

Article

Quantitative Evaluation and Prediction Analysis of the Healthy and Sustainable Development of China's Sports Industry

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Abstract: In this paper, to explore the current situation and future trend of the healthy development of China's sports industry, the health evaluation index system of the sports industry was established by deconstructing the health dimension of the sports industry. The health evaluation model of the sports industry was constructed by using the entropy method and the multi-objective linear weighting method. The model was used to empirically analyze the characteristics and laws of the health of China's sports industry from 2008 to 2017 and predict the health status of China's sports industry in the next 10 years with the combination with the GM (1.1) model. The results show that the potential health degree of China's sports industry exhibits a fluctuating growth trend, the actual health degree of the sports industry, and the health degree of the supporting environment in the sports industry show a steady growth trend on the whole. In the next 10 years, the health degree of China's sports industry will maintain a healthy state in which the actual health degree and potential health degree of the sports industry will enter a healthy state in 2021 and 2024, respectively. In contrast, the health degree of the supporting environment in the sports industry is always in a very unhealthy state.

Keywords: sports industry; health degree; evaluation; prediction analysis

1. Introduction

China's sports industry has made great progress since China's reform and opening up in 1979. The report of the 19th National Congress of the Communist Party of China pointed out that "extensive nationwide fitness activities should be carried out to accelerate the construction of a strong sports country". Therefore, comprehensive fitness has become China's national strategy. Expanding and strengthening the sports industry is an important measure to speed up the construction of a strong sports country, promote high-quality economic development, and realize people's yearning for a better life. In recent years, China has begun to attach great importance to the healthy and sustainable development of the sports industry. In October 2014, the Chinese government issued several opinions on accelerating the development of sports industry and promoting sports consumption, which include promoting the healthy development of characteristic sports, accelerating the integration of fitness and leisure and related industries, and optimizing the structure and layout of fitness and leisure industry [1]. In October 2016, the Chinese government issued the outline of "Healthy China 2030" plan, which puts forward promoting the construction of a healthy China, integrating health into all policies, further optimizing the market environment of the sports industry, cultivating multiple subjects, and actively developing the fitness and leisure industry [2]. In 2018, the China Sports Industry Development Conference elaborated on the existing problems and future development direction of China's sports industry and gave guidance on how to develop ice and snow industry in a more orderly

and healthy way, comprehensively boosting the construction of sports power. Therefore, the timely diagnosis of the problems and shortcomings in China's sports industry and the scientific evaluation of the healthy development level of the sports industry can help to predict the development trend of the sports industry and grasp the development characteristics of the sports industry so as to formulate reasonable measures for the high-quality development of the sports industry and help build a healthy China and a strong sports country.

Health degree is the representation of human health and a quantitative index to measure the health degree of the human body. Leopole [3] and Woodwell [4] introduced health degree into natural ecosystems, mainly on the basis of quantitative evaluation and analysis of islands, water bodies, wetlands, deserts, and plants, based on mathematical models including quality index method, fuzzy mathematics method, and cluster analysis method, so as to improve the diversity and balance of the development of natural ecosystems. With people's continuous acceptance and cognition of the concept of sustainable development, the application of health has begun to change, from the original application of the pure natural ecosystem to the natural social composite system. Many scholars use set pair analysis [5], Pressure-State-Response (PSR) model [6] and emergy evaluation [7] to analyze the health status of agriculture and urban ecosystem from the aspects of vitality, ecological potential, living state, and vitality, so as to promote the coordination of human land relationship. In the 21st century, the academic community began to pay close attention to the research of pure social system health and the literature about health is not limited to the natural social composite system and pure natural ecosystem. For example, based on the analysis of the connotation and composition of the growth health of enterprises, Lou [8] established the evaluation index system and evaluation model of the growth health of innovative enterprises and conducted empirical research. Xie [9], Li [10], and Wang [11] conducted research on market health, information system health, brand health, etc.

In recent years, scholars have begun to pay attention to the health of industries, but there are few related studies, mainly focusing on the financial industry, real estate industry, and health industry [12–14]. With regard to the healthy development of sports industry, Shen [15] proposed realizing the healthy and sustainable development of sports industry, which should be guided by the five new development concepts of “innovation, coordination, green, opening and sharing” proposed by the Fifth Plenary Session of the 18th CPC Central Committee, and promoting the supply-side structural reform of the sports industry. Shen [16] believed that China's sports industry ushered in a golden development period, and the supply-side reform of the sports industry in the context of the new normal economy is an objective need to ensure the healthy and sustainable development of sports industry. Liu [17] analyzed the deep mechanism, construction mode, and influencing factors of the deep integration of the health industry and the sports industry. These documents have important theoretical reference value for the healthy development of China's sports industry, while the quantitative research on the health evaluation of the sports industry has not been carried out.

There are some relevant research focuses on the sustainable development of the sports industry and the competitiveness of the sports industry. For example, Lindsey [18] studied the relevance of the sustainable development goals across diverse sectors of the sport industry and illustrated complexities within and across countries that make pursuit of comprehensive policy coherence infeasible. Zhao [19] studied the optimization strategy of the ice and snow sports industry for sustainable development. Li [20] adopted the method of systematic analysis and qualitative analysis, applied the mixed-method paradigm of correlation analysis, prediction analysis and grounded theoretical analysis, and explored the dynamic model of ski industry chain correlation and prediction effect and sustainable development of ski industry. Ren [21] constructed the evaluation index system of sports industry competitiveness and conducted factor analysis on the competitiveness of China's sports industry from 1996 to 2013. Sun [22] used matter-element model to build a two-dimensional evaluation system of sustainable competitiveness of the provincial sports industry composed of “development degree sustainability” to comprehensively measure the competitiveness level of China's Provincial Sports Industry.

