Distribution and difference of medical resources among provinces in China

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Abstract

Objective: To explore the distribution and difference of medical resources among 31 provinces (municipalities) in China. Methods and process: According to the health resource indicators of 31 provinces in China Health Statistical Yearbook and China Statistical Yearbook, we described and analyzed the total amount of medical and health resources, per capita medical and health resources and high-quality medical resources. By using cluster analysis and RSR (Rank-sum ratio) comprehensive evaluation method, the difference of medical resources among 31 provinces in China in 2020 was calculated, and the medical resources of each province were classified, compared and analyzed to describe the difference. Results and conclusions:(1) From the perspective of total medical resources, the total medical resources in the western region are far less than those in the eastern region, showing a situation of "more in the east and less in the west". Provinces with large populations have large medical resources. Developed cities such as Beijing and Shanghai have great advantages in medical and health financial resources, while provinces in remote areas are extremely backward in human, material and financial resources.(2)Unbalanced distribution of high-quality medical resources: tertiary hospitals are mainly concentrated in eastern and central China. The number and scale of tertiary hospitals in western China are obviously backward. China's top 100 hospitals are mainly distributed in the first tier and economically developed cities. Beijing, Shanghai and Guangzhou accounted for half of the top 100 hospitals. Nearly half of China's provinces have no hospitals on the "Top 100" list. (3) Per capita medical resources vary greatly. The per capita level of medical resources in the three northeastern provinces (Inner Mongolia, Qinghai, Sichuan, Beijing and Shanghai) is relatively high. The per capita level of medical resources in Anhui, Jiangxi, Guangdong, Ningxia and other provinces is low.

Title:Distribution and difference of medical resources among provinces in China Short title:To explore the distribution and difference of medical resources among 31 provinces in China from three aspects: total medical resources, per capita medical resources and high-quality medical resources

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Keywords : Medical resources; Difference analysis; resource distribution

Highlights:

- At present, there are few researches on the distribution of medical resources in China as a whole, that is, among provinces.
- In the research path, this paper conducts a comparative analysis from three aspects of total amount, per capita ownership and high-quality resources.
- The conclusions obtained are more comprehensive, accurate and specific.
- In the context of the COVID-19, this study has certain reference and enlightenment significance for the research related to the balanced development of global medical resources.

Ethics statement: Ethic statement - Not applicable

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Introduction

In January 2020, the World Health Organization declared COVID-19 an international public health emergency. The emergence and outbreak of COVID-19 has sounded an alarm bell for the development of medical and health undertakings in countries around the world. In the face of large-scale infectious diseases, many

countries' medical resources are in a state of tension and paralysis[1].Therefore, in areas where medical resources are scarce, patients die because they cannot be treated in time. A large number of studies have proved that the number of medical resources (i.e. hospitals, doctors and beds) has an impact on the mortality of residents. Increasing hospitals, beds and medical students in underdeveloped western regions can more effectively alleviate the local mortality[2].Therefore, studying the distribution and difference of medical resources among provinces in a country is conducive to understanding the problems in the balance and fairness of the development of medical and health services, thus providing some guidance for the government's medical construction.

In terms of research methods, the common method to study the fairness and balance of medical resources is to calculate various fairness indicators, such as the Thiel index, Gini coefficient, etc[3+4].But for a country as a whole, to analyze the differences between provinces, it is also a very intuitive and effective analysis method to select the corresponding indicators of medical and health resources for comparative analysis[5].

From which aspects should we evaluate the level of medical resources in the region? Or what data and indicators are used to reflect the medical resources of a region?Liu HM and other scholars took China as the research object and uses cartograms and half-violin plots to visualize the hospital beds per 10,000 people, medical personnel per 10,000 people and number of 3A hospitals in China.In this study, the number of hospital beds per 10000 people and the number of medical personnel per 10000 people in China were used as the evaluation indicators for the primary health care system, and 3A hospital was used as the evaluation indicator for high-quality medical resources[6].Sida Wan and other scholars analyzed 369 Chinese cities and constructed a medical resource evaluation model based on the grading of medical institutions using the Delphi method."Research area and data point distribution" divides the types of medical institutions, including Clinic,First Aid Center,Pharmacy,Specialized Hospital etc[7].Chao Tan and other scholars studied the relationship between medical resources and the proportion of the elderly population in China.In the article, they use the number of beds in hospitals and medical centers to represent "medical resources"[8].

To sum up, most scholars have some limitations on the evaluation of medical resources. This paper tries to reflect "medical resources" as comprehensively as possible. Therefore, it compares and analyzes the differences between different provinces in China from three aspects: the amount of medical resources per capita, the total amount of regional medical resources, and the total amount of regional high-quality medical resources.

