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SCIENTIFIC PRESS PTE.LTD.

Molecular & Cellular Biomechanics 2024, 21(2), 481.
https://doi.org/10.62617/mcb.v21i2.481

Article

The internal relationship of college students' physical exercise behavior and related factors based on ecological model

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CITATION

Su X, Li M, Shao L, et al. The internal relationship of college students' physical exercise behavior and related factors based on ecological model. Molecular & Cellular Biomechanics. 2024; 21(2): 481. https://doi.org/10.62617/mcb.v21i2.481

ARTICLE INFO

Received: 9 October 2024
Accepted: 21 October 2024
Available online: 6 November 2024

Abstract: Background: The persistence of college students' physical exercise behavior has an important impact on their physical health level and their positive psychological effects. The health behavior ecology model is more comprehensive and progressive than other exercise psychology theories in explaining the effect of physical activity intervention on long-term maintenance. Based on this, In this study, using the socio-ecological model theory as the entry point, applying five different levels of influencing factors in the theoretical model to the field of adolescent physical exercise behavior, The aim is to seek the internal connection between the ecological factors that promote college students' physical exercise behavior through the investigation, so as to provide corresponding intervention strategies for promoting the healthy development of their physical fitness. So as to promote the formation of college students' physical exercise habits. **Methods:** In 2023, 1015 college students were surveyed by questionnaire and measurement scale, followed by descriptive statistical analysis of college students' current physical exercise behavior, and factor analysis of ecological factors affecting college students' physical exercise. **Results:** From the behavior characteristics of college students' physical exercise, different gender of college students in physical exercise, weekly exercise, exercise time is very significant difference ($P < 0.001$), the boys in sports participation higher than girls 15.2%, choose occasionally exercise boy's ratio 10% higher than girls, girls do not participate in exercise more than boys. In terms of exercise time, a few boys choose to do physical exercise on weekends; the proportion of boys in more than 60 min of physical exercise is 7 percentage points higher than girls. In the time of extracurricular exercise, support of parents and physical exercise ($P < 0.05$), there was no significant difference between male and female students in the aspects of intensity of each exercise, participation in sports competition and reasons for not exercise ($P > 0.05$). The principal component analysis of the influencing factors of college students' physical exercise behavior was conducted from the individual, family, school, community, and policy levels. The KOM value was 0.984, which met the judgment criteria of factor analysis. Through principal component analysis of the above five levels, according to the requirements of factors greater than 1, the individual level, family level, school level and policy level respectively two factors, corresponding cumulative contribution rate is 56.545%, 595.350%, 64.870% and 85.700% respectively, community level three factors, corresponding to the cumulative contribution rate of 76.450%. **Conclusion:** The advantage of the health behavior ecology model is that the comprehensive intervention strategies based on multi-level, multi-level effects greatly expand people's understanding of the intervention. This model is applied to the field of physical health promotion of college students, to study human exercise behavior through the joint action of physiological, psychological and environmental factors, so as to more comprehensively reveal the various factors of exercise behavior, as well as the mutual relationship and influence between them. The results of this study indicate that: among the ecological factors that affect the physical exercise behavior of college students, the individual factors of college students are a necessary

condition for physical exercise, while family, school and community factors affect the direction of the change and development of college students' physical exercise behavior. Policy factors are a powerful driving force for college students' physical exercise behavior. Only by considering the relationship between the relevant factors can we better understand the characteristics of college students' physical exercise development, put forward the corresponding intervention strategies, and promote the formation of college students' physical exercise habits through effective ways.

Keywords: ecological model; physical exercise behavior; related factors; college students

1. Introduction

According to the results of the survey on Chinese students' physical health data in 2019, a total of 374,000 students were selected, and the excellent rate of students reached 23.8%. The excellent rate of students aged 13–22 increased from 14.8% in 2014 to 17.7% in 2019, up 2.9 percentage points. Compared with the 2014 survey results, students' physical shape and physical function indicators continue to improve [1]; but it is worrying that the declining physical fitness of college students remains unchanged. Compared with the data of 2014, the speed, explosive force, endurance and other physical quality indicators of college students have decreased, among which the standing long jump performance decreased the most, the average decrease of 3 cm and 2.9 cm respectively; the visual index of college students is 2.87 percentage points higher than that of 2014, the obesity rate of college students continues to rise, the BMI index increased by 0.84 and 0.36 respectively, it can be seen that insufficient physical exercise is one of the important factors for the decline of students' physical fitness [2]. The amount and intensity of physical activity failing to meet the recommended criteria can result in physical inactivity. Physical inactivity has a significant impact on health and has become the fourth leading cause of death worldwide. On average, college students have a long sitting time per day and have relatively little physical activity [3]. The physical health and healthy lifestyle of college students are jointly influenced by various factors such as personal habits, environmental atmosphere, health knowledge, psychology and cognition, including [4]. College students have problems such as weak sports consciousness, sports attitude is not correct, the purpose of participating in physical exercise is not clear, and the motivation of physical exercise is not strong. These problems are difficult to arouse college students' strong interest in sports activities and develop good sports habits. Tu Xiaohong et al. took nearly 10,000 college students from 4 universities in Hubei, Jiangxi and Chongqing provinces (municipalities directly under the Central Government) to analyze the relationship between outdoor sports, physical exercise and the decline of resistance. The results showed that the lack of outdoor activities is an important reason for the reduction of immunity of college students [5].

Early exercise psychology theories emphasize the influence of individual factors on healthy behavior, such as health belief model, planned behavior theory and stages of change theory, which are based on intervention to individuals, and tries to achieve the purpose of changing individual behavior by changing individual psychological factors, such as self-efficacy, attitude, belief, etc. These theories are effective for interfering with individual behavior changes in the short term, and once the

intervention is stopped, the individual's behavior will possibly return to its original state; therefore, they are relatively limited in explaining the effect of physical activity intervention on maintaining long-term effects [6,7]. The basic view of social ecology is that individual behavior may be affected by other factors besides psychological factors. The generation of individual behavior is closely related to the environment in which it is located and is vulnerable to environmental factors [8]. Therefore, research needs to pay attention to the changes of human behavior in natural and social environments [9]. In 2008, Sallis, Owen & Fisher proposed that the socio-ecological model emphasizes that the influencing factors of healthy behavior are multi-levels, including five levels: individual, interpersonal, organization, community and public policy; different factors interacted and can be divided into three systems according to the influence on individual exercise behavior and the distance from individual, i.e. the micro-system including individual factors, the mid-system including interpersonal relationship, organization and community levels and the macro-system of policy; multi-level intervention strategy is the most effective for behavior change. The factors that play a role may be a direct one-to-one relationship or a one-to-many relationship [10].