Although much progress has been made, there is little research on the sustainable development of the sports industry from the perspective of the health degree of the sports industry. Additionally, the sports industry is regarded as a strategic pillar industry in China [23], and the sustainable development of the sports industry has an important role on the construction of ecological civilization, while the research on the health degree of China's sports industry has not been carried out yet, and the evolution characteristics and laws of the healthy development of China's sports industry are still not clear. Therefore, it is essential to analyze the current situation and prospects of the healthy and sustainable development of China's sports industry.

In this paper, to explore the current situation and future trend of the healthy development of China's sports industry, the health evaluation index system of the sports industry was established by deconstructing the health dimension of the sports industry. The health evaluation model of the sports industry was constructed by using the entropy method and the multi-objective linear weighting method. The model was used to empirically analyze the characteristics and laws of the health of China's sports industry from 2008 to 2017 and predict the health status of China's sports industry in the next 10 years with the combination with the grey model (1.1), i.e. GM(1.1) model. On the basis of deconstructing the health dimension of China's sports industry, this paper intends to build the health evaluation index system of sports industry, use a multi-dimensional evaluation model to analyze the health of China's sports industry in 2008–2017, and predict and analyze the health status of China's sports industry in the next 10 years, in order to provide reference for China and other countries' sports industry to improve quality, increase efficiency and transform development.

2. Basic Concept and Rationale

2.1. Basic Concept

2.1.1. Sports Industry

The sports industry is emerging in the modern human economy in the form of a new industrial economy [24,25]. Combining the connotation and extension of sports industry, it can be understood mainly in a broad sense and in a narrow sense. In a broad sense, the sports industry is the sum of all industries that produce sports material products and spiritual products and provide sports services, including sports service industry, as well as sports goods manufacturing, sales, sports buildings, and other industries. In a narrow sense, the sports industry is the sports service industry, a collection of enterprises that produce and provide sports services or service products. Referring to the statistical classification of sports industry (2019) jointly developed by the General Administration of sport of China and the National Bureau of statistics, the sports industry can be defined as “a collection of production activities that provide various sports products (goods and services) and sports related products for the society”, which is identified and adopted in this paper.

2.1.2. Health of Sports Industry

Health is an abstract concept which is often used to describe the efficiency state and balance state of a human body or ecosystem. The meaning of modern health is diverse and extensive. It can be said that it is the result of the interaction of many factors. In the judgment of health, it can be perceived, and at the same time, it is also a dynamic state with timeliness. That is to say, present health does not represent future continuous health, so it can be said that health is a relative concept. With the extension of the concept of health, the word “health” is widely used in other fields, and the healthy development of industrial health and sports industry is derived from it. For example, Woodwell [5] firstly elaborated the connotation of ecosystem health and believed that ecosystem health refers to the ecosystem with complexity, balance, and stability; that is, there is no disease and larger development space. Schaeffer [6] pointed out that when the ecosystem organization is weakened and damaged, being in a disease state means that the ecosystem is unhealthy. If the ecosystem is not in a disease

state, it means that the ecosystem is healthy. According to Hu [26], the health of the urban ecosystem includes natural environment, living environment, urban economy and culture, urban population, etc. Zhao [27] believes that healthy ecological community is a multidimensional urban human settlements ecosystem that integrates health goals with ecological concepts, and ultimately realizes the harmonious coexistence of people, communities, and even the environment. Zhang [28] believed that ecotourism industry health refers to the coordinated development with economy, society, and culture on the basis of sustainable development of ecotourism. It is found that although there is no unified definition of ecosystem health, it can be summarized into two aspects: first, system health should show the ability of self-recovery and regulation and have the sustainability and stability of the system; second, system health usually involves the integration of social, economic, ecological, and cultural aspects analysis, not just one aspect of the system. The sports industry is a complex system which is highly integrated with the social environment; thus, the health of the sports industry in this paper is used to describe the development of the sports industry system. This paper holds that if the sports industry can form a state of integration, stability, efficiency, sustainability, strong vitality, and competitiveness with the help of diversified resources integration on the basis of orderly and stable development of its internal structure, then the sports industry is in a healthy state.

2.2. Basic Rationale

2.2.1. System Theory

System theory regards the object of study as a system and holds that system and elements, and elements and elements, interact and are interrelated. The purpose of the research system is to adjust the system structure, coordinate the relationship between various elements, and make the system reach the optimization goal [29]. According to the relevant theory of system science, the sports industry can be regarded as a complex system. This paper analyzes the composition and interrelationship of several subsystems such as the development scale, development speed, development effect, and development mode of the sports industry, finds out the mechanism and development law of the interaction of various elements of the sports industry, and provides support for the healthy development of the sports industry.

2.2.2. Life Cycle Theory

According to the theory of industry life cycle, industry generally experiences four periods: forming period, growing period, mature period, and declining period [30,31]. Different industries have different time periods. As a new industry, the sports industry also has its own life cycle. Taking corresponding measures in each corresponding period can ensure the healthy development of the sports industry.

