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Psychological Mechanisms and Optimization Strategies for Promoting Exercise Behavior Among College Students Through Sports Apps

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Abstract Exploring the relationship between the use of exercise APP and the psychological mechanism of college students' active exercise can help promote the formation of college students' physical exercise habits and encourage them to participate in and adhere to physical exercise regularly. In this paper, 480 college students from some colleges and universities in Jilin Province were surveyed by questionnaire, and the data collected by questionnaire were calculated at multiple levels by multiple linear regression analysis and hierarchical analysis. The results of multivariate linear regression analysis showed that the loyalty of using the exercise APP had a greater impact on the ability motivation, appearance motivation and health motivation of exercise motivation compared to the trust, while the trust of the exercise APP had a greater impact on the social motivation and fun motivation. Conducting multilevel computational analysis, based on the results of the total hierarchical ranking, improving the reliability of data as well as enhancing the professionalism of the content are the most prioritized options for exercise APP operators to enhance the active exercise psychology of college students, with the weights reaching 0.278 and 0.272, respectively.

Index Terms multiple linear regression analysis, hierarchical analysis, questionnaire survey method, active exercise

I. Introduction

With the development of society, people's life rhythm is getting faster and faster, and the importance of sports is also emphasized by more and more people, especially college student groups, who are in their youthful years, and the cultivation of physical fitness is crucial for their growth [1]-[3]. In the busy study and life, many college students tend to lack the habit of exercise, and even appear to stay in the dormitory or library, in order to change this phenomenon, more and more college students began to choose to use the exercise app on the cell phone to manage their sports behavior [4]-[7].

Exercise apps usually make personalized exercise plans for users according to their personal situation and exercise goals, and guide them to exercise in a scientific and reasonable way [8], [9]. For college students, they lack professional exercise guidance and planning arrangements, and exercise apps can make up for this deficiency, help them better master exercise skills and exercise time arrangements, and improve exercise effects [10]-[12]. Exercise apps can not only provide exercise programs and guidance, but also continuously instill fitness knowledge and scientific theories to users in daily use, so that users can understand the body's movement mechanism and cultivate a healthy concept of exercise, and the popularization of scientific knowledge is very important for college students to establish a correct concept of exercise and develop good exercise habits [13]-[16]. In addition, sports apps usually set up functions such as sports punch card, sports ranking, social circle, etc., which allow users to interact with their friends and share the results of sports in the process of sports, and get the incentives and support from their friends, and this kind of social interaction can increase the interest of college students in sports, stimulate their motivation for sports, and promote the continuity of sports behavior [17]-[20].

Literature [21] examined the use of technology in sport based on a literature review and found that students' motivation for technology was widely noted and revealed that the use of technology can increase students' interest in participating in sport. Literature [22] examined college students' intentions and factors influencing the use of sports apps in mandatory situations and showed that performance expectations and effort expectations positively influence app use intentions, while control motivation does the opposite, which contributes to learning to develop appropriate improvement strategies to enhance the role of sports apps in college students' sports behaviors. Literature [23] explored the use of sports apps in teaching and concluded that “sports apps + physical education” had a positive impact on students' exercise, and was important for improving the attitudes and behaviors of college

students in using sports apps to improve physical activity and enhance students' awareness of health management. Literature [24] analyzed the effect of sports apps on college students' attitudes toward physical activity and physical fitness, indicating that the apps positively affected college students' attitudes toward physical activity and physical fitness, and this result provides ideas for advancing the reform of teaching and the development of apps. Literature [25] examined the effect of exercise motivation on college students' mental health, emphasizing the positive nature of this effect, and that college students with a high use of exercise apps had a stronger relationship between exercise motivation and exercise adherence, which provides ideas for college students' mental health interventions. Literature [26] describes that sports apps are widely used, which not only has a positive effect on college students' participation in national fitness, but also helps to promote sports, and examines the application of sports apps in college student groups in the Sichuan region, emphasizing the importance of apps' influence on college students' sports behaviors. Literature [27] examined the possibility of sports apps in promoting college students' health based on the theory of planned behavior and sports apps, pointing out that the use of sports app's can make college students' attitudes toward health behaviors more positive and enhance their master self-efficacy toward health behaviors.

Literature [28] analyzed the attitudes of college students towards the use of mobile health apps and its impact on improving the exercise and health habits of college students, expressing that students had positive attitudes towards the apps and there was no significant difference between men and women. Literature [29] explored the impact of exercise apps on users' participation in physical activity, expressing a significant positive correlation between the use of exercise apps and users' participation in exercise activities, indicating a positive link between exercise apps and exercise behavior. Literature [30] examined the factors influencing college students' use of exercise apps, revealing that exercise apps effectively improved college students' health, social influence, and effort expectations were important factors influencing college students' use of apps, while behavioral intention and gender played a moderating role. Literature [31] analyzed the relationship between college students' acceptance of sports apps and satisfaction with usage, specifying that college students have higher acceptance and satisfaction with sports apps, and that there is a large difference between gender on app acceptance and satisfaction with usage. Literature [32] aimed to study the use of sports apps and its impact on individual attitudes and behavioral patterns, indicating that users' integration of sports apps influences their attitudes and behavioral patterns towards physical activity. Literature [33] examined the intention to use sports apps, by proposing a model to assess the intention of sports consumers to use sports apps, and the results showed that diet/fitness apps were the highest rated apps. Based on the theory of social support and self-efficacy, literature [34] explored the influencing factors of college students' physical activity behavior and the mediating relationship of self-efficacy, specifying that the integrated sports facility environment is conducive to college students' physical activity, and that social support has a greater impact on students' physical activity behavior. Literature [35] discussed the effect of sports apps based on goal-oriented management in college students' physical activity, and the results showed that the intervention of apps effectively promoted college students' health literacy, physical activity and physical fitness. The above study describes the application of sports apps in college students' physical exercise and affirms their impact, revealing that sports apps have a positive impact on improving students' interest in sports and physical fitness.

