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ORIGINAL

SPORTS PHYSICAL FITNESS ANALYSIS SYSTEM OF COLLEGE STUDENTS UNDER HEALTH PROMOTION TEACHING MODE BASED ON DATA MINING

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ABSTRACT

There was a clear emphasis on the multifaceted goals of quality education. It was stated that the pursuit of quality education should not only focus on academic achievements and moral development but also encompass the development of students' physical strength and overall well-being. This chapter introduces the physical fitness test data of a university in China and the data collected from "Physical Fitness Health Self-evaluation Table" to discuss the specific situation of college students' physical fitness under the health promotion teaching mode. Upon analyzing the data gathered for this study, both decision tree and association rule algorithms were employed to investigate the specifics of college students' physical fitness under the health promotion teaching model. Following the data analysis, it was observed that alterations in the daily activities of college students are closely linked to changes in their physical fitness, with the majority of these relationships being positive.

KEYWORDS: Data Mining; Physical fitness; Association Rule Algorithm; Decision Tree Algorithm

1. INTRODUCTION

Given the observed decline in the physical health of young people in

China, the National People's Congress has taken legislative action, amending the Sports Law of the People's Republic of China on two occasions, in 2009 and 2016. Chapter three of this law explicitly defines the role of school physical education in the education system, including the organization of physical education classes, the conduct of extracurricular sports activities, the provision of sports venues and facilities, the appointment of physical education teachers, and the establishment of student physical fitness monitoring programs(Liu et al., 2022). The State Council has emphasized that "the physical well-being of China's youth is a significant matter that is closely linked to the nation's revitalization and progress. It requires the comprehensive attention and support from governments at all levels, party committees, institutional organizations, and society as a whole"(Zong et al., 2021). Nevertheless, research indicates that despite the significant emphasis placed on sports development by the nation and society, the approaches college students employ to enhance their overall quality have become increasingly varied, influenced by the prevailing school teaching paradigms. However, from the current physical quality of college students, most students do not form the correct exercise mode in daily life, let alone scientific exercise methods(Xiangqin et al., 2020). This paper for the process of health promotion teaching mode using the decision tree and the association recommended two algorithms, by comparing the students 'habits in daily life, collection body comprehensive quality of data comparison, finally based on the comparison results of the application of the algorithm more accurate, in order to further improve the comprehensive quality of the students' research, gradually form the growing environment of college students.

2. Research Status of College Students' Physical Fitness Analysis

While the academic research on data is gradually deepened, it can integrate more fields with the technology, and even the data analysis can be applied to the teaching field. After the analysis of information technology, foreign scholars show that the integration of computer technology and education will be the development direction of the education industry(Wang, 2020). Foreign scholars analyze the influence of information technology on education by combining theory and practice. In addition, the teaching content can be evaluated in higher teaching through information analysis, including not only the collection of teaching achievements, but also the processing of students' basic information(Dongbing, 2020). On the whole, the theoretical content and practice of integrating data mining and teaching need to be extended. In the domestic research on college students 'physical fitness, in the environment of the number of students has increased, both academic circles and universities for the combing and analysis of students' quality data is also significantly improved, if the traditional data processing method obviously cannot meet the analysis of a large number of college students' data(Liu et al.,

2021).Therefore, domestic scholars combine computer algorithms with college students 'sports and physical fitness through data analysis(Jiao et al., 2023). For example, Chinese scholars sort out students' learning situation through related algorithms, and build a related algorithm model to assist teachers to complete the evaluation of students' performance(Lu & Li, 2020). Some scholars also collect the physical fitness data of college students by building a decision tree model, and then determine the correlation between students 'living habits and physical fitness through the analysis results. Through the research results, it is found that students' living habits and physical conditions are positively correlated(Zhang, 2022).

In addition, in the analysis of the physical fitness of college students, because the theoretical analysis is not applied to the practical education and teaching; on the other hand, because the college sports management system is still stuck in the comprehensive statistical processing of students' information and scores, the basic function is still stuck in the data backup and data query. As a result, a large number of students' physical fitness data are simply processed, and students and teachers can only observe the surface information of the data, such as excellent physical performance evaluation, good, passing and other simple grade calculation(Kai, 2020).