2.2.3. Sustainable Development Theory

The theory of sustainable development mainly studies how to meet the needs of contemporary people without harming future generations. The connotation of sustainable development theory includes two aspects: sustainability and development [32]. Sustainable development is not extensive development but focuses on quality and efficiency. The theory of sustainable development has not been put forward for a long time, but it has a profound impact. More and more people study it from the perspectives of ecology, society, and economy. Similarly, the growth of the sports industry in the new era is no longer a “regular pattern” growth, but an “intensive” growth gradually focusing on quality and efficiency.

Based on the above rationale and definition of sports industry health, this paper generalizes the characteristics of sports industry health into four aspects: (1) The stability of sports industry. The overall scale of sports industry growth, orderly and stable development, the continuous optimization of industrial structure, and no maladjusted symptoms. (2) The coordination of sports industry. The continuous enhancement of sports industry effect, the maintenance of medium- and high-speed

annual average growth rate, the formation of intensive development mode, the development of sports industry in the direction of benign coordination, has a larger development space and potential. (3) The resilience of the sports industry, which can quickly recover and effectively respond to emergencies or adverse domestic and foreign industry environments, and has the ability to quickly get out of the trough. (4) The dependence of the sports industry. The development of the sports industry should form a high-level coupling and coordination with the social economy and ecological environment, which needs the support of related systems. Furthermore, this paper divides the sports industry health into three dimensions: actual health degree, potential health degree, and health degree of the supporting environment. The actual health degree of the sports industry is the basis of the healthy development of the sports industry, which can most intuitively reflect its health status and development status. The potential health degree of the sports industry is the basis for evaluating its development effect and potential, reflecting its current development quality and future development ability. The health degree of the supporting environment in the sports industry reflects the impact of environmental quality on its healthy development. High-quality social environment and natural environment will promote the development of the sports industry to a large extent; otherwise, it will inhibit the development of the sports industry.

3. Research Methods, Index System and Data Sources

3.1. Research Methods

3.1.1. Entropy Method

At present, the main method to determine the weight is the entropy weight method, which includes the subjective and objective weight method. In this paper, the objective weighting method of entropy weighting method is adopted, mainly considering the objectivity, correctness, and scientificity of the evaluation results. The weight process of the entropy weight method is reproducible and transparent, with high reliability, and can avoid human interference. The equations are as follows:

$$Y_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}, \quad (1)$$

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^n X_{ij}}, \quad (2)$$

$$e_j = -K \sum_{i=1}^n P_{ij} \ln P_{ij}, K, k = \frac{1}{\ln(n)}, \quad (3)$$

$$d_j = 1 - e'_j, \quad (4)$$

$$W_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (5)$$

where indexes and years are represented by j and i , respectively, which are from 1 to n ; X_{ij} indicates the value of j index in i year; P_{ij} indicates the proportion of X_{ij} index; e_j is the entropy value of j item; d_j is the difference coefficient of j item; W_j is the index weight.

First of all, the original data are standardized by Equation (1) and the proportion of j item of i year in j index by Equation (2). Secondly, the entropy value and difference coefficient of j item index are calculated by Equation (3) and Equation (4). Finally, the information weight of the j index (W_j) is calculated by Equation (5).

3.1.2. Health Degree Evaluation Model

In order to make the health degree of sports industry more scientific, this paper uses a multi-objective linear weighting method, that is, a comprehensive analysis method, to calculate the health degree of the sports industry. The equations are as follows:

$$Q_k = I_k \times R_k, \quad (6)$$

$$Y = \sum_{h=1}^P \left\{ \sum_{i=1}^m \left[\sum_{j=1}^n \left(\sum_{k=1}^I I_k \times R_k \right) U_j \right] w_i \right\} V_h \times 10 \quad (7)$$

where R_k , I_k , and Q_k represent the weight, standardized value, and health degree of each index, respectively; V_h represents the comprehensive weight of the three dimensions of the actual health degree of the sports industry, the potential health degree of the sports industry and the supporting environment health degree of the sports industry; w_i represents the weight of three dimensions; U_j is the comprehensive weight of an index at the upper level; Y is the comprehensive health degree of the sports industry or the health degree of a certain level. The evaluation value of each index of the sports industry can be calculated by Equation (6), and then the comprehensive health degree and different levels of health degree of the sports industry can be calculated by Equation (7). In addition, in order to make the health level of China's sports industry more scientific for evaluation and measurement, according to the actual situation of the sports industry and the practice of scholars [33,34], the health level of the sports industry is divided by the order of evaluation score from inferior to excellent, from low to high, and the classification standard is shown in Table 1.

Table 1. Classification standard of health degree of the sports industry.

Serial Number	Health Degree of Sports Industry (H)	Classification	Grade
1	$H < 0.3$	Level 5	Extremely unhealthy
2	$0.3 \leq H < 0.5$	Level 4	Unhealthy
3	$0.5 \leq H < 0.7$	Level 3	Sub-health
4	$0.7 \leq H < 0.8$	Level 2	Healthier
5	$0.8 \leq H$	Level 1	Healthy

3.1.3. Prediction Model of Health Degree

According to the characteristics of grey prediction objects [35,36], the types of health prediction methods can be divided into system-comprehensive prediction, topology prediction, sequence prediction, seasonal disaster prediction, disaster prediction, etc. In this work, the sequence prediction method is used to predict the development and change of an index quantitatively, and the specific value of the index in the future is its forecast result. The equations are as follows:

$$\frac{dX_1}{dt} + aX_1 = \mu, \quad (8)$$

$$x_1^T \overline{X_1}(k+1) = \left[x_n(1) - \frac{u}{a} \right] e^{-ak} + \frac{u}{a} \quad k = 1, 2, 3, \dots, n \quad (9)$$

