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## **Measurement and Empirical Study on High-Quality Development Index of Sports Industry - A Case Study of Shanghai, China**

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### **Abstract**

The high-quality development of China's sports industry represents a pivotal national strategy requiring systematic evaluation mechanisms. This study establishes a multidimensional indicator system through systematic literature review and Delphi expert consultation, encompassing four foundational dimensions (industrial foundation, quality, efficiency, and motive power), 11 secondary and 35 tertiary indicators. We employ a novel "dscatter degree evaluation method" to develop a dynamic evaluation model enabling temporal comparisons and spatial benchmarking. Empirical validation through longitudinal measurement (2014-2020) of Shanghai's sports industry reveals a 150.91% growth trajectory in its high-quality development index, while spatial analysis identifies distinct regional polarization patterns. Our findings demonstrate the system's capacity to transform empirical assessments into quantifiable metrics, providing an empirical framework for data-driven policy formulation in

sports-developed urban centres. The methodology offers replicable tools for monitoring industrial transformation efficiency and optimizing resource allocation strategies in emerging sports economies.

**Keywords:** sports industry development; high-quality industrial upgrading; performance indicator system; dynamic evaluation modeling; regional polarization; Delphi-expert consultation; Yangtze River Delta integration

## 1 Introduction

In September 2019, China released *the Opinions on Promoting National Fitness and Sports Consumption to Drive High-Quality Development of the Sports Industry*, which, for the first time, establishes the strategic orientation for the future high-quality development of China's sports industry at the national level. Promoting the sports industry is instrumental in facilitating high-quality development, thus positioning the industry as a pivotal component of the national economy. Promoting the sports industry to make new progress in high-quality development is not only an important way to make the sports industry become a pillar industry of the national economy but also a key link in the construction of a socialist modernized sports powerhouse, and an intrinsic requirement to satisfy the people's growing needs for a better life. Moreover, what is the connotation of the high-quality development of the sports industry? How can we ensure the orderly realization of the high-quality development of the sports industry? These issues are becoming hot topics for discussion in the sports sector. Relevant scholars have proposed that the high-quality development of the sports industry should be guided by the index, relying on the index standard and static and dynamic monitoring to test and feedback and establish an evaluation and feedback mechanism to ensure the practical realization of the goal of high-quality development of the sports industry in the new era[1,2]. Index measurement can not only help to objectively understand the dynamic development of the high-quality development of the sports industry but also be conducive to the stage-by-stage and summative results test, which can be used to optimize the new round of high-quality development further.

It is worth noting that in recent years, under the promotion of the Yangtze River Delta integration and Yangtze River Economic Belt strategy, Shanghai's sports industry has become an important growth pole for the high-quality development of China's sports industry. It is an important breakthrough that will lead to the high-quality development of the national sports industry. Its evolution trend of high-quality development of the sports industry is typical and

exemplary for exploring the future development of the sports industry in sports-developed cities. Given this, this paper takes Shanghai as an example, and based on constructing the indicator system for the high-quality development of the sports industry, scientifically constructs the evaluation model and carries out the multi-level index measurement and comprehensive evaluation of the high-quality development level of Shanghai's sports industry, to provide a reasonable yardstick and feasible reference for the sports developed cities to promote the high-quality development of sports industry.

## **2 Theoretical basis**

### **2.1 The connotation of high-quality development of the sports industry**

The "high-quality development" concept has emerged as a new expression of China's economic and social development. However, among academics, there is yet to be a unanimous consensus on its conceptualization. The extant literature on the subject has primarily explored it from the perspectives of the five development concepts<sup>[1-2]</sup>, the requirements for high-quality development<sup>[3]</sup>, and supply and demand<sup>[4-5]</sup>. Throughout the existing literature, although the current research perspectives are different, the most fundamental starting point and destination are people-centred, and the core elements are structural optimization, power transformation and efficiency enhancement, which are inspiring for the definition of the connotation of "high-quality development of sports industry". Accurately grasping the connotation is the basis for scientifically constructing a high-quality development indicator system for the sports industry. The current research perspectives on its connotation can be divided into three types: the economic development perspective. Xu Kaijuan et al.<sup>[6]</sup> proposed in their study that "the high-quality development of the sports industry refers to the organic unity of the advanced structure, optimal efficiency and maximum value of the sports industry under the guidance of the new development concept". The second is the macro, meso and micro perspective. Guo Han et al.<sup>[7]</sup> I believe that the high-quality development of the sports industry includes five dimensions: product supply, market players, industrial integration, innovation drive, and the quality of the governance system. Third is the livelihood perspective. Li Rongri<sup>[8]</sup> proposed that the evaluation structure of the high-quality development of the sports industry should include two parts: the core element (well-being) and the system element (development dynamics, industrial body, industrial structure, industrial operation, industrial layout)

Based on the above research, this study starts from the logical framework of the process

of "Subject (Element)-Goal (Value)-Behaviour (Path)-Outcome (Evaluation)" and understands the high-quality development of the sports industry refers to the dynamic and gradual qualitative change process of the development mode of the sports industry, optimizing the structure of sports industry and transforming the growth momentum of sports industry. In this process, under the guidance of the new development philosophy, the government, society, market and other central bodies, with the fundamental purpose of continuously satisfying and leading the people's growing sports demand, relying on knowledge, technology, data and other high-end innovation elements, adhering to the principle of quality first and benefit first, with the strategic goal of building a modern sports industry system, and with the organic combination of deepening the supply-side structural reform and strengthening the demand-side management as the main line of development, the quality transformation, efficiency transformation and power transformation of sports industry will be achieved.

## **2.2 Core elements of high-quality development of the sports industry**

High-quality development of the sports industry involves both "quantitative expansion" and "qualitative improvement"<sup>[9]</sup>. In this study, the former is unified as an "industrial foundation", which aims to support "quality" from the dimension of "quantity". The latter is the transformation in quality; according to the theory of "three major transformations" of high-quality development, quality transformation, efficiency transformation, and power transformation are the main ways to achieve high-quality development. To summarise the three dimensions of "industrial quality, industrial efficiency and industrial motive power" for the high-quality development of the sports industry<sup>[10]</sup>. Therefore, industrial foundation, quality, efficiency, and motive power are the core elements of high-quality development in the sports industry.