Research method and data indicators

The research methods and ideas of this paper are shown in Figure 1. The article reflects the medical resources of each province in China from three aspects: the total amount of medical resources in the region, the per capita medical resources in the region, and the high-quality medical resources in the region.

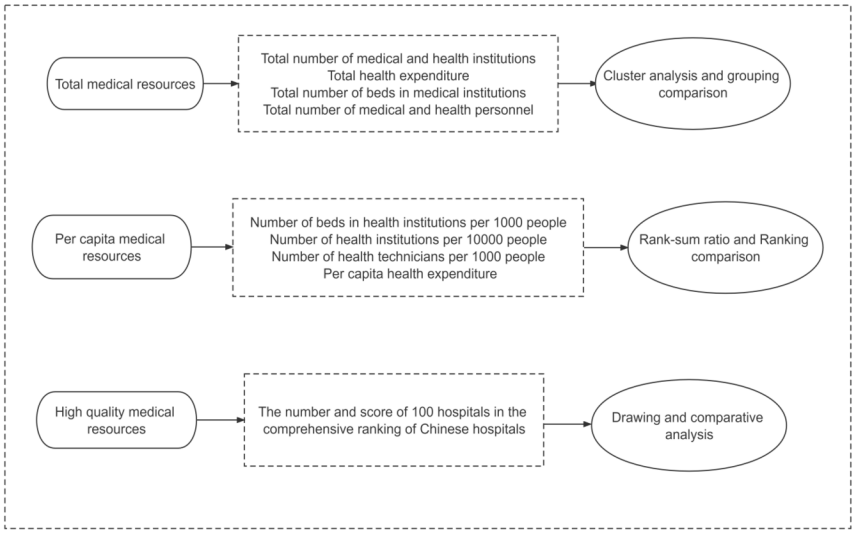

Figure 1. Research method and idea map of the article.

According to the definition of medical and health resources, human, material and financial resources cover the "hard resources" in medical and health resources. In China, due to the large differences in development status and statistical caliber among provinces, the selection of medical hard resources can objectively and fairly reflect the differences among regions, and has certain comparability and representativeness.Therefore, in terms of data indicators, the article focuses on "human, material and financial resources"

In order to comprehensively compare the differences of medical resources among provinces, four indicators are selected for the total number of medical and health institutions, total health expenditure, number of beds in medical institutions and number of medical and health personnel.In terms of the amount of medical resources per capita, the indicators of the number of beds of health institutions per 1000 people, the number of health institutions per 10000 people, the number of health technicians per 1000 people, and the per capita health cost were selected.In terms of high-quality medical resources, the comprehensive ranking of Chinese hospitals produced by Fudan University in 2020 was selected, and the top 100 hospitals were selected as the basis for determining the score of high-quality medical resources in each province.

The above data and indicators are all from the Annual Review of China's Statistics and the Annual Review of China's Health Statistics issued by the China Health Commission in 2020.

Analysis on the difference of total medical resources among provinces

There are gaps in the total amount of medical resources among various provinces in China. In order to facilitate and objectively compare the differences and differences in the total amount of resources between regions and facilitate analysis and induction, it is necessary to distinguish the total amount of medical resources in various regions of China, select corresponding indicators, and divide 31 provinces and cities into several categories according to the similarity of the total amount of resources allocated, and conduct comparative analysis by category groups as a unit.

As shown in Table 1, four data indicators of total medical resources have been selected.The number of medical and health institutions and beds in medical institutions can directly reflect the affordability of local areas for disease diagnosis and treatment activities, and directly reflect the material level of regional medical resource allocation. The number of medical and health personnel is the most important and objective indicator of medical and health human resources, which refers to the number of technicians who use medical and preventive equipment and are engaged in clinical services in all medical and preventive health institutions in the region. The total health expenditure of a region is composed of three parts: government, society and

individual health expenditure, which can better represent the strength of the financial investment in the medical and health field of the local region and reflect the financial situation of the local medical and health resources.

In order to facilitate grouping and comparison of differences, the index data of 31 provinces are clustered.Cluster analysis can automatically classify samples (or variables) according to their many characteristics and the degree of closeness without a priori, and produce classification results. The individual characteristics within the same class are similar, and the individual characteristics between different classes are quite different. Q-cluster analysis is to classify all observation objects according to certain properties, so that objects with similar properties are classified into the same category, and objects with large differences in properties are classified into another category. It is mainly based on the distance between different objects. The close ones are divided into one category and the far ones into different categories.This paper uses Q-type clustering and SPSS software to classify the total amount of medical resources in 31 provinces and cities in China (excluding Hong Kong, Macao and Taiwan), and selects a reasonable number of categories according to the results.