Researches abroad on the influence of ecological model on adolescent physical health has achieved fruitful results. McLeroy researched on the choice of health promotion projects from an ecological perspective [11]. Stokols studied the establishment and maintaining of a health-promoted social ecological environment [12]. Sallis and Owen evaluated the impact of the school ecological environment on students' physical activity, and the results showed that the environmental characteristics were related to the enthusiasm of male and female students for physical activity, and the characteristics of the ecological environment became a variable affecting 42% of girls and 59% of boys to participate actively in physical activity. Then Health Behavior and Health Education: Theory, Research and Practice was published which described the ecological model of healthy behavior in detail [13]. Hovell et al. integrated the health and behavioral science knowledge systems, and constructed the behavioral ecological model to promote physical activity experience and evaluation procedures [14]. Fisher et al. used ecological methods to establish a model of self-management of diabetes [15]. Sallis et al. created more communities suitable for physical activity through ecological methods [16]. Based on the social-ecological model, the environment, society and psychology of adolescent physical activity were studied abroad which focused on the interrelationship of health, physical activity, and the environment [17].

Social ecology takes the influence of people on the surrounding environment and takes the interaction between people and the environment as the starting point. At the same time, this theory holds that factors such as individuals themselves, relationships with others, public places, residential parks and related systems can all affect individual behavior. The theory of social ecology has been widely used in all walks of life, and the following lists the related fields of movement. Zhang used the healthy ecological model of three influence factors to investigate the sports activities in a university in Beijing, and divided them into two categories: promotion and strengthening, and determined that the research areas of both were government institutions and school associations [18]. Through the in-depth discussion of physical

education teaching, Zhang believed that through this mode, the physical activities of college students can be explained, so as to expand the scope of sports exploration to two aspects of environment and society. Xie and Ouyang from the perspective of movement ecology, put forward the movement of ecological social ecological problems, but because of its focus is the natural environment of sports ecological development, so rarely involves other aspects, and from the perspective of sports participants environment system to physical activity of social ecological discussion is currently no [19]. Zhang et al. from the micro, medium and macro physical exercise three levels, using the basic principles of social ecology, from the perspective of the restriction mechanism and restriction factors [20]. Finally, the physical exercise behavior at different levels is discussed, and the corresponding countermeasures and suggestions are put forward. Many scholars have studied the factors affecting physical activity from social support, family factors, coaching paternalistic behavior, physical education teaching and psychological fatigue. Ma pointed out that the current social and ecological environment of college students is very complex, and their sports activities are closely related to their environment. College students 'physical exercise needs personal factors as the main driving force, interpersonal level, environmental factors, community factors all have an impact on the development trend of college students' physical exercise, and the policy factor is the external motivation of college students to adhere to long-term physical exercise [21]. There are differences between the influencing factors of physical activity and physical exercise, and the influencing factors of physical activity are relatively complex. Existing studies have analyzed the influencing factors of physical activity from multiple perspectives to explore the personal factors, family factors, environmental and social factors affecting individual participation in physical activity.

Based on the above review, this study takes the social ecology model theory as the breakthrough point, applies the five different levels of influencing factors to the youth physical exercise behavior, forms the corresponding five dimensions, namely individual, family, school, community and the policy dimensions, analyzes the influencing factors on youth physical exercise behavior, researches on the interrelation of each influencing factors in order to better understand the influencing factors of college students' physical exercise development, proposes the corresponding intervention strategy and promotes the youth physical exercise habit formation through effective ways.

2. Materials and methods

2.1. Participants

In 2023, 1100 college students in Shenyang, Liaoning province (including 1 comprehensive university, 1 engineering university, 1 normal university, 1 art college and 1 medical university) were randomly selected for questionnaire survey and scale measurement. The selection of samples can comprehensively cover all professional fields, can reflect the characteristics of college students, and has a certain representativeness. The data are from the ongoing Youth Health Promotion Project ("ATY" & "JKR") baseline survey, which aims to explore the internal links within the ecological factors affecting physical exercise behavior among college students. A total

of 1100 college students were invited to participate in this study, with a sample of 550 of both girls and boys, whose questionnaires of 1015 subjects met the requirements of the study and their data were analyzed.

2.2. Measuring instrument

According to the research plan, this paper looks up the literature on the behavior and habits of young people's physical exercise, and summarizes the viewpoints. Combined with theoretical analysis and interview results, a questionnaire on the present situation and influencing factors of young people's physical exercise behavior was designed. The questionnaire was conducted from five levels: individual, family, school, community and policy, and the contents of the survey were coded by category, that is, A, B, C, D, S represent the above five dimensions respectively. The questionnaire uses 5 scaling method according to the influencing degree of each variable, that is, " no influence = 1, little influence = 2, general influence = 3, great influence = 4, very great influence = 5". Questionnaires of experts and students were selected twice, the first time was to screen out the items with the mean value less than "3" in the questionnaire, the second time was to carry out analysis in order to test the homogeneity of each item, and finally screened out 57 items that meet the requirements.

2.3. Reliability of the questionnaire

A preliminary questionnaire was prepared, and then the statistical data were collected and sorted through the second round of data screening, and the α coefficients and standardized α coefficients of each component table of the questionnaire were obtained (see **Table 1**).

Table 1. Reliability of each influencing factor of adolescent physical exercise behavior & variables statistics.

