Visualization-Big-Data-Based Model of Spatial Environment of Fitness Activities in Tianjin Main Urban Area

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Abstract

The development of sports for all people, an important method to enhance people’s physique and improve people’s physical and mental health, aims to promote the sustainable development of sports industry in China. China attaches great importance to the development of the nationwide sports and fitness undertaking. Related preferential treatments have been given in taxation, and a series of important laws and regulations have been put forward. August 8th has been established as National Fitness Day, representing national attention to the development of comprehensive sports. The construction of sports fitness activity space is an important basis for the development of sports for all people. Influenced by many subjective or objective factors, the construction level of sports fitness activities in China has yet to be improved. It is necessary to bear in the mind that the lack of fitness facilities and inadequate corresponding construction in many places for the physical fitness activities plays the role of the restriction in the development of sports for all people. Therefore, from the perspective of visualization of big data, taking the main urban area of Tianjin as an example, this paper studies the space environment of its physical fitness activities, which serves as reference for the development of physical fitness activities in the main urban area of Tianjin.

Keywords: Big Data, Visualization, Fitness Space.

1. RESEARCH REVIEW

1.1 Research background

After Beijing hosted the 29th Summer Olympic Games in 2008, Chinese people are paying more and more attention to sports. Since 2009, the August 8th of each year has been established as the National Fitness Day and the National Sports Day officially, when the development of sports for all people began. In 2014, the State Council issued Several Opinions on Speeding up the Development of Sports Industry and Promoting Sports Consumption, which explicitly put forward the task of promoting the development of sports industry and deepening the reform of sports industry as the center of government work. The Opinions also put forward that the sports industry in China will become the pillar industry of the national development and the scale of the total sports industries will strive to reach over 5 trillion yuan before 2025. This goal has always have always attached importance from all levels of Chinese government. The development of sports can promote China’s social and economic development, and effectively improve people’s quality of life, promoting the real transition from a sports country to a sports power, The transition from the Gold Medal Sports into a Comprehensive Sports is of great significance to enhancing people’s quality of life and promoting a sound and sustainable social and economic development.

1.2 Literature review

There are following problems in the development of comprehensive sports in China. First, China is in the primary stage of socialism with limited resources. The development of comprehensive sports needs manpower, material and financial resources for all aspects. Hence there is contradiction between the development needs and the social resources provided; second, the government invest inadequately for public sports, failing to give full play to the role of intelligence public sports service, leading to a weak Chinese public sports with a huge gap between the public service and the private ones.; third, it lacks grass-roots folk sports fitness organizations, failing to play a synergistic role of the masses. At the same time, management and organization of most of the grass-roots folk sports fitness organizations is lowly efficient, failing to play its duty; fourth, compared with the developed countries, Chinese people have weaker sense of sports, who are under more pressure to work and
study. They have less time to participate in physical exercise; there are only a small number of people who regularly participate in physical exercise. Young people, especially young children, have the least time for exercise, showing a downward trend in their physical health; fifth, the lack of an overall management mechanism for physical fitness makes it difficult to arouse people’s enthusiasm for physical exercise. The standardization of sports development is relatively low (Chang, 2017). With the continuous development of social economy, the basic needs for food and clothing have been generally solved, which have set new demands on the spiritual civilization and the overall quality. However, as an important part of spiritual civilization, the sports industry has a relatively low level of development and hardly meets the needs of socialist modernization. On one hand, people’s awareness of physical exercise and enthusiasm generally remains low with a small number of people participating in physical exercise; on the other hand, physical activity space is relatively small with inadequate level of infrastructure construction, which is not conducive to the healthy and sustainable development of sports development (Liu and Zhang, 2012).