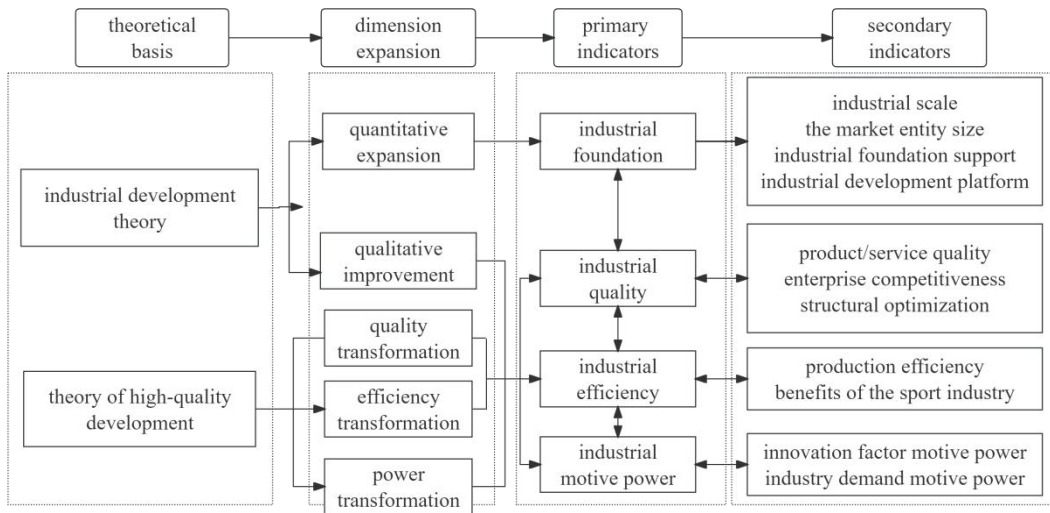
Firstly, the industrial foundation is the "key ability" that determines the quality of industrial development and industrial competitiveness and the overall quality and comprehensive strength of the sports industry<sup>[11]</sup>. Most scholars believe that appropriate scale and reasonable growth rate are the basis of high-quality development<sup>[12]</sup>. Considering the reality of the development of China's sports industry and the statistical difficulty of evaluating index data, the study focuses on the industrial foundation in the category of 'quantity' of sports industry development. It considers that the industrial scale, the market entity size, the industrial foundation support and the industrial development platform are the core of the industrial foundation.

Secondly, industrial quality is a mesoscopic concept that runs through the development

process of products, enterprises, industries and regions. It extends down to micro-product quality and enterprise quality, macro-industrial quality, and so on<sup>[13]</sup>. Therefore, the industrial quality system includes improving the quality of products and services, as commonly referred to, improving the capacity and level of enterprises, and promoting the industrial structure to move towards the middle and high end<sup>[14]</sup>.

Thirdly, industrial efficiency, which mainly examines the comparative relationship between factor inputs and outputs in the development of the sports industry, high productivity and high efficiency are the essence of high-quality growth of the sports industry<sup>[15]</sup>. China's sports industry urgently needs to improve the input and output efficiency of resources through efficiency transformation, promote the transformation of production factors from less efficient sectors to more efficient sectors, fill up all kinds of inefficiency depressions, break down all kinds of institutional and institutional barriers restricting the improvement of efficiency, and ultimately promote the enhancement of the benefits of sports industry development through the enhancement of total factor productivity<sup>[16]</sup>. Therefore, industrial efficiency is the key to the high-quality development of the sports industry and is an important manifestation of the high-quality development of the sports industry, which mainly includes two major constituent elements, namely, industrial production efficiency and benefits.

Fourthly, industrial motive power refers to various elements of force and their synthesis that can stimulate, cause and drive a particular industry's germination, development and growth<sup>[17]</sup>. Many studies have shown that in the context of China's weakening traditional power, the power in the stage of high-quality development should be transformed from the traditional factor driving force to the innovation driving force<sup>[18]</sup>. Considering the current reality of the development of China's sports industry and the statistical difficulty of evaluation index data, this study divides the industry power into two subsystems: innovation factor motive power and industry demand motive power. Innovation is the power source of high-quality development and the core of enhancing the competitiveness of the sports industry, upgrading industrial capacity and maintaining industrial vitality. Demand is the purpose and fundamental power of industry generation and the driving force for the formation and development of the sports industry.



**Fig. 1. Formation logic of high-quality development elements in the sports industry**

### 3 Research methods and data sources

#### 3.1 Research methods

##### 3.1.1 Indicator construction method: literature analysis and Delphi

Firstly, the literature analysis method. Based on the above analysis, the whole indicator system can be divided into three primary levels, high to low, which are primary indicators, secondary indicators, and tertiary indicators. Based on the connotation and core elements of the high-quality development of the sports industry, the primary and secondary indicators have been established (fig.1). The determination of tertiary indicators is mainly through the literature analysis method, reading relevant policies, planning documents and literature journals, master and doctoral dissertations, books and relevant research results in the previous period, primarily based on the collection and collation of the relevant research results on the evaluation of the sports industry in the previous period, to summarize and analyze what the indicators reflecting the high-quality development of the sports industry generally include, to form the tertiary indicator pool, and then get the preliminary Indicator system.

Second, the Delphi method. Based on the literature analysis method, the study continues to select the Delphi method to screen and determine the indicator system for the high-quality development of the sports industry. By the purpose and principles of constructing the indicator system, 16 experts in the sports industry were selected to issue the expert consultation comment form. After two rounds of Delphi research, the indicators at all levels of this indicator system were agreed upon. The final indicator system for the high-quality

development of the sports industry was determined.

**Table 1. High-Quality Development indicator system for Sports Industry**

The primary indicators	The secondary indicators	The tertiary indicators
Industrial Foundation	Industrial Scale	Total output of the sports industry
		Value added to the sports industry
		Annual growth rate of value added of the sports industry
	Market Entity Size	Number of sports enterprises
		Revenue of sports enterprises
		Profits of sports enterprises
		Number of sports organizations
	Industrial Foundation Support	Area of sports ground per capita
		Proportion of people regularly participating in physical activity
	Industrial Development Platform	Number of sports industry demonstration units
		Number of sports industry platforms built
Industrial Quality	Product/Service Quality	Number of sports industry demonstration projects
		Number of national and above sports events
	Enterprise Competitiveness	Number of large-scale sports enterprises
		Number of sports industry demonstration units
		Percentage of enterprises in the core sports industry (competition and performance industry and fitness and leisure industry)
	Structural Optimization	Share of added value of the sports service industry in the added value of the sports industry
		Share of added value of the competition and performance industry in the added value of the sports industry
		Regional disparities in sports output per capita
Industrial	Production Efficiency	Value-added rate of sports services

Efficiency		Value-added rate of sports manufacturing
		Revenue margins for sports businesses
		Sports business unit output rate
		Labor productivity
	Economic/Social Benefits	Contribution of sports industry to GDP
		Pull rate of the sports industry to the economy
		Total corporate income tax paid by sports enterprises
		Employment contribution rate
Industrial Motive Power	Innovation Factor Motive Power	R&D investment intensity in sports
		Number of patents granted to sports enterprises
	Industry Demand Motive Power	Scale of resident sports consumption
		Share of sports spending in disposable income
		Proportion of participation/spectator consumption
		Proportion of sports consumers