Equation (8) is the GM (1,1) model differential equation, where μ is the endogenous control grey number and a is the development grey number. Equation (9) is a prediction model obtained by solving differential equations, where u is grey action. The specific calculation steps are as follows: (1) Set n observation values of original time series $X = \{\chi(1), \chi(2) \dots \chi(n)\}$ and a new series $X_1 = \{\chi_1(1), \chi_1(2) \dots \chi_1(n)\}$ can be obtained by accumulating the original series; (2) the parameter vector to be estimated is set as $\beta (\beta = [a/u])$, and the least square method is used to get $\beta = (B^T B - 1) B^T Y_n$; (3) according to the grey prediction accuracy test grade standard in Table 2, the accuracy of the grey prediction formula is tested. If both small error probability (P) and mean

square deviation ratio (C) are in the allowable range, the predicted value of this index can be calculated. Otherwise, the residual sequence should be analyzed and the formula should be revised.

Table 2. Evaluation standard of model accuracy grade.

Accuracy grade	Small Error Probability (P)	Mean Square Deviation Ratio (C)
Good	>0.95	<0.35
Qualified	>0.80	<0.50
Barely qualified	>0.70	<0.65
unqualified	≥0.70	≤0.65

3.2. Index System and Data Source

Based on the principles of operability, hierarchy, systematization, and scientificity of index system construction, referring to the index system of existing research results [20–22,37], combined with the dimension deconstruction of sports industry health, this paper constructs the health index system of the sports industry, which includes 20 specific indexes and three subsystems: the actual health degree, the potential health, and the health degree of the supporting environment in sports industry.

The actual health degree of the sports industry includes three levels: sports industry scale, sports trade, and sports industry structure. The health degree of sports industry scale includes the added value of the sports industry and the number of sports venues. The health degree of sports trade involves the number of legal entities in the sports industry, the sales volume of sports lottery, and other relevant indexes. The health degree of sports industry structure is mainly reflected by the proportion of added value of the sports industry in GDP and the proportion of sports lottery sales in total lottery sales. The relevant data are shown in Table 3.

Table 3. Evaluation of the actual health degree of the sports industry.

Health Degree Index of the Sports Industry	Specific Index	Weight
Health degree of sports industry scale	Added value of the sports industry	0.103629
	Number of sports venues	0.075516
Health degree of sports trade	Number of legal entities in the sports industry	0.120530
	Sales volume of sports lottery	0.102735
Health degree of sports industry structure	Proportion of added value of the sports industry in GDP	0.032919
	Proportion of sports lottery sales in total lottery sales	0.002490

The potential health degree of the sports industry includes four levels: production factor, effect, speed, and model. The health degree of production factor in the sports industry is measured by the number of employees in sports system institutions and the fixed asset investment in the sports industry. The health degree of the sports industry effect is reflected by the proportion of the added value of the sports industry in the added value of the tertiary industry and the proportion of the number of employees of sports system institutions in the total number of employees. The health degree of the sports industry speed can be evaluated by the growth rate of added value of the sports industry and the growth rate of the number of legal entities in the sports industry. The health degree of sports industry model is measured by the ratio of the added value of sports industry to the fixed asset investment of the sports industry, and the ratio of the added value of the sports industry to the number of employees in sports system institutions. The relevant data are shown in Table 4.

The health degree of the supporting environment in the sports industry is composed of the social-economic environment and the natural ecological environment. The health degree of the social-economic environment is reflected by the indexes such as GDP, per capita disposable income of urban residents, and urbanization rate. The health degree of the natural ecological environment is measured by the green coverage rate of the built-up area, the harmless treatment rate of urban garbage, and the treatment rate of urban sewage. The relevant data are shown in Table 5.

Table 4. Evaluation of the potential health degree of the sports industry.

Health Degree Index of Sports Industry	Specific Index	Weight
Health degree of production factor	Number of employees in sports system institutions	0.000655
	Fixed asset investment	0.107287
Health degree of sports industry effect	Proportion of the added value of the sports industry in the tertiary industry	0.018040
	Proportion of the number of employees of sports system institutions	0.000968
Health degree of sports industry speed	Growth rate of added value of the sports industry	0.041990
	Growth rate of the number of legal entities	0.146967
Health degree of sports industry model	Ratio of the added value of the sports industry to the fixed asset investment	0.020953
	Ratio of the added value of the sports industry in sports system institutions	0.108748

Table 5. Evaluation of the health degree of the supporting environment in the sports industry.

Health Degree Index of the Sports Industry	Specific Index	Weight
Heath degree of social economic environment	Total GDP	0.050185
	Per capita disposable income of urban residents	0.043495
	Urbanization rate	0.003981
Health degree of natural ecological environment	Green coverage of built-up area	0.000602
	Harmless treatment rate of urban waste	0.011654
	Urban sewage treatment rate	0.006655

In view of the fact that the statistical data of China's sports industry were relatively unified after the promulgation of the classification of sports and related industries (Trial) in 2008, and following the availability, systematization, and accuracy required by the sample data, this paper adopts the panel data of China's sports industry for 10 years from 2008 to 2017. The data of each index mainly come from China Statistical Yearbook, China tertiary industry statistical yearbook, China National Economic and social development statistical bulletin, China Environmental Statistical Yearbook, the website of China Statistics Bureau, the website of China Ministry of finance, the website of China General Administration of sports, etc.