3. Analysis of College Students' Physical Fitness Under the Teaching Mode of Health Promotion Based on Data Mining

3.1 Overview of Data Mining

Data mining is a process of data processing, which is also an inevitable trend in the environment of a large increase of data volume, and the academic research is becoming more and more abundant. Through the computer processing of the data in the system, the value of the data itself can be maximized. Therefore, for most subjects, it is very critical to adopt scientific algorithms in the process of processing the data through information technology. The research content of this topic also shows the importance of data mining to the education industry. This current application method comprehensively analyzes the research results of academic circles(Yu, 2024). The specific contents are as follows in table 1:

Table 1: Application of Data Mining

CLASSIFICATION STANDARD	CATEGORY
FIELD	Retail, Finance, Communications
TECHNIQUES USED	Data analysis, visualization, etc
KNOWLEDGE	Feature analysis, decision tree, etc
DATABASE	Media, Education, etc

3.2 Selection of Data Mining Algorithms

3.2.1 Principle of Decision Tree Algorithm

During the construction of a decision tree, the process begins with the selection of an attribute from the training dataset to serve as the basis for classifying the current node. Subsequently, child nodes are created in a top-down manner, following the evaluation metrics, until the data becomes indistinguishable or pure(Huaman, 2021). Ultimately, pruning is applied to minimize the tree's complexity, thereby mitigating the risk of overfitting in the decision tree model. The above steps are to select different features as classification criteria and different evaluation criteria for each internal node, thus deriving different decision tree algorithms (Figure 1).

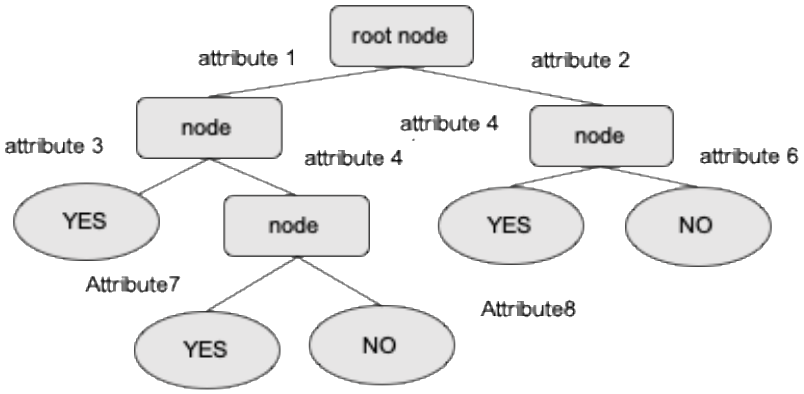

Figure 1: Decision Tree

As shown in Table 2. There are few cases of applying data mining to sports health research, this paper attempts to use C4.5 algorithm to mine, By collecting the effective information of college students' physical fitness under the health promotion teaching mode, a reasonable decision tree model is constructed.

Table 2: Classification of Decision Tree Algorithm

DECISION TREE ALGORITHM	DESCRIBE
ID3 ALGORITHM	Based on the information gain, the decision tree nodes are obtained, which helps to use the most appropriate attribute when selecting nodes.
C4.5 ALGORITHM	After optimizing through the previous way, the information gain rate is obtained, and the subsequent operation process is completed.
CART ALGORITHM	CART algorithm is a method that can do both regression and classification. When CART tree is built and pruned, when the end point is persistent variable, the decision tree is regression tree; When the end variable is a classification variable, it is a classification tree.

3.2.2 C4.5 Algorithm

Analysis of information data in the decision tree algorithm, the data set can be obtained, and by comparing the attributes of the data set $C_i(1,2,\cdots\cdots,m)$, and the number of samplesC_i 、 S_j, the operation formula is as follows:

$$I(s_1,s_2,\cdots,s_m)=P_i log_2(P_i)$$

Using the decision tree classification, the information values of the divided samples are:

$$E(A)=\frac{S_1+S_1+\cdots+S_1}{S}I(S_{1j},S_{2j},\cdots,S_{mj})$$

The improved algorithm of this subject is based on different attributes, and the specific content is shown in the improved algorithm in the table above, by calculating the information gain rate.

$$Splitl(A)=-\sum_{j=1}^{m}\frac{|S_j|}{|S|}\times log_2\frac{|S_j|}{|S|}$$

$$GainRatio(A)=\frac{Gain(A)}{Splot(A)}$$

According to the review opinions given by the review, the content of the literature review was added to the current situation section of the study.After combing the research results at home and abroad, the research results are reviewed. The revised content is shown in the red mark of the article(Fan et al., 2024).

