.

3. Results

3.1 CORRELATION ANALYSIS OF VARIABLES

From Table I, it can be learned that there is a significant negative correlation between cumulative ecological risk and college students' exercise

TABLE I
Correlations between cumulative ecological risk, exercise atmosphere, exercise motivation, and exercise adherence among college students (r).

Project	M	SD	Cumulative ecological risks	Exercise atmosphere	Exercise motivation	Exercise adherence
Cumulative ecological risks	151.23	22.17	1			
Exercise atmosphere	56.04	8.34	-0.412**	1		
Exercise motivation	33.45	9.05	-0.273**	0.468**	1	
Exercise adherence	31.67	19.78	-0.718**	0.359**	0.493**	1

Note: *p<0.05, **p<0.01, same below.

adherence, and there is a significant negative correlation between cumulative ecological risk and exercise motivation and exercise atmosphere. A significant positive correlation exists between college students' exercise motivation, exercise atmosphere, and adherence.

3.2 MEDIATION EFFECT TEST ANALYSIS

The goodness-of-fit test was constructed for the cumulative ecological risk model. The model fitting results showed that $CMIN/DF=3.85$, $GFI=0.97$, $AGFI=0.91$, $CFI=0.97$, and $RMSEA=0.068$, indicating a high degree of model fit. The results of path coefficients show that cumulative ecological risk has the most significant degree of influence on college students' exercise adherence, with a standardized path coefficient of -0.692 , followed by exercise motivation with a standardized path coefficient of 0.387 , and relatively small exercise atmosphere, with a standardized path coefficient of 0.193 . In the correlation between the latent variables, among them, cumulative ecological risk has a standardized path coefficient of -0.179 for the motivation of college students, a standardized path coefficient of -0.179 , and the standardized path coefficients of cumulative ecological risk and exercise atmosphere on exercise motivation are divided into -0.289 , 0.451 . Based on the above data, the hypotheses H1, H2, H3, and H4 proposed in this study are all valid; see Figure 2 and Table II.

Bootstrap mediation effect validation results showed that cumulative ecological risk's direct and indirect effects on college students' exercise

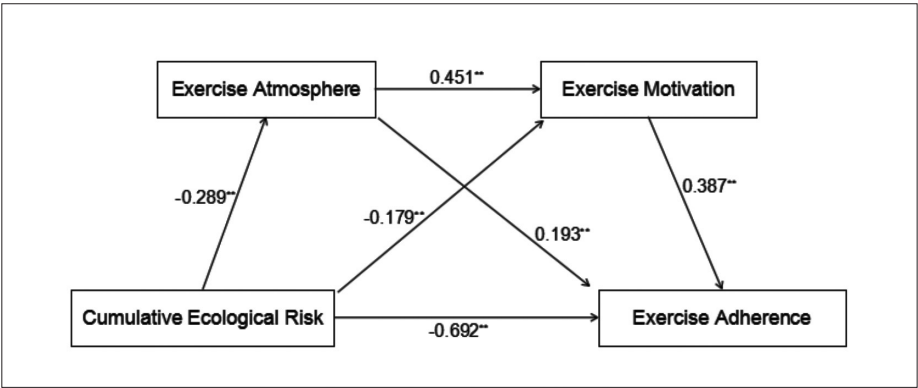


Figure 2. Structural equation modeling diagram.

TABLE II
Path test results

Project	Path coefficient	S.E.	P
Cumulative ecological risk → movement atmosphere	-0.289	0.058	P<0.001
Cumulative ecological risk → Exercise Motivation	-0.179	0.052	0.020
Cumulative ecological risk → Exercise adherence	-0.692	0.037	P<0.001
Exercise atmosphere → exercise motivation	0.451	0.056	P<0.001
Exercise atmosphere → exercise adherence	0.193	0.035	P<0.001
Exercise motivation → exercise adherence	0.387	0.006	P<0.001

adherence did not include 0 at the 95% confidence interval, $P<0.001$, which was significant, and that exercise atmosphere and motivation partially mediated. In the three paths of “cumulative ecological risk-exercise atmosphere-exercise adherence,” “cumulative ecological risk-exercise motivation-exercise adherence,” and “cumulative ecological risk-exercise atmosphere-exercise motivation-exercise adherence,” the 95% confidence intervals did not include 0, indicating that there is a mediating effect of the exercise atmosphere and the exercise motivation in the cumulative ecological risk and college student’s exercise adherence, see Table III.

