SIN-CHN SCIENTIFIC PRESS PTE.LTD.

Molecular & Cellular Biomechanics 2025, 22(1), 423.
https://doi.org/10.62617/mcb423

Article

Biomechanical analysis of physical exercise behavior and characteristics of college students within the framework of ecological model

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CITATION

Su X, Wang Z, Shao L, et al. Biomechanical analysis of physical exercise behavior and characteristics of college students within the framework of ecological model. Molecular & Cellular Biomechanics. 2025; 22(1): 423. https://doi.org/10.62617/mcb423

ARTICLE INFO

Received: 26 September 2024
Accepted: 23 October 2024
Available online: 10 January 2025

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Abstract: Based on biomechanical measurement techniques, motion capture systems, and other research methods, the biomechanical model related to physical exercise is comprehensively explored in this paper. From the perspective of this model, the biomechanical individual factors of the microscopic system, such as muscle force generation and joint movement patterns, the biomechanical family, school, community factors of the mesoscopic system, like the influence of sports facilities and coaching on exercise biomechanics, and the biomechanical environment, policies and other factors of the macroscopic system, for example, the impact of urban planning and sports regulations on the biomechanics of exercise spaces, the influencing factors of college students' physical exercise behavior are analyzed systematically, in detail. The aim is to identify the interconnections between these various biomechanical factors and gain a deeper understanding of the biomechanical characteristics of college students' physical exercise development. Subsequently, corresponding biomechanical optimization strategies and effective biomechanical training methods to promote the development of college students' scientific and healthy physical exercise habits are proposed.

Keywords: ecological model; biomechanical model; college students; physical exercise behavior; characteristics

1. Introduction

21st Century is the era of continuous and rapid development of economy, science and technology information network. Undoubtedly, the rapid development of society brings not only conveniences for people's daily life, but also many health risks. The new way of life makes people under pressure of high intensity and fast pace of life, so that the contradiction between society progress and gradual weakening of health condition emerges. Over the past twenty years, the continuous downturn of teenagers' health tells us the physical problems have become a social problem, it needs the whole society to pay attention to. Insufficient physical activity, as a global health issue, has become the fourth leading behavioral risk factor for global mortality. Based on this, the World Health Organization has proposed guidelines for physical activity, setting appropriate exercise intensity and duration for different populations to cater to various exercise references [1]. In order to promote the participation of young people in sports and the establishment of a sports lifestyle, our country has successively introduced a series of corresponding measures to encourage young people to participate in various forms of sports activities. At present, places for sports are increasingly rich, time and forms of physical exercise are also gradually personalized, at the same time, the

participation motivations are of individual differences and with different features. Thus, the characteristics of adolescent physical exercise are affected by many factors.

The early theory of exercise psychology emphasizes the impact of individual factors on health behavior, such as the health belief model, theory of planned behavior and phase change theory based on individual intervention, try to change the individual psychological factors, such as self-efficacy, attitude, belief etc. in order to change the behavior of individuals. These theories are more effective for the short-term intervention in individual behavior change, once the intervention is stopped, the individual behavior will easily return to the original state; As a result, they are Relatively limited in explaining the long-term effects of physical activity interventions [2,3]. The basic viewpoint 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 under which it is located. It is easy to be influenced by environmental factors [4,5].

Therefore, it is necessary to pay attention to the change of human behavior under natural and social environment [6]. In 2008, Sallis et al. and Fisher proposed that the social ecological model emphasizes that the factors affecting healthy behavior are multi-level, including individual, interpersonal, organization, community and public policy, altogether five level; Factors of different levels interact, and according to the level of impact on individual exercise behavior and the intimate degree of distance to the individual, they are divided into three systems, including the micro system of individual level, Intermediate systems of interpersonal relations, organization and community levels, macro systems of the policy level; Multilevel intervention strategy is the most effective way to change behavior. The factors that play a role may be one to one direct relationship, or one to many relationships [7–9].

Foreign countries have made fruitful achievements in researches on the impact of ecological models on young people's physical health. Specific research has McLeroy et al. [10] from the ecological point of view of health promotion project selection. Stokols [11] establishing and Maintaining Health-Promoting Social Ecology. The study of Sallis and Owen [12] evaluated the impact of school environment on students' physical activity. The results showed that there was a relationship between environmental characteristics and the enthusiasm of boys and girls in physical activity, and the characteristics of ecological environment became the influencing factors for 42% of girls and 59% of boys actively involved in physical activity variables. And wrote a book entitled "Healthy Behavioral and Health Education: Theory, Research, and Practice" that provides an exhaustive description of The Ecological Model of Health Behavior [13]. Integrates Health and Behavioral Science Systems of Knowledge to Build Activities to Promote Physical Activity Experience and Evaluation Procedures Ecological model. Fisher et al. [14] used ecological methods to establish a pattern of self-management of diabetes. Sallis et al. [15] used ecologically-based methods to create more physically fit communities. Overseas Based on the social-ecological model of adolescent physical activity-built environment, social and psychological research. Research focuses on the relationship between health, physical activity and the environment [16–18].