According to the ranking of provinces in China's annual statistical examination, the total medical resources of 31 provinces in China are clustered, and the hierarchical chart of cluster analysis is shown in Figure 2.

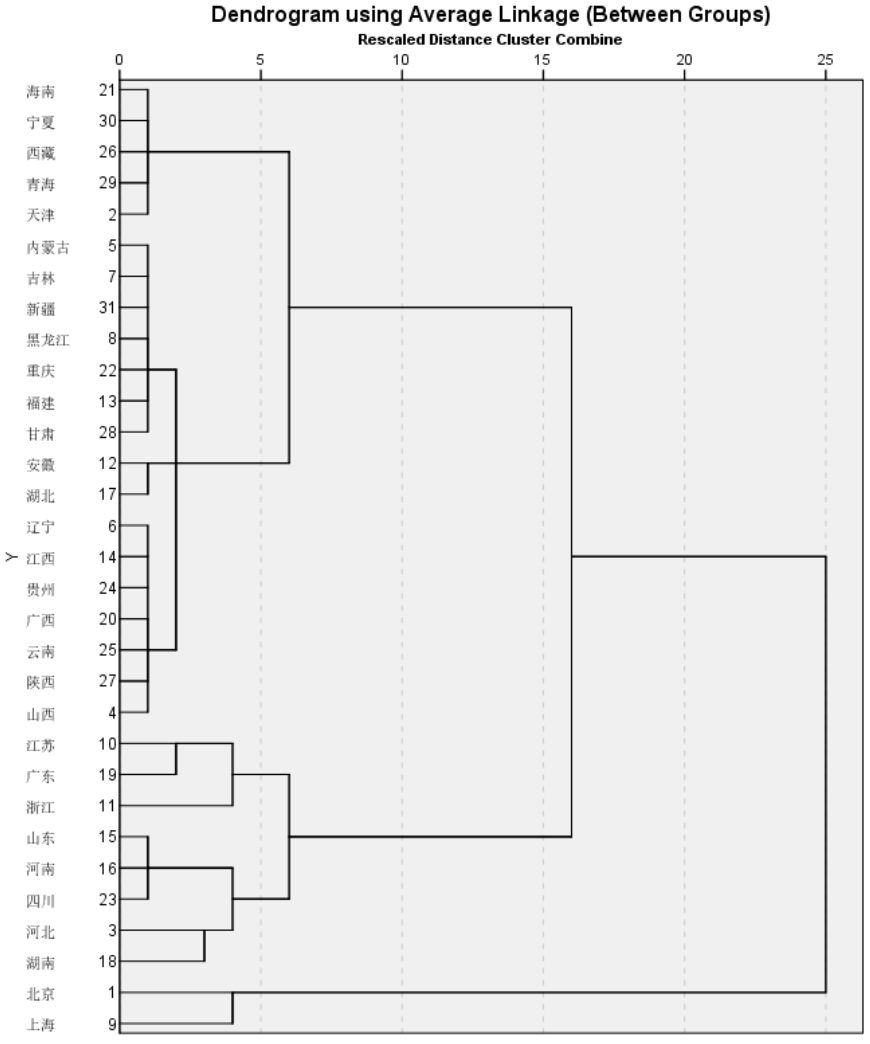

Figure 2. Cluster analysis pedigree.

As shown in Figure 2, according to the hierarchical clustering tree, in order to highlight the characteristics of the total amount of medical resource allocation in the regions and highlight comparability, it is selected to be divided into five groups, and the specific regions included in each group are shown in Table 1 below.

Table 1. Cluster grouping of total medical resources in China's provinces in 2020.

category	Province
Group 1	Hainan, Ningxia, Tibet, Qinghai, Tianjin
Group 2	Inner Mongolia, Jilin, Xinjiang, Heilongjiang, Chongqing, Fujian, Gansu, Anhui, Hubei, Liaoning, Jiangxi, Guizh
Group 3	Jiangsu, Guangdong, Zhejiang
Group 4	Shandong, Henan, Sichuan, Hebei, Hunan
Group 5	Beijing, Shanghai

The grouping results are shown in Table 1. The first group includes Hainan, Ningxia, Tibet, Qinghai and Tianjin. Except for Tianjin, which is a municipality directly under the Central Government of China, Ningxia, Qinghai and Tibet are all located in the west of China, while Hainan is located in the southernmost part of China. From the perspective of geographical location and historical development, the population in this region is small, and the GDP and economic level are at the backward level of China. The second group includes Inner Mongolia, Jilin, Xinjiang, Heilongjiang, Chongqing, Fujian, Gansu, Anhui, Hubei, Liaoning, Jiangxi, Guizhou, Guangxi, Yunnan, Shaanxi and Shanxi. The second group has a large number of regions. From the perspective of geographical location, it is mainly the northeast, central, southwest and northwest regions of China. The third group is Jiangsu, Zhejiang and Guangdong, which are located on the east coast and the south coast of China. They are economically developed regions in China and the core provinces of the Pearl River Delta and the Yangtze River Delta. The fourth group is Shandong, Henan, Sichuan, Hebei and Hunan provinces, which are located near the central region of China. The fifth group is Beijing and Shanghai, which are also the first tier cities in China.