TABLE III
Results of the mediation effect test

Impact pathways	Efficiency value	Bootstrap 95% CI lower limit	Bootstrap 95% CI Upper Limit	Amount of effect (%)
Cumulative ecological risk → Exercise atmosphere → Exercise adherence	-0.056	-0.073	-0.021	5.2%
Cumulative ecological risk → Exercise motivation → Exercise adherence	-0.069	-0.099	-0.038	9.3%
Cumulative ecological risk → Exercise atmosphere → Exercise motivation → Exercise adherence	-0.050	-0.089	-0.020	6.7%
Total indirect effect	-0.175	-0.274	-0.149	19.5%
Direct effect	-0.692	-0.731	-0.643	83.4%

4. Discussion

4.1 DIRECT EFFECTS OF CUMULATIVE ECOLOGICAL RISK ON COLLEGE STUDENT EXERCISE ADHERENCE

After investigation and analysis, the study found that cumulative ecological risk can negatively affect college students' adherence to sports, and long-term regular exercise, influenced by multiple factors such as family, peers, community, school, network, etc. When the cumulative ecological risk factors are small, the school, family, and society provide college students with a well-equipped sports environment and sufficient field equipment and facilities. The scientific planning of sports grounds in the community makes it easy for students to play sports; schools encourage college students to persist in participating in sports through a variety of systems; parents' long-term adherence to sports plays an imitative role in college students' adherence to sports; they provide good sports equipment for their children to support them in participating in sports; and parents play sports with their children and supervise college students' adherence to sports on vacations, which to a certain extent promotes the adherence to sports among college students and contributes to the formation of healthy life for college students. Parents and their children exercise together during vacation and supervise college students' adherence to exercise, which promotes their adherence to exercise and helps them form a healthy lifestyle. Peer support is also necessary for college students' adherence to sports. Peer support directly affects college students' selectivity and adherence to sports programs. In addition, the degree of importance attached to sports by school leaders, the activity of school sports clubs, and the sports culture environment are all crucial factors for college students' long-term regular participation in sports, and the convenience of school and community sports facilities and the green environment of extracurricular sports venues will attract students to take the initiative to go out and participate in sports. Schools increase extracurricular exercise time and opportunities for college students to gain a pleasurable and successful experience by improving exercise knowledge and skill levels so that students can form stable exercise habits (Ming & Jing, 2022). When the cumulative ecological risk factors of the environment in which college students live are high, the lack of multiple supportive resources for college students in physical exercise exposes individuals to more ecological adversity in their exercise life. The lack of resources for self-control and coping efficacy makes it more likely that they will develop a poor lifestyle to alleviate the undesirable state. This is because adverse environmental and social factors may diminish

their cheerful willingness and ability to adhere to exercise. The lack of a favorable exercise environment for college students, the lack of or untimely maintenance of sports venues and equipment, the unreasonable planning, management, and opening hours of sports venues, the irrational arrangement of functional areas for exercise, and the lack of accessibility to exercise may lead to the interruption or even withdrawal of college students from exercise, which is not conducive to the formation of a healthy lifestyle among college students.

4.2 THE DIRECT EFFECT OF EXERCISE ATMOSPHERE AND EXERCISE MOTIVATION ON COLLEGE STUDENTS' EXERCISE ADHERENCE

This study found that a positive Exercise atmosphere can motivate college students to participate in sports and enhance their sport adherence. For example, social support: support and encouragement FROM family, friends, coaches, and peers can enhance college students' positive attitudes toward and participation in sports. Social support can provide emotional, informational, and substantive support to help college students overcome difficulties, stay motivated, and persist in their sports. Role models: The presence of positive sports role models around college students, such as sports icons, successful athletes, or coaches, can stimulate their interest and motivation in sports and encourage them to persist in sports participation. Exercise facilities and resources: The availability of adequate, convenient, and diversified exercise facilities and resources for university students, such as gyms, sports venues, clubs, etc., can provide convenient and diversified choices and increase their opportunities and interest in playing exercise.