In order to enhance and cultivate college students' active exercise psychology and lifelong exercise awareness, the relationship between the use of sports APP and its active exercise psychological mechanism was studied in depth. Based on the keywords of physical exercise behavior and physical exercise psychology, relevant papers were collected as theoretical basis, and the questionnaires “Scale of College Students’ Exercise APP Usage” and “Scale of College Students’ Active Exercise Psychology Influencing Factors” were designed, and the research data were collected by distributing electronic questionnaires and paper questionnaires. Multiple linear regression analysis was used to analyze the correlation between exercise APP use and active exercise psychology, and the influence of exercise APP use on active exercise psychology, and to explore the relationship between exercise APP use and college students' active exercise psychological mechanisms. Finally, through the hierarchical analysis method, the AHP hierarchical analysis structure chart was established to further analyze the influence factors of exercise APP on university active exercise psychology, and to excavate the optimization strategy to promote university students' active exercise.

II. Subject and methodology of the study

II. A. Subjects of study

The sample of this study is 480 college students (valid 457) who use exercise APPs in some colleges and universities in Jilin Province, and the gender structure of the survey respondents is 54.7% male and 45.3% female. In the age group, the highest proportion of people is concentrated in the age of 18~35, accounting for 92.56% of the total number of survey respondents, and 7.44% of people under 18 and over 35. In the education structure, the

proportion of senior college, bachelor's degree, master's degree and above were 18.16%, 54.92% and 26.92% respectively.

II. B.Research methodology

II. B. 1) Literature method

According to the needs of the study, we searched on China Knowledge Network, Wanfang Database, and Wipu Journal Database with the keywords of exercise APP, physical exercise behavior, and physical exercise psychology, and found 10 doctoral dissertations, 18 master's dissertations, and 21 periodicals, as well as checking about the types, functions, and characteristics of the exercise APPs, to provide a theoretical basis for this study.

II. B. 2) Questionnaire method

1) Questionnaire design

In order to be able to better understand Southeast University undergraduates' understanding and use of exercise APPs as well as the influence of using exercise APPs on physical exercise behavior, and following the research methodology of sports science and the basic requirements of questionnaire design, the first drafts of the questionnaires, “Scale for the Use of Exercise APPs by Undergraduates” and “Scale for the Influence of College Students' Psychological Influence Factors on Active Exercise” were designed, and then, on the basis of the experts' opinions and suggestions Then on the basis of experts' opinions and suggestions, the structure and content of the questionnaires were supplemented and modified to form the official questionnaires. The questionnaire was finally designed as an electronic questionnaire and a paper questionnaire.

2) Questionnaire Reliability Test

The reliability of the questionnaires was tested by retesting method, the first time the questionnaires of “College Students’ Exercise APP Usage Scale” and “College Students’ Active Exercise Psychological Influencing Factors Scale” were distributed to 50 students each, and then the questionnaires were retested to the 50 students after a lapse of 5 days. After all the questionnaires were collected, the choices of each option for each question in the two questionnaires were statistically compared. The comparison results showed that the questionnaire reliability coefficients α of “College Students’ Exercise APP Usage Scale” and “College Students’ Active Exercise Psychological Influence Factors Scale” were 0.89 and 0.86, respectively, and P were less than 0.05, which met the requirements of statistical research.

II. B. 3) Mathematical and statistical methods

The data obtained from the questionnaire survey were entered into the computer, and the valid questionnaires recovered were entered and processed using Excel sheets in the computer software WPS, using tables and charts to reflect the basic characteristics of the data in a visual and concise manner.

II. B. 4) Multiple linear regression analysis

Multiple linear regression analysis, also known as complex linear regression analysis, is a mathematical and statistical method that analyzes how several independent variables directly affect a dependent variable and the correlation that exists between them, which is also called univariate linear regression analysis because the model involves only one dependent variable [36]. In real life, the change of a variable is always accompanied by the influence of multiple factors, and studying the influence of only one factor on the dependent variable cannot fully, comprehensively and accurately explain the explained variable. Therefore, the use of multiple variables to estimate this explanatory variable is more consistent with the solution of practical problems in the ever-changing world, and the predicted results are more effective, so the multiple linear regression model applies to a wide range of conditions, and the software is simple to operate for people to understand and realize, and it is widely used in the fields of transportation, economy, environment, and so on.

We often assume that the dependent variable is Y and there are M independent variables: $x_1, x_2, \cdots x_m$, and that there is a direct linear relationship between Y and these M independent variables, then the multiple linear regression model is as follows:

$$Y = b_0 + \sum_{i=1}^{m} b_i x_i \tag{1}$$

where $b_0, b_1, \cdots, b_m$, are the $\mathrm{M}+1$ parameters to be estimated.