### 3.1.2 Comprehensive evaluation method: scatter degree evaluation method

Through the comparison and screening of various methods, this study believes that the "scatter degree evaluation method" has outstanding advantages in the data processing of this study. Based on this, we adopt Guo Yajun's<sup>[19]</sup> two types of "vertical" and "vertical and horizontal" scatter degree evaluation methods as the evaluation indicator allocation method of this study and choose the "vertical" scatter degree evaluation method to evaluate the time-series data of the high-quality development of the sports industry, to understand the comprehensive trajectory of "itself" and to facilitate the summing up of experience. The time series data evaluation of the sports industry's high-quality development is evaluated to understand the comprehensive trajectory of "itself" and to summarise the experience. The "vertical and horizontal" scatter degree evaluation method is chosen to evaluate the panel data for the high-quality development of the sports industry, which solves the problem of comparing different evaluation objects in different periods. For the "vertical" scatter degree



evaluation method, we chose the benchmark comparison method to pre-process the indicator. We chose the efficacy coefficient method for the "vertical and horizontal" scatter degree evaluation method to pre-process the indicators. Overall, the scatter degree evaluation method is a dynamic and comprehensive evaluation method that is practical, easy to operate and "transparent" in the evaluation process, which not only solves the problem of inter-period comparisons but has the advantages of transparency, ease of operation and objectivity.

### **3.1.3 Spatial analysis methods: Spatial clustering method**

The spatial clustering method divides evaluation units into categories according to the quantitative combination relationship of different elemental attributes within the evaluation unit. It is an important auxiliary means to identify the spatial differentiation pattern of Shanghai's sports industry based on the evaluation results of indicators. According to the concentrated and contiguous characteristics of the spatial clustering results, areas with high similarity in the high-quality development of the sports industry can be identified.

## **3.2 Data Sources**

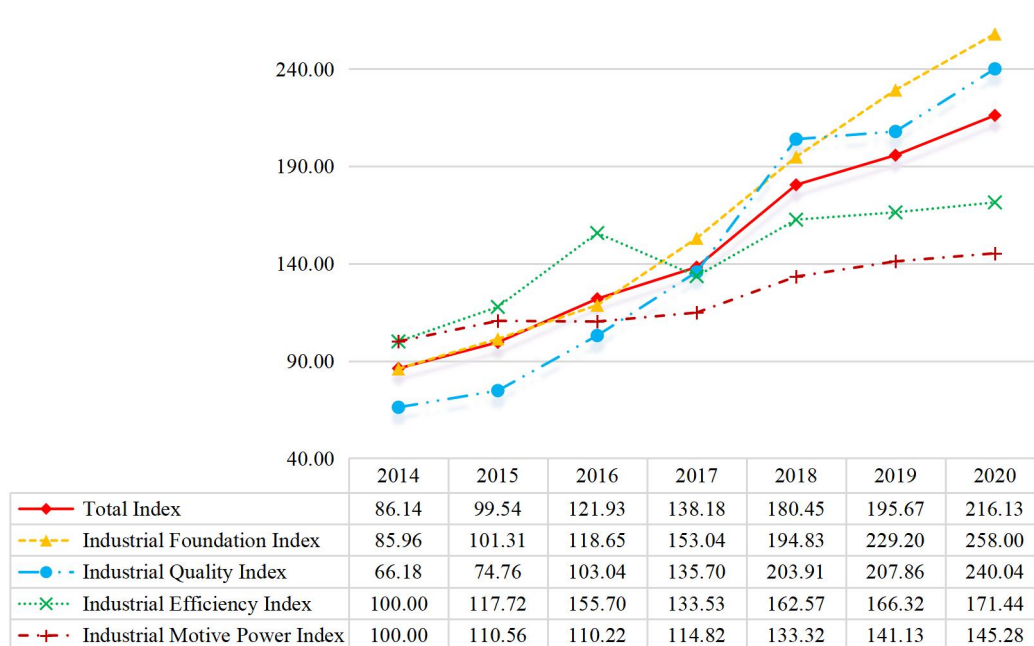
There are two types of indicator data; one is the data that is not processed and calculated, which is directly derived from relevant statistics, which is obtained through three channels: (1) Official statistics, including Shanghai Sports Industry Development Report (2017-2018), Shanghai Sports Industry Development Report (2019-2021) and Shanghai Sports Industry Units Directory Database. (2) Government departments, including the Shanghai Municipal Sports Bureau, Taxation Bureau, Statistics Bureau, Intellectual Property Office, etc. (3) Official websites, including the official websites of State Customs, State General Administration of Sport and Shanghai Municipal Sports Bureau. The second is based on the indicator data collected, calculated and processed. The period of the indicator data in this study is 2014-2020. The local fitting method calculates the regression equation for the missing indicator data with the base period value and growth rate as the independent variables. The weighted linear regression method is used to obtain the simulated value of the load for interpolation.

## **4 Research Results**

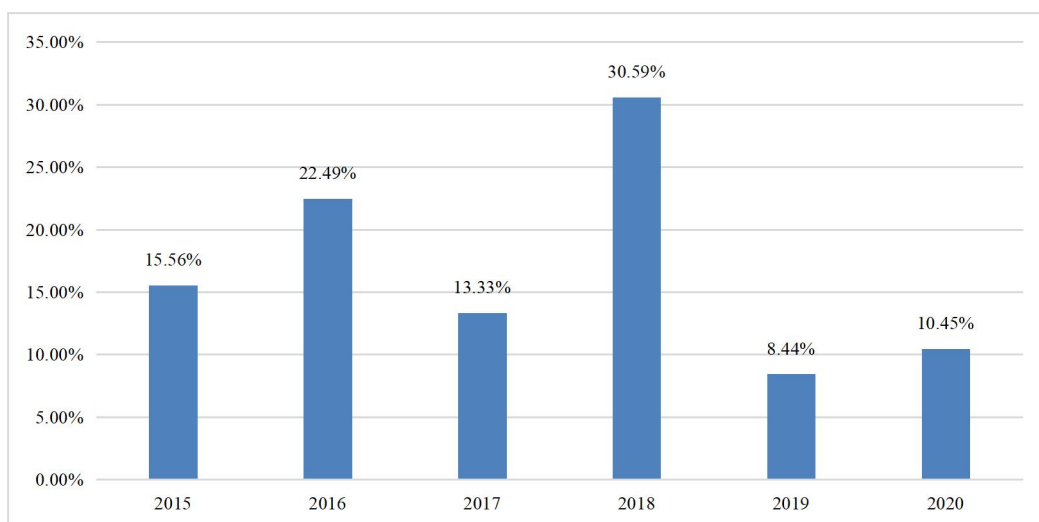
### **4.1 Measuring the Shanghai (Municipal Level) Sports Industry High-quality Development Index**