Dimension	Cronbach *α* coefficient	Standardizing *α* coefficient	Number of items	Variables and items
Individual	0.866	0.867	11	A1 Physical quality A2 Health status A3 Motivation of sports A4 Interest in sports A5 Sense of achievement in sports A6 Degree of attention to one's own health A7 Benefits of physical exercise A8 Happy Experience of Sport A9 Positive expectations of sports outcomes A10 Positive self-evaluation A11 Sports knowledge and attitudes
Family	0.910	0.911	12	B1Parents' life style B2 Parents' upbringing style B3Communication between parents and children B4 Sports atmosphere of the family B5 Parents' sports knowledge and habitsB6 financial situation of the family B7 Parents' Educational idea B8 Parents' sports awareness and behaviour B9 Parents' character B10 Support of the family B11 Distribution and Control of Children's Time by Parents. B12 Leisure and entertainment mode of the family

Table 1. (*Continued*).

Dimension	Cronbach α coefficient	Standardizing α coefficient	Number of items	Variables and items
School	0.899	0.900	10	C1 Teaching idea of PE Teachers C2 Teaching methods of PE teachers C3 Professional qualities of PE teachers C4 Exercise awareness and behavior of school leaders C5 Degree of attention to sports by school leaders C6 Sports funds of schoolC7 Education evaluation mechanismC8 Situation of extracurricular sports activities C9 Sports facilities of school C10 Support from peers and friends
Community	0.925	0.926	14	D1 Distribution of gymnastical equipment in the communityD2 Sports facilities in the community D3 Number of exercise trail D4 Sports instructors D5 Effects of sports facilities on college students' sports behavior D6 Publicity of sports by public media D7 Major international sports events. D8 Sports star effect D9 Social sports values D10 Spatial distribution of exercise sites in the community D11 Sports competitions in the community. D12 number of exercise groups in the community. D13 Publicity of sports culture D14 Popularizing of Sports Knowledge
Policy	0.942	0.942	10	S1 Youth sports in "14th Five-Year Plan". S2 Comments of the Central Committee on strengthening youth sports and enhancing physical qualities. S3 Decision of the Central Committee on deepening education reform and promoting quality education. S4 Sports Regulations of the school. S5 《National Health Standards for Students》. S6 Plan for monitoring and intervention of students' physical health. S7 Degree of attention to adolescent health education by the education administration S8 Support for Sport Promotion from the government S9 Sports policy implementation resources S10 Reality of the implementation of sports policy in schools

From the data of **Table 1**, the Cronbach α coefficient of the family, community and policy aspect was more than 0.90, and the Cronbach α coefficient of the individual and school level aspect was 0.866 and 0.899. According to Henson (2001), the judgement principle of the internal consistency reliability coefficient index: when 0.80 ≤ α coefficient < 0.90, it indicates that the reliability of the test or scale is ideal, and when theαcoefficient ≥ 0.90, it indicates that the reliability of the test or scale is very good, thus the results show that the reliability of the questionnaire of influencing factors of youth physical exercise behavior reaches an ideal and very good level [22].

2.4. Test of the validity of the questionnaire

The results of the validity test of the questionnaire in **Figure 1** shows that the KMO value > 0.8 indicates the suitability for factor analysis. KMO was used to test the partial correlation between variables, taking values between 0 and 1, and the closer the KMO value was to 1, the better the factor analysis effect was. In general, a KMO above 0.9 is highly suitable for factor analysis. Bartlett The P value < 0.05 for the

spherical test, rejecting the assumption of independence of each variable, which is a strong correlation between the variables, allows factor analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olin	Measure of Sampling Adequacy	.984
Bartlett's test for sphericity	approximately chi-square	55791.221
	df	1596
	Significance	.000

Figure 1. KMO and Bartlett-test results.

2.5. Statistical analysis

The present situation of physical exercise behavior of college students is analyzed by descriptive statistics, the gender difference test is carried out at the same time, and the exploratory factor analysis is carried out for the influencing factors.

3. Results

3.1. Characteristics of physical exercises of college students

In terms of participation in physical exercise and the choice of time for extracurricular physical exercise, the proportion of people who choose to participate in extracurricular physical exercise, occasionally participate and do not participate is 40.1%, 53.4% and 6.5%, respectively. Among them, the proportion of male students is 45.8%, 49.8%, 4.4%, and the proportion of female students is 30.6%, 59.3% and 10.1%, respectively. The proportion of college students participating in physical exercise was 19.7%, 48.1% and 20.1% in the morning, evening and weekend respectively. Among them, the proportion of male students was 19.7%, 44.2%, 22.9%, and the proportion of female students was 19.7%, 54.3% and 15.6%. respectively.

In terms of the frequency, time and intensity of physical exercise, 59.3% of the students choose once or twice a week and 12.3% of the students choose more than 3 times. Among them, the proportion of male students is 59.2%,13.1% and female students 59.4%, 11.1%, respectively; most of the duration of exercise is 20–60 min, occupying 63.7%; 19.6% over 60 min. Among them, the proportion of male students is 62.8%, 22.3% and male students 65.1% and 15.2%, respectively. As to the intensity of exercise, 52.6% feel a bit tired with sweat; 15.3% feel very tired with lots of sweat, and the proportion of male and female students is 50.9%, 16.6%, and 55.4%, 13.2% respectively.

In the aspect of supporting youth physical exercise, 86.3% of the students can get strong support from their elders, and 56.4% of the students have participated in sports competitions. The proportion of male and female students is 84.7%,55.9% and 88.9%, 57.3% respectively.

In the group survey of students who do not participate in physical exercise, as to the reasons that prevent them from taking part in physical exercise, 48% of the students think it is because they have no time; 16.9% think it is because of their heavy study tasks; and 15.5% of the students choose they have no peer. The proportion of male and

female is 47% ,18%, 16.9%, and 49.6%, 15.1%, 14.1%, respectively. As to the factors that restrict physical exercise, 47.6% of the students think it is because of the restrictions of time, 20.3% think it is because that they have no peer support. Among them, the proportion of male and female students is 48.9%, 21.2%, 20.7%, and 45.5%, 19.5% 19.7%, respectively.