This paper elaborates the ecological model theory, applies it to the field of health promotion of youth, studies people's exercise behavior from the interaction of

physiological, psychological and environmental factors in order to reveal the various influential factors and their interrelation [19]. This model is more advanced than other physical exercise line models, which can comprehensively reflect the individual differences at the multifunctional level. On this basis, it is hoped that the countermeasures will be put forward and reliable theoretical basis will be provided for construction of theoretical model of Chinese young people' sports life style.

2. Research subjects and methods

2.1. Research subjects

This study included undergraduate students in Liaoning Province. Seven universities were randomly selected as a study sample for the questionnaire survey. Among them, there is 1 science and engineering university, 2 comprehensive universities, 1 normal university, 1 medical university, 1 Academy of Agricultural Sciences and 1 art university, covering relatively comprehensive majors and fields, and the sample selection has certain representativeness. This sample included 1236 boys and 755 girls. The effective sample number was 1991 individuals. **Table 1** shows the quantitative distribution of the survey questionnaires.

Table 1. Statistics of the quantitative distribution of the samples.

College name	Sample content of college students		Sample total
	boys	girls	
Shenyang**** University	270	30	300
Liaoning * learn	87	213	300
Shenyang * * University	39	259	298
Dalian * * University	230	76	306
Liaoning * * University	259	41	300
Liaoning * * University	209	91	300
China * * University	134	53	187
Sample total	1236	755	1991

2.2. Research methods

2.2.1. Document research

Large number of documents are searched and studied by the system of CNKI. In addition, many books on exercise theory, psychology, life style theory and sociology are studied. Data were collected as the theoretical foundation for the study.

2.2.2. Questionnaire survey

(1) The design of the questionnaire

According to the research content, the questionnaire was designed on the basis of theoretical analysis and interview. The questionnaire was compiled from the basic information, motivation and demand of sports behavior, physical exercise behavior, sports consumption and exercise benefit and (SRHMS V1.0) scale. The questionnaire was compiled in closed form, and 2100 questionnaires were distributed in Liaoning

Province, 2015 questionnaires were recovered, the recovery rate was 95.9%; 1991, and the effective recovery rate was 98.8%.

(2) The reliability and validity of the questionnaire

Part of the questionnaire was adjusted according to the feedback from the experts. 94% of the experts believe that the revised questionnaire was more reasonable, meeting the requirements of the research. The reliability of the questionnaire was tested by small sample retest method, and time interval between the two tests was15 days. The two results were compared, the correlation coefficient is greater than 0.85, and $P < 0.05$, which shows that the questionnaire is of high reliability.

2.2.3. Interviews

Experts in the research field of physical exercise, that is, 20 P.E. teachers were interviewed in order to comprehensively understand the conditions of college students' physical exercise and the influencing factors.

3. Analysis of the influencing factors of college students' physical exercise behavior in Liaoning

Social ecological models provide a new perspective of research. Unlike the previous studies which studied the influence/determinants of physical activity solely on an individual level, the social-ecological model focuses on the possible interaction between the activities of children and adolescents and the social environment as a whole. Many factors are integrated into the overall research perspective of social ecology [20]. In this study, under the framework of social ecology model and in combination with WHO (Individual, Social Environment, Physical Environment, Policy) [21], Sallis (Individual, Human Relationship, Institution, Community, Public Policy) [22], Welk (school, family, community) [23] and so on, based on the integration of the core elements of all levels, and then from the micro, meso and macro three dimensions to examine young people's physical exercise behavior characteristics, so as to reveal the impact of college students participating in physical exercise factors (See **Figure 1**), found the causes of different behavioral characteristics, and then develop targeted intervention strategies.