#### **4.1.1 General time series analysis**

The measurement results draw a trend graph, as shown in Figure 2. From Figure 2, the overall high-quality development index of the Shanghai sports industry from 2014 to 2020 shows a rapid upward trend. It maintains a stable, balanced and rapid development trend in 7 years, with less fluctuation. The overall high-quality development index of the Shanghai sports industry in 2020 reached 216.13, with an increase of 150.91% compared with that of 2014, and the effect of high-quality development is relatively good. However, it should also be seen that the growth of the total index of high-quality development of Shanghai's sports industry from 2014 to 2020 is not stable, and the growth rate dropped sharply to 8.44% in 2019 (Fig.3), which means that the high-quality development of Shanghai's sports industry faces a significant challenge. According to the chronological change of the index of primary indicators, it can be found that the index of industrial foundation for high-quality development of the sports industry, the index of industrial quality, the index of industrial efficiency and the index of industrial dynamics are all gradually improving in fluctuation. The index of industrial foundation and the index of industrial quality have a larger fluctuation amplitude. Shanghai's sports industry's high level of high-quality development constantly fluctuates and evolves from the low to the high level with the contribution of complex interactions under the four first-level indexes.



**Fig. 2. Total index and index of primary indicators of high-quality development of Shanghai's sports industry**

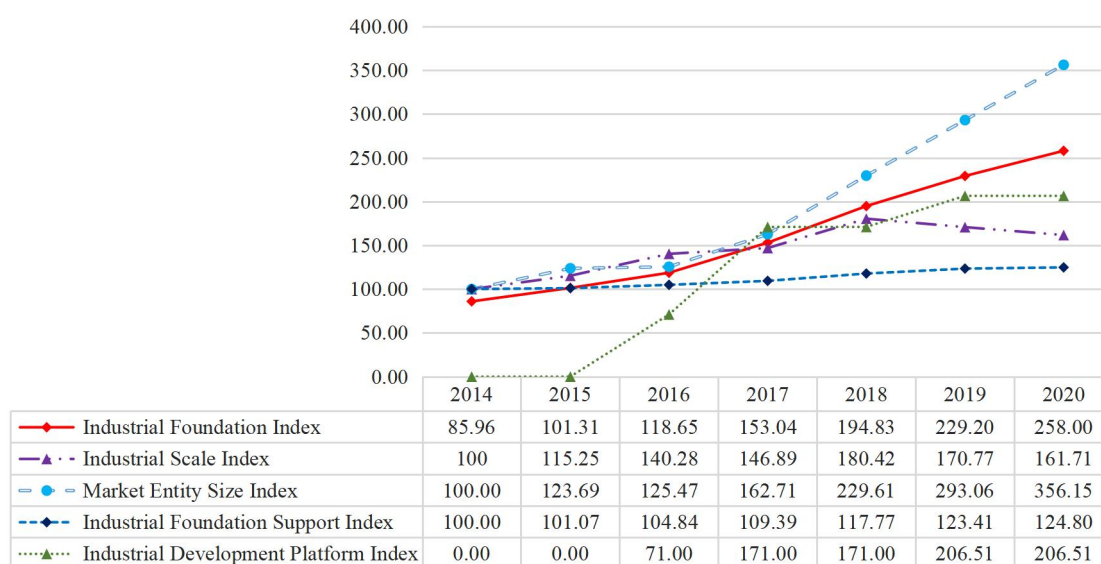


**Fig. 3. Annual growth rate of the total index of high-quality development of Shanghai's sports industry**

The effectiveness of the high-quality development of Shanghai's sports industry is closely related to the top-level design of the sports industry policy. In 2014, the State Council promulgated *"Several Opinions on Accelerating the Development of the Sports Industry and Promoting Sports Consumption"*, and Shanghai seized this important opportunity and successively issued a series of documents, such as *"Shanghai Municipal People's Government's Opinions on the Implementation of Accelerating the Development of the Sports Industry and Promoting Sports Consumption"* and *"Outline for the Construction of a Global Famous Sports City"* and other series of documents, these oriented policies play an important role in deepening the reform of "management and service" in sports, optimising the industrial environment, increasing the supply of industrial elements which is a key point to promote the index of high-quality development of Shanghai's sports industry. Through the continuous release of sports industry policy dividends and the gradual emergence of the inter-regional sports industry cooperation effect, the sports industry quality-development index has been "revitalised", and the index has been continuously improved. In recent years, Shanghai has actively explored the integrated development of the sports industry in the Yangtze River Delta. It has become the main engine of the high-quality integrated development of the Yangtze River Delta. The integrated and coordinated development of the Yangtze River Delta has given Shanghai a unique advantage in organising major events, market-based allocation and sharing of sports resources, and cultivating new sports industries, providing impetus for the high-quality development of Shanghai's sports industry.

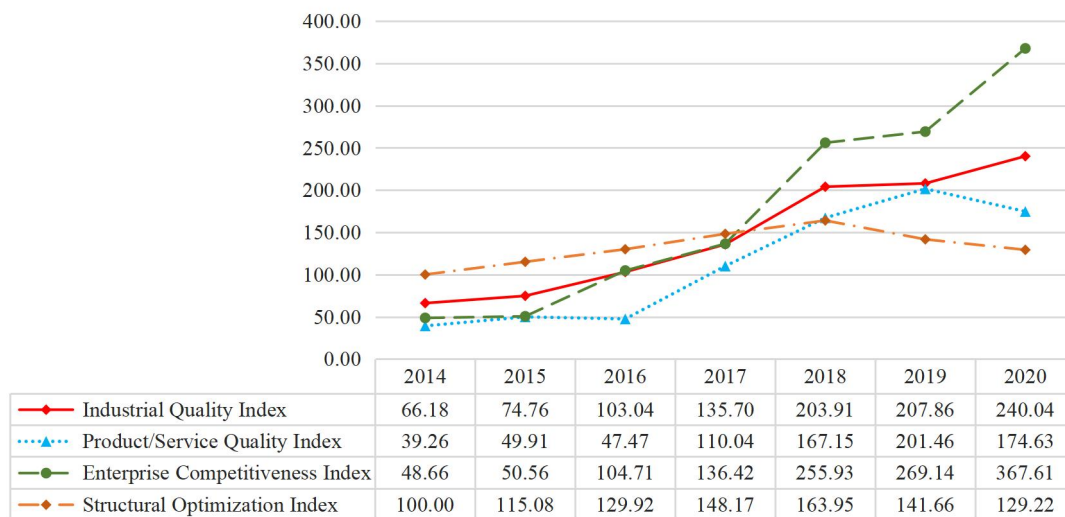
### 4.1.2 Classification index analysis

The industrial foundation index for the high-quality development of Shanghai's sports industry shows a basic trend of rapid growth (Fig. 4). The index reached 258.08 in 2020, ranking No. 1 among the four first-level indexes and increasing by 200.14 per cent compared with 2014, and the continuous improvement of the industrial foundation index lays the cornerstone for the high-quality development of Shanghai's sports industry. Figure 4 shows that the scale index of Shanghai's sports industry is unsatisfactory, and the growth of the index of industrial foundation guarantee is slow. However, the scale of the market's main body expands obviously, and the index of the development of the industrial platform is better.