To promote the development of sports for all resides in the following aspects. First, to further enhance the important role of all-round development of sports in building a harmonious society; second, to improve government leaders’ and the masses’ understanding of sports for all people, clarifying the importance of sports fitness; third, the government shall expand capital and equipment investment, and strengthen physical fitness infrastructure; fourth, it should steadily boost the total number of sports population with rational control of sports population structure; fifth, to accelerate the construction of the physical fitness facilities to enhance the rational layout of facilities; sixth, to strengthen the system construction, to improve the long-term mechanism with the establishment of laws and regulations for the development of sports for all people; seventh, to strengthen the training of social sports instructors; eighth, to give full play to sports resources of teachers and students, in order to enhance services of sports universities for the development of comprehensive sports for all people; ninth, publicity of National Fitness Ordinance serves as better model for the national sports for all people; tenth, to actively organize various forms of comprehensive sports events, so as to build a good sports environment (Liu and Zhang, 2013).

2. QUALITY ASSESSMENT OF PHYSICAL FITNESS ACTIVITIES SPACE ENVIRONMENT

In the context of the advanced development of operations research, statistics and many other disciplines, the modern comprehensive evaluation method has shown a diversified development trend, such as the earliest expert evaluation method, AHP generated by the combination of operations research and mathematics, fuzzy comprehensive evaluation method, data envelopment analysis, principal component analysis based on the combination of statistics and economics, discriminant analysis, cluster analysis and so on. In addition, there are some artificial neural network evaluation methods and gray comprehensive evaluation methods which are produced in the context of the advanced development of information technology (Yin and Guo, 2012). Among them, the result of functional comprehensive evaluation method is more intuitive. Moreover, there is no connection between the various links with rich contents. In view of the characteristics of space environment quality assessment of physical fitness activities, the comprehensive evaluation method using function has better effect. Therefore, this study mainly evaluates the spatial environmental quality of physical fitness activities through the method of functional comprehensive evaluation. The steps are as follows.

2.1 To establish indicator weights

There are some differences in the space and environment construction of sports and fitness activities in various places. Taking the main urban area of Tianjin as an example, the choice of indicators can be carried out in three ways. First, the subjective experience method, that is, through the researchers’ own understanding of the research questions, the solutions are put forward. Second, the expert evaluation method, that is, let experts and scholars independently express their own views on the issue, and calculate the weights. Third, Delphi method, that is, to understand the experts and scholar's view on the problems through questionnaires and other means, and to use multiple rounds of accounting for the weight of the evaluation indicators. Fourth, the analytic hierarchy process, that is, by way of constructing the judgment matrix, comparing the influencing factors of one thing with each other and calculating, to obtain the most influencing elements. The accuracy of these methods is arranged based on their difficult levels from the easiest (Lan et al., 2016). In order to ensure the accuracy of the results obtained, this study uses the analytic hierarchy process to get the index weights, and the formula is as follows:

$$W_i = \frac{1}{n} \sum_{j=1}^{n} V_{ij}$$ (1)
where, $W_i$ represents the weight of No. i index, $i=1, 2, ..., k, ..., n$, $V_{ij}$ represents the weight given by No. j expert of the No. i index, and n represents the number of participating experts (Lei, 2017).

2.2 AHP specific process

![Flow Chart of Analytic Hierarchy Process](image)

According to the above flow chart, the judgment matrix A is constructed as shown below:

$$A = \begin{bmatrix}
W_{11} & W_{12} & ... & W_{1n} \\
W_{21} & W_{22} & ... & W_{2n} \\
... & ... & ... & ... \\
W_{n1} & W_{n2} & ... & W_{nn}
\end{bmatrix}$$

(2)

Each matrix of the two indicators will be calculated according to the formula $w_{ij} = \frac{x_i}{x_j}$, and the results are shown in Table 1 in accordance with the 1 to 9 scale:

**Table 1 Evaluation Index Relative Importance Rating Scale**

<table>
<thead>
<tr>
<th>Scaling</th>
<th>Meaning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The two indicators are equally important</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The two indicator, the former is slightly more important than the latter</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The two index, the former is more important than the latter</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The two index, the former is obviously more important than the latter</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>The two indicator, the former is significantly more important than the latter</td>
<td></td>
</tr>
<tr>
<td>2, 4, 6, 8</td>
<td>The intermediate value of the above judgment</td>
<td></td>
</tr>
</tbody>
</table>

where, 1 represents the two indicators which are the same important; 3 represents two indicators, with the former slightly more important than the latter; 5 represents two indicators, with the former obviously more important than the latter; 7 represents two indicators, with the former significantly more important than the latter; 9 represents two indicators, with the former extremely more important than the latter; 2, 4, 6, 8 represent the median values among these judgments (Zhang and Shen, 2014).