3.2. Results of gender difference in college students' sports concept and exercise behavior

As shown in **Table 2**, several variables are investigated, including the degree of interest of college students in physical exercise, the position of physical exercise in personal life, the degree of personal understanding of lifelong physical education, and the desire to exercise, if they do not exercise every few days. It shows that there are significant differences between boys and girls ($p < 0.001$). By in-depth investigation, it is found that college students still have some problems in the cultivation of exercise persistence and exercise habits, and their awareness of sports for life is relatively weak. Their understanding of sports only stays in the stage of perceptual cognition, and has not yet reached the rational thinking and understanding of the essence of sports. It is this rational cognition that determines the effect of college students' participation in sports activities; there are very significant differences between male and female students in extracurricular physical exercise participation, frequency of exercises per week, duration of exercise each time, and so on. There are significant differences between male and female students in terms of the time of extra-curricular exercise, the degree of support from parents and the constraints of physical exercise. However, there is no significant difference between male and female students in the intensity of exercise, participation in sports competitions and the reasons for not exercising.

Table 2. Comparison of gender differences of college students' sports concept and exercise behavior.

Variable	Gender	*N*	Mean	Standard deviation	*t*-value
Degree of interest in physical exercise	male	500	3.45	0.81	13.528***
	female	515	3.10	0.93	
Position of physical exercise in personal life	male	500	3.46	0.73	5.733***
	female	515	3.33	0.71	
Degree of personal understanding of lifelong sports	male	500	3.01	0.98	4.588***
	female	515	2.88	0.90	
Strong desire to exercise without sports several days	male	500	2.94	1.07	9.149***
	female	515	2.65	1.07	
Extracurricular physical exercise participation	male	500	1.59	0.575	−7.343***
	female	515	1.80	0.604	
Time of extra-curricular exercise	male	500	3.02	1.356	2.198 *
	female	515	2.88	1.225	
Frequency of exercise per week	male	500	3.05	1.420	3.921 ***
	female	515	2.78	1.399	
Duration of exercise each time	male	500	2.66	1.855	4.851 ***
	female	515	2.35	0.963	

Table 2. (*Continued*).

Variable	Gender	*N*	Mean	Standard deviation	*t*-value
Intensity of exercise	male	500	2.92	2.336	0.966 n.s.
	female	515	2.83	1.470	
Degree of support from parents	male	500	1.17	0.436	2.447 *
	female	515	1.12	0.373	
Participation in sports competitions	male	500	1.45	0.516	0.060 n.s.
	female	515	1.44	0.549	
Reasons for not exercising	male	500	2.42	1.112	−1.150n.s.
	female	515	2.49	1.131	
Constraints of physical exercise	male	500	2.23	0.999	-2.069 *
	female	515	2.41	1.159	

* $P < 0.05$ ***$P < 0.01$ n.s. $P > 0.05$

4. Discussion

4.1. Degree of college students' sports participation and choice of sports time

The results show that nearly half of the college students are able to participate in physical exercise, and 40% of the students choose to exercise at night. The number of students who occasionally participate in exercise is more than half, and the number who never participate in exercise is a minority. However, in the long run, the participation in physical exercise does not have a stable and lasting effect. This result may be due to the following reasons: first, after entering college, the increase of activities, academic and employment pressure caused them to spend too much time busy with their own things, and thus did not form a stable physical exercise behavior. Second, some college students fail to realize the promotion effect of physical exercise on their own physique, so that the participation in sports is greatly affected by other conditions, such as the influence of peers or friends. Third, a small number of college students do not participate in physical exercise because of their poor innate physique. In either case, it is worth our thinking that although some students are involved in physical exercise, and some students occasionally take physical exercise, it may be a short-term need, rather than a real interest in sports, so the result is not optimistic, so how to stimulate students' interest in sports should be our concern.

4.2. Frequency, time and intensity of college students' physical exercise

The data of the questionnaire survey showed that the male and female students had high consistency in the frequency, duration and intensity of physical exercise, and nearly 60% of the students do physical exercises once or twice per week, duration is 20–60 min, and the exercise intensity is medium, also there are symptoms of fatigue and sweating after exercise. Compared with the standard that our country prescribes the sports population is to carry on the moderate intensity physical exercise at least three times a week, not less than 30 min, there is still a certain gap in the physical exercise of college students. The survey data show that only 19.6% of the students are able to exercise regularly, and male students are better than female groups. The reasons

for this are that, on the one hand, boys are more active and more athletic than girls because of gender differences, on the other hand, there are some differences between boys and girls in sports ability and sports attainment [23]. In addition, girls are more likely than boys to be afraid of being tired, afraid of hardship resulting in reduced interest in sports.

4.3. Social support for college students' physical exercise

According to the survey data, more than 80% of college students can get the support from the family, and more than half of the students have participated in sports competitions. Jiang's research showed that through the questionnaire feedback of parents' participation in physical exercise, parents' physical exercise behavior has a close relationship with the formation of students' physical exercise habits. The data show that the proportion of parents who form exercise habits is 8.6% higher than that of parents who do not. Thus, parents' physical exercise behavior has an important impact on the formation of students' physical exercise habit [24]. The acceleration of life rhythm in modern society and the increase of work pressure have enhanced people's awareness of their own health. From the development of the fitness team and the square dance in spare time, it is not difficult to see that public fitness movement is booming. The promotion of parents' health awareness is bound to have an important impact on future generations, which is a very optimistic result. But it is not optimistic because of the occasionality and lack of lasting motivation of youth physical exercise, so we need to seriously think and study how to promote physical exercise of college students, develop the behavior habits of physical exercise, in order that physical education occupies an important position in the life of college students.

4.4. Reasons for college students not participating in physical exercise

In the investigation among the students who do not participate in physical exercises, half of them choose "no time" for the reason not participating in sports and the factors restricting physical activity. It was found that the great employment pressure forced them to spend too much time on their studies. They were busy with "charging up, passing Grade exams, Certificate exams" to increase the chances of employment, and some students hope to go for further study. In addition, some college students are not good at planning time and making a proper balance between work and rest, which makes them have no enough spare time and neglect physical exercise.