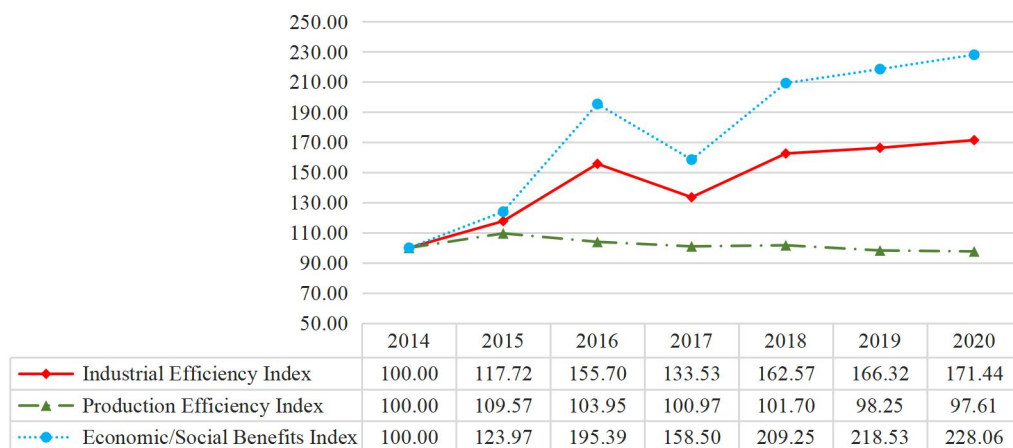
**Fig. 4. Industrial foundation index for high-quality development of Shanghai's sports industry**

The industrial quality index of the high-quality development of Shanghai's sports industry is growing faster (Fig.5), with the index increasing from 66.18 to 240.04 in 7 years, a growth rate of 262.71%, and the index value in 2020 ranks second among the four first-level indicator indices, second only to the industrial foundation index. This indicates that the quality level of Shanghai's sports industry has improved significantly since 2014. Figure 5 shows that the quality index of Shanghai's sports products and services is at a medium level, and the quality index of sports enterprises is growing rapidly. However, the performance of the industrial structure optimisation index is not satisfactory.



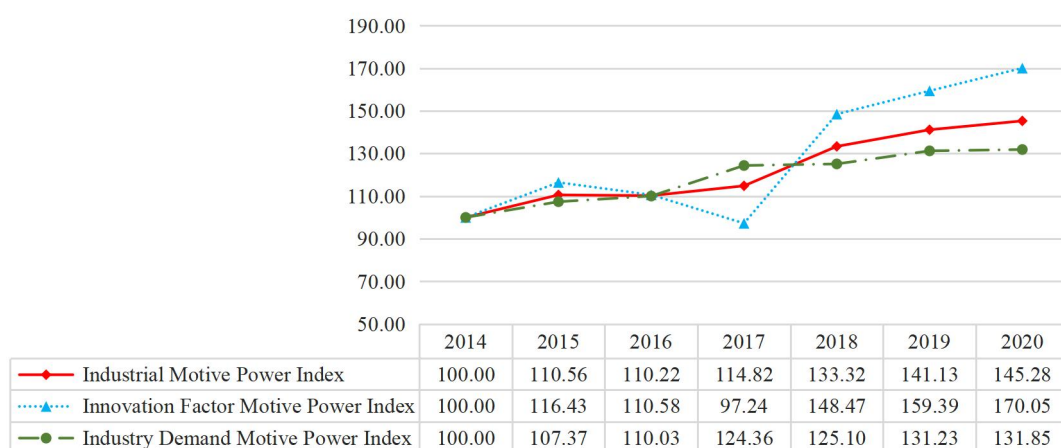
**Fig. 5. Industrial quality index for high-quality development of Shanghai's sports industry**

The industrial efficiency index of the high-quality development of Shanghai's sports industry shows a slow upward trend with small fluctuations (Fig.6). From 2014 to 2016, the industrial efficiency index rose slightly to 155.70, fell to 133.53 in 2017, and rebounded to 171.44 in 2020, reaching a peak in seven years and ranking third among the four first-level index indicators. As the core connotation of high-quality development, the role of industrial efficiency has not yet been fully reflected. From the point of view of the production efficiency index, it is still in the doldrums, and the index shows negative growth, and it will only be 97.61 in 2020. The industrial efficiency index of the high-quality development of Shanghai's sports industry has achieved better results. However, it fluctuates a lot, which has an impact on the overall industrial efficiency index.



**Fig. 6. Industrial efficiency index for high-quality development of Shanghai's sports industry**

The industrial momentum index for the high-quality development of Shanghai's sports industry grows slowly (Fig.7), and the index in 2020 is only 145.28, which ranks first at the bottom of the four indexes of the primary indicators, indicating that the development momentum of Shanghai's sports industry has been insufficient since 2014. The reason is mainly due to the slow growth of the industry's demand power index. On the one hand, the innovation factor power index fluctuates but slowly and also had negative growth in 2017, ranking 5th among 11 secondary indicators, and its key indicators, such as sports science and technology investment intensity and the number of patents applied for and granted by sports enterprises, all grow more slowly. On the other hand, the industry demand dynamics index ranks 4th from the bottom among 11 secondary indicators, with only 131.85 by 2020, and its key indicators, such as the scale of sports consumption by residents, the proportion of disposable income accounted for by per capita sports consumption, the proportion of participatory and ornamental sports consumption, and the proportion of the population consuming sports, all grow more slowly.



**Fig. 7. Industrial motive power index for high-quality development of Shanghai's sports industry**

#### **4.2 Measuring the high-quality development index of the sports industry in Shanghai (district and county level)**

Based on the effectiveness coefficient method and the "vertical and horizontal" scatter degree evaluation method, the high-quality development index of the sports industry of 16 districts in Shanghai from 2014 to 2020 (Table 2) was calculated using MATLAB R2019a with 2014 as the base period. The ranking (Table 3) was carried out to reflect the change in the high-quality development index of Shanghai's sports industry in a more intuitive way. In order to further analyse the volatility of the ranking of the sports industry high-quality development index of

Shanghai districts, the ranking variance of the index of Shanghai districts was calculated. Based on the variation range of the variance, the types of high-quality development of the sports industry in the 16 districts of Shanghai were classified into three categories, including Those with a ranking variance of  $0 \leq s^2 \leq 3$  of the stable development type, those with a ranking variance of  $3 < s^2 \leq 8$  are of the fluctuating development type; and those with a ranking variance of  $s^2 > 8$  are of the jumping development type, which is the development type. The types of high-quality development of the sports industry in 16 districts of Shanghai are shown in Figure 8. In the following section, in-depth analyses are made based on the index measurement results from the following perspectives.