3.3 Association Rule Algorithm

Association rules are frequent patterns and association rules that usually use association data and transaction data as carriers to find the existence between things or objects. Among the applications of association rule mining, the quintessential example that stands out is the well-known market basket analysis(Zhu & Zhang, 2022).

3.3.1 Definition of Association Rules

The correlation rules used in this topic can comprehensively analyze the data, and the correlation between the data is mainly conducted through the indicators determined by the research results of scholars. Which is measured by the proportion of itemset occurrences. The expression is as follows:

$$Support(A) = P(A)$$

$$Support(A \rightarrow B) = P(A \cap B)$$

Confidence level:

$$Confidence(A \rightarrow B) = P(B|A)$$

Promotion degree. Promotion degree means that item set A exists at the same time as item set B, but it also controls the popularity of item set B:

$$Lift(A \rightarrow B) = \frac{Support(A, B)}{Support(A) \times Support(B)}$$

3.4 Comparison of Decision Tree and Association Algorithm

The decision tree and association rule algorithms exhibit both interconnections and disparities. From the point of view of algorithm purpose and technology: ① decision tree belongs to classification model, which is suitable for classifying data items; Association rules are more suitable for mining the relationship between data. Classification rules belong to supervised learning; While association rules are unsupervised learning. 3. The difference of the realization process between them: Decision tree is classified by training model and training set; Association rules are based on the principle of minimum support and minimum confidence, and the strong association rules are screened out by layer-by-layer search iteration. Combined with the research contents: ① The physical fitness analysis of college students studied in this paper is based on two groups of data: the data of students' physical fitness test and the data collected from the Self-assessment Form of Physical Fitness. The decision tree algorithm is particularly adept at uncovering the underlying relationships between physical education assessment data and students' routine behavioral patterns. Meanwhile, association rule mining is employed to explore the interconnections among various elements within the physical assessment data. The two algorithms can reflect different functions, find scientific basis for physical education, promote the construction of college physical education, and better serve college students.

4. Experimental Analysis of College Students' Physical Fitness Under the Teaching Mode of Health Promotion Based on Data Mining

4.1 Data Preprocessing

4.1.1 Data Selection and Cleaning

The data used in this chapter comes from the physical fitness data of students in a university in China and the data collected from the

Self-assessment Form of Physical Fitness. Students' physical fitness data, taking 2021 level data as research data samples, the sample data is stored and managed by SQL Server 2008 in the university, and managed synchronously with students' personal information in the educational administration system. After deleting relevant personal privacy information and irrelevant fields, the final sample information includes the following fields: gender, height, weight, vital capacity, 50-meter running, female surname 800-meter running, male surname 1000-meter running, standing long jump, sitting forward flexion, female surname 1-minute sit-up, male surname pull-up, left eye naked eye vision, right eye naked eye vision, total score and total score grade. Data in the process of collection and sorting, due to the particularity of the data, during processing a large amount of data largely data instability, therefore, need to screen the data, during this period can be processed through feasible research results, for the principle of data processing need to abide by, will complete data determined, for the next step. Combined with the relevant research results, the process of data screening is shown as follows in figure 2:

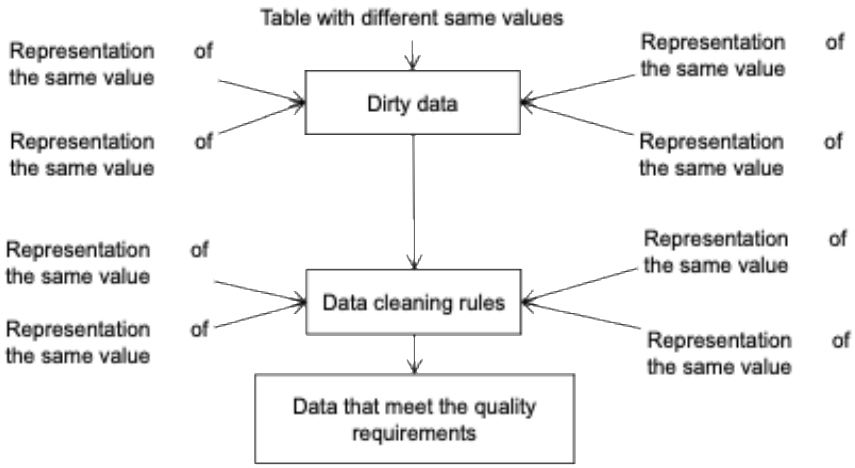

Figure 2: Principle of Data Cleaning

4.1.2 Data Normalization

In this paper on the physical fitness analysis of college students under the health promotion teaching mode, the analysis results will be biased based on different collection methods and values of data. Based on this point, data processing is extremely critical. According to the data of students' physical fitness test and the data collected in the Self-assessment Form of Physical Fitness, the standardized operation of data mainly includes the following aspects:

(1) Data discretization: Due to the lack of pertinence, readability, and guidance, this paper for the analysis of health promotion teaching mode of sports fitness in the way of index construction through indicators of students'

physical fitness, including cardiopulmonary, muscle and other five aspects, after the overall analysis of data compared with standard data.

① Cardiopulmonary function: vital capacity, running at 50/800/1000 meters; ② Muscle strength: standing long jump, sit-ups and pull-ups ③ Muscle endurance: 50/800/1000 meters running ④ Softness: Bend forward in sitting position ⑤ Obesity degree: weight and height. In accordance with the assessment criteria outlined in the National Physical Fitness Standard for Students, the final score for each individual in the aforementioned group is determined for every physical fitness test item. If any health indicator scores below 60 points, the overall assessment is deemed to be unqualified. Utilizing this approach, the five health indicators are categorized into two distinct categories: qualified and unqualified. An individual is deemed unqualified if they score below 60 in any sports event, while those scoring above 60 in all sports events are considered qualified. For the data collected in the Evaluation Form of College Students' Sports Physical Fitness under Health Promotion Teaching Mode, there are four factors, each of which has a score of 1-5, which can be divided into two intervals: reaching the standard and not reaching the standard, in which a score greater than 2 represents reaching the standard and a score lower than 2 represents not reaching the standard.

(2) Format normalization: Format normalization is to transform the data that is not easy to read into the data that is easy to read and formatted. The data used in this paper uses the combination of English and numbers instead of Chinese symbols, so as to improve the mining efficiency. For example, men and women in gender are replaced by XB1 and XB2; The two intervals of cardiopulmonary function are replaced by XF1, XF2 and so on. The formatted standard table of "Analysis and Evaluation of College Students' Sports" is shown in Table 3.

Table 3(a): Analysis and Evaluation Standard Table of College Students' Sports

	DESCRIBE	ATTRIBUTE VALUE	CODE
XB	Gender	Reach the standard	XB1
		Not up to standard	XB2
XFGN	Cardiopulmonary function	Reach the standard	XF1
		Not up to standard	XF2
JRLL	Muscle strength	Reach the standard	LL1
		Not up to standard	LL2
JRNL	Muscle endurance	Reach the standard	NL1
		Not up to standard	NL2
RRD	Softness	Reach the standard	RR1
		Not up to standard	RR2
FPCD	Degree of obesity	Reach the standard	FP1
		Not up to standard	FP2

Table 3(b): Analysis and Evaluation Standard Table of College Students' Sports

	DESCRIBE	ATTRIBUTE VALUE	CODE
FPCD	Degree of obesity	Reach the standard	FP1
		Not up to standard	FP2
YS	Diet	Reach the standard	YS1
		Not up to standard	YS2
ZX	Work and rest	Reach the standard	ZX1
		Not up to standard	ZX2
DLXG	Exercise habit	Reach the standard	DL1
		Not up to standard	DL2
TNJK	Attention to physical fitness and health	Reach the standard	TN1
		Not up to standard	TN2

4.2 Example Application of Decision Tree Algorithm

4.2.1 Algorithm Application

In examining the physical fitness of college students within the health promotion teaching model, a significant disparity is observed in the physical fitness levels of students as assessed by cardiopulmonary fitness tests. The analysis results can be divided into qualified and unqualified. The results obtained after calculating the sample number are as follows:

$$I(XF1, XF2) = I(1139,1862) = 0.9577$$

Calculate the information gain rate (Gain Ratio) of each attribute:

Table 4: Computing Result

CALCULATION ITEM	YS	ZX	DL	TN
TONE-UP	0.9528	0.9209	0.8759	0.9503
GAIN	0.0048	0.0368	0.0818	0.0074
SPLIT	0.8682	0.7600	0.9266	0.9985
GAIN RATIO	0.0055	0.0484	0.0883	0.0074

Through the analysis of the above calculation results in table 4, the calculation results of one dimension gain the most obvious change, and the change range is also larger. Subsequently, the attribute values were calculated, and a new classification was formed through the decision tree algorithm. After many iterations, the analysis results of the data were divided, and finally the model and results of "cardiopulmonary function" were obtained. In the process of analyzing the above contents, more obvious findings can be made. Although the decision tree can analyze the data, the noise of the data should be integrated into it. The above steps should be repeated through comprehensive analysis, and the new data analysis results can be obtained after iteration. Combined with the survey subjects, in the sports and physical fitness analysis

of college students under the health promotion teaching mode, computer technology is adopted for data mining. The final data analysis results are shown in the following figure 3:

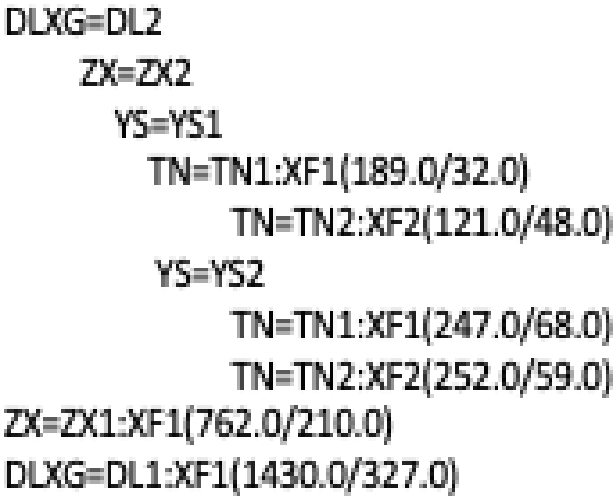

Figure 3: Output of Decision Tree

4.2.2 Result Analysis

The cardiopulmonary function of college students has the greatest correlation with "exercise habits". Combined with the real life on campus, students' sports forms are mainly aerobic sports such as physical education class and various ball games. According to the above analysis results, in order to make college students' own sports conditions meet the national standards, we need to pay more attention to physical exercise in daily life, especially for cardiopulmonary exercise. Students' work-rest cycles and dietary habits are closely linked to their cardiopulmonary fitness levels. A healthy work-rest balance significantly bolsters immunity and overall health, whereas a pattern of staying up late can lead to a continuous decline in physical well-being. Additionally, while diet is an essential factor, an improper diet can result in obesity, which in turn can significantly impair cardiopulmonary capacity. Thirdly, the importance of college students' physical fitness is related to cardiopulmonary function. Physical education includes the opening of college physical education class and the degree of students' scientific understanding of physical exercise. Actively participating in classroom and extracurricular sports activities and developing scientific sports habits independently can enhance physical fitness(Hu, 2022). In view of the above research conclusions, after getting the physical test data, the school can systematically and pertinently give real-time feedback to the physical health of each student in various parts. Moreover, teachers can find students' problems and trends more intuitively through physical health data, and give corresponding guidance in time. It is of great significance to the construction of physical education in universities(Zhong et al., 2023).

4.3 Example Application of Association Rule Algorithm

4.3.1 Algorithm Application

In the study of the physical fitness analysis of college students under the health promotion teaching mode, the effective indicators were determined above all, and then the study sample was determined by random way, and analyzed through the database, and the database D was defined after data screening. The object database D contains 8 objects and is sorted according to the dictionary order, as shown in Table 5.

Table 5: Transaction Database D

TID	ITEMS
T1	I1, I2, I4, I5
T1	I1, I2
T1	I2, I4, I5
T1	I2, I3, I4, I5
T1	I1, I4
T1	I1, I2, I5
T1	I1, I3
T1	I1, I2, I3, I4, I5

Apriori algorithm implementation process: ① If the preset minimum support count is 4, the minimum support is 50%. By scanning all items in the transaction D, a single item set C1 is obtained, and a frequent single item set L1 is generated by screening with the preset minimum support count as the standard. Secondly, the frequent single set L1 is connected to generate a binomial set C2, and the frequent binomial set L2 is also generated by screening through the preset minimum support count. Thirdly, the frequent binomial set L2 is connected to generate binomial set C3, and the frequent binomial set L3 is generated by pruning. After the analysis of the sports physical fitness of college students, the cost control subset of this research sample is obtained. Finally, after the data is analyzed through the association rules, and the set calculation results are obtained in the table 6 as follows.