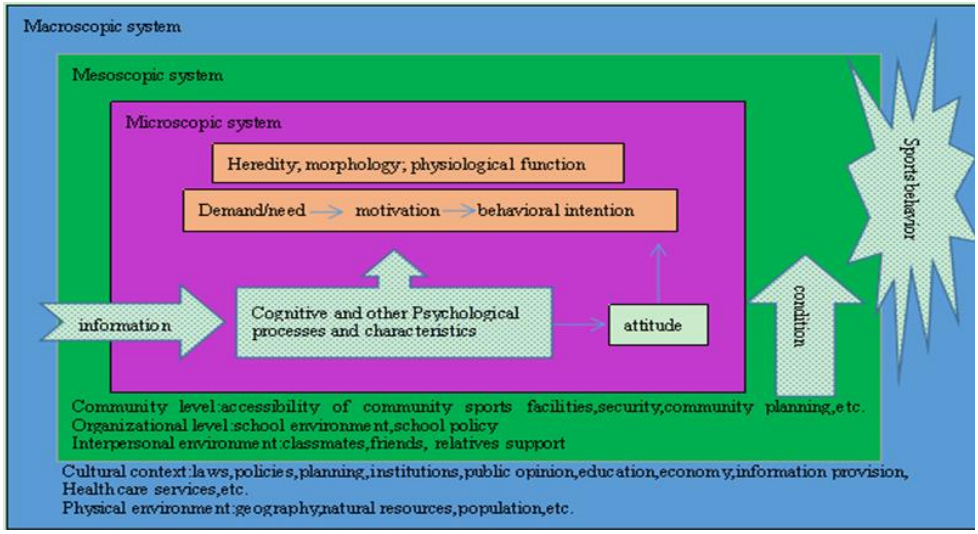

Figure 1. Factors affecting college students' physical exercise behavior.

3.1. Microscopic system

Analysis of individual factors

The health condition is the direct factors influencing the participation in physical exercise. In order to investigate college students' health conditions, the self-rated health measurement scale (SRHMSV1.0) by Xu Jun was employed. 1991 college students in Liaoning were tested and reliable data were obtained. SRHMS includes 48 items and 9 dimensions. It applies psychometric testing and tests the health condition comprehensively from three aspects, that is, physical health, mental health and social health. The test results are shown in **Table 2**.

Table 2. Statistics of college students' self-rated health in Liaoning (N = 1991).

Text index dimension	Dimensionality	Aggregate score	average	Standard deviation	percentage
Physiological health	physical symptoms and organ function	70	45.76	7.98	65.37
	Daily life function	50	48.68	5.72	97.36
	Physical activity function	50	45.78	6.12	91.56
	Sub scale score	170	140.22	13.14	82.48
Mental health level	positive emotion	50	39.47	8.09	78.94
	Physiological symptoms and negative Emotion	70	28.54	12.11	40.77
	Cognitive function	30	21.49	7.90	71.63
	Sub scale score	150	89.50	13.13	59.69
Social health level	Role activity and social adaptation	40	30.30	5.78	75.75
	Social resource and social contact	50	38.72	9.05	77.44
	Social support	30	19.45	5.10	64.83
	Sub scale score	120	88.47	13.45	31.40
	Self-rated health	440	318.19	31.40	72.32

According to the statistics presented in **Table 2**, Total score of SRHMS V1.0 of college students in Liaoning Province (72.32 ± 7.14), The male and female student scores were divided into (72.58, 72.15, P = 0.063), Physical Health Sub scale score (82.48 ± 7.73), Scores for boys and girls (82.78, 81.35, P = 0.003), Mental health sub scale score (59.67 ± 8.75), Scores for boys and girls (60.11, 59.30, P = 0.001), Social health sub scale score (73.72 ± 11.21), Scores for boys and girls (72.93, 74.40, P = 0.007); thus it can be seen, Comparison of physical, psychological and social health subscale scores, The difference was statistically significant (P < 0.01); Comparison of the SRHMS V1.0 total score of different gender college students, Not statistically significant difference (P > 0.05). Through comparative analysis, it can be seen that the highest score of the three scales is physiological health of 82.48, Social health was ranked second at 73.72, Worst mental health failure; Further into the subscale data, we can see that the "physical symptoms and organ function" dimension is slightly above the pass line, All the other points are excellent; Physical symptoms and organ function are mainly examined from visual, auditory, digestive and neurological functions as well as body sensation, College students in this dimension, Is likely to be influenced by innate genetic factors, It may also be acquired bad living habits and physical exercise and other factors constraints; Mental health aspects, Research indicates that

individuals who regularly engage in physical exercise (PE) experience significantly lower levels of negative emotions, such as depression and anxiety, compared to those who do not exercise. Conversely, those who participate in PE report higher levels of positive emotions and overall happiness. PE is increasingly recognized not only as a means to improve physical fitness but also as a vital tool for psychological regulation [24].

In this study, college students' mental health subscale is less than 60, Among them, the "psychological symptoms and negative emotions" dimension is only 40.77, Showed that the mental health level of college students has appeared serious problems, especially in the face of setbacks, the psychological endurance is getting worse and worse. This result is mainly because on the one hand, their growth environment is too superior, the vast majority of families are the only child, formed a self-centered concept, they lack of difficulties and setbacks, often can not calm, treat others lack of generosity, tolerance and other good quality, social responsibility weak peace parents' education lacks; on the other hand, the social progress to people's pressure escalating, In particular, college students are particularly sensitive to physical health (PH) and mental health (MH) challenges due to prolonged sedentary behavior, academic stress, and irregular physical activity [25].