So far, the evaluation of the health degree of China's sports industry has not been studied, and the evolution characteristics and laws of the healthy development of China's sports industry are still not clear. Therefore, it is very important to carry out relevant research. Based on the above research methods, index system and data sources, this paper tries to analyze the change characteristics of the health degree of China's sports industry in 2008–2017 and then forecasts and analyzes the health degree of China's sports industry in the next 10 years, so as to provide reference for China and other countries to improve the quality and efficiency of the sports industry in the future.

4. Results and Discussions

This paper analyzes the actual health degree, potential health degree, and supporting environment health degree of the sports industry, and then makes a comprehensive evaluation of the health degree of the sports industry. Based on GM (1,1) prediction model, we calculate the health degree prediction value of the sports industry in the 10 years before 2018–2027 and analyze the results. At the same time, the results of the study are compared with other existing studies, and the possible limitations and future research directions of the study are described.

4.1. Analysis of Actual Health Degree of Sports Industry

The actual health degree of the sports industry is an important index to measure the stable and sustainable development of the sports industry, which can simply reflect its past and current development. Figure 1 shows the curves of the actual health degree of China's sports industry in

2008–2017. As can be seen from Figure 1, the actual health degree of the sports industry shows a steady growth trend on the whole, which means that the development of China's sports industry is in good condition. The health degree of sports industry scale has been at a high level from 2008 to 2013, and it has maintained steady growth since 2014. It is closely related to the development goal that the total scale of the sports industry will exceed RMB 500 billion by 2025, which is proposed in the opinions on accelerating the development of the sports industry and promoting sports consumption issued by the Chinese government in 2014. The health degree of sports trade shows a strong growth state. By 2014, surpassed the scale health degree and was ranked first, mainly due to the rapid growth of the number of legal entities in China's sports industry and sports lottery sales. However, the health degree of sports industry structure has been growing slowly in the low position in the past 10 years, which also proves that the proportion of sports service industry in China is not high and that the structure of the sports industry is unbalanced. This result is consistent with the report by Ren [38], which reveals that the current situation of China's sports industrial structure is that the output value structure and supply structure are unreasonable. In summary, the actual health degree of China's sports industry is rising steadily. The health degree of the sports industry trade has surpassed the health degree of sports industry scale, ranking first, the health degree of sports industry scale is second, and the contribution of the health degree of sports industry structure is the lowest.

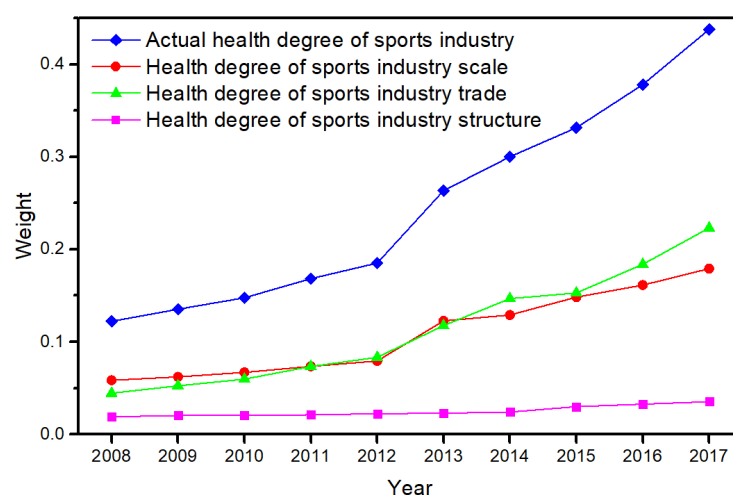


Figure 1. The curves of actual health degree of China's sports industry in 2008–2017.

4.2. Analysis of Potential Health Degree of Sports Industry

The potential health degree of the sports industry refers to a potential ability produced in the process of industrial development, which can support and guarantee the future development of the industry. Therefore, when measuring and evaluating the healthy development of the sports industry, it is necessary to analyze its potential health degree. Figure 2 shows the curves of the potential health degree of China's sports industry in 2008–2017. As can be seen from Figure 2, the potential health degree of China's sports industry shows a fluctuating growth trend. It fell into a low in 2010, peaked in 2013, and accelerated significantly after 2014. Therefore, we believed that the development of China's sports industry is not stable, but the ability to regulate and self-repair is relatively strong. For example, China's sports industry began to decline under the influence of Beijing's "Post Olympic Valley Effect" and the financial crisis in 2008. However, after the Chinese government issued the "opinions on accelerating the development of sports industry and promoting sports consumption" and other documents, and more and more capital flowed into the sports industry, China's sports industry quickly emerged from the crisis and showed strong development. This is in accordance with Zheng's point of view that as China enters the post-Olympic era, with the improvement of the living standards of urban residents and the increasing awareness of participating in leisure sports activities, the strong

support of the government and the further implementation of the national fitness strategy, the trend of sports industrialization is becoming stronger and stronger [39]. This also proves that China's sports industry should establish the internal mechanism of stable growth from the practical aspect in order to prevent the sports industry from developing a large range of ups and downs from high to low. In addition, the health degree of the sports industry speed has changed greatly, and its contribution to the potential health degree of the sports industry has dropped from first place in 2008 and 2013 to third place. After 2014, the health degree of the sports industry model ranked first. The health degree of production factors of the sports industry has also risen from third place in 2008 to second place, while the contribution value of the health degree of sports industry effect is the lowest, which has been in the last place and slowly improved.