#### **4.2.1 Overall time series characteristics**

From 2014 to 2020, the average value of the sports industry high-quality development index of the 16 districts in Shanghai steadily increased from 72.35 to 89.31 (Table 2), an increase of 23.44%, indicating that the overall trend of change in the level of high-quality development of the sports industry in Shanghai is relatively good. From the perspective of regional indices, the high-quality development indices of the 16 districts have all improved to some extent. Among them, Xuhui District, Hongkou District and Pudong New District have improved significantly, and the indices of the above three districts in 2020 have improved by 60.01, 42.72 and 22.85, respectively, compared with 2014—the high-quality development of the sports industry in Shanghai results from the joint promotion of various factors.

Macroscopically, Shanghai is located at the core of the Yangtze River Delta integration, leading the Yangtze River Delta to become the most influential, strong and active growth pole in the country, gathering many high-end sports elements. Under the leadership of the construction of the global sports city, Shanghai has formed a developed sports headquarters economy, and the level of sports commercialisation is leading in the country. Mesoscopically, Shanghai's sports industry and sports consumption policies have been tested first. In recent years, Shanghai has successively issued a series of documents, such as "Several Opinions on Accelerating the Innovative Development of the City's Sports Industry", which play an important role in deepening the reform of sports "management and service", optimising the industrial environment and increasing the supply of industrial elements, and so on.

Meanwhile, Shanghai has formed a relatively perfect sports industry statistics system and sports consumption statistics system, and the construction of the directory database of key sports industry units is leading in the country. Microscopically, the development of Shanghai's sports market players is very active, with sufficient innovation power, and the number of

sports enterprises has increased from 7,938 in 2015 to 28,425 in 2020, an increase of 258.09%<sup>[20]</sup>. Good development opportunities, perfect industrial policies and active market players have led to a steady increase in the quality development index of Shanghai's sports industry.

**Table 2. High-quality development index of the sports industry in 16 districts of Shanghai, 2014-2020**

District	Time weighted coefficient							Weighted composite index
	2014year	2015year	2016year	2017year	2018year	2019year	2020year	
	1/28	2/28	3/28	4/28	5/28	6/28	7/28	
Huangpu	79.16	80.59	72.90	72.68	76.79	87.55	85.75	80.69
Xuhui	76.11	75.76	121.95	105.16	114.27	114.27	139.17	115.90
Changning	78.57	85.73	89.19	78.86	79.66	89.58	89.53	85.55
Jingan	75.17	79.31	73.84	73.08	81.63	84.78	83.78	80.39
Putuo	67.35	69.52	64.41	68.74	70.94	68.98	73.73	69.97
Hongkou	73.51	78.48	84.35	95.74	110.75	113.88	116.23	104.19
Yangpu	74.37	76.92	82.81	79.64	89.07	95.94	97.89	89.34
Minhang	74.02	75.52	75.98	80.62	82.43	86.31	88.48	83.03
Baoshan	64.75	65.71	65.81	66.83	83.49	69.80	72.55	71.61
Jiading	74.27	76.03	76.28	73.69	78.37	82.05	85.74	79.80
Pudong	84.67	87.88	98.61	95.93	105.06	100.32	107.52	100.71
Jinshan	65.29	65.14	65.08	71.64	71.04	70.72	72.57	70.17
Songjiang	67.84	68.92	66.57	70.79	75.19	73.67	74.49	72.42
Qingpu	68.97	70.78	73.40	73.23	79.81	81.93	82.39	78.25
Fengxian	66.82	67.21	68.42	70.05	75.12	75.26	78.93	73.80
Chongming	66.76	68.89	70.53	91.17	87.39	78.27	80.17	80.31
average value	72.35	74.53	78.13	79.24	85.06	85.83	89.31	83.51

**Table 3. Ranking and ranking variance of high-quality development index of the sports industry in 16 districts of Shanghai from 2014 to 2020**

District	2014year	2015year	2016year	2017year	2018year	2019year	2020year	variance
Huangpu	2	3	10	11	12	6	7	13.06
Xuhui	4	8	1	1	1	1	1	6.24
Changning	3	2	3	7	10	5	5	6.57
Jingan	5	4	8	10	8	8	9	3.96
Putuo	12	11	16	15	16	16	14	3.63
Hongkou	9	5	4	3	2	2	2	5.55
Yangpu	6	6	5	6	4	4	4	0.86
Minhang	8	9	7	5	7	7	6	1.43
Baoshan	16	15	14	16	6	15	16	11.14
Jiading	7	7	6	8	11	9	8	2.29
Pudong	1	1	2	2	3	3	3	0.69
Jinshan	15	16	15	12	15	14	15	1.39
Songjiang	11	12	13	13	13	13	13	0.53
Qingpu	10	10	9	9	9	10	10	0.24
Fengxian	13	14	12	14	14	12	12	0.86