4.5. Analysis on college students' physical exercise behavior of different genders

In this study, the differences of physical exercise behavior of male and female students were tested. The results show that there are significant differences between male and female students in physical participation, the frequency and time of exercises. The proportion of male students in physical participation is 15.2% higher than that of female students, the proportion of male students who exercise occasionally is 10% higher than that of female students, and the proportion of female students who do not participate in exercise is 5% higher than that of male students. In the choice of exercise time, a minority of boys choose to take physical exercise on the weekend; the

proportion of male students who exercise longer than 60 min is 7% higher than female. This result is more in line with the personality characteristics of college students. Boys are active and active with girls, good at challenging themselves and pursuing physical transcendence, and trying to broaden their social communication through sports means. Girls are introverted and relatively quiet, leading to relatively weak times of sports participation and exercise. In terms of the time of extra-curricular exercise, the degree of support from parents and the restricting factors of physical exercise, there are significant differences between male and female students, Whether parents participate in sports has a significant effect on the frequency of college students participating in physical exercise. It is mainly because the exemplary role of parents will have a subtle impact on their children. Parents, as the first teachers of their children, assume the role of example, habits and other aspects play an indispensable role. but there is no significant difference in the intensity of exercise each time, the degree of participation in physical competition and the reasons for not exercising.

4.6. Analysis of ecological factors influencing physical exercise behavior of college students

To study the behavior characteristics of college students' physical exercise by the theory of ecological model, it is necessary to fully understand the status and role of these factors in the ecological model, so as to make targeted intervention strategies by revealing the influencing factors of college students' participation in physical exercise. The influencing factors of college students' physical exercise behavior are mainly analyzed from five levels: individual, family, school, community and policy level. Through the principal component analysis of the survey data, the KMO value is 0.984. According to Kaiser (1974), when performing factor analysis, the judgment criterion of KMO index value is that the statistical value is above 0.70, the factor analysis can be carried out.

Therefore, to do the principal component analysis of the variables of the five dimensions, the number of factors with characteristic value greater than 1 was extracted. The results of factor analysis showed (**Table 3**): two factors were extracted at individual dimension, named "sports participation motivation" and "physical health guarantee" respectively. The cumulative contribution rate is 56.545%. Two factors were extracted at family dimension, named "family sports health awareness" and "family economic and educational environment", the cumulative contribution rate is 59.350%. Two factors were extracted at school dimension, named "professional quality of PE teachers" and "exercise environment in school", the cumulative contribution rate is 64.870%. Three factors were extracted at community dimension, named "equipment guarantee", "sports values" and "group influence", the cumulative contribution rate is 76.450%. Two factors were extracted at the policy dimension, named "sports administration execution" and "policy resource guarantee" the cumulative contribution rate is 85.700%.

Table 3. Parameters related to the extraction of factors affecting the physical exercise behavior of youth.

Level	Factor	Variables	Post-rotation load matrix										
			FA		FB		FC		FD			FS	
			F1	F2	F1	F2	F1	F2	F1	F2	F3	F1	F2
Individual	sports participation motivation	A3	0.673										
		A4	0.736										
		A5	0.749										
		A8	0.685										
		A9	0.667										
		A10	0.643										
		A11	0.565										
	Physical health guarantee	A1		0.848									
		A2		0.876									
		A6		0.536									
		A7		0.553									
	eigenvalue		3.642	2.578									
	Contribution rate		33.109	23.436									
	cumulative contribution rate		33.109	56.545									
Family dimension	family culture of health awareness	B1			0.785								
		B2			0.748								
		B3			0.679								
		B4			0.857								
		B5			0.648								
		B8			0.642								
		B10			0.548								
		B12			0.546								
	family economic and educational environment	B6				0.768							
		B7				0.624							
		B9				0.748							
		B11				0.694							

Table 3. (*Continued*).

Level	Factor	Variables	Post-rotation load matrix										
			FA		FB		FC		FD			FS	
			F1	F2	F1	F2	F1	F2	F1	F2	F3	F1	F2
	eigenvalue				4.175	3.342							
	Contribution rate				34.792	27.850							
	cumulative contribution rate				34.792	62.642							
School dimension	professional quality of PE teachers	C1					0.875						
		C2					0.883						
		C3					0.841						
	exercise environment in school	C4						0.725					
		C5						0.824					
		C6						0.779					
		C7						0.696					
		C8						0.732					
		C9						0.643					
		C10						0.557					
	eigenvalue						3.804	2.683					
	Contribution rate						38.040	26.830					
	cumulative contribution rate						38.040	64.870					
Community dimension	equipment guarantee	D1							0.738				
		D2							0.685				
		D3							0.604				
		D4							0.744				
	sports values	D5								0.597			
		D6								0.709			
		D7								0.827			
		D8								0.812			
		D9								0.705			
		D10								0.590			
	group influence	D11									0.529		

Table 3. (*Continued*).

Level	Factor	Variables	Post-rotation load matrix										
			FA		FB		FC		FD			FS	
			F1	F2	F1	F2	F1	F2	F1	F2	F3	F1	F2
		D12									0.893		
		D13									0.838		
		D14									0.793		
	eigenvalue								3.758	3.751	3.194		
	Contribution rate								26.843	26.793	22.814		
	cumulative contribution rate								26.843	53.636	76.450		
	sports administration execution	S1										0.751	
		S2										0.806	
		S3										0.832	
		S4										0.804	
		S5										0.735	
		S6										0.572	
Policy dimension		S7											0.726
	policy resource guarantee	S8											0.815
		S9											0.696
		S10											0.752
	eigenvalue											4.634	3.936
	Contribution rate											46.340	39.360
	cumulative contribution rate											46.360	85.700

4.7. Analysis and discussion

Individual dimension:

At the individual level, factor 1 mainly reflects the motivation, interest of physical exercise, the sense of sports achievement, the pleasant experience of sports, the positive expectation of sports results, the positive self-evaluation and the attitude towards sports knowledge. Among them, the sense of sports achievement and the interest in sports has the highest correlation with F1, which indicates that they are very important factors in explaining the behavior of young people in physical exercise. The sense of achievement in sports can lead to the inner pleasure and the psychological tendency of success, which all result from the active participation of individuals in sports. Sports behavior formed by sports interest can enable individuals to acquire more knowledge of sports and health, improve sports skills, promote the healthy development of body and mind, and also produce pleasant emotional experience. Besides, the motivation of exercise is also a factor that cannot be ignored. Ryan et al.'s research shows that "the stronger the intrinsic motivation of those who take part in physical exercise, the more able to persist in exercise" [25]. The motivation of physical exercise is positively related to the persistence of exercise, and extrinsic motivation can promote people to participate in physical exercise, while people with intrinsic motivation can participate in physical exercise more often and for a longer time [26]. The correlation between attitudes towards sports knowledge and factor 1 is slightly lower, indicating that it is less important than other factors. According to Mao, the value and function of physical exercise recognized by students are highly related to the long-term insistence on physical exercise (r = 0.87), which shows that the understanding of the value and function of physical exercise itself is an important factor affecting students' adherence to physical exercise [27]. It can be seen that there are some differences in the role of attitude factors in physical exercise behavior at two different stages.