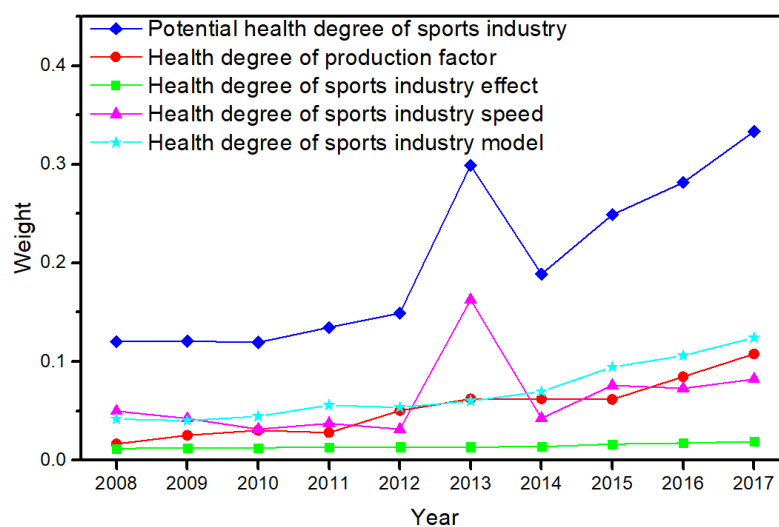


Figure 2. The curves of potential health degree of China's sports industry in 2008–2017.

4.3. Analysis of the Health Degree of the Supporting Environment in Sports Industry

In the development of the sports industry, the external environment plays an important role. With the emergence of the concept of national fitness and the layout of regional sports industry, the quality of resources and environment has become a key factor to attract the masses to participate in fitness and accelerate the development of regional sports industry. Therefore, the key factors to evaluate the health of Chinese sports industry should include the social-economic environment and the natural ecological environment. Figure 3 shows the curves of the health degree of the supporting environment in the sports industry. It can be seen that the health degree of the supporting environment in the sports industry is steadily increasing. This is consistent with the literature report [40] which believes that the overall supporting conditions for the development of China's sports industry are showing a good trend, and the supporting conditions for the development of the sports industry continue to improve. This means the social economy and natural ecological environment supporting the development of China's sports industry are continuously improving. Among them, the growth trend of the health degree of the social-economic environment is also obvious from 2008 to 2017, mainly due to the continuous improvement of the quality of life of Chinese residents, the continuous promotion of new urbanization construction, and the continuous operation of the economy in a reasonable range. Although the health degree of the natural ecological environment has been improved slowly, it has also maintained growth, which is related to China's implementation of the scientific outlook on development, adherence to the "five overall plans", promotion of the harmonious development of people and nature, implementation of the "healthy China 2030" plan, integration of health into all policies, and promotion of the construction of a healthy China. In addition, the evaluation value of the natural ecological environment is always lower than that of the social-economic environment, which shows that China's social and economic development has been ahead of the construction of the natural

ecological environment, and can provide material support and financial guarantee to optimize the natural ecological environment.

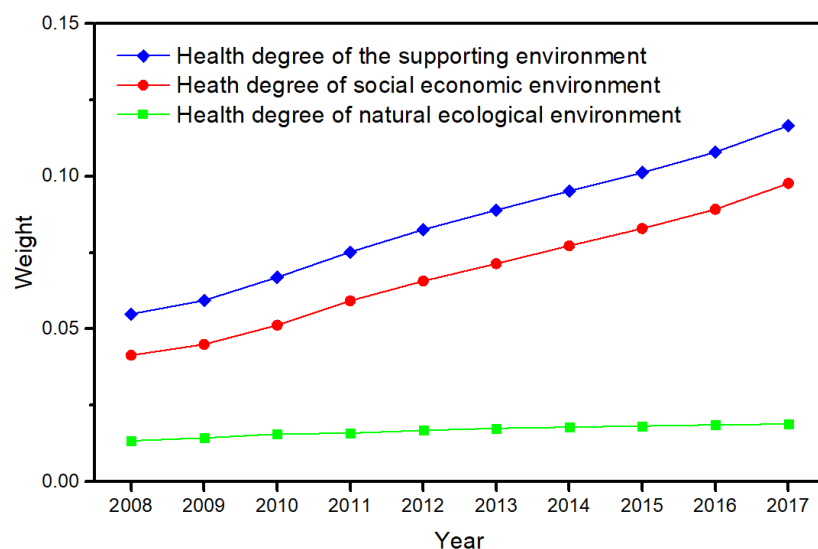


Figure 3. The curves of the health degree of the supporting environment in the sports industry in 2008–2017.

