Evaluation of Health and Fairness in Medical Facilities in China National-Level

Hanzhi Yang
Xi'an Jiaotong-Liverpool University, Suzhou 215004, China.

Abstract: The right to health is the most basic right of residents. The distribution of public medical facilities is also closely related to the quality of life of residents. Based on the fairness of medical facilities, this paper will take China's provinces as the research unit, and evaluate the fairness of medical facilities from three levels (equity index, health demand, the degree of health and equity). In terms of fairness index, the distribution of medical resources in each province is relatively balanced. In terms of health demand, the central and north western provinces have higher demands, and the north eastern provinces have lower demands. In terms of the degree of health and equity, the distribution of medical facilities in various provinces in China is uneven. Through these three levels, gradually deepen the research and discuss the characteristics of the distribution of medical facilities in China, and provide some suggestions to improve them according to the evaluation results.

Keywords: Health Equity; GIS; Medical Facilities

1. Introduction

Medical facilities are one of the most important public facilities in a city and an important criterion for evaluating the level of urban development. Whether the spatial distribution of urban medical facilities is fair and reasonable also directly affects the quality of life of residents [2]. However, due to the scarcity of resources and unbalanced development, the distribution of medical resources is often unfair and inefficient. How to establish an efficient and fair medical system that can control the allocation of resources according to health needs is crucial to the sustainable development of society [6]. Using GIS to analyse the spatial layout of existing medical facilities and scientifically evaluating their fairness can provide a strong basis for the formulation and planning of subsequent policies.

In previous studies, GIS is often used to analyse the fairness of the spatial layout of different medical facilities based on human needs [1,8,9]. From these studies, it is a common method to evaluate medical facilities based on the needs of people (especially the elderly and children). Lackof assessments from national-level for medical facilities. Based on this, this paper will analyze the spatial distribution of medical resources on the basis of fairness and people's health demand at national-level in China.

Author	Details
Alegana et al. (2012)	Alegana et al. (no date) used GIS to predict the future demand for health care facilities by analyzing the use of health care facilities for children under five years of age with fever in Namibia.
Wu and Fan (2020)	Wu and Fan (2020) used GIS to analyze the health equity of the distribution of urban and rural health care facilities, using Changsha City as an example.
Yu (2021)	Based on GIS information system, Yu (2021) evaluated the fairness of distribution of primary health care facilities in Fuzhou from two aspects of daily demand satisfaction and road resistance.

Figure 1: Previous studies (Made by author,2022)

Figure 2: Research area (Made by author,2022)

2. Method
2.1 Study area and data source

The research area of this paper is mainland China (including 31 provinces, excluding the Nansha Islands), with 31 provinces as the research unit (Figure 2). The population data and medical facility data for this study were obtained from the 2020 National Statistical Yearbook. The map data comes from Learning mall. The poi data of medical resources comes from hospitals in GEOFABRIK (2020). After data cleaning, a total of 1686 hospitals were screened.

2.2 Method and research steps

The research is mainly divided into four steps. Firstly, the relationship between the layout of medical facilities nationwide and the population, as well as the aggregation and dispersion of facilities, is analyzed as a whole. The second is to evaluate by calculating the fairness index method:

$$R_i = [1 - \frac{1}{2} \mid \frac{X_i}{\sum X_i} - \frac{Y_i}{\sum Y_i} \mid] \times 100\%$$

Xi is the population of the 'i' research unit; ΣXi is the total population; Yi is the number of medical facilities corresponding to the 'i' research unit; ΣYi is the sum of the medical facilities; Ri is the fairness index of the i research unit, the closer the value is 100% means higher fairness. Then it is divided into five categories according to the quantile method: Highest, Higher, Medium, Lower, and Lowest. The third step is to evaluate the health needs of the elderly and children by the proportion of the population. Finally, the results of the second and third steps are spatially superimposed on ArcGIS to obtain the degree of health equity of medical facilities in different regions [9].

3. Results and Analysis

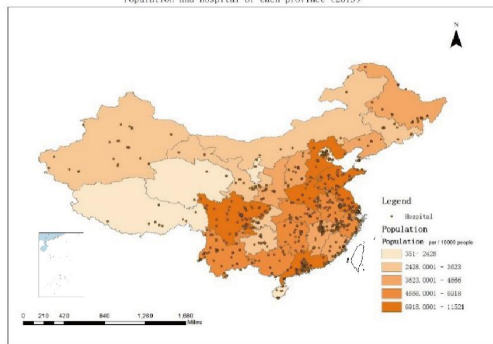## 3.1 Generally evaluation of the spatial distribution of medical facilities