If there are N sets of observations: $x_{i1}, x_{i2}, \cdots x_{im}$; y_t, $t = 1, 2, \cdots, n$, then this N set of observations has the following structural form:

$$\begin{cases} y_1 = b_0 + b_1 x_{11} + b_2 x_{12} + \cdots + b_m x_{1m} \\ y_2 = b_0 + b_1 x_{21} + b_2 x_{22} + \cdots + b_m x_{2m} \\ \vdots \\ y_1 = b_0 + b_1 x_{m1} + b_2 x_{m2} + \cdots + b_m x_{mm} \end{cases} \tag{2}$$

II. B. 5) Hierarchical Analysis

The hierarchical analysis method (AHP) is a decision analysis method that hierarchizes and systematizes complex problems, which establishes hierarchical structural models such as goal, criterion, and program levels by combining quantitative and qualitative methods, constructs judgment matrices using pairwise comparisons and consistency tests, and determines the relative importance of each criterion in order to carry out a comprehensive evaluation [37]. Numerous scholars have adopted the hierarchical analysis method in conducting the evaluation of emergency response capacity, which mainly includes:

(1) Constructing hierarchical structure model: according to the research objectives and problems, construct the hierarchical structure model. The hierarchical structure is usually divided into target layer, criterion layer and program layer. The first target layer is the evaluation object; the second criterion layer is the criterion used to evaluate the target object; the third indicator layer is the refinement of each criterion layer.

(2) Constructing judgment matrix: the relative importance of each criterion and program is obtained through expert surveys and interviews, and the judgment matrix is constructed [38]. The judgment matrix is used to compare the importance of each element in each level relative to an element in the previous level. The pairwise comparison matrix is shown in equation (3):

$$A = (a_{ij})_{n\times n} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & & a_{2n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \tag{3}$$

3) Consistency test: The consistency test is used to test whether the pairwise comparison matrix constructed in the second step is reasonable. If it passes, the fourth step is carried out; otherwise, it is returned to the second step, and the pairwise comparison matrix is normalized by columns, and Eq. (4) and Eq. (5) are executed:

$$Z = (z_{ij})_{n\times n} = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1n} \\ z_{21} & z_{22} & & z_{2n} \\ \vdots & & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nn} \end{bmatrix} \tag{4}$$

$$z_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \tag{5}$$

Calculate the eigenvectors of matrix Z, see Eqs. (6) and (7):

$$\omega = (\omega_i)_{1\times n} = (\omega_1\ \omega_2 \cdots \omega_n)^T \tag{6}$$

$$\omega_i = \sum_{j=1}^{n} z_{ij} \tag{7}$$

Calculate the largest characteristic root of the matrix Z, see equation (8):

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n} \frac{(A\cdot\omega)_i}{\omega_i} \tag{8}$$

Calculate the consistency test index CI, see equation (9):

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{9}$$

Calculate the random consistency index, see equation (10):

$$CR = \frac{CI}{RI} \tag{10}$$

where RI is the average random consistency index, a constant.

If $CR < 0.1$, the pairwise comparison matrix A passes the consistency test. At this point, proceed to step four.

4) Determine the criterion layer weights and indicator layer weights. When the consistency test is passed, the feature vector ω that is, the criterion layer or indicator layer relative to its previous layer of the weight direction, the individual elements of the weight vector ω, that is, on behalf of the corresponding weights.

5) Determine the integrated indicator weight vector. Multiply the two layers of indicator weights to obtain the integrated indicator weights.

III. Analysis of the use of sports apps by university students

The use of Exercise App in college physical education courses allows students to be free from the control of time and space, and at any time through the teaching video in the App can do physical exercise, but also can monitor their exercise intensity and load, with monitoring exercise data and other functions. This chapter will analyze the use of exercise App in college students.

III. A. Analysis of the Purpose of Sports App Use

Exercise App contains some sports knowledge and exercise methods, making fitness programs, monitoring exercise data and other functions. The survey data on the purpose of college students' use of exercise App is specifically shown in Figure 1. As shown in the figure, 75.7% of the students use exercise App for the purpose of completing the tasks assigned by the school or teachers. In addition to completing school tasks, students who aim to supervise self-exercise and monitor exercise data accounted for 51.36% and 43.78%, indicating that students have a sense of self-exercise, and they observe their exercise status and body changes in real time by punching cards and setting goals through exercise Apps.

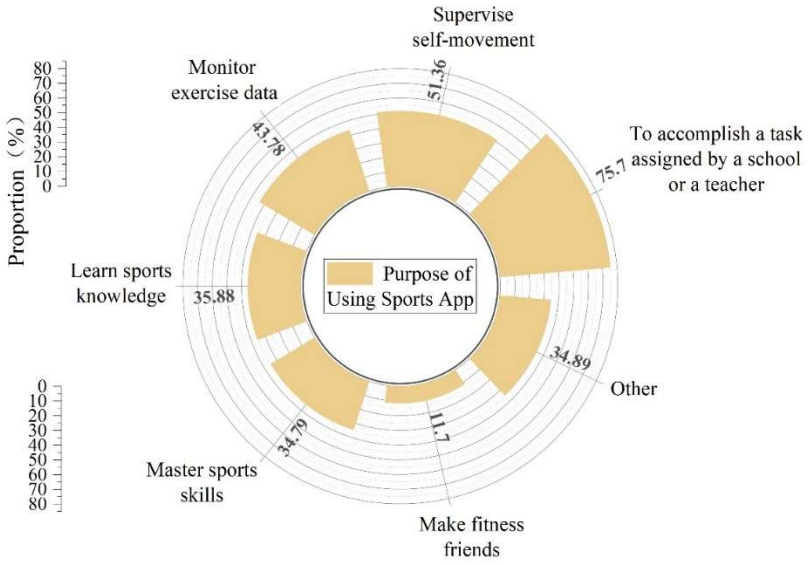


Figure 1: The Purpose of Using Sports App for College Students

III. B. Campaign App Acquisition Channel Analysis

The sources and channels of college students' access to sports Apps are specifically shown in Figure 2. As can be seen from the figure, the highest proportion of students' channels of acquiring sports apps through schools or teachers is 78.87%. The second is through friends' introduction, accounting for 29.73%. WeChat or microblogging recommendation and cell phone self-carrying accounted for 20.72% and 13.01%, respectively, and advertisements accounted for the smallest proportion of 9.51%.