Factor 2 mainly reflects the individual's physical quality, health status, attention to their own health and the benefits of physical exercise. Among them, the individual's health status and physical quality have a high correlation, it can be said that the individual's physical quality and health status is the necessary premise to achieve a variety of psychological factors, and the physical basis of exercise behavior. Therefore, physical health factors and psychological factors complement each other, physical health factors are the basis of psychological factors, and psychological factors play a role in promoting physical health. Epstein et al. argued that although obese people were more likely to choose daily moderate-intensity activities such as walking, they still show lower participation compared with people of normal weight in public interventions including walking and climbing [28]. Female college students' physical exercise motivation is closely related to their own body shape, and 42% variation of their physical exercise motivation is caused by the change of the Ketolai index [28].

4.8. Family dimension

The family influencing factor 1 is named "family culture of health awareness", which mainly explains the family life style, communication style to children, interaction with children, parents' sports knowledge structure, sports habits, sports

awareness and behavior, the degree of support from relatives, family leisure and entertainment style and so on. Among the factors with high correlation with factor 1 are the family's sports atmosphere, family life style and family education style. It shows that these factors have an important influence on the behavior of young people's physical exercise, and the behavior of young people's physical exercise is often closely related to the physical atmosphere of the family. Parents' physical idea, attitude to sports, awareness and behavior habits all have a subtle influence on their children. The results show that if parents and children actively participate in sports together, children can be guided to actively participate in sports activities, thus forming a habit of physical exercise [29–31].

Parents' lack of awareness and habit of physical exercise is an important factor affecting children's physical participation. Jiang found that parents' physical exercise behavior is highly related to children's physical exercise habits, and the proportion for children whose parents have exercise habits to participate in physical exercise is 8.6% higher than those of parents without exercise habits. The proportion of the children whose parents have no exercise habit never or seldom to participate in sports is 11% higher than those of parents who have exercise habit, which reflects that parents' physical exercise behavior influences the formation of students' physical exercise habits greatly [32]; the health concept of family has a great influence on the persistence of exercise. The family who takes health as the happiest thing spend 86.7% of their leisure time on exercise. 94.5% of the parents often (or sometimes) take their children to do physical exercises. While the family who take other items (brilliant career, rich income, comfortable housing conditions and good interpersonal relationships) as the happiest thing only spend 32.1% of their leisure time on physical exercise, and only 15.2% often take their children to exercise. For families concerned with the health of the next generation, 73.8% of their children consciously engage in physical exercise outside the PE class; and 54.6% believe they will continue to exercise after graduation [33].

Factor 2 explains the family's economic situation, parents' educational concept, parents' personality and the monitoring and distribution of children's time, so it is named "family economic and educational environment". Generally speaking, the higher the socioeconomic status of the family, the better the educational concept of parents may be, the more reasonable the degree of monitoring of children. From the correlation degree of several variables, the family's economic condition and the parents' personality have higher correlation degree with F2. The economic situation of the family is positively related to the students' sports consumption, that is, parents with good economic conditions are willing to invest in sports for their children. Parents' personality is crucial in children's education and sometimes even affects their life. Parents' educational ideas also have a certain impact on their children's physical behavior. Many parents think that children without disease are healthy, their concern for immediate health without serious thinking about the guarantee of the children's future health is very narrow.

4.9. School dimension

The influencing factors at school level are the professional quality of PE teachers and the exercise environment of the school. The professional quality of PE teachers includes three variables: the teaching idea, teaching method and professional accomplishment; school exercise environment includes seven variables, including the exercise consciousness and behavior of school leaders, the degree of leaders' attention to sports, the financial support of the school for sports, the educational evaluation mechanism, the development of extracurricular sports activities, the allocation of facilities and the support of peers and friends. The three variables in factor 1 are all important factors that affect the physical exercise of students. Modern teaching theory emphasizes students as center, it also emphasizes teachers' leading role. Physical education is a purposeful and planned process of cultivating people. Jiang et al. showed that 67.9% of students think that PE teachers play an important role in the formation of their physical exercise habits. PE has a great influence on the formation of students' physical exercise habits, and whether students have exercise habits has a significant correlation with the satisfaction degree of PE, teaching contents and PE course [32].

The 7 variables in factor 2 are the concentrated embodiment of the school sports environment. The attitude of school leaders to PE, the degree of emphasis on PE and the financial support for PE are also important factors to promote the physical exercise behavior of young people. Whether the physical exercise behavior of college students can last, the environment of physical exercise in school is an important guarantee. Sports facilities are the basic conditions for normal physical education and extracurricular sports activities. The number of sports facilities, the utilization rate of facilities and providing scientific fitness guidance services for students are factors to decide the degree of physical education. The sports cognition and sports ability of college students are gradually developed through continuous sports practice, so sufficient sports facilities resources are an important guarantee for the development of students' sports. Schools should be equipped with necessary sports equipment according to students' needs, and schools with sufficient sports facilities should take the development of students as the premise, provide more opportunities for students to do exercises, and stimulate students' enthusiasm for physical exercise.

Sallis studied the impact of school environmental characteristics, such as the type, size and fixed facilities of school activity areas, on the physical activity of adolescents, and found that environmental characteristics are related to the enthusiasm of male and female students for physical activity. Environmental characteristics explain 42% of the variations that affect girls' participation in physical activity and 59% of those affecting boys'; Therefore, to strengthen school management and provide more fixed facilities can promote the participation of young students in the physical activities at spare time in school. At the same time, the policy support, supervision and management of physical activities by school also play a positive role in promoting students' physical activities, which is basically consistent with the results of this study [34].