3.2. Mesoscopic system

3.2.1. Analysis of family factors

Exercise behavior of youth is usually closely linked to family factors. Parents' sports ideology, consciousness, attitude and physical exercise habits, sports lifestyle exert a subtle influence on children. The results show that parents and children actively participate in sports, can lead and guide children to take part in sports activities, so as to form a habit of keeping up with physical exercises [26–28]. However, with the rapid pace of social life that is rapidly changing and evolving, the lack of role played by parents, especially their fathers, in promoting the healthy growth of children and adolescents has failed to produce the positive promotion they deserve for the training of young children's sportsmanship and sports interests' effect [29–31].

The concept of family health has a great impact on insisting on exercising. Taking a healthy body as the greatest happy family, 86.7% of them spend their free time on exercising. 94.5% of parents regularly (or sometimes) bring their children to physical activity. While considering other things (brilliant career, generous income, comfortable housing conditions and good interpersonal relationships) as the happiest parents in the family, only 32.1% of them took leisure time for physical exercise and only 15.2% often bring their children to exercise. Concerned about the health status of the next generation of families, 73.8% of their children will be consciously engaged in physical exercise outside the physical education; 54.6% believe they will continue to practice after graduation [32].

Some children have their own desire to participate in physical exercise, but are discouraged by families and friends, thus the exercise habits cannot be sustained. This kind of cases are caused by a lack of family physical education. The survey shows 60.4% of the students said their parents support their physical exercise and sports competition, and the boys are better than girls in the aspects of frequency and time of

physical exercise. There is a development trend of diversified activities. Besides, there are gender differences in the choice of sports activities. Boys are more interested in the intensive, competitive and exciting sports, while girls like less intensive, competitive sports more, usually graceful, operable. As to exercise places, they usually choose natural outdoor places. Sports consumption and family economic conditions of college students are positively related, parents of high income are willing to fund for children's exercise (see **Table 3**).

Table 3. Statistics of physical exercise of young and family members in Liaoning.

Survey question	**reelection**	**Result of Multiple choice for boys (*N* = 1236)**		**Result of multiple choice for girls (*N* = 755)**		**Family (*N* = 1991)**	
		f(*n*)	***p*%**	**f(*n*)**	***p*%**	**f(*n*)**	***p*%**
Physical exercise mode	Alone	441	35.7	170	22.6	798	40.1
	With the family	269	21.8	251	33.1	689	34.6
	With friends	771	62.4	440	58.4	1145	57.5
Physical exercise project	Running(walking)	303	24.5	426	56.4	1543	77.5
	Ball games	1001	80.1	366	48.5	457	23.0
	Nation traditional sports	261	21.1	32	4.3	1089	54.7
	Rhythmic gymnastics	45	3.7	235	31.2	0	0
	Expanding sports	402	32.6	162	21.5	0	0
	Body building	228	18.5	66	8.7	786	39.5
	other	62	5.1	47	6.3	236	11.9
Physical exercise place	community site facilities	160	12.9	213	28.2	987	49.6
	School site facilities	670	54.2	435	57.6	245	12.3
	Health club	385	31.1	135	17.9	456	22.9
	Park and outdoor facilities	430	34.8	358	47.4	1325	66.5
Physical exercise motivation	Body building	785	63.5	453	60.0	1590	79.9
	Keeping fit	367	29.7	588	77.9	788	39.6
	Social communication	790	63.9	478	63.3	859	43.1
	Recreation	453	36.7	367	48.6	987	49.6
	Catharsis	690	55.8	490	64.9	516	25.9
	Coping with examinations	370	29.9	398	52.7	0	0
Sport consumption	Sportswear and equipment	679	54.9	456	60.4	1058	53.1
	Renting sports site & facilities	345	27.9	135	17.9	487	24.5
	Tickets for sports events	589	47.7	247	32.7	852	41.4
	Taking part in all kinds of sports training	322	26.1	190	25.2	613	30.8
	Sports books, multimedia data	238	19.3	345	45.7	649	32.6

Note: results of multiple choice, means that when this item is selected, other items are also selected at the same time, so the sum of the percentage of the number of options is not equal to 100%.

In the study of "Research on the influence of family factors in physical exercise among Chinese teenagers", According to the China Education Tracking Survey (CEPS) data [33], With the weekly duration of exercise as the dependent variable,

Family background, family structure, emotional connection, financial support, and living environment as the dependent variables, And perform the necessary variable control, Such as individual sex, age, school, peers, First to list the basic characteristics of the main variables by descriptive statistical analysis, Next, to perform the correlation analysis, To verify whether the correlation of the five factors with the duration of adolescent physical exercise was significant, Finally, the least-squares linear (OLS) regression model is constructed, To verify whether this correlation is causal. This framework analyzes the influence of family factors on physical exercise in China. The study shows that

(1) Family factors have a significant impact on the physical exercise time of teenagers, among which economic support and family background have the highest degree of influence, family structure, emotional connection and relatively low, but higher than living environment factors. The physical exercise time of students of different genders is positively correlated with family background, family structure, economic support and living environment, with significant family structure is close with boys and girls and less emotional relationship, family background, emotional relationship and higher correlation with boys physical exercise time, while living environment has higher correlation with female physical exercise time, and emotional relationship is unrelated with female physical exercise time; (2) There are obvious gender differences in the influence of family factors on teenagers 'physical exercise time. Emotional connection is one of the influencing factors of boys' physical exercise time. The large range exceeds the influence of family structure and living environment, but it has a weak impact on girls. On the contrary, family structure has a great influence on girls' physical exercise; (3) For girls, the only child's time for physical exercise is 15% higher than that of the non-only child. This may be because the only-child families have close expectations for boys and girls, and believe that the traditional concept of sports exclusive to men is weakened in the only-child families, thus having a smaller inhibitory effect on girls' sports.