The main channel for students to obtain sports apps is the school or teachers, the reason is that with the development of science and technology, the emergence of smart classroom, mobile teaching and other online and offline hybrid teaching mode, breaking the traditional teaching mode, teachers began to introduce “Internet +” and other technologies into the teaching, such as uploading teaching videos, assigning homework, Posting discussion questions, etc., can observe the students' learning status in real time, so they will recommend students to download some learning apps and establish online classrooms. The second is to use a certain sports app through the introduction of friends. Different sports apps have different fitness modules, functions and operation means, and students will choose them according to their own purposes and preferences, and will recommend them to their friends or classmates after obtaining a better experience. The smallest proportion is advertising. Generally speaking, when a company develops something new, the most direct means to let customers understand its functions is advertising, but for college students, this kind of publicity does not seem to be advantageous.

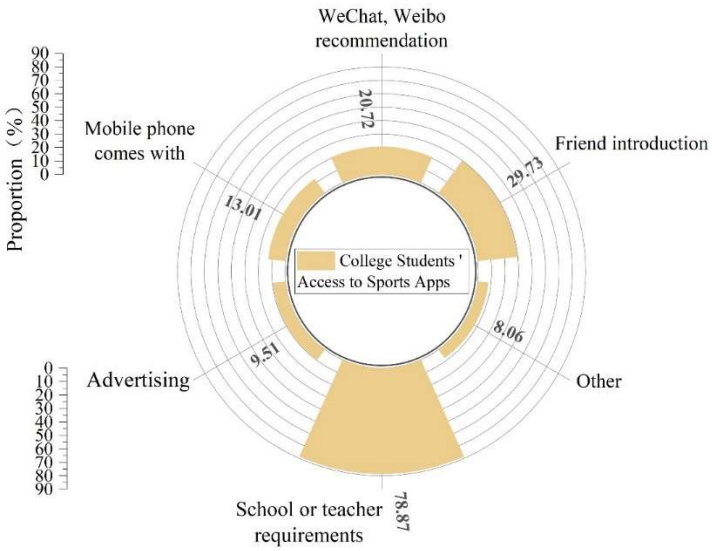
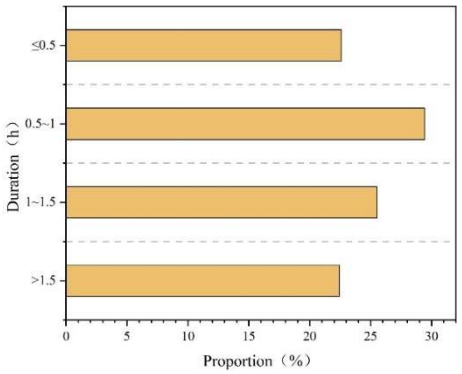


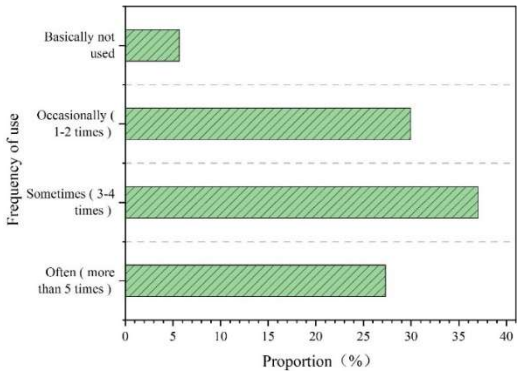
Figure 2: College Students ' Access to Sports Apps

III. C. Sports App Usage Time Analysis

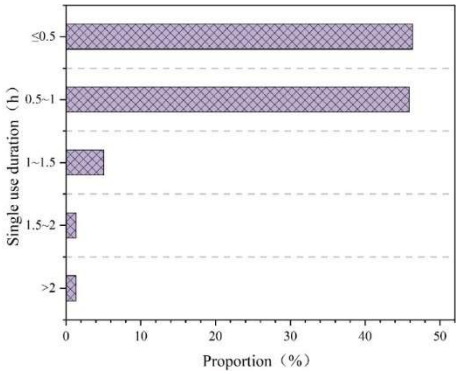
The statistics of students' single time duration of using exercise App is shown in Fig. 3. Figures (a)~(c) show the duration, frequency and single time duration of college students' use of exercise App, respectively. The duration of using exercise App by students >1.5h accounted for 22.44%, 1~1.5h accounted for 25.52%, 0.5~1h accounted for 29.44%, and ⩽0.5h accounted for 22.6%. The number of students who used the exercise app for exercise frequently (⩾5 times) per week was 27.32%, the number of students who used the exercise app for exercise sometimes (3~4 times) was the largest, accounting for 37.04%, the number of students who used the exercise app for exercise occasionally (1~2 times) was 29.95%, and those who basically did not use the exercise app for exercise accounted for 5.69%. The number of students who used the Exercise App to exercise for ⩽0.5h on a single occasion accounted for 46.34%, the number of students who exercised for 0.5~1h accounted for 45.9%, the number of students who exercised for 1~1.5h accounted for 5.06%, and the number of students who exercised for 1.5~2 h and >2h both accounted for 1.35%.