Table 2. Overview of total medical resources in Group 1.

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of beds in medical inst
Tibet	6939	4.1	1.9
Qinghai	6407	6.4	4.1
Hainan	6127	9.4	5.9
Tianjin	5838	14.3	6.8
Ningxia	4574	7.2	4.1

As shown in Table 2,the first group of regions composed of Hainan, Ningxia, Tibet and other provinces, except that the total health expenditure remains around 5000 yuan, which is at the middle level of China, the number of medical institutions, the number of medical personnel and the number of beds in medical and health institutions are about 6000, 83000 and 46000 respectively, which are at the lowest level of China.

Table 3. Overview of total medical resources in Group 2.

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of beds in medi
Shanxi	41140	35.1	22.4
Jiangxi	36716	36.8	28.6
Hubei	35447	53.8	41.1
Shaanxi	34983	44.5	27.2

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of beds in medi
Liaoning	34131	40.2	31.5
Guangxi	33875	47.2	29.6
Anhui	29391	50.3	40.8
Guizhou	28880	36.7	27.6
Fujian	28105	35.1	21.7
Yunnan	26626	45.9	32.5
Gansu	26204	22.9	17.2
Jilin	25616	27.3	17.3
Inner Mongolia	24549	25.5	16.2
Chongqing	20922	30.2	23.6
Heilongjiang	20461	31.0	25.3
Xinjiang	18158	24.5	18.2

As shown in Table 3,From the average medical resource data of the second group of regions in Inner Mongolia, Anhui, Heilongjiang and Jiangxi, it can be seen that the comprehensive level of medical resources in these regions is also at a lower level in China: the average number of medical institutions in the second group is less than 30000, the average number of medical personnel is 367000, the average number of beds is 263000, and the total health expenditure is around 3000 to 4000, which is at a lower level in China.

Table 4. Overview of total medical resources in Group 3.

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of beds in medical i
Jiangsu	35747	82.3	53.5
Zhejiang	34400	66.0	36.1
Guangdong	55900	100.6	56.5

The third group includes Jiangsu, Zhejiang and Guangdong. As shown in Table 4,The average number of medical personnel is 830000, which is in the forefront of China; The average of the total health expenditure, the number of beds in medical institutions and the number of medical institutions were 557.48 billion yuan, 487000 and more than 77000, respectively, which were at the upper middle level in China. The overall medical resources are abundant.

Table 5. Overview of total medical resources in Group 4.

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of beds in medical ins
Hebei	86939	67.5	44.2
Shandong	84872	102.8	64.7
Henan	74644	94.0	66.7
Hunan	56042	61.4	52.0
Sichuan	82793	82.4	65.0

As shown in Table 5,The fourth group of provinces and regions, represented by Sichuan and Hunan, has a large base number of medical institutions, averaging more than 77000, and the corresponding number of beds of medical institutions has reached 585000, which is also at a higher level in China, and its number is far more than that of other regions. In terms of manpower, the medical and health personnel with an average of 816000 are very close to the average level of the third group, and also in the forefront. In addition, Henan, Shandong, Sichuan and other populous provinces have the highest number of medical personnel in China.

Table 6. Overview of total medical resources in Group 5.

province	Number of medical institutions	Number of medical personnel (ten thousand)	Number of medical personnel (
Beijing	10599	34.8	12.7
Shanghai	5897	26.1	15.2

As shown in Table 6,The fifth group of regions composed of Beijing and Shanghai has obvious economic advantages: on average, they have a total health expenditure of up to 1.2 trillion yuan, more than twice that of other regions. However, because it is a municipality directly under the Central Government and its urban area is limited, its number of beds in medical institutions and the total resources of medical personnel are far behind the second, third and fourth groups.

4.Analysis on the difference of per capita medical resources in different provinces

In different provinces, due to different population bases, simply comparing the total amount of medical and health resources or the top quality medical resources among provinces and cities cannot reflect the regional fairness and balance. Therefore, if we want to compare the level of basic medical resources in different regions and analyze the difference of medical resources in different regions, the per capita medical resource data has more practical significance and value.