3.2.2. Analysis of school factors

Schools are the primary social environment in which children and adolescents observe, learn and practice health-related behaviors and are most easily organized Intervention with students' level of physical activity also means that their activities and values are the most vulnerable to school environment Schools are the primary social environment for children and adolescents to observe, learn and practice health-related behaviors. They are the easiest to organize to intervene in the physical activity of students and mean that their activities and values are most easily influenced by the school environment. In the 1990s, academics such as McKenzie realized that although students may have regular physical education courses, their physical skills may not be effectively met because of limitations in class size and time [34] and are available through physical education classes Equipment (physical environment), physical activity space (policy), qualified teachers (social environment) and other measures are effective measures to increase students' overall physical activity [35].

The ultimate goal of school physical education is to cultivate students' lifelong sports consciousness and ability, and constantly improve the physical quality of the students. The physical exercise behavior of college students cannot be separated from

PE in school, mainly reflected in the teaching ideas, teaching methods and professional quality of PE teachers.

The survey data show that college students think among the three factors according to their importance, the teaching method ranks first, teaching ideas second, and the last is the PE Teachers' professional quality. Therefore, PE Teachers' teaching method is the factor which is paid most attention to by students. So, in PE class, teachers should pay attention to arousing students' interest and making the class more entertaining and interesting, so that more students are able to change the class contents into their own cognitive structure, thus forming the self- consciousness of exercise, and participating physical exercises actively in a relaxed and pleasant atmosphere, as a result to promote the development of physical and mental health. The research of Jiang et al. [36] showed that 77.9% of students think PE teachers play an important role in the formation of students' habit of physical exercise. Companion or friend exercise has a greater impact on the formation of students' physical exercise habits. Students with exercise habits think that 51.5% of the students or friends around them exercise regularly, while students who do not exercise think that they are only around 34.9% of students or friends exercise regularly. This shows that students or friends around often engaged in physical exercise on the students themselves to form a positive impact on physical exercise habits [37].

To make college students' physical exercise behavior lasting, the sports environment of school is an important guarantee. Sports facilities is a basic condition for normal school sports teaching and extracurricular sports activities. The factors like the number of stadiums, the rate of using the stadiums, the scientific fitness guidance services for students are all evidences of the school's PE level. Students' cognition of physical education and sports ability are developed gradually through exercises, so enough sports facilities resources are an important guarantee for students' sports development. Schools should be equipped with necessary sports equipment according to students' sport's needs. For those schools with enough sports facilities, they should take students' development as the premise, provide students with more opportunities to do sports, and stimulate students' physical exercise enthusiasm.

Sallis class, On the characteristics of the school environment, Such as the type, size and fixation of school activity areas, To examine the effects of physical activity in adolescents, Found a relationship between environmental characteristics and the motivation of physical activity in boys and girls, Environmental characteristics explain 42% of the variability affecting girls' participation in physical activity, 59% of the variation affecting male student participation in physical activity; therefore, Strengthening school management and providing more fixed facilities can encourage adolescent participation in physical activity during their leisure time, at the same time, School policy support, supervision and management of physical activity can also play a positive role in promoting adolescent physical activity, This is generally consistent with the findings of this study [37].

We found in the survey, high consistency of satisfaction of male and female students with the schools' sports environments. In the aspects of sports facilities, sports stadium opening time, number of sports equipment, quality of sports equipment, and more than half students are satisfied or more than satisfied. 20% students are dissatisfied or less than dissatisfied. In the research, independent sample T-test is

employed to see whether there is gender difference (see **Table 4**). The results show that there are significant differences in satisfaction with sports equipment between male and female students ($p < 0.05$). Other three items show no significant differences ($p > 0.05$). Therefore, there are differences on sports equipment among different schools.

Table 4. A comparison of the gender differences in the degree of satisfaction with the school physical exercise environment ($N = 1991$).