(a)Duration of College Students Using Sports Apps



(b)Frequency of college students using sports apps every week



(c)Duration of college students ' single use of sports Apps

Figure 3: The duration of college students ' single use of sports Apps

IV. Analysis of factors influencing the psychology of active exercise among university students

IV. A. Mean value analysis of psychological influences on active exercise

The overall situation of the psychological influences on students' active exercise in the survey questionnaire was counted and analyzed with descriptive statistics, and the specific results are shown in Table 1. As can be seen from the data in the table, the mean value of attitude in all dimensions of ability motivation, health motivation, appearance motivation, social motivation and fun motivation in the table is relatively high, with a mean value of 3.26, which shows that the college students participating in the survey are still high in the recognition of the exercise behavior, and basically they can accept the physical exercise emotionally and understand the physical exercise from the professional knowledge. In the dimension of fun motivation, the score of the dimension of will is relatively low, with a mean value of 2.59, which also indicates that although college students recognize the importance of physical exercise, their will to perform physical exercise is not very strong.

In the dimension of appearance motivation, relative to the social pressure with a mean value of 2.77, the influence of close friends or other characters scored higher with a mean value of 3.2, indicating that this dimension has a stronger influence on college students. In terms of ability motivation, the mean value of the variable of time is lower, with a mean value of only 2.06, which may be due to the fact that the curriculum of colleges and universities is relatively more compact, and students do not have much discretionary time, so their scores on the time dimension of ability motivation are not very satisfactory. The same reason for the low score in the dimension of self-management is that college students are not self-disciplined, their life and study are influenced by other factors, and they do not have enough determination. In terms of social motivation, instrumental support and information support have a greater impact on students' physical activity. Low self-efficacy in health motivation may also be the main reason for students' lack of active exercise.

Table 1: Psychological influence factors of active exercise

Dimensions	Variables	Mean value	Standard deviation
Fun motivation	Emotion	3.26	0.28
	Cognition	3.11	0.24
	Will	2.59	0.4
Appearance motivation	Social pressure	2.77	0.23
	The Influence of Friends and Others	3.2	0.4
Ability motivation	Time	2.06	0.58
	Self-management	2.18	0.41
	Knowledge and skills	3.02	0.18
Social motivation	Tool support	2.96	0.15
	Information support	2.92	0.21
	Peer support	2.7	0.19
Health motivation	Self-efficacy	2.33	0.36

IV. B. Analysis of Demographic Differences in Psychological Influences on Active Exercise

IV. B. 1) Analysis of gender differences

Collating the choices of students of different genders under different dimensions, the results in the table are shown in Table 2. From the data in the table, it can be seen that the choice scores of male junior high school students in several dimensions such as physical exercise behavior, active exercise psychology, fun motivation, social motivation, and health motivation are higher than those of female students in these dimensions, and the mean values are higher by 0.43, 0.11, 0.13, 0.14, and 0.01, respectively. And in the aspects of appearance motivation and ability motivation girls chose higher scores, higher than boys 0.08 and 0.11. Among the above variables, there is a significant difference between the scores of male and female students only in terms of physical activity behavior, which indicates that gender differences can have a different impact on the physical activity behavior of male and female students.

Table 2: Sex differences

Variables	Gender	Mean value	Standard deviation	T	P
Physical exercise behavior	Male	3.48	1.022	0.659	0.015
	Female	3.05	0.019	0.584	
Active exercise psychology	Male	2.75	1.659	0.536	0.714
	Female	2.64	1.718	0.626	
Fun motivation	Male	2.92	1.179	0.558	0.872
	Female	2.79	1.002	0.72	
Appearance motivation	Male	2.82	0.869	1.846	0.805
	Female	2.9	0.824	1.067	
Ability motivation	Male	2.72	0.794	0.512	0.728
	Female	2.83	0.818	0.631	
Social motivation	Male	2.23	0.665	0.805	0.924
	Female	2.09	0.701	0.717	
Health motivation	Male	2.74	0.548	0.662	0.315
	Female	2.73	0.625	0.619	

IV. B. 2) Analysis of differences in school types

Differences in school types lead to differences in students' educational philosophy, educational methods, and teaching arrangements, and therefore indirectly affect students' learning and life. The statistics of students' choice scores of different types of schools are shown in Table 3. From the table, it can be seen that the difference between the students' choice scores of public universities and private universities is smaller, and from the aspect of significance, the significance results of the test of students' performance in different school types in terms of physical exercise behavior, active exercise psychology, fun motivation, appearance motivation, competence motivation, social motivation, and health motivation are all greater than 0.05, from which it can be judged that the school type will not affect the students' exercise behavior and exercise psychology.

Table 3: Differences in school types

Variables	School type	Mean value	Standard deviation	T	P
Physical exercise behavior	Public schools	3.14	1.136	0.573	0.656
	Private schools	3.2	1.115	0.55	
Active exercise psychology	Public schools	2.55	1.37	0.423	0.607
	Private schools	2.48	1.258	0.505	
Fun motivation	Public schools	2.73	1.145	0.561	0.519
	Private schools	2.79	1.227	0.43	
Appearance motivation	Public schools	2.79	0.738	1.412	0.466
	Private schools	2.64	0.711	1.206	
Ability motivation	Public schools	2.58	0.613	0.565	0.625
	Private schools	2.5	0.706	0.519	
Social motivation	Public schools	2.92	0.543	0.712	0.824
	Private schools	2.64	0.619	0.714	
Health motivation	Public schools	2.69	0.473	0.683	0.582