If the school leaders do not have the idea to strengthen the physical education of young people, and cannot understand the function of physical education basically, the school policy cannot actively play a guiding role in the participation of students in

physical exercises; Zhou believed that the attitude of school leaders to physical education, teachers' working attitude and teaching ability are important external factors affecting college students' physical exercise [35]. Sports funds are the economic guarantee of the facilities of physical education in schools. If the facilities of sports are not well equipped, the conditions of extracurricular sports activities will be insufficient, which will directly affect the effect of youth physical exercise. The result of Jiang et al. showed that 60% of students think that the school pays attention to the formation of students' physical exercise habits, and that among the students who think the school does not attach importance to students' physical exercise, the proportion of students without exercise habits is higher than that of students with exercise habits [32]. Teachers' evaluation of students also has an impact on students' sports behavior. The new educational concept advocates diversified evaluation methods, such as self-evaluation of students, mutual evaluation of students, comprehensive evaluation of teachers and so on. Because evaluation is a highly subjective activity, the objectivity and scientific nature of evaluation is particularly important.

4.10. Community dimension

Researches abroad mainly focus on the community factors that affect individual behavior, for example, Saelens et al. used the environmental scale to assess the differences in the physical activity and weight status of community residents. The scale includes variables such as community environmental characteristics, walking suitability, residential density, complexity of land structure utilization, street connectivity, aesthetics and safety issues. The results show that the scale has good reliability, and in the communities with higher walking suitability have higher residential density, land structure utilization complexity, street connectivity, aesthetics and safety, residents spend longer time in physical activity and the obesity rate is lower [36]. At the same time, Brian conducted an in-depth study on the environmental characteristics of the community. it is concluded that the environmental characteristics of the community affect the walking/cycling behavior of the residents. The larger the population density, the better the connectivity, and the more complex the land utilization, the higher the proportion of their residents ride/walk [37].

The studies on transportation, urban design, urban planning and other factors presents a new vision for the interdisciplinary research in the field of sports activities, and points out the direction for expanding the community factors that affect individual behavior. Nevertheless, the relevant research in the field of exercise behavior should start from the actual situation, draw lessons from foreign researches, in order to solve the practical problems at present. As far as the object of study is concerned, the particular characteristics of the student group make it a preferred object of the researchers. Gyurcsik et al. studied the dyskinesia of college students, and the results show that the perceived dyskinesia of students are positively correlated with grade, and the dyskinesia of freshmen are significantly higher than those of other grades [38]. Unlike other studies, the study emphasizes the classification of dyskinesia by ecological models rather than simply dividing it into individual internal and individual external factors, while also providing guidance for later intervention design.

Community is the main place for teenagers to live, and it is also the main place for teenagers to carry out extracurricular activities. Carrying out sports activities in the community is of great significance to enhance the physical fitness and promote the healthy growth of teenagers. Current problems in the development of community sports activities: first, the policies and regulations for developing community sports activities are not perfect; second, the youth lack of guidance in developing community sports activities; third, the lack of community sports activities venues and equipment; fourth, the youth can choose community sports activities are single; fifth, the development of community sports activities is not enough [39].

The factors of facility support are mainly reflected in the distribution of fitness equipment in the district, the facilities of sports, the number of exercise trails and the distribution of sports instructors. From the data shown in **Table 4**, the variables with relatively high correlation coefficient with factor 1 are the distribution of fitness equipment and sports instructors. Community sports resources are an important guarantee for community residents to carry out physical exercise. And the sports facilities directly affect the effect of community residents' participation in physical exercise. At present, the benefiting-people policy of sports in our province has been carried out and implemented, and the venues and facilities of sports are carried out according to the standard of "one field, three pavilions and one center"; the provincial government attaches great importance to the national fitness project. By 2023, there are a number of sports venues in 88,481, with an area of 113 million square meters. The per capita area of Liaoning province is 2.69 square meters, 34,005 fitness paths, 3679 gyms and 1735 fitness trails, with the urban coverage rate reaching 80%. Social sports instructor is an important role in the national fitness campaign, they shoulder the responsibility of sports promotion, organization and guidance, and ensure the fitness of science, health, steady development, in recent years, the relevant government related functional departments attaches great importance to the public scientific fitness guidance work, and organize the training of various projects. By the end of 2020, the number of registered social instructors in the province has exceeded 120,000, who are a strong guarantee for guiding the public in scientific fitness [40].

The factors of sports values are mainly reflected by the influence of exercise places on young people's sports behavior, the intensity of sports publicity in media, major international sports events, sports star effect, social sports values and the spatial layout of the community exercise places, and so on. **Table 3** shows that the international major sports events, sports star effect and the intensity of the public media are the factors which have high correlation coefficient with the F2 factor, and the international major sports events are to increase the sports cultural exchange activities among countries through the platform of competitive sports. Canadian scholars Jackson found through a survey of 377 people that 10% of the people become actively involved in sports because of the Canadian media sports promotion activities [41]. The star effect brought by the media is also an important influencing factor. Bi's research showed that teenagers can correctly treat and appreciate the external beauty of sports stars, and those young people affected by sports stars have a better understanding of sports function [42].

Table 4. The correlation coefficient of college students' physical exercise behavior.

	Individual	Family	School	Community	Policy
Individual	1.000				
Family	0.584**	1.000			
School	0.560**	0.548**	1.000		
Community	0.469**	0.595**	0.506**	1.000	
Policy	0.158**	0.194**	0.320**	0.378**	1.000

**indicates significant correlation at 0.01 level (bilateral).

Group influence factor mainly embodies organization of competition activities in the community, the number of community exercise teams, the publicity of sports culture and the popularization of sports fitness knowledge. Among them, the number of community exercise teams and the publicity of sports culture have high correlation coefficient with factor 2. The community physical exercise team is generally a spontaneous exercise team organized by the residents of the community or nearby with specific sports, and the content of the exercise is also showing a trend of diversification, including square dance, folk dance, ballroom dance, fast walk and so on. The research by Estabrooks shows that in group exercise programs, the enhancement of group cohesion helps to persist in exercise; the size of exercise group also affects the persistence of exercise. Individuals in small groups show a higher tendency of persistence than individuals in large groups, and most individuals often do not like to exercise alone [43]. Once the number of community exercise groups increases to a certain extent, it will affect and drive the residents of the community to participate in physical exercise, forming a universal effect. The propaganda of community sports culture is also an important factor to promote college students' physical exercise. Li et al. found by survey that the publicity of sports news plays a positive role in promoting the "understanding the meaning and concept of sports", "the improvement of sports level" and "forming the habit of insisting on physical exercise" [44].