Considering the comparability and operability of the selected data indicators to reflect the regional per capita data resources, the per capita medical resources of each province in China are also selected from the perspectives of human, material and financial resources. Therefore, four detailed secondary medical and health resource data indicators are selected to form the evaluation indicator group. In terms of manpower, the number of health technicians reflects the characteristics of human resource attributes in medical and health resources. In order to facilitate comparison, after calculation, the number of health technicians per thousand people is selected as the data indicator. In terms of material resources, the number of medical and health institutions per 10000 people and the number of beds per 1000 people are very basic and important indicators for the needs of the people, which can well reflect the level of infrastructure capacity of a region's medical resources and material resources. The per capita health expenditure is still a measure of the level of medical related financial resources in the local area.

Table 7. Evaluation index system of per capita medical resources in all provinces of China.

Indicator group	Specific indicators
Material index group	R_1 Number of beds in health institutions per 1000 people
	R_2 Number of health institutions per 10000 people
HR indicator group	R_3 Number of health technicians per 1000 people
Financial indicator group	R_4 Per capita health expenditure

In order to compare the difference of per capita medical resources among various provinces in China, the rank sum ratio comprehensive evaluation method was used to rank and classify provinces.

Rank sum ratio(RSR) comprehensive evaluation method is the most common method used to analyze economic, resource and other data in different groups. Its principle is to obtain dimensionless statistics RSR through rank conversion in several groups of index data; Then the distribution of RSR is studied by using the concept and method of parameter statistical analysis; The RSR[9] value is used to rank the advantages and disadvantages of the evaluation objects, so as to make a comprehensive evaluation of the evaluation objects. In order to accurately classify and rank the per capita medical resources in 31 provinces and cities in China except Hong Kong, Macao and Taiwan, the article uses RSR rank sum ratio comprehensive evaluation method to analyze the secondary indicators in the evaluation index system of per capita medical resources

in Table 7.

In the analysis of per capita medical resources in China's provinces in 2020 by using RSR, the following steps were followed: 1. Ranking. The four evaluation indicators of China's 31 provinces and cities in 2020 are arranged into 31 rows and four columns of the original data table. As the selected indicators are all high quality indicators, the compilation rank is directly from low to high. The resulting rank matrix. 2. Calculate the rank sum ratio of 31 provinces and cities in China. 3. Calculate the cumulative frequency Pi. Refer to the Comparison Table of Percentages and Probability Units to obtain the probability unit probit corresponding to each Pi value. 4. Calculate the linear regression equation. RSR=a+b* probit ◦ 5. Sort by file. Taking the probability unit probit as the grading boundary value, this study is divided into five grades according to the best grading principle.

Table 8. Ranking Results of Medical Resources Per Capita in China's Provinces.

Province	R_1	R_2	R_3	R_4	RSR
Beijing	7	6	31	28	0.64
Jilin	24	27	16	26	0.46
Qinghai	20	28	27	22	0.46
Sichuan	27	24	17	14	0.45
Shaanxi	19	23	20	27	0.44
Inner Mongolia	17	25	19	23	0.42
Hunan	28	22	10	13	0.42
Heilongjiang	29	12	11	15	0.40
Shanghai	10	1	30	25	0.40
Liaoning	26	19	12	11	0.39
Chongqing	25	13	18	11	0.37
Shanxi	14	30	2	16	0.36
Tibet	3	31	25	1	0.36
Gansu	18	26	4	8	0.36
Xinjiang	21	16	22	10	0.36
Guizhou	23	17	8	12	0.35
Shandong	13	21	13	19	0.34
Hubei	22	10	15	11	0.34
Hebei	9	29	9	6	0.31
Yunnan	19	8	6	17	0.31
Jiangsu	11	3	26	18	0.30
Zhejiang	5	7	28	24	0.30
Henan	16	18	7	7	0.30
Ningxia	6	11	23	20	0.29
Hainan	7	9	21	9	0.26
Jiangxi	12	20	5	2	0.25
Anhui	15	5	3	5	0.24
Guangxi	8	14	1	11	0.24
Tianjin	2	2	29	21	0.23
Fujian	4	15	14	4	0.19
Guangdong	1	4	24	3	0.12

Since the four indicators selected for the evaluation of the per capita medical and health resource allocation in China are all high priority positive indicators, they are ranked according to the indicator values from small to large. The average rank is compiled for those with the same indicator value, and the RSR of each region is calculated. The results are shown in Table 8 above. In the result of group RSR distribution, Beijing

has the best RSR, which is 0.64; The worst is Guangdong City, with the RSR of 0.12, which is nearly five times the difference. The value gap in other regions is also very obvious. The RSR values in Fujian, Anhui, Jiangxi and other provinces are at the bottom of China. Qinghai, Inner Mongolia and other western regions have obvious advantages in per capita medical resources.