	Private schools	2.59	0.509	0.665	

IV. B. 3) Analysis of differences in average monthly household income

Differences in average monthly family income affect the expenditure of family life and family consumption choices, some equipment needs to be purchased in physical exercise, while the average monthly family income provides material security. Statistics of students' choices in different kinds of family income types are shown in Table 4. The analysis of the choices of students with different monthly family incomes, the results of the test of significance of the performance of students of different school types in terms of physical activity behavior, active exercise intention, attitude, subjective norms, sense of behavioral control, social support, and self-efficacy were 0.012, 0.018, 0.104, 0.138, 0.073, 0.066, and 0.085, respectively. Only the physical activity behavior and active exercise intention have significant differences, and the results of several other dimensions of the test are greater than 0.05, so it can be judged that the difference in monthly family income will have significant results on physical activity behavior and active exercise intention.

Table 4: Difference of family monthly income

Variables	Family monthly income	Mean value	Standard deviation	T	P
Physical exercise behavior	3000 yuan and below	2.77	1.055	0.646	0.012
	3001-5000 yuan	2.84	1.124	0.716	
	5001-7000 yuan	2.99	1.095	0.524	
	More than 7001 yuan	3.16	1.714	0.55	
Active exercise psychology	3000 yuan and below	2.72	0.45	0.608	0.018
	3001-5000 yuan	2.91	0.424	0.622	
	5001-7000 yuan	3.17	0.62	0.616	
	More than 7001 yuan	3.51	0.528	0.734	
Fun motivation	3000 yuan and below	2.79	1.003	0.781	0.104
	3001-5000 yuan	2.59	1.157	0.804	
	5001-7000 yuan	2.72	1.152	0.709	
	More than 7001 yuan	2.76	1.023	0.608	
Appearance motivation	3000 yuan and below	2.71	0.816	0.616	0.138
	3001-5000 yuan	2.69	0.728	0.612	
	5001-7000 yuan	2.66	0.727	0.711	
	More than 7001 yuan	2.82	0.807	0.72	
Ability motivation	3000 yuan and below	2.52	0.785	0.566	0.073
	3001-5000 yuan	2.68	0.771	0.492	
	5001-7000 yuan	2.35	0.794	0.58	
	More than 7001 yuan	2.77	0.739	0.592	
Social motivation	3000 yuan and below	2.87	0.814	0.883	0.066
	3001-5000 yuan	2.9	0.928	0.684	
	5001-7000 yuan	2.73	1.055	0.72	
	More than 7001 yuan	3.47	0.85	0.853	
Health motivation	3000 yuan and below	2.87	1.016	0.799	0.085
	3001-5000 yuan	2.98	1.179	0.678	
	5001-7000 yuan	3.11	1.043	0.798	
	More than 7001 yuan	3.04	1.118	0.776	

V. Multiple Regression Linear Analysis of Sports App Use and Active Exercise Psychology

V. A. Correlation analysis between exercise app use and active exercise psychology

The correlation analysis function of SPSS 23.0 software was used to correlate the mean values of 2 dimensions of college students' exercise APP usage, exercise APP trust and exercise APP usage loyalty, with the mean values of 5 dimensions of active exercise psychological mechanism, namely fun motivation, appearance motivation, ability motivation, social motivation, and health motivation, and the results are shown in Figure 4. D1~D7 in the figure correspond to exercise APP trust, exercise APP use loyalty, ability motivation, health motivation, appearance motivation, social motivation, and fun motivation, respectively. From the figure, it can be seen that the correlation

between sport APP trust, use loyalty and ability motivation, health motivation, appearance motivation, social motivation and fun motivation is statistically significant at the 0.01 level.

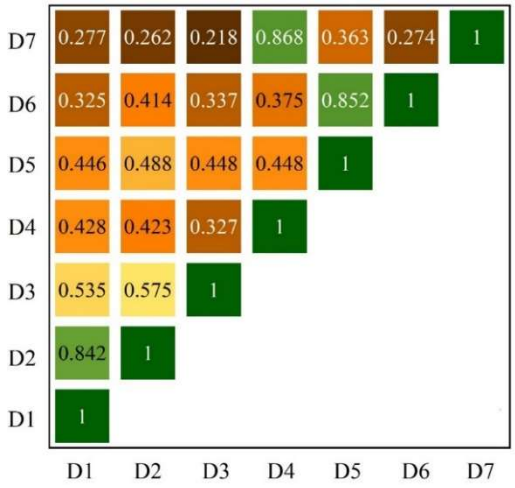


Figure 4: Correlation between the use of sports APP and active exercise psychology

V. B. Analysis of the Impact of Exercise APP Use on Active Exercise Psychology

Based on the results of the correlation analysis of the mean values of the 2 dimensions of college students' exercise APP usage and the mean values of the 5 dimensions of exercise motivation, multiple linear regression analysis was conducted with the ability motivation of exercise motivation as the dependent variable, and the trust and loyalty in using the exercise APP as the independent variables, and the results showed that the compound correlation coefficient of R=0.597, and the difference was very significant at P<0.01 after ANOVA test, and could be further regression analysis. The results of regression analysis are shown in Table 5.