Figure 3 Population and hospital of each province (Made by author,2022)
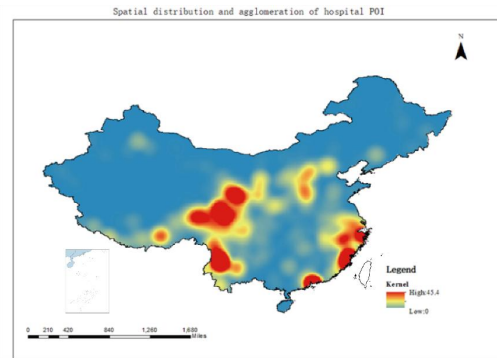

Figure 4: Spatial distribution and agglomeration of hospital (Made by author,2022)

According to Figures 3 and 4, the distribution of medical resources in my country is relatively unbalanced, showing that the southwest and southeast coastal areas are relatively dense, and the northwest area is relatively sparse. In addition, most provinces with large populations also have more medical resources. However, the three populous provinces of Henan, Hebei and Shandong have fewer medical resources. This is consistent with the cluster analysis results of my country's economic development in Liu and Lu's research [5]. Therefore, the unbalanced distribution of medical resources may be related to the unbalanced regional economic development. Besides, the medical distribution density in some rural areas at the border of provinces is low, which reflects the uneven medical resources between urban and rural areas in China (Figure 4).

3.2 Fairness index and health demand analysis

To further explore more specific situations, the calculation of the equity index will be used to assess the equity of regional medical resources. From the results, the provincial distribution of medical resources in my country is relatively balanced, and the overall index is relatively high. The lowest is 97.08% in Shandong, and the highest is more than 100% in Beijing (Figure 5). From the perspective of spatial distribution, municipalities directly under the central government, such as Beijing and Shanghai, have relatively high index, while the index of central regions is relatively low. This is consistent with the situation in the overall analysis. However, what differ from overall analysis is that the northwest provinces with fewer medical facilities and low kernel density have higher fairness while Guangdong Province's index is relatively low. Taking into account the calculation of the fairness index, this is due to the impact of population, so that some areas with rich resources are still unable to meet people's medical needs, and areas with less resources also have fewer medical needs.

Equity issues need to consider the needs of different social groups, and public service facilities need to be targeted rather

than standardized [3]. The elderly and children have a higher demand for medical facilities [8]. In order to be more specific, Figure 6 shows the spatial distribution characteristics of health needs according to the total proportion of elderly people over 65 years old and children aged 0 to 14 years. The results show that the central region and the northwest region have more elderly and children, and the higher the health needs, while the northeast region is less.

Some areas with rapid economic development in the previous article, such as Beijing, Shanghai, and Guangdong, also have less demand. Demographic structure affects regional health needs to a certain extent.
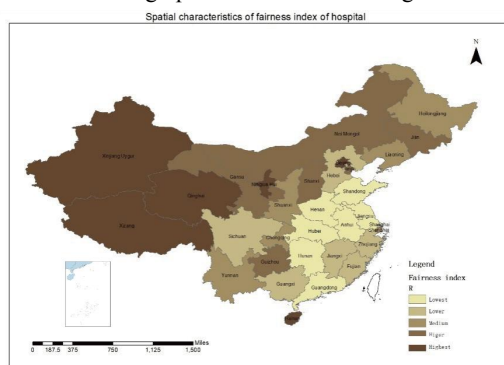

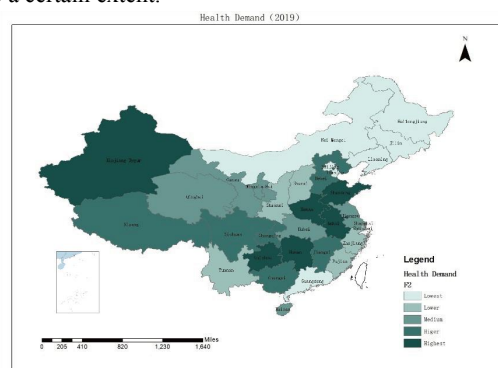Figure 5 Spatial character of fairness index (Made by author,2022)

Figure 6 Health demand (Made by author,2022)

3.3 The degree of both health and fairness analysis

To facilitate comparison and evaluation, Figures 7 and 8 show the results and corresponding tables according to the spatial overlap method in ArcGIS. There are 19 provinces in the health and fairness or critical value, accounting for more than 50%. There are 4 provinces with level 1 inequity, 1 province with level 2 inequity, 6 provinces with level 3 inequity, and 1 province with level 4 inequity. In general, China still faces the problem of unbalanced regional development of medical facilities. The central region has the lowest level of health equity, especially Henan, Anhui, Shandong, and Hunan with the most serious problems. According to the research of Liu et al. [6], these regions are all provinces with large grain production and a large population base, but also face the problem of population loss and relatively backward economic development. The other regions are generally better.