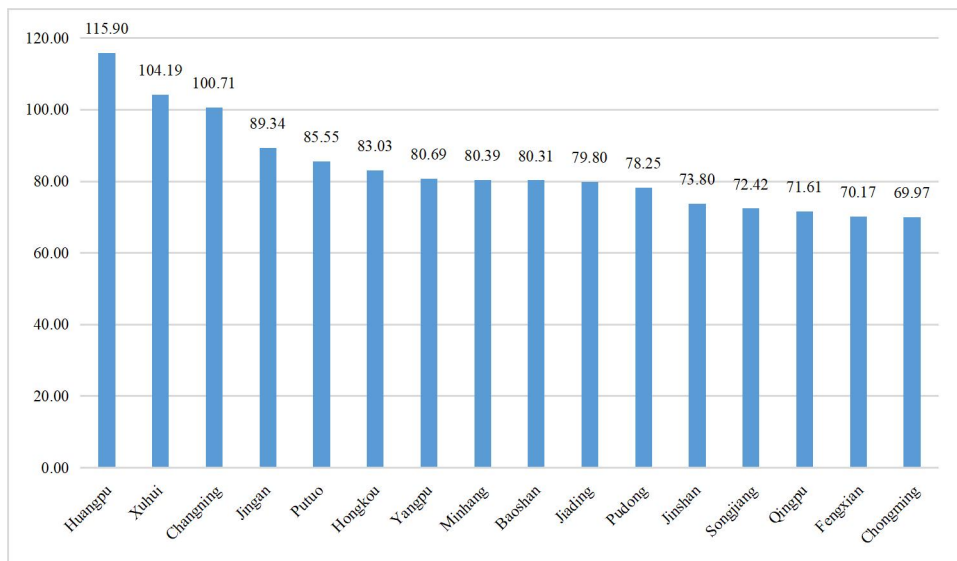


#### 4.2.2 Classification of development types

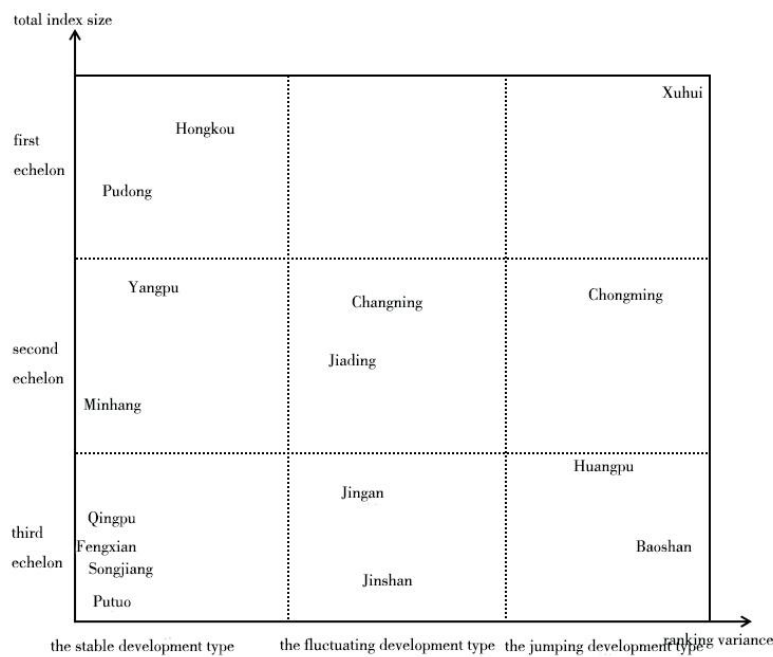
According to the idea of "thick present and thin past", the high-quality development index of Shanghai districts over the years is time-weighted, and the composite index is calculated over the past 7 years. The comprehensive index represents the comprehensive level of high-quality development of the sports industry in 16 districts of Shanghai over the past 7 years, and the larger the comprehensive index, the higher the level of high-quality development of the sports industry, and vice versa, the lower the level, and the calculation results are shown in Table 4.

Based on the calculation results, the bar chart is made figure 8. From the chart, it can be seen that Xuhui District, Hongkou District and Pudong New District are in the leading position of the high-quality development level of the sports industry in Shanghai, with a great advantage of the leading slope; Chongming District, Jing'an District, Qingpu District, Fengxian District, Baoshan District, Songjiang District, Jinshan District and Putuo District are in a relatively backward position of the high-quality development index of the sports industry. The index value is lower than 80. Taking Putuo District as an example, due to the unsatisfactory quality development index of the sports industry, most of the indexes, such as total output and value-added of the sports industry, are at the bottom of 16 districts, which leads to the low index of Putuo District. The index value of other districts is within 80-90.

Accordingly, the index of high-quality development of Shanghai's sports industry can initially be divided into three types of echelons, where the first echelon consists of Xuhui District, Hongkou District and Pudong New District (index >100), the second echelon consists of Yangpu, Changning, Minhang, Huangpu, Jing'an and Jiading districts (80<index<90), and the other districts (index<80) are in the third echelon (Fig.9). From a numerical point of view, there are no extreme differences in the regional indices, but there is a 'gap' in the indices, with no regions having indices in the 90-100 range.



**Fig. 8. Comprehensive index of high-quality development of the sports industry in 16 districts of Shanghai in 7 years**