Table 5: Multivariate regression coefficients

Model	Unnormalized coefficient		Normalized factor	T	Significance
	B	Standard error	Beta		
(Constant)	2.406	0.194	-	12.379	0.000
Sports APP trust degree	0.206	0.49	0.258	4.201	0.000
Sports APP use loyalty	0.329	0.047	0.432	7.031	0.000

The multiple linear regression equation between ability motivation (Y) and sport APP trust (X_1) and sport APP use loyalty (X_2) established based on the above table is:

$$Y=0.206X_1+0.329X_2+2.406 \tag{11}$$

As shown in equation (11), the unstandardized regression coefficients of exercise APP trust and use loyalty are 0.206 and 0.329, respectively, indicating that exercise APP use loyalty has a greater impact on ability motivation. Using the same method, multiple linear regression analyses were conducted sequentially with the other four motives in exercise motivation (appearance motivation, health motivation, fun motivation, and social motivation) as the dependent variable, and exercise APP trust and use loyalty as the independent variables. The final results showed that the use loyalty of exercise APP had a greater impact on appearance motivation and health motivation, while the trust of exercise APP had a greater impact on social motivation and fun motivation.

VI. Multilevel analysis of the factors influencing the psychological impact of exercise apps on active exercise

Through the analysis of the relationship between the influence of exercise APP on the psychological mechanism of active exercise of college students in the previous chapter, the AHP hierarchical analysis structure diagram is established, as shown in Figure 5. There are 3 levels, which are the goal level (exercise motivation A), criterion level (fun motivation C_1 , health motivation C_2 , social motivation C_3 , appearance motivation C_4 , and competence motivation C_5), and the program level (content enhancement) Professionalism P_1 , Enhancement of Data

Reliability P_2, Ensuring Information Accuracy P_3, Establishment of Punch Card Reward Mechanism P_4, Enhancement of Attractive User Content P_5).

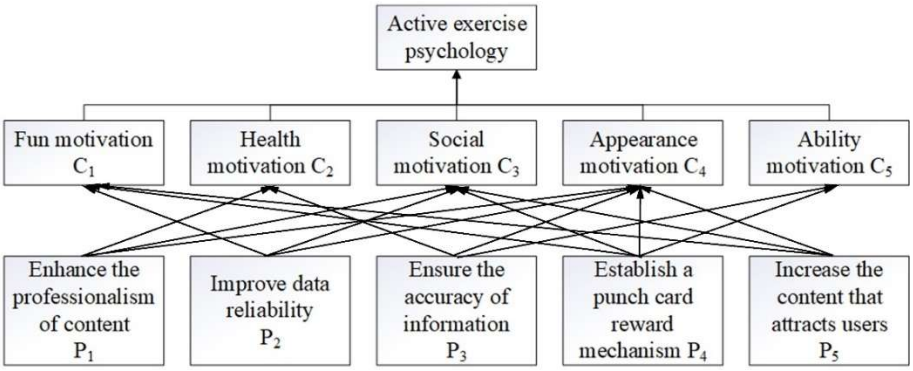


Figure 5: Hierarchical analysis structure diagram

Using the Delphi method to compare the elements in the guideline layer of the hierarchical analysis structure chart two by two, resulting in a judgment matrix. The value of the judgment matrix reflects the relative importance of each factor indicator, this paper adopts 1~9 scale, as shown in Table 6.

Table 6: 1~9 scale

Scale	The importance level of pairwise comparison
1	It means that the two factors are as important as each other.
3	Compared with the two factors, the former is slightly more important than the latter.
5	Compared with the two factors, the former is more important than the latter.
7	Compared with the two factors, the former is more important than the latter.
9	Compared with the two factors, the former is more important than the latter.
2,4,6,8	The importance ratio is between the above two adjacent levels.

VI. A. Criterion Hierarchy Single Order Analysis

A two-by-two comparison was made between the first-level indicators affecting the target level, i.e., fun motivation, health motivation, social motivation, appearance motivation, and competence motivation, and the judgment matrix for the two-by-two comparison of the five factors of the criterion level's influence on the target level is shown in Table 7.CR=0.0943<0.1, so it can be judged that the comparison matrix has a satisfactory consistency, and that all the weights are valid, i.e., the weight indicators of the factors of health motivation, fun motivation, competence motivation, and ability motivation, and appearance motivation factors have weight indicators of 0.2846, 0.2622, 0.2502, 0.1111, and 0.0919, respectively. among the five first-level indicators of the psychological influence factors of active exercise, the health motivation, fun motivation, and ability motivation have larger influence weights.

Table 7: Judgment matrix

Index	C_1	C_2	C_3	C_4	C_5	Weight
C_1	1	0.5	2	3	2	0.2622
C_2	2	1	3	3	0.5	0.2846
C_3	0.5	0.3333	1	0.5	0.5	0.0919
C_4	0.3333	0.5	2	1	0.5	0.1111
C_5	0.5	2	2	2	1	0.2502

VI. B. Programmatic Hierarchy Single Order Analysis

Two-by-two comparisons of the secondary indicators were made to form judgment matrices, as shown in Table 8. Their consistency ratios are all less than 0.1, thus the consistency test of each judgment matrix is acceptable, indicating that the program had the establishment of each factor is reasonable. Enhancing data reliability is the most weighted of the factors influencing fun motivation, which is 0.6244, indicating that the reliability of the data provided

by the exercise APP is the primary factor influencing users' fun motivation. Enhancing the professionalism of the content of the exercise APP is the most weighted factor in the health motivation factor, at 0.5419, indicating that the professionalism of the content of the exercise APP can maximize the user's health motivation. Enhancing the professionalism of the content of the sport APP has a weight of 0.4121, which is the most influential factor of social motivation, in other words, the professionalism of the content of the sport APP can enhance the social motivation of the users. The weight of ensuring the accuracy of the information of the sports APP is 0.4155, which is the highest weight in the influence factors of appearance motivation. It can be seen that ensuring the accuracy of the information of the exercise APP is the key to encourage users to persist in exercising and build a good appearance. In addition, ensuring the accuracy of the information of the exercise app also has the highest weight of 0.5318 among the factors influencing the ability motivation, which indicates that the accuracy of the information can enhance the ability motivation.