College students' motivation for exercise can influence their commitment and adherence to exercise. Specifically, when college students have intrinsic pleasure and enjoyment of exercise, they are more likely to persist in playing it. Extrinsic motivation: such as obtaining rewards, social recognition, or avoiding punishment, can promote college students' adherence to exercise. Although extrinsic motivations can be motivating, they usually do not have the same long-term effects on exercise adherence as intrinsic motivations. Goal setting: Setting clear goals and challenges can motivate college students and help them persist in exercising. Goals with quantifiable, achievable, and specific time limits can provide clear direction and motivation. A positive exercise atmosphere and intrinsic motivation directly affect college students' exercise adherence.

4.3 MEDIATING EFFECTS OF EXERCISE ATMOSPHERE AND EXERCISE MOTIVATION

The mediating effect of exercise atmosphere: The findings showed that exercise atmosphere partially mediated the path relationship between cumulative ecological risk and college students' exercise adherence. When the cumulative ecological risk of college students' environment is low, a good sports environment and harmonious interpersonal support provide essential support for college students' sport adherence. In terms of exercise environment, schools or communities provide good exercise facilities and resources to facilitate college students' participation in various exercise activities. For example, easy and practical exercise equipment is arranged in living areas, libraries, dormitories, and teaching areas. Students with easy access to appropriate sports venues, equipment, and coaching guidance are likelier to remain actively engaged in sports.

Regarding social support, college students can join sports teams, clubs, or organizations at school to train and compete with other students. In the community, they can participate in sports and health forums conducted by community street offices and organize community fun activities and family games. College students' sports participation tends towards a herd mentality, where parents and peers work together to encourage and help form long-term sports relationships. This environment of social support and teamwork enhances their exercise adherence because they feel part of a team that encourages and supports each other.

Overall, a positive exercise atmosphere stimulates college students' interest and motivation, provides opportunities for social support and teamwork, inspires self-confidence through rewards and recognition, provides good facilities and resource support, and motivates them to adhere to exercise through role modeling and visibility. These factors interact with each other to enhance the motivation and willingness of college students to participate in and adhere to sports, which helps them exercise regularly for a long time and develop a good and healthy lifestyle.

The mediating effect of exercise motivation: Cumulative ecological risk is a comprehensive factor formed by multiple subjects such as community, family, school, and peers, including the exercise environment provided by the community and school and the support and supervision of individual exercise by parents, teachers, and peers. The improvement of cumulative ecological risk has a better prediction effect on college students' exercise motivation. When the cumulative risk of college students' participation in exercise is more negligible, the community and school provide college students with a convenient and accessible exercise environment; parents pro-

vide college students with adequate exercise support; college students encourage and help each other and can generate strong motivation and interest in exercise participation and continue to improve, and can complete the exercise tasks in time. Teachers and students, students and students, home and school, are in a harmonious sports atmosphere, college students can get spiritual support and psychological satisfaction in sports learning, can get help and support from teachers and parents, peers supervise each other's exercise, and also exchange sports knowledge, sports skills, and experience, enriching the students' cognitive level of sports. At the same time, it is conducive to enhancing the emotional exchange between peers, enabling students to obtain a pleasant emotional experience through exercise, and enhancing students' motivation to complete the established exercise tasks independently (Shen et al., 2016). If the cumulative ecological risk is high, communities and schools cannot provide students with perfect sports venues and equipment facilities, sports participation lacks encouragement and support from peers and teachers, and motivation for sports is low, college students encounter challenges in sports and turn to relatively relaxing online games for entertainment in order to avoid negative evaluations, resulting in delays or interruptions in sports. Schools and communities should create a positive sports atmosphere to increase students' motivation to exercise to enhance their adherence to exercise.