The degree of health Demand Fairness index	Highest	Higer	Medium	Lower	Lowest
Highest	The critical value of fairness	Health and fairness	Health and fairness	Health and fairness	Health and fairness
Higer	Level 4 Unfairness	The critical value of fairness	Health and fairness	Health and fairness	Health and fairness
Medium	Level 3 Unfairness	Level 4 Unfairness	The critical value of fairness	Health and fairness	Health and fairness
Lower	Level 2 Unfairness	Level 3 Unfairness	Level 4 Unfairness	The critical value of fairness	Health and fairness
Lowest	Level 1 Unfairness	Level 2 Unfairness	Level 3 Unfairness	Level 4 Unfairness	The critical value of fairness

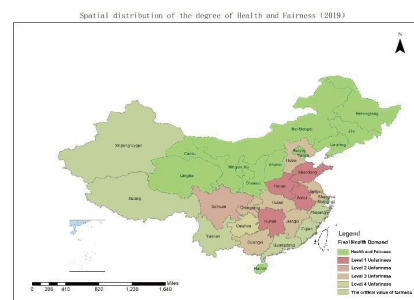Figure 7 Health and fairness evaluation (Made by author,2022)

Figure 8 Spatial distribution of the health and Fairness degree (Made by author,2022)

4. Discussion and Conclusion

This study takes the provinces in mainland China as the research unit, not only analyzes the overall spatial distribution of medical resources in mainland China, but also superimposes the equity index and the degree of health demand through the spatial overlay in ArcGIS to obtain the health equity assessment of each province.

Overall, there are three main problems in the spatial layout of medical facilities in my country. First, the density of medical resources varies between provinces and between urban and rural areas. According to Lie et al. [4], the country's financial investment in medical resources in the western region far exceeds that in the central region, where the problem is more serious. In response to this problem, the government should increase financial subsidies to the central region to help the central region accelerate the construction of medical resources. In addition, it optimizes medical resources at different levels to help the construction of medical facilities in rural areas.

Second, the distribution of medical resources in some regions cannot meet people's needs, especially the elderly and children. Optimize and adjust medical resources in areas with severe aging and more newborns, and promote aging-appropriate and children-friendly medical facilities.

Third, high-quality medical resources in some regions are too concentrated (for example, the fairness index in Beijing exceeds 100%). The municipalities directly under the Central Government with rapid economic development and the southeastern coastal areas have relatively intensive medical resources. Therefore, it is necessary to improve the utilization rate of medical resources. The government needs to encourage and support the development of medical care, promote the application of telemedicine technology and speed up the construction of medical cooperation, and solve the problems of distance and accessibility through technology.

Restricted by many factors, this article also has certain limitations. First of all, the data of medical facilities is only at the hospital level, and there is a lack of poi of some primary medical facilities. Second, the data mainly from the 2020 Statistical Yearbook may lack timeliness. The third only considers the fairness of population distribution, and lacks the fairness of geographical distribution and the analysis of accessibility. In future research, the fairness of geographical distribution will also be included in a comprehensive analysis to promote the sustainable development of regional medical facilities.

References

[1] Alegana VA. et al. (2012) 'Spatial modelling of healthcare utilisation for treatment of fever in Namibia', International Journal of Health Geographics, 11.

[2] Ding S, Chen BZ. (2017) 'Rationality assessment of the spatial distributions of urban medical facility', Journal of Geo-information Science, 19(2), pp.185-196.

[3] Erkip F. (1997) 'The distribution of urban public services: the case of parks and recreational services in Ankara', Cities, 14(6), pp.353-361.

[4] Lei P. et al. (2019) 'Evaluation of the status quo of medical resource allocation and service utilization in China', Health Economics Research, 36(5), pp. 50–55.

[5] Liu G. and Lu Y. (2018) 'Cluster analysis of regional economic development level in China', Productivity Research, (1), pp. 68–71.

[6] Liu N. (2014) 'A Research on the Effect of Rural Human Capital Drain on Regional Agriculture Growth:Based on the Panel Data of 13 Major Grain Production Provinces', Population & Economics, (4), pp. 23–32.

[7] Yan FR (2010) 'Equity assessment of resources allocation of Chinese health services', Chinese Health Resources, 13(6), pp.122-143.

[8] Yu N. (2021) 'Assessing equity of the spatial distribution of primary health care facilities in Fuzhou City, China: A comprehensive method', PLoS ONE, 16(12), pp.122-143.

[9] Wu MJ. et al. (2020) 'Assessment and Suggestions on the Configuration of Medical Service Facilities in Urban and Rural Areas from the Perspective of Health Equity: A Case Study of Changsha City', Architecture & Culture, (12), pp. 131–133.