Test variable	Sex	*N*	average	Standard deviation	*t* vaule
Satisfaction of sports facilities	male	1236	2.46	1.557	1.798 n.s.
	female	755	2.35	0.992	
Satisfaction of Opening hours of stadiums and gymnasiums	male	1236	2.53	0.986	−0.422 n.s.
	female	755	2.55	0.992	
Satisfaction of the quantity of sports equipment	male	1236	2.41	0.925	−2.402*
	female	755	2.52	1.007	
satisfaction of the quality of sports equipment	male	1236	2.52	1.491	1.443 n.s.
	female	755	2.42	1.177	

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

3.2.3. Analysis of community factors

Foreign countries mainly focus on the community factors that affect the behavior of individuals, such as Jiang et al. [36] and others use the environmental scale to assess the community sports activities and weight status differences, the scale includes the characteristics of community environment, community walkability, community living Density, land use structure complexity, street connectivity, aesthetics and safety issues. The results show that the scale has good retest reliability and the communities with higher walking fitness have higher residential density, complex land use structure, street connectivity, aesthetics and safety. The residents' physical activity time Longer, lower obesity rate [38]. In the meantime, Saelens et al. [39] conducted an in-depth study of the characteristics of the community environment, believing that the characteristics of the community environment affect the walking/cycling behavior of residents, the population density is greater, the connectivity is better, and the more complex land-use communities are also residents/the higher. The researches on traffic, urban design and urban planning present a completely new field of vision for interdisciplinary research in the field of sports activities, pointing out the direction for expanding community factors that influence individual behavior. Nevertheless, the relevant research in the field of exercise behavior should proceed from the actual situation, learn from the perspectives of foreign studies, and combine Chinese and Western elements to solve the practical problems currently facing them.

As far as the research object is concerned, the particularity of the student population makes it a favorite object of the researchers. Gyurcsik et al. [40] studied the obstacles of the students' physical activity. The results showed that the movement disorder perceived by the students was positively correlated with the grade, the freshmen's mobility disorder is significantly higher than other grades. Unlike other research institutes, this study emphasizes the classification of dyskinesia with

ecological models, rather than simply classifying dyskinesia into individual internal factors and individual external factors, as well as providing guidance for future intervention design.

In this research, verified by KOM and spherical Bartlett of data, the KOM value is 0.806. When performing factor analysis, the criterion for the KMO measure is that the KMO statistic value should be above 0.70 to be acceptable for factor analysis [41]. So among related variables of community factors, principal the components are analyzed, according to the requirement, the factors whose feature value are greater than 1 are extracted. The number of factors was 3, the cumulative contribution rate was 66.901%, indicating that these three factors can explain other variables. According to the description of the index containing variables, the 3 factors are named: Facility guarantee, team influence, sports values. The three factors extracted rotate the influencing variables and get the loading matrix (**Table 5**).

Table 5. Analysis results of community level factors.

Influencing factors variable	**Factor load after orthonormal maximum rotation**		
	F1	F2	F3
	Facilities guarantee	Sports values	Group impact
Distribution of sports equipment in community	0.738		
Sports places and facilities	0.685		
Number of fitness footpaths	0.604		
Sports instructor	0.744		
The influence of sports places on the sports behavior of college students		0.597	
Sports publicity of public media		0.709	
Major international sports events		0.827	
Sports star effect		0.812	
Social sports values		0.705	
The spatial layout of the workplaces where the community is located		0.590	
Community organized competition			0.529
The number of community training groups			0.893
The publicity of sports culture			0.838
Popularization of physical fitness knowledge			0.793
Eigenvalue	3.578	3.751	3.149
Interpretation of variation in contribution rate %	26.843	26.793	22.814
Cumulative interpretation of variation in contribution rate %	26.843	53.636	76.450

Among the facilities guarantee factors, variables with relatively high correlation coefficients are sports equipment distribution of the community and providing of sports instructors. At present, in Liaoning province, the sports policies benefiting the people have been carried out, the sports places and facilities are put into effect by the standard of *a stadium, three gyms, and a center*. The provincial government pays much attention to the fitness projects. 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 [42].

Among the sports value factors, variables with relatively high correlation coefficients are major international sports events, sports stars effect and public media propaganda. The international major sports competitions are platforms to increase the sports cultural exchanges between countries. The Canadian scholar Jackson did a survey of 377 people and showed that 10% of the people became active in sports as a result of Canadian media propaganda. Star effects from media are another important influencing factor. The study by Bi [43] shows that young people can treat and appreciate the beauty of sports stars show correctly. Those young people influenced by sports stars understand the function of sports better.

Among the team factors, variables with relatively high correlation coefficients are the number of community exercise team and the propaganda of sports culture. Community sports teams are generally residents of the same community or nearby organized spontaneously to do the specific sports item. There is a trend of diversification, including square dance, folk dance, ballroom dance, walking team, etc. Estabrooks [44] showed that in team exercise, cohesion contributes to the persistence of sports. The size of team also influences the persistence of sports. Individuals of small teams show higher persistence trend than individuals of large teams, but most individuals do not like to exercise alone [45]. When the number of community exercise increased to a certain extent, it will influence and promote community residents to participate in the exercise. Community sports culture propaganda is also an important factor in promoting college students' physical exercise. Li et al. [45] did the investigation of sports news propaganda and concluded that the sports news play important roles for college students to better understand the meaning of sports, promote the sports level and form exercise habits.