Table 8: Evaluation index weight and consistency ratio

Criterion layer	Scheme layer	Scheme layer weight	Consistency test	Consistency ratio	Weight
C_1	P_4	1	3.0264	0.0707<0.1	0.2714
	P_5	1			0.1272
	P_2	0.3333			0.6244
C_2	P_1	1	3.0172	0.0174<0.1	0.5419
	P_3	3			0.2028
	P_2	2			0.2442
C_3	P_2	1	5.3753	0.0838<0.1	0.2437
	P_3	2			0.015
	P_4	4			0.0856
	P_5	3			0.0658
	P_1	0.3333			0.4121
C_4	P_2	1	4.182	0.0255<0.1	0.1879
	P_3	0.5			0.4155
	P_4	2			0.106
	P_5	0.5			0.2886
C_5	P_1	1	3.0524	0.0525<0.1	0.3295
	P_4	3			0.1486
	P_3	0.5			0.5318

VI. C. Hierarchical General Ordering Analysis

The results of the total hierarchical ranking are specifically shown in Table 9. The calculation results show that CI=0.016, RI=0.8314, CR=0.0192<0.1, which passes the consistency test. In order to enhance the exercise motivation of the exercise APP users, for the operator of the exercise APP, the proposed five scenarios are prioritized as:

1) P_2 - Enhance data reliability with a weight of 0.278.
2) P_1 - Enhancement of content specialization, with a weight of 0.272.
3) P_4 - Establish a reward mechanism for punching cards, with a weight of 0.222.
4) P_3 - Ensure the accuracy of information, with a weight of 0.159.
5) P_5 - add content that attracts users, with a weight of 0.068.

Table 9: Calculation results of hierarchical total ranking

Scheme	C_1	C_2	C_3	C_4	C_5	Weight	Project sequencing
P_1	0	0.549	0.411	0	0.333	0.272	2
P_2	0.614	0.24	0.243	0.185	0	0.278	1

P_3	0	0.209	0.201	0.107	0.528	0.159	4
P_4	0.268	0	0.088	0.416	0.14	0.222	3
P_5	0.117	0	0.058	0.293	0	0.068	5

VI. D. Optimization of Strategies for Sport App Use to Promote Active Exercise

Exercisers should choose exercise APPs scientifically according to their actual situation and exercise needs, so that they can develop good exercise habits in continuous exercise. The operators of sports APP should further improve the accuracy of data and the authority of information, so as to stimulate the motivation of college students to exercise and ensure the continuity and long-term nature of college students' participation in physical exercise.

VII. Conclusion

This paper analyzes the current situation of college students' use of exercise APP through literature, questionnaire survey, mathematical statistics, multiple linear regression analysis and hierarchical analysis, and explores the influence of the use of exercise APP on the psychological mechanism of college students' active exercise.

Firstly, we analyzed the situation of college students' use of exercise APP. In terms of the purpose of use, 75.7% of the students were to complete the tasks assigned by the school or teachers, while 51.36% and 43.78% were to supervise self-exercise and monitor exercise data, respectively. The main source and channel for acquiring exercise apps was through school or teachers, accounting for 78.87%, while other channels accounted for a smaller percentage. The percentages of students who used exercise apps occasionally (1~2 times) and frequently ($\geqslant$5 times) per week were 29.95% and 27.32%, respectively. The combined percentage of students who used exercise apps for exercise $\leqslant$0.5h and 0.5-1h in a single session was as high as 90.24%.

The factors affecting college students' active exercise psychology were analyzed in terms of mean and demographic differences. Among all the dimensions, the mean value of attitude is relatively high at 3.26, and the influence of close friends or other personalities is also high at 3.2. The dimension with the lowest score is time, with a mean value of only 2.06. The differences in the factors influencing the psychology of active exercise are analyzed in terms of gender, type of school, and average monthly income of the family. Based on the results of the analysis, it can be seen that gender differences will have different physical activity behavior of male and female students, and differences in average monthly family income will significantly affect the physical activity behavior and active exercise intention of college students. And the difference in school type does not affect students' exercise behavior, exercise psychology.

In the multiple regression linear analysis, the correlation between trust in exercise APP, loyalty in use and ability motivation, health motivation, appearance motivation, social motivation and fun motivation is statistically significant at the 0.01 level. In the degree of influence, loyalty to use of exercise APP had a greater influence on appearance motivation and health motivation, while trust in exercise APP had a greater influence on social motivation and fun motivation.

Based on the results of multiple regression linear analysis, the AHP hierarchical analysis structure diagram was established to carry out the multilevel analysis of the psychological influence mechanism of sport APP to promote active exercise. Among the five first-level indicators of exercise motivation factors, health motivation, fun motivation and ability motivation have larger weights, with weights of 0.2846, 0.2622 and 0.2502, respectively, and the weights of P_2 and P_1 are the highest in the scenario level, with 0.278 and 0.272, respectively, which mean that the promotion of data reliability and enhancement of content professionalism are the important inner same of exercise APP operators to enhance the active exercise psychology of college students. Finally, combining the results of each analysis, we propose the optimization of the strategy for the use of sports APP to promote active exercise, college students need to choose sports APP scientifically and continuously develop good exercise habits, while sports APP operators need to further ensure the accuracy of data and the professionalism of content.

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