4.4. Comprehensive Evaluation of Health Degree of Sports Industry

The health degree of the sports industry is an important index to evaluate whether its development is healthy. Its evaluation dimensions include the actual health degree of the sports industry, its potential health degree, and the health degree of supporting environment in the sports industry. Therefore, in the comprehensive evaluation of the sports industry health, we should comprehensively analyze the three evaluation systems of sports industry health. Figure 4 shows the curves of the health degree of China's sports industry. It can be seen from that the health degree of China's sports industry shows a rising trend of fluctuation and a rising–falling–rising trend from 2013 to 2015, which shows that when China's sports industry is confronted with development difficulties due to the great impact of external environment, it can recover rapidly in a short time after macro-control by the government, showing a greater development flexibility. In the three evaluation systems, the first contribution value is the actual health degree of the sports industry. In addition to surpassing the actual health degree in 2013, the potential health degree of the sports industry is lower than the actual health degree of sports in other years, ranking the second on the whole. This indicates that although the potential of China's sports industry has been released and the space is huge, the industrial development is still in the investment stage, which cannot be separated from the strong promotion of national top-level policy. The health degree of the supporting environment in the sports industry is the last place in the slow growth, and its contribution to the health of the sports industry is also increasing, which indicates that the healthy development of the sports industry is more and more affected by the supporting environment. Based on the comprehensive evaluation value of health degree of the sports industry in 2008–2017 and the classification standard of its health degree in Table 1, the following evaluation results are obtained: (1) the measurement value of health degree of the Chinese sports industry is between 0.29761–0.417022 from 2008–2012, indicating that the development of sports industry is in a very unhealthy and unhealthy state. This is closely related to the “Post-Olympic low effect” of Beijing in 2008 and the impact of the financial crisis and other events. (2) The health degree of the sports industry is between 0.583945–0.681584 in 2013–2015, which indicates that the development of the sports industry is still in a sub-health state, but it has been greatly improved compared with 2008–2012. The main reason is that the important policy documents issued by China and the joint efforts of all sectors of society at this stage, the sports industry presents a good development trend.

(3) In 2016 and 2017, the measurement values of the health degree of China's sports industry were 0.767406 and 0.887736 respectively, indicating that the sports industry entered a relatively healthy state in 2016 and reached a healthy state in 2017. This is closely related to the promulgation and implementation of China's national fitness plan (2016–2020), outline of “healthy China 2030”, guiding opinions on accelerating the development of the fitness and leisure industry, and guiding opinions on vigorously developing sports tourism and other documents. Driven by the policy dividend, the sports industry has become an investment outlet, laying a foundation for promoting the healthy and rapid development of China's sports industry.

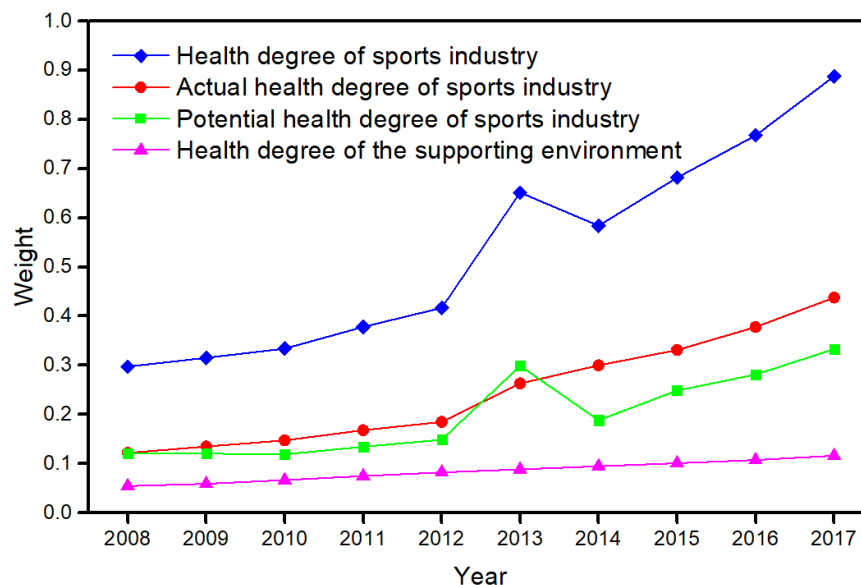


Figure 4. The curves of the health degree of China's sports industry in 2008–2017.

4.5. Prediction and Analysis of Sports Industry

Based on the GM (1,1) prediction model, this paper selects the health degree of China's sports industry in 2008–2017, three evaluation systems and measurement values of each level as the analysis data, and calculates the health degree prediction value of China's sports industry in the next 10 years (2018–2027). The results are listed in Table 6. It can be seen that in the next 10 years, the health degree of China's sports industry will continue to be at the state of 2017, which has been maintained at a health stage of more than 0.8. Among them, the actual health degree of the sports industry will enter a healthier state in 2020, reach a healthy state in 2021 and above 0.8, and maintain a steady growth trend. This is in line with the 13th five-year plan for sports development issued and implemented by the General Administration of sports of China in 2016. It is proposed that by 2020, the scale and quality of sports industry will be continuously improved, and the level of sports consumption will be significantly improved, so as to promote the comprehensive, coordinated, and sustainable development of sports. The potential health degree of the sports industry will enter a healthy state in 2023, reach 0.8 or above in 2024, and maintain a steady growth trend. This is in line with the plan outline of “healthy China 2030” issued by the Chinese government in 2016, which proposes to integrate health into all policies. By 2030, the development in the field of health will be more coordinated, and the main health indexes will enter the ranks of high-income countries with the same goal. However, compared with the previous 10 years, the health degree of supporting environment in sports industry has been improved by a relatively high margin, but it has always been in a very unhealthy state below 0.3, which is worthy of further consideration.

Table 6. Prediction of healthy development of China's sports industry in 2018–2027.