Chain-mediated effects of exercise atmosphere and motivation: Cumulative ecological risk reflects the scarcity of supportive resources and the prominence of unstructured socialization characteristics of the environment in which college students live; for college students, family environment, school atmosphere, and peer support are essential factors for exercise participation. Family, school, peers, and community are the most direct and long-lasting ecological subsystems of college students' development, profoundly impacting individual athletic adherence. Factors such as the adequate supply and scientific configuration of community sports facilities and equipment, the community's culture and values, and the community's role models all influence individual motivation to play sports. Family is the earliest place of individual socialization; parents' sports values and interests affect the formation of college students' exercise adherence and play an essential role in forming individual sports values. Previous studies have shown that parents' educational level and sports habits will subconsciously influence their children and guide the formation of their children's sports habits, thus increasing the possibility of exercise adherence. The better the peer relationship, the easier it is to form an interpersonal atmosphere of supervision and mutual support in exercise, and their exercise adherence is relatively high. Cheerful family,

school, peer, and community factors all enhance the exercise atmosphere around the individual, which in turn increases the individual's level of exercise motivation, and the deeper the individual's perception of exercise, which is conducive to the formation of long-term regular exercise behavior (Yaqi et al., 2022). If unfavorable factors abound in all areas, the unstructured environment indicates that college students' sports participation needs to be supported and supervised by parents, teachers, and peers. Unable to form a good exercise atmosphere, unable to obtain timely support and help when facing pressure and frustration, exercise motivation will also be reduced, often taking a negative approach to avoid exercise, there will be exercise delays and interruptions, which is not conducive to the development of college students exercise adherence behavior.

5. Conclusion

In summary, cumulative ecological risk is significantly negatively correlated with exercise atmosphere, exercise motivation, and college students' exercise adherence; cumulative ecological risk can directly negatively predict college students' exercise adherence and also indirectly predict college students' exercise adherence through the mediating effects of exercise atmosphere and exercise motivation. The results of the Bootstrap test method show that the total indirect effect is -0.175, and the proportion of the indirect impact is 19.5%. Therefore, families, schools, and society should provide college students suitable exercise environments and positive interpersonal support. Mental health support services can be established to provide college students with psychological counseling and support to help them cope with the psychological stress caused by cumulative ecological risk and enhance their motivation and adherence to exercise. Creating a supportive social environment: organizing various sports clubs, activities, or teams to give college students an active and friendly sports social circle. This social environment can enhance social support and encouragement and stimulate their interest and motivation to participate in sports. Encourage college students to develop intrinsic motivation to play sports, for example, by providing diverse sports programs and activities to meet their interests and preferences. At the same time, positive feedback and rewards are provided to enhance their self-efficacy and intrinsic motivation.

Therefore, exercise promotion strategies suitable for the individualized development of college students can be developed according to specific situations. It is also possible to increase college students' adherence

to exercise by improving their motivation to participate and creating a favorable climate for exercise. At the same time, providing individualized support and resources to meet the needs of different college students can help enhance college students' exercise adherence and help them develop a healthy lifestyle.

Author Contributions: Yaming Li made significant contributions to this study, including study design, data collection, and analysis, interpretation of results, and writing of the paper. He was actively involved throughout the study and was responsible for the completeness and accuracy of the paper.

Jamalsafria Bin Saibon provided significant guidance and support as a corresponding author, giving valuable advice on the overall direction and content of the study. He reviewed and revised the study and communicated and coordinated effectively with the editor and peer reviewers during the submission and publication.

This study was supported by USM and Zuni Vocational and Technical College research grants.

Institutional review board statement: Not applicable. This study did not involve human medical or biological research, the subjects were adult cognitively and discerning college students over 18, and participant data were confidential and anonymous. If there are any ethical issues or concerns about the rights of the study participants, steps will be taken to investigate and resolve them promptly.

Acknowledgments

We thank the anonymous reviewers and editors for their comments.

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