Table 6: Confidence Calculation Results of Association Rules

ITEM SET ASSOCIATION	CONFIDENCE (CONFIDENCE)
$\mathbf{I_2 \cap I_2 \rightarrow I_5}$	1
$\mathbf{I_2 \cap 5 \rightarrow I_4}$	0.8
$\mathbf{I_4 \cap I_5 \rightarrow I_2}$	1
$\mathbf{I_2 \cap I_4 \rightarrow I_5}$	0.67
$\mathbf{I_4 \cap I_2 \rightarrow I_5}$	0.8
$\mathbf{I_5 \cap I_2 \rightarrow I_4}$	0.8

Get association rules I2, I4 → I5 and I4, I5 → I2. Apriori algorithm can

filter the number of instances according to the support degree, while the confidence degree is the proportion of instances generated by the data results. Usually, 100% confidence is not preset for filtering, but is set to the minimum as much as possible, so as to find the maximum support when the confidence is the minimum.

4.3.2 Result Analysis

Based on Weka data mining platform, Apriori algorithm is used and its parameters (minimum support, minimum confidence, number of generated rules, etc.) are constantly changed to achieve the effect of data mining. The three best association rules found by running results are shown in Table 7.

Table 7: Confidence Degree of Association Rules of College Students' Sports Physical Fitness

RULES	THE PRECEDING ITEM (CONDITIONAL ITEM)	LAST ITEM (RESULT ITEM)	DEGREE OF SUPPORT	CONFIDENCE	LIFTING DEGREE
1	XF = Not up to standard NL = Not up to standard RR = Non-compliance	FP = = Not up to standard	0.08	0.99	1.17
2	FP = Not up to standard XF = Not up to standard	RR = Non-compliance	0.15	0.97	1.16
3	LL== Not up to standard NL = Not up to standard	XF = Not up to standard	0.12	0.89	1.12

From the strong association rules output above, we can see that: Students whose cardiopulmonary function, muscle endurance and softness are not up to standard are likely to be obese at the same time; Students with substandard obesity and cardiopulmonary function are likely to have substandard softness; Muscle and endurance and the standard values, found that there is a gap between the two, which affects the physical fitness of college students. It is of great significance to the prevention and guidance of students' physical health by mining the potential connection between sports health items of college students through association algorithm.

5. Conclusion

By collecting and sorting the application of computer technology in between enterprises and education results can see, at present the technology has been involved in a field, but the analysis of health data is indeed, this is because our country pay more attention to students in education, and the lack of attention to students' physical quality, so this lesson is to make up for this a research content, the theory and practice camera and, through the health promotion teaching mode of college students sports fitness analysis to data

evaluation. The research in this paper is based on data mining, talking about college students as a research object, through the operation of data, the analysis content is as follows. The research content of this topic combines the decision tree and the association rules to analyze the sports physical fitness of college students in the promotion of teaching mode. Secondly, this paper mainly selects the physical fitness test data and self-assessment data of freshmen of Grade 2021 in a university as the research object. Data preprocessing operation was carried out on the two data, and five physical health factors were obtained from the physical fitness test data; Four behavioral characteristic factors were obtained from the self-assessment data of physical fitness. Using decision tree C4.5 algorithm, a decision tree model about "cardiopulmonary function" is constructed, and the classification law of students' physical health is obtained; The Apriori algorithm, a prominent method in association rule learning, is deployed to uncover the five key factors within physical fitness test data. Through this process, the latent correlations among these five characteristics are revealed. This study provides a scientific basis for teachers to guide students with different physical characteristics. To sum up, the article for health promotion teaching mode of college students 'sports physical analysis through the computer algorithm, the content of the research for college students' physical level, due to the current research results are relatively few, in the subsequent research, need to enrich data sources to improve the accuracy of the research results, can even through the construction model or scale to improve the depth and breadth of research, this is also the subsequent research direction of this paper.

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