Table 9. Linear regression results.

	Denormalization coefficient B	standard error	Standardization coefficient Beta	t	p	Vif	R^2
Constant	-0.148	0.02	-	-7.49	0.000^{***}	-	0.9
Probit	0.097	0.004	0.978	25.397	0.000^{***}	1	

Note: * * *, * * and * represent the significance level of 1%, 5% and 10% respectively

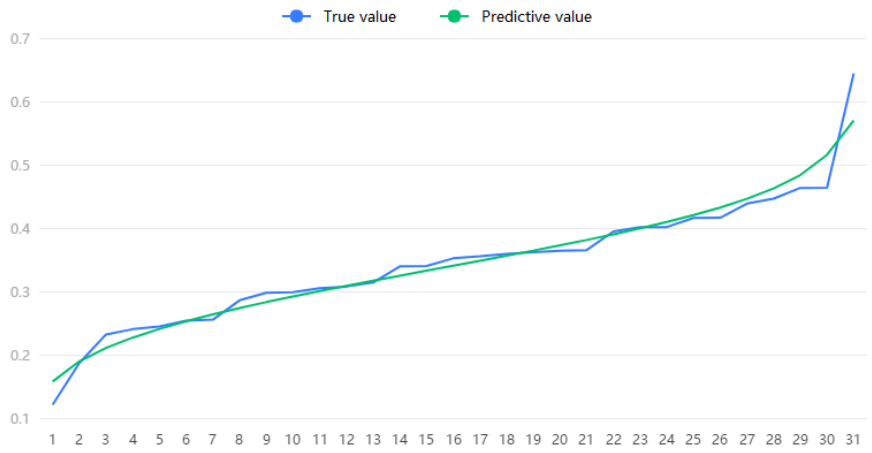

Figure 3. Effect Diagram of Model Curve Fitting

As shown in Table 9 and Figure 3,The correlation analysis results of the rank sum ratio and the probability unit Probit show that, from the analysis of the results of the F test, the rank sum ratio and the probability unit Probit are highly positively correlated (R=0.990, P¡0.001). The original hypothesis that the regression coefficient is 0 is rejected, and the goodness of fit of the model R^2 is 0.957, the model performance is excellent, so the model basically meets the requirements, and the model is well constructed. The formula of the model is y=-0.148+0.097 * Probit, and the equation is statistically significant.

Table 10. Table of Graded Sorting Critical Values.

Grade	Percentile threshold	Probit	RSR threshold (Fitted value)
Grade 1	96.407 ˜	6.8 ˜	0.5109 ˜
Grade 2	72.575 ˜	5.6 ˜	0.3946 ˜
Grade 3	27.425 ˜	4.4 ˜	0.2784 ˜
Grade 4	3.593 ˜	3.2 ˜	0.1621 ˜
Grade 5	<3.593	<3.2	<0.1621

According to the RSR comprehensive evaluation score of per capita medical resource allocation in 31 provinces and cities in China, and in combination with the critical value table 10 for ranking, these provinces are ranked and classified according to the score from low to high. According to the regional characteristics,

scale and comparability principle, China's 31 provinces and cities are divided into five grades.

Table 11. Graded results of per capita medical resource allocation in 31 provinces and cities of China. (excluding Hong Kong, Macao and Taiwan)

Grade	Level	List of provinces
Grade 1	High	Beijing, Qinghai
Grade 2	Higher	Inner Mongolia, Shaanxi, Jilin, Heilongjiang, Shanghai, Sichuan, Hunan
Grade 3	Secondary	Hubei, Gansu, Tibet, Yunnan, Guizhou, Chongqing, Henan, Shandong, Zhejiang, Jiangsu, Liaoning,
Grade 4	Lower	Tianjin, Guangxi, Hainan, Jiangxi, Fujian, Anhui, Ningxia
Grade 5	Low	Guangdong

As shown in Table 11, the fifth level is only in Guangdong Province, and its per capita comprehensive medical resource allocation is also the lowest level in China. The fourth category includes Tianjin, Guangxi, Hainan, Jiangxi, Fujian, Anhui and Ningxia. Except for Tianjin, other regions are concentrated in the central and southern regions of China. The per capita medical resource allocation in these regions is at a low level in China. The third tier includes 14 provinces and cities including Hubei, Gansu, Tibet, Yunnan, Guizhou, Chongqing, Henan, Shandong, Zhejiang, Jiangsu, Liaoning, Shanxi, Hebei and Xinjiang. The per capita level of medical resources in these regions is at the middle level of China. The fourth level includes 7 provinces and cities including Inner Mongolia, Shaanxi, Jilin, Heilongjiang, Shanghai, Sichuan, and Hunan, with relatively sufficient medical resources per capita. The first level is Beijing and Qinghai, which rank first among the per capita medical resources in China.