3.3. Macroscopic system

3.3.1. Environmental factors

(1) Analysis of natural ecological factors

The natural ecological factor is the external environment for the survival of the world, which is composed of ecological systems of air, water, sunlight, vegetation and topography, etc. To look back the development of sports throughout human history, we can find that during the early period, the effects of natural ecological aspects were studied. The results showed that in area with pleasant climate conditions and wide and flat terrains, sports participation always increased. While in the areas with relatively harsh climatic conditions and complex terrains, the forms of sports were always with regional characteristics, whose forms and contents were always rich and diversified. These fully illustrated that early people were adapted to local conditions and explored

suitable sports forms. They created different types of traditional sports activities according to different natural conditions.

Outside of physical education classes, school extracurricular activities are the main form of unstructured activity for students. Pretty put forward the concept of "Green Exercise" [46] in 2003, with special emphasis on the benefits of children and adolescents doing activities outdoors under natural conditions. Wood et al. [47] found that compared to physical education classes, outdoor free time allows for independent, unstructured physical activity and is more enjoyed by students, especially girls. Although outdoor activities have a limited contribution to the overall physical activity level of [48,49], unstructured outdoor activities can help students to understand their relationship with the surrounding environment and promote social interaction [49], which in turn can affect young students' physical activity, Important factor to participate in physical exercise.

(2) Analysis of social factors

With the continuous acceleration of social development, China's urbanization process continues to deepen. In this process, the disharmony between the pace of sports development and the improvement of urbanization level is becoming more and more significant. From 2018 to 2020, China's urbanization level has increased by nearly 5 percentage points. This data shows that China's urban and rural population structure has undergone essential changes, and the urbanization level has gradually improved. According to the development of sports in the process of urbanization in western developed countries, when the development of urban sports realizes a leap from quantitative change to qualitative change, people's demand for sports will reach its peak. The successful holding of the 2022 Winter Olympic Games in Beijing marks making Beijing an unprecedented city carrying the glory of the Summer and Winter Olympics. This brilliant achievement will always be recorded in history. All kinds of sports stars show the development of Chinese sports to the world, but also bring star effect. A large number of teenagers see them as role models and actively devote themselves to sports activities. In this context, mass sports flourish at an unprecedented speed, and the group of sports fans is increasingly large. As a kind of urban culture, sports activities have been deeply integrated into the daily life of modern people.

From the perspective of the industrial structure, In recent 5 years from 2018–2020, Affected by the global outbreak, The three major industries have seen a wavy alternating trend, Primary and secondary industries will peak in 2020 and 2021, In 2020, the first and secondary industries will be 10.4 and 43.3, respectively, In 2021, the first and secondary industries will be 10.5 and 47.7, respectively; The tertiary industry reached a peak of 61.5 in 2019, In 2022, it will reach a trough of 41.8, That's down nearly 20 percentage points from 2018; From the contribution rate of the three major industries to GDP, The contribution rate of China's three major industries to GDP in 2022 is: 10.0%, 46.67% and 43.33%, respectively, As visible from **Table 6**, In the years of 2018–2020, Affected by the outbreak, The GDP contribution rate of the three major industries also shows a wavy alternating increase and decrease, With the gradual recovery of our own economy, I believe that the demand for services will gradually pick up. In the future, China's sports industry will certainly become an important force to promote economic development and improve people's livelihood.

Table 6. Statistics of industrial structure and contribution rate from 2018 to 2022.

Year	Three major industries constitute%			The GDP of the three major industries contributed by%		
	Primary industry	Secondary industry	Tertiary industry	Primary industry	Secondary industry	Tertiary industry
2018	4.1	34.4	61.5	4.48	34.33	62.69
2019	3.9	32.6	63.5	3.33	31.67	63.33
2020	10.4	43.3	46.3	9.10	45.46	45.46
2021	6.4	38.9	54.7	5.95	39.29	54.76
2022	10.5	47.7	41.8	10.0	46.67	43.33

Data source: China Statistical Yearbook in China 2023.

3.3.2. Analysis of policy factors

The policy guidance and laws and regulations on physical activity provided by the government and non-governmental organizations may have a long-term impact on the entire group [50], which is also the most prominent feature of the influencing factor. World Health Organization [51], the American Medical Association [52], and the British Council [53] have all taken environmental and policy changes as a key strategy, initiative, and guideline for countering obesity and improving physical activity. People actually take action to improve their health, especially physical Activities to promote the order and norms, at the regional, regional and even all levels of the country to play a role [51]. Public policy is to achieve the long-term effects of improving people's lifestyles by creating a top-level design that coordinates the social and physical environment, providing infrastructure, public awareness and an enabling framework. For example, World Health Organization has set the government a nuclear role in the Global Strategy on Diet, Physical Activity and Health by creating a climate that encourages physical activity for individuals, families and communities [51].