4.11. Policy dimension

Policy dimension is considered as the most important to change individual behavior. Because the impact of policies and regulations is huge, it can impact on public awareness and behavior from macro and multi-level [37]. The executive factors of sports administration mainly reflect the guiding documents, policies and regulations of national sports work. Among them, the State Council's document on deepening educational reform and comprehensively promoting quality education, the State Council's No .7 document and the regulations on school physical education work are all guiding documents to promote youth physical exercise, which have macro orientation. In the past 20 years, China has formulated more than 20 related policies to promote youth physical exercise, including adolescent physical health policy, adolescent physical health promotion policy and strengthening school physical education work policies, have received a positive response and implementation from local governments and education authorities. For example, the 14th Five-Year Plan for Youth Sports is specially designed for the youth group according to the contents of the 14th Five-Year Plan for the development of sports undertakings and the relevant laws

and documents. It puts forward that the integration of sports and education leads the high-quality development of youth sports work in the new stage.

The policy resource guarantee factor is mainly responsible for the implementation and guarantee of the policy by the education implementation department. The government support to promote the work of sports and the authenticity of the school sports policy is the important factors affecting the youth physical exercise behavior, policy is only a programmatic provision, if the administrative departments to carry out the effect is not good, the rights and interests of teenagers in the growth cannot be effectively protected. So the future policy should still be to promote adolescent physical health as the core goal, the requirement of exercise to improve and detailed, and combined with the physical and psychological characteristics of teenagers constantly revised exercise standard, evaluation and incentive mechanism, in order to teenagers in each growth stage have clear sports goals, realize the effectiveness of the exercise process, improve the effect of exercise.

4.12. Correlation analysis of the five-dimension factors in social ecology model

To study the behavior characteristics of college students' physical exercise by the theory of ecological model, it is necessary to fully understand the status and role of these factors in the ecological model, so as to make targeted intervention strategies by revealing the influencing factors of young people's participation in physical exercise. The influencing factors of youth physical exercise behavior are mainly analyzed from five dimensions, namely, individual, family, school, community and policy dimension. The data of the above five levels were analyzed by mathematical statistics. The results showed that the correlation coefficients between the scales reached a significant level, indicating that each scale can well explain the influencing factors of the corresponding dimension (see **Table 4**).

In these five dimensions, the individual dimension belongs to the micro-system, the family, school and community dimensions belong to the meso-system, and the policy dimension the macro-system. Factors affecting health behavior are generated by the interaction of multiple systems. Interaction means that different factors play a role at the same time, such as the education of adolescents to make sure of one hour of exercise every day, combines with the specific measures of the national macro-policy "sunshine sports" project to promote the physical health of adolescents [8]; McLeroy et al. proposed that "ecological models emphasize the impact of the environment on individual behavior and explore the relationship between the interactions of different environmental factors"[11]. This model points to the problem of multi-level factors, emphasizing that all levels of factors are crisscrossed, interacting with individuals, people and groups, organizations and institutions, communities and policies. Therefore, family, school and community factors can work together on the individual and affect the development direction of the individual's behavior change; policy factors promote the physical health of teenagers through the formulation of macro-systems and regulations. Social ecology model mainly discusses the relationship between individual and environment and influence, model five dimensions interaction and influence, overall, college students' individual level is an

important basis of their physical exercise, and family, school, community and other factors affect the development of individual physical exercise behavior change direction, policy factors is a powerful driving force of young student's physical exercise behavior. This study for the dimensions of the discussion is fully, but for the interaction mechanism between the dimensions remains to be explored, college students 'physical health promotion in the field of research need to keep normalized continuous attention, the future from the perspective of social governance the need to explore the dimension work mechanism to promote college students' physical development, and build a universal college students' physical health promote social governance model.

5. Conclusion and suggestions

In the individual dimension, the dynamic factor of physical participation is the key factor of exercise persistence, and the physical health factor is the important factor to perform exercise behavior.

In the family dimension, the sports atmosphere and lifestyle of the family can promote the students to perform sports behavior, the economic status of the family can improve the family exercise environment, and the enhancement of parents' exercise awareness can affect the students' sports behavior.

In the school dimension, students pay more attention to teachers' teaching ideas and teaching methods, and physical facilities are the material guarantee for students' physical exercise. The level of physical education in schools cannot be separated from the support and attention of educational decision makers.

In the community dimension, the availability of facilities directly affects the participation of young people in sports; values can promote and increase the interest of young people in sports; and group influence can also promote the participation of young people in physical exercise.

In the policy dimension, the implementation of sports administration and the guarantee of policy resources play a macro-oriented role in young people's physical exercise behavior, which can promote the sustainable development of young people's physical exercise behavior.

College students 'physical exercise habit is not achieved overnight, the macro level to promote the development of college students' physical policy, medium level to explore the family, school and community linkage mode system and mechanism, for individual level, further strengthen students on physical and sports comprehension and understanding of life, improve the lifelong sports consciousness and ability, we only consider the connection between all levels, to better understand the characteristics of the development of college students' physical exercise, put forward the corresponding intervention strategy, through effective ways to promote their physical exercise habits.

Author contributions: Conceptualization, XS and YT; methodology, XS; software, LS; validation, XS, ML and ZW; formal analysis, YM; investigation, ML; resources, YT; data curation, LS; writing—original draft preparation, XS; writing—review and editing, YT; visualization, YM; supervision, YT; project administration, YM; funding

acquisition, XS. All authors have read and agreed to the published version of the manuscript.

Funding: Scientific Research Funding Project of Liaoning Provincial Education Department in 2021 (General Project) To build a new collaborative governance model of promoting adolescent physical health in the new era (LJKR0356); Liaoning Provincial Social Science Fund in 2022 (major project) Research on the construction and application of social governance model of adolescent health literacy and physical health promotion in the new era (L22ATY007).

Ethical approval: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

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