According to the comprehensive evaluation score of RSR and the results of sorting and grouping, the per capita medical resource allocation level in 31 provinces and cities in China (excluding Hong Kong, Macao and Taiwan) is divided into five levels, which are arranged according to the comprehensive score of RSR and drawn into a regional distribution chart, as shown in Figure 4.

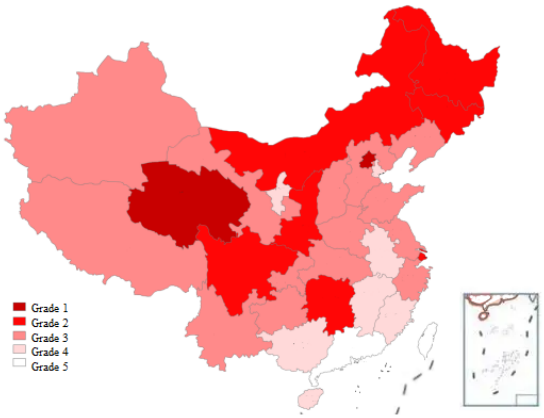

Figure 4. Level distribution of per capita medical resources in 31 provinces of China.

From the perspective of regional distribution, the fifth and fourth grade provinces and cities with relatively high per capita medical resources in China are mainly distributed in the northeast and western regions of

China. Most other provinces in the central region are in the second grade except Hunan Province, which is in the fourth grade. The per capita medical resource level in Anhui, Jiangxi, Fujian, Guangxi, Ningxia, Hainan and other regions is at the bottom of China, and the per capita medical resource level in Guangdong Province is the only one that has been separately classified in the first level, indicating that the per capita medical resource level in Guangdong Province has a large gap compared with other regions and is at a very backward level.

The gap in the number of medical beds per thousand people in various regions of China is relatively stable, which is basically about 6. Hunan, Sichuan and other regions have reached nearly 8 units, which is a high level. The number of medical beds per thousand people in Guangdong Province is only 4.5, which is the lowest level in China. Due to the great difference in population between regions in China, the number of medical institutions per 10000 people in Tibet is 18.96, ranking the first in China. The number of medical institutions per 10000 people in Shanghai is only 2.37, ranking the lowest in China, which is very different from that in Tibet.

Due to the high economic level of Beijing, Shanghai and other regions, the per capita health expenditure of both regions has exceeded 10000 yuan, which is in the forefront of China. Compared with the low level of Anhui Province, the difference in value is four to five times, and the difference between different regions is significant. In terms of the number of health technicians per 1000 people, Beijing still ranks first in China with 12.6 people. It has significant advantages in medical and health human resources. The basic value of other regions remains around 6to7, with a small gap. It is worth noting that Jiangsu Province and Guangdong Province, as the developed provinces with the highest GDP output in the eastern and southern regions of China, do not show their unique economic advantages in terms of per capita medical and health resources. Jiangsu is at the middle level, while Guangdong is at the bottom one.

5.Analysis on the differences of high-quality medical resources in different provinces

In China, there is no clear definition of high-quality medical resources. Generally speaking, high-quality medical resources refer to the advantages of regional medical and health institutions, such as larger scale, higher technical level of medical and health personnel, and more complete equipment, compared with ordinary medical institutions. This paper uses the 2020 "Comprehensive Ranking List of Chinese Hospitals" and "Professional Reputation Ranking List of Chinese Hospitals" issued by the Hospital Management Research Institute of Fudan University in Shanghai as the evaluation criteria for high-quality medical resources. According to the "reputation weight" and "scientific research weight" of the top 100 hospitals in China, the top 100 third tier hospitals in China are scored and calculated, and finally the ranking is obtained.

From the distribution of the number of top 100 hospitals in provinces, Beijing, Shanghai and Guangdong accounted for nearly half of the total. Beijing, Shanghai and Guangzhou are also the first tier cities in China. These regions have a solid foundation of economic strength. The level of medical research is higher than that of other regions. Both quantity and quality have reached the leading level in China. Secondly, with the economic advantages of the provinces, Jiangsu and Zhejiang have also developed rapidly in medical professional technology. Among the 31 provinces and cities in China, only 19 provinces have top 100 hospitals.Fudan University released the "Comprehensive Ranking List of Chinese Hospitals in 2020", which scored and calculated the reputation and scientific research level of each hospital. The ranking was also based on the sum of "reputation score" and "scientific research score". In order to further highlight the differences in the distribution of China's top 100 hospitals among regions, the paper establishes the scores of the number of top 100 hospitals in provinces, which can more accurately measure the status of high-quality medical resources in regions.