Subsequently, a single rank order and consistency test are conducted. Level single rank means the order of importance of a lower level for the upper level indicators. Therefore, the single rank order is calculating the judgment matrix features and the eigenvectors. The largest feature value is $\lambda_{max}$, and the eigenvector is $W = [w_1, w_2, w_3, ..., w_n]^T$, $AW = \lambda_{max}W$. The formula is as follows:

$$W_i = \left(\prod_{j=1}^{n} a_{ij}\right)^{\frac{1}{\sum_{k=1}^{n} \left(\prod_{j=1}^{n} a_{kj}\right)}}$$

(3)
The formula for the root of largest eigenvalue is shown below:

$$\lambda_{\text{max}} = \sum_{i=1}^{n} \left( \frac{A(W)_i}{W_i} \right)$$  \hspace{1cm} (4)

However, due to many subjective or objective factors, different indicators may be biased in quantitative calculation. Therefore, it is necessary to test the consistency of the obtained results. The formula is as follows:

$$CI = \frac{\lambda_{\text{max}} - n}{n-1}$$  \hspace{1cm} (5)

where, n represents the average judgment matrix order (Liu, 2014). The calculation of CI is as follows:

$$CR = \frac{CI}{RI}$$  \hspace{1cm} (6)

The range of RI is shown in Table 2:

<table>
<thead>
<tr>
<th>Order number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
</tr>
</tbody>
</table>

The value of RI is put into the above formula, so as to obtain the final CR value. If $CR \leq 0.1$, the results prove that there is a certain consistency, and the results can effectively reflect the quality of mathematics teaching. If $CR > 0.1$, however, the results prove to be erroneously large, which means it needs to be re-calculated until $CR \leq 0.1$ (Yan and Wen, 2013).

3. VISUAL-BIG-DATA-BASED TIANJIN URBAN AREA FITNESS SPACE ENVIRONMENT

3.1 Overview of Tianjin city

As Tianjin is near Beijing, it is one of the four major municipalities directly under the administration of the Central Government. It is also the national center urban area, megalopolis and economic center of the Bohai Rim. It is one of the first coastal open cities in China. Tianjin is mainly divided into three parts of six districts in the urban area, four districts around the urban area and three districts in the outer suburbs. Among them, the six districts in the urban area are mainly Heping District, Hedong District, Hexi District, Nankai District, Hebei District and Hongqiao District. In the four districts around the urban area, there are mainly Xiqing District, Dongli District, Jinnan District, Beichen District. Two districts and three districts in the outer suburbs mainly include Wuqing District, Baodi District, Jinhai County, Ninghe County and Jixian County. Among them, two districts and three districts in the outer suburbs no longer belong to the main urban area, which are therefore not studied.

3.2 Research methods

In this study, residents in six districts in the urban area and four districts around the urban area were selected as survey subjects. 1000 questionnaires were randomly distributed, of which 952 questionnaires were collected with the recovery rate of 95.2%. The number of valid questionnaires was 911 with effective rate of 95.6%. Specific distributions are shown in Table 3:

<table>
<thead>
<tr>
<th>Under 35 years old</th>
<th>35-55 years old</th>
<th>55-75 years old</th>
<th>Above 75 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of</td>
<td>158</td>
<td>331</td>
<td>274</td>
</tr>
<tr>
<td>Percentage</td>
<td>17.3%</td>
<td>33.4%</td>
<td>30%</td>
</tr>
</tbody>
</table>
Analysis of the figure shows that in the 911 effective questionnaire, 158 respondents under the age of 35 accounted for 17.3% of the total number of respondents; 331 people of 35 years old to 55 years old accounted for 33.4% of the total number of respondents; 274 respondents aged 55 years old to 75 years old accounted for 30% of the total number of respondents, and 148 respondents aged 75 years old and over accounted for 16.2% of the total (Li, 2013). From this, it can be seen that respondents under the age of 35 years old are generally under more pressure to work or study. Although the overall number in the age group is larger, the number of respondents is smaller, indicating that few of young people under the age of 35 years old participate in physical exercise. However, the number of people aged 35 years old to 75 years old is relatively large. The middle-aged and elderly people at this age have a steady general career with relatively low working pressure, and they put more emphasis on their own health. Therefore, they often participate in sports exercise as the main group of physical exercise in China (Wei and Yang, 2016). For those over 75 years, however, physical conditions have deteriorated and many older persons are unable to perform regular physical activity. As a result, it is less likely for the older persons to use specialized physical fitness spaces, similar in number to those under 35 years old.

According to the survey, as early as in 2001, China has witnessed a clear aging trend. In 2015, the elderly population reached 144 million, accounting for about 16.2% of the national total. It is estimated that the number of elderly people in 2020 may reach 248 million, entering into the era of serious aging. At the same time, the level of aging in Tianjin is much higher than the national average. It is the third city to enter into the aging following Beijing and Shanghai. By 2020, the elderly population may reach 2.73 million (Gao et al., 2015). The elderly in the family with their extensive experience and deep qualifications make them inextricably linked with many fields, which plays an important role in maintaining the healthy development of the community. Therefore, only by providing the elderly with superior living space can it stabilize the overall situation and promote the harmonious development of society.

### 3.3 Building ideas of fitness activities space in main urban area of Tianjin

#### 3.3.1 To enhance awareness of sports for all people

Sports for all people are essentially a social welfare undertaking, which plays an important role in promoting the social and economic development and building a harmonious society (Wang et al., 2015). Therefore, leaders at all levels of the government should pay enough attention to the development of sports for all people, increase investment in manpower, financial resources and material resources, improve the construction of sports infrastructure in Tianjin, and provide space for more Tianjin citizens to exercise and enhance physical activity level.

#### 3.3.2 To build sports fitness and cultural environment

Cultural environment will exert a subtle influence on people’s thinking and behavior. The national movement is an important strategic plan for the development of China. If it wants to promote the development of national fitness, it must construct a good sports and fitness culture environment. Therefore, Tianjin can attract more residents to participate in physical exercise by holding sports and fitness activities. At the same time, Tianjin should promote the National Fitness Day and various national fitness and sports activities, so as to effectively stimulate the enthusiasm of Tianjin citizens to perform physical exercises, prompting Tianjin to form the love of physical exercise, creating good social atmosphere for universal physical activity (Yan and Liang, 2015).

#### 3.3.3 To strengthen school physical education

The school is the main place for cultivating talented people, which have been shown in the above contents. The relatively low level of students’ young sportsmanship and the gradual decline of their physical quality have become a serious social problem. Therefore, the government should urge the school to carry out the teaching reform and attach importance to the development of the physical education curriculum. At the same time, it is necessary to ensure that the school organize students’ daily physical exercise, so as to provide students with time for physical exercise, which can effectively enhance the students’ physical exercise level and promote students’ healthy and comprehensive development (Jiang et al., 2011).

#### 3.3.4 To establish social sports guidance team
Not all physical exercises can benefit physical fitness. Wrong physical exercises cannot improve residents’ physical fitness, but they would produce many negative effects. However, most residents do not receive formal physical training. Therefore, the social sports instructor team needs to be established. The popularization of resident’ sports knowledge and the guidance of residents in carrying out proper physical exercises can effectively enhance the level of sports of the overall citizenship of Tianjin, and improve the quality of sports of the Tianjin citizens, giving full play to the promotion of universal sports, which is of great significance to the continuous development of sports for all people.

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