In the past two decades, there are both regulations and sports laws guiding school physical education and national fitness, and programs for promoting health education, including sports development plans and fitness programs, and a work plan for the prevention and treatment of chronic diseases [54].Through a careful review of the essence of these policies, it can be observed that the policy expression generally has a tendency of simplification, which only makes hard rules on the length of exercise time, but ignores the specific guidance on the selection of exercise items, appropriate exercise intensity and expected effect, and the lack of effective incentive measures. Considering the significant differences between adolescents' physical diversity and the physical condition among students, the existing policies fail to set differentiated development goals according to these differences, which leads to the lack of pertinence and certain blindness in the implementation of physical exercise in vulnerable groups. Moreover, specific requirements for exercise intensity are omitted, which may undermine the practical benefits of physical activity. Given the limitation of time resources, how to improve the efficiency of exercise has become a core issue for policy makers to consider. Looking to the future, policy should continue to focus on the fundamental purpose of adolescent physical enhancement, strive to exercise requirements of comprehensive and refinement, and need to blend in the periodic characteristics of adolescent physiological and psychological development, establish

a set of scientific exercise standards, evaluation system and incentive mechanism, to ensure that teenagers in each growth stage can have clear exercise goals, so as to strengthen the effectiveness of the exercise process and improve the actual results.

In view of the limitations of physical health improvement policies in dealing with practical challenges: First, such policies are rooted in the actual background of the current adolescent physical condition and sports activities, aiming to deal with the problem of adolescent physical decline. However, with the rapid development of the society, the sports practice environment and values of teenagers are constantly changing, and the formulation, promulgation and implementation of policies must go through certain procedures. When the cycle of policy formulation is too long and lags behind the solution of practical problems, the problem of poor effectiveness will arise. Second, some of the policy contents do not fit the needs of the healthy physical development of teenagers in China.

For example, most of the documents mentioned the goal of reducing students' schoolwork burden and ensuring that students exercise one hour a day, but today, the excessive workload of teenagers has not changed fundamentally, and the goal of exercising one hour a day is difficult to achieve [54]. Thirdly, the formulation of relevant policies for the physical promotion of adolescents is taken as programmatic documents from the macro and overall perspective, and the lack of supporting implementation rules, resulting in regional differences in policy interpretation and limited ability to solve practical problems; Fourthly, the specific implementation of policies for adolescents requires high consciousness and responsibility, but due to the lack of normative evaluation and supervision mechanism of the policy implementation effect, the deviation in the policy implementation process occurs, and there is a large gap between "proper effectiveness" and "real results" to solve practical problems.

4. Conclusion and suggestion

Based on the ecological model of health behavior, this paper makes a comprehensive analysis on College Students' physical exercise behavior, from the aspects of the microscopic, mesoscopic and macroscopic systems. By analyzing the conditions of college students' sports participation, we find that individual levels are the material bases for them to take part in exercises; But family, school, community factors influence the development directions of individual behaviors; in addition, environment and policy factors are the driving force for sports behavior features of college students.

At the macro policy level, the government functional departments actively formulate the policy of youth physical fitness development, improve the supervision mechanism and system of youth sports policies to ensure the implementation of the policies; At the middle level, play the family, school and community linkage working mode, actively expand the family sports and community sports activities as a useful supplement to school physical education; At the micro level, play the advantages of school physical education, improve the physical education course, improve students' cognition, experience and perception of physical education, and ability. Only by considering the interrelationship among the related factors, can we better understand the characteristics of physical exercises of college students, put forward the

corresponding intervention strategies, and promote the cultivation of college students' physical exercise habit through effective ways.

5. Study limitations and perspectives

This paper focuses on the theory of social ecology, mainly examines the environment influence on individual behavior, from the various elements reveal college students 'physical exercise behavior characteristics, sample selection of regional single, may lead to the research results, the study of single element more concrete, the lack of the relationship between the elements and the mechanism, the future from the perspective of system theory and collaborative construction of college students' physical health promotion model and the application in practice, further enhance the sports governance efficiency.

Author contributions: Conceptualization, XS and YS; methodology, XS; software, LS; validation, XS, ML and ZW; formal analysis, YM; investigation, ZW; resources, XY; data curation, LS; writing—original draft preparation, XS; writing—review and editing, XY; visualization, YM; supervision, YS; project administration, YM; funding acquisition, XS. All authors have read and agreed to the published version of the manuscript.

Funding: This projected was supported by Scientific Research Funding Project of Liaoning Provincial Education Department in 2021 (General Project); Liaoning Provincial Social Science Fund in 2022 (major project); To build a new collaborative governance model of promoting adolescent physical health in the new era (LJKR0356); 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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