Score of high-quality medical resources in a province=reputation score of all top 100 hospitals in the province+scientific research score.

After statistics and summation calculation, the total score of high-quality medical resources in all provinces of China is obtained, as shown in Figure 5 below.

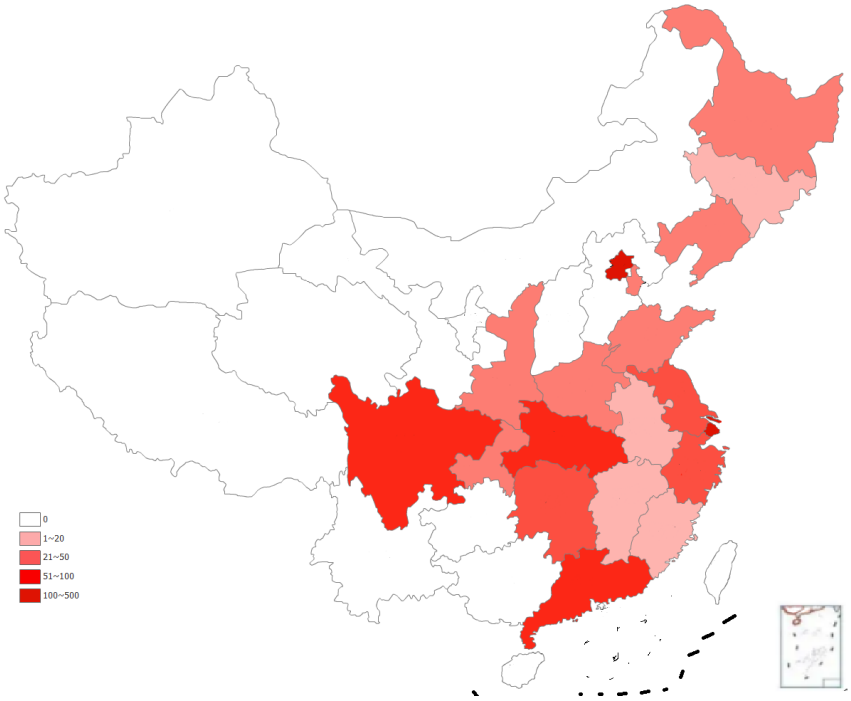

Figure 5. Distribution of high-quality medical resources in 31 provinces of China.

As shown in Figure 5, the regional color level represents the comprehensive score of the top 100 hospitals in the region, which can reflect the quality of medical and health resources in the region. From the regional perspective, most provinces and cities in the west, northwest and southwest of China do not have a top 100 hospital, and the comprehensive score is zero. Superior medical resources are concentrated in the central and eastern regions of China. Beijing, Shanghai, Sichuan, Hubei and Guangdong are all regions with relatively developed high-quality medical resources. Obviously, there are great differences in the distribution of high-quality medical and health resources between the eastern and western regions.

6.Conclusion and prospect

The results show that: (1) In terms of the total amount of medical resources, there are significant differences in medical resources among regions in China. The total amount of medical resources in the western region is much less than that in the eastern region, showing a situation of "more in the east and less in the west" as a whole. In Hebei, Guangdong, Henan, Shandong and other populous provinces, they have a large amount of medical resources. Beijing and Shanghai have great advantages in medical and health financial resources, while Hainan, Ningxia, Tibet, Qinghai and other remote areas are extremely backward in terms of human, material and financial resources. (2) China's high-quality medical resources are extremely distributed: the top 100 hospitals are mainly distributed in the first tier and economically developed cities, such as Beijing, Shanghai and Guangzhou, which account for half of the list of "top 100 hospitals". Nearly half of the provinces in China have no hospitals on the "Top 100" list, and the trend of extreme distribution is obvious. (3) There is a large difference in medical resources per capita in China. The three northeastern provinces, Inner Mongolia, Qinghai, Sichuan, Beijing and Shanghai have a high level of medical resources per capita. Anhui, Jiangxi, Guangdong, Ningxia and other provinces have low levels of medical resources per capita. (4) The per capita medical resources and the total amount of medical resources in the region are not balanced. Guangdong ranks first in the total amount of various medical resources and has considerable advantages in the total amount, but the per capita basic medical resources are the last in China.

In recent years, global public health events have occurred frequently, and the development of medical and

health undertakings in various countries has faced new challenges. In terms of the development layout of medical resources, more attention should be paid to the differences between regions and provinces, and targeted strategies should be taken to promote the balanced development of medical and health resources.

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