Predicted Index	Year									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CCHD ¹	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy
AHD ²	0.517407	0.602347	0.701231	0.816348	0.950364	1.106379	1.288007	1.499452	1.745609	2.032176
HDS ³	0.21468	0.246735	0.283577	0.32592	0.374586	0.430518	0.494801	0.568683	0.653597	0.751191
HDST ⁴	0.268823	0.321432	0.384338	0.459554	0.54949	0.657027	0.785609	0.939355	1.123189	1.343001
HDSIS ⁵	0.037108	0.040162	0.043468	0.047045	0.050917	0.055108	0.059644	0.064553	0.069866	0.075617
PHD ⁶	0.375284	0.426515	0.48474	0.550913	0.626119	0.711592	0.808733	0.919135	1.044609	1.187211
HDPF ⁷	0.122386	0.145434	0.172821	0.205365	0.244039	0.289995	0.344605	0.409499	0.486614	0.57825
EHD ⁸	0.019131	0.020197	0.021322	0.022511	0.023765	0.025089	0.026487	0.027963	0.029521	0.031167
SHD ⁹	0.097039	0.105635	0.114993	0.125179	0.136268	0.148339	0.161479	0.175783	0.191355	0.208305
MHD ¹⁰	0.140464	0.163358	0.189984	0.220949	0.256962	0.298844	0.347553	0.404201	0.470082	0.546701
HDSE ¹¹	0.127578	0.137892	0.149041	0.16109	0.174114	0.188191	0.203406	0.219851	0.237626	0.256838
HDSEE ¹²	0.108053	0.118095	0.129069	0.141064	0.154173	0.168501	0.18416	0.201274	0.219979	0.240422
HDNEE ¹³	0.01999	0.02063	0.021291	0.021973	0.022677	0.023404	0.024154	0.024928	0.025727	0.026551

¹ CCHD is comprehensive comment on health degree of sports industry; ² AHD is actual health degree of sports industry; ³ HDS is health degree of sports industry scale; ⁴ HDST is health degree of sports trade; ⁵ HDSIS is health degree of sports industry structure; ⁶ PHD is potential health degree of sports industry; ⁷ HDPF is health degree of production factor; ⁸ EHD is health degree of sports industry effect; ⁹ SHD is health degree of sports industry speed; ¹⁰ MHD is health degree of sports industry model; ¹¹ HDSE is health degree of the supporting environment in sports industry; ¹² HDSEE is health degree of social-economic environment; ¹³ HDNEE is health degree of natural ecological environment.

4.6. Limitation and Prospect

The health evaluation of the sports industry is a new research topic. The related theoretical system is not perfect and needs to be tested in practice. The purpose of this paper is to establish a scientific evaluation system of sports industry health in order to promote the healthy development of the sports industry. However, due to various limitations, the research on the health assessment of the sports industry is still preliminary. This paper selects the time series data from 2008 to 2017 to make quantitative empirical analysis and evaluation on the health level of the development of China's sports industry. The time-series data fully reflect the process and trend of the development and evolution of China's sports industry, which is consistent with the results of other researchers [41]. It is noted that the development of China's sports industry shows a certain imbalance in space. Due to the spatial differences in economic development level, location conditions, and other factors of the sports industry, the regional differences are relatively obvious [42]. Therefore, if we can make a spatial analysis of the health degree of the development of China's sports industry, we can objectively present the health degree of the supporting environment of the sports industry in various provinces and cities, which are the limitations of this study and the direction of future research. In the future, it would be worth comparing the results of the research with the northern and eastern Chinese provinces.

5. Conclusions

Based on the characteristics of the sports industry, this paper defines the concept of sports industry health and summarizes its characteristics. According to the definition and characteristics of sports industry health, sports industry health is divided into three dimensions: actual health degree, potential health degree, and health degree of supportive environment. The theoretical content of health research on China's sports industry has been enriched. In addition, this paper constructs a scientific and reasonable health evaluation model of the sports industry and empirically analyzes the changes of health characteristics of the Chinese sports industry from 2008 to 2017. At the same time, it uses the GM (1,1) prediction model to predict and analyze the evolution characteristics of health of Chinese sports industry in the next 10 years and draws the following conclusions:

- (1) In the 10 years from 2008 to 2017, the health degree of China's sports industry has changed from extremely unhealthy to sub-healthy and finally reached a healthy state. However, the health degree curve of the sports industry shows an upward fluctuation, indicating that China's

sports industry has not yet established a long-term mechanism for stable development, and the industrial development is not mature.

- (2) In general, the actual health degree of the sports industry shows a steady growth trend, in which the health degree of sports industry structure is always in a low position and slowly growing, which shows that there are still problems of unbalanced structure and low proportion of sports service industry in the sports industry.
- (3) The potential health degree of the sports industry shows a fluctuating growth trend, among which the contribution value of the health degree of sports industry effect is the lowest. It indicates that the development of China's sports industry is not stable, but the abilities of regulation and self-repair are strong.
- (4) The health degree of the supporting environment in sports industry is increasing steadily, and the evaluation value of the natural ecological environment is always lower than that of the social-economic environment, which indicates that China's social-economic development has been ahead of the construction of natural ecological environment and can provide material support and financial guarantee to optimize the natural ecological environment.
- (5) In the next 10 years, the health degree of sports industry will maintain a healthy state, in which the actual health degree of the sports industry will enter a healthy state in 2021, the potential health degree of the sports industry will enter a healthy state in 2024, and maintain a steady growth trend, which is consistent with the relevant objectives of the 13th five-year plan for sports development and the outline of the healthy China 2030 plan issued by the Chinese government. However, the health degree of supporting environment in sports industry is always in a very unhealthy state.

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