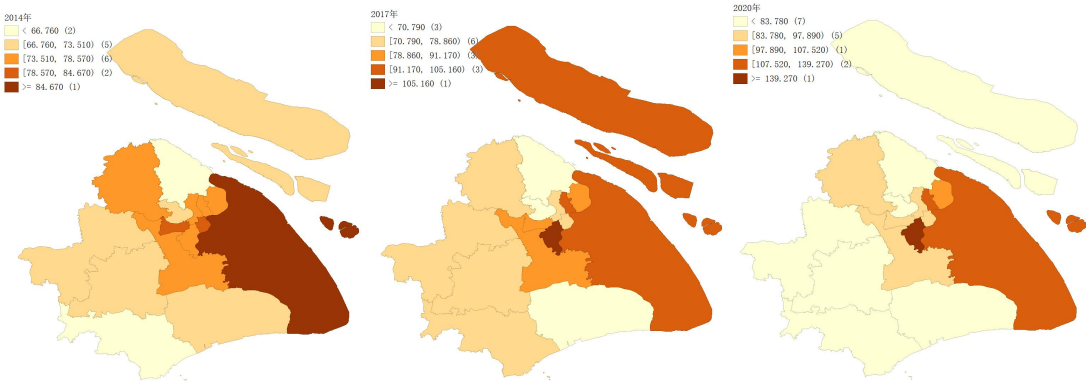


**Fig. 9. Types of high-quality development of the sports industry in 16 districts of Shanghai City**

#### 4.2.3 Spatial characterisation

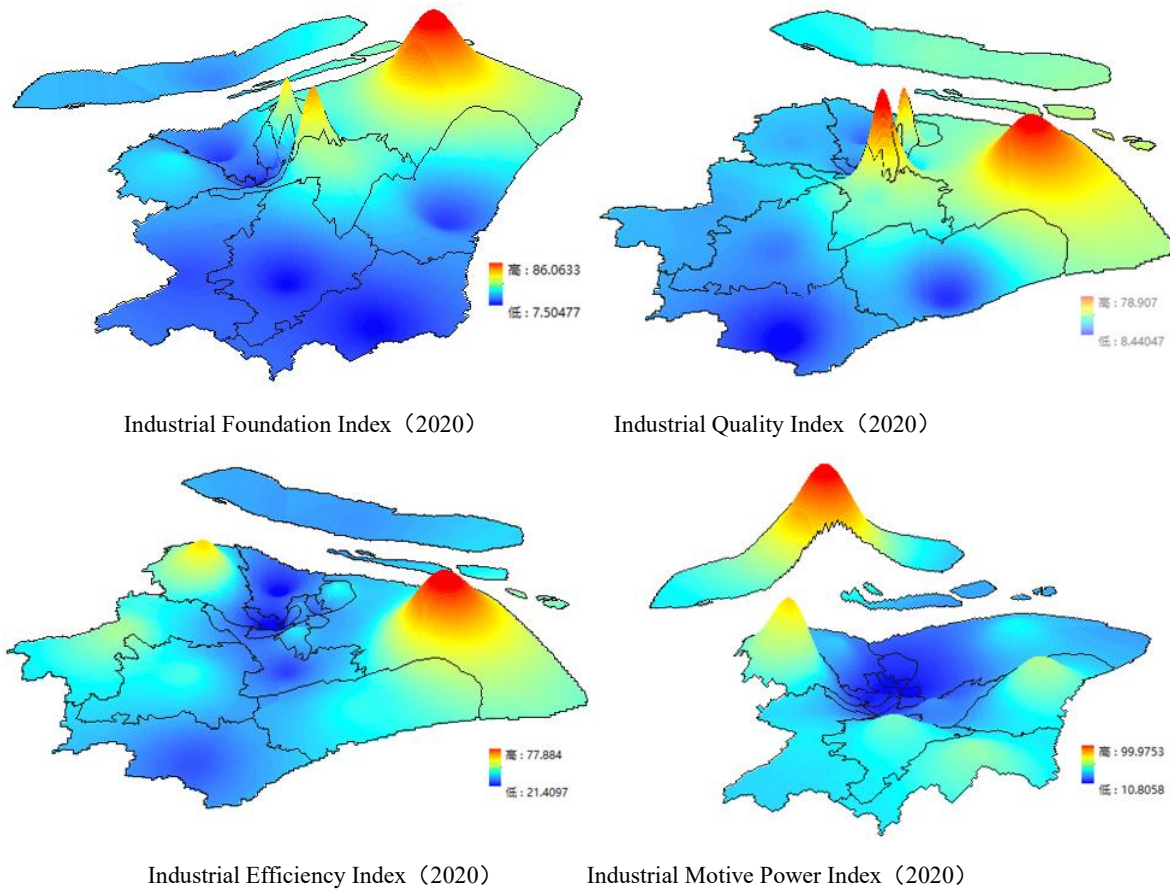
In order to clarify the development of Shanghai's sports industry and the distribution of agglomeration, the sports industry high-quality development index of 16 districts in Shanghai in 2014, 2017 and 2020 is divided into four categories using the natural break method of Geo-DA geographic analysis software, and the spatial visual representation is carried out (Fig.10).

The sports industry's high-quality development index was mainly concentrated in the east-central part of Shanghai in 2014 and was distributed piecewise. The high-quality development index of the sports industry in 2017 was mainly concentrated in the east-central part of Shanghai and was distributed piecemeal. The high-quality development index of the sports industry in 2018 was mainly concentrated in the east-central part of Shanghai and was distributed piecemeal. The high-quality development index of the sports industry in 2019 was mainly concentrated in the east-central part of Shanghai and was distributed piecemeal.



**Fig. 10. Spatial differentiation pattern of high-quality development of Shanghai's sports industry**

The 3D model of ArcScene was further used to express the industrial foundation, industrial quality, industrial efficiency and industrial motive power indices of 16 districts in Shanghai in 2020 in 3D (Fig.11) in order to explore the spatial pattern characteristics and patterns of the component indices of the high-quality development of Shanghai's sports industry. Regarding the sports industry foundation index, the districts of Pudong, Xuhui, Hongkou, Jiading and Minhang are higher, while Qingpu, Songjiang, Jinshan, and Fengxian districts are relatively lower. Regarding the sports industry quality index, Xuhui, Pudong, and Hongkou are relatively high, while Jinshan, Baoshan, Putuo, Changning and Hongkou are relatively low. Regarding the sports industry efficiency index, the Pudong, Yangpu, Minhang, Xuhui, and Hongkou districts are relatively high, while the Jinshan, Fengxian, Putuo, and Huangpu districts are relatively low. Regarding the Sports Industry Dynamics Index, Chongming district is relatively high, while urban areas such as Minhang, Yangpu and Jing'an are relatively low.



**Fig. 11. Analysis of the spatial pattern of high-quality development index of Shanghai's sports industry based on a three-dimensional visualisation approach**

Overall, the spatial changes in the high-quality development of Shanghai's sports industry have the following characteristics: First, high-quality districts are mainly concentrated in the east, medium-quality districts are mainly concentrated in the centre, and low-quality districts are concentrated in the southwest. Second, the high-quality development of Shanghai's inter-regional sports industry shows a noticeable polarisation effect, and the imbalance is growing, showing the spatial development trend of clustering in a few districts, especially the concentration trend to the east. From the map, it can be seen that the high-quality development area of the sports industry is mainly located in the area radiating from the centre of Pudong, Xuhui, Hongkou and shows a gradual shrinking trend, except that Pudong, Xuhui, Hongkou have maintained "hotness", Chongming, Qingpu, Jing'an, Huangpu and other hotness are gradually disappearing. At the same time, the low-quality development area of the sports industry is expanding year by year. Expanding.

## 5 Conclusion

From the above empirical research results, we can draw the changing trend of the level of high-quality development of Shanghai's sports industry over time and the ranking of the

high-quality development of Shanghai's inter-regional sports industry, and the empirical results correspond to the status quo of the high-quality development of Shanghai's sports industry. This shows that the constructed indicator system and index model of the high-quality development of the sports industry is highly feasible. Suppose there are national or 31 provincial (autonomous regions and municipalities directly under the central government) level sports industry statistics. In that case, the national level and the provincial (autonomous regions and municipalities directly under the central government) level of the high-quality development of the sports industry can be measured to realise the high-quality level of the sports industry in horizontal and vertical comparisons and dynamic monitoring.

It is found that: (1) the overall high-quality level of Shanghai sports industry is in an upward trend, and the effect of high-quality development is better; (2) the continuous improvement of the industrial foundation index lays the foundation for the high-quality development of Shanghai sports industry, among which the market main body scale index is outstanding; (3) The quality level of Shanghai's sports industry has been dramatically improved, which has become the key to promote the high-quality development of Shanghai's sports industry, which is closely related to the significant improvement of the quality index of sports enterprises, but the performance of the index of optimisation of the industrial structure is not satisfactory; (4) The performance of the efficiency of the sports industry is unsatisfactory, which seriously restricts the high-quality development of Shanghai's sports industry; (5) The power of high-quality development of Shanghai's sports industry is insufficient. The role of innovation factor power has not been revealed, and the growth of the industry demand power index is slow; (6) the high-quality development of the sports industry in Shanghai districts shows a noticeable polarisation effect, which is manifested in the spatial development trend of gathering to a few districts, especially the concentration trend to the east. So far, the author has carried out empirical evidence and analysis on the high-quality development of the sports industry in Shanghai as an example and verified the feasibility of the index system and evaluation model.

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**Authors' contribution:**

Lu Kang: Selecting the topic, setting the framework, writing, unifying and revising the manuscript.

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