

Is Health Material Allocation in Beijing Equitable? Analysis on Health Institutions in 2016

Le Yang¹ and Hongman Wang^{1,*}

¹The School of Health Humanities, Peking University, Beijing, China

**corresponding author*

Keywords: health material, equality, Beijing, Gini coefficient, Theil L index

Abstract: Objective: Health material plays important role in people's health protection and promotion, especially the hospitals and primary health institutions. The unsatisfactory equality in health resource allocation is common in China and many developing countries, even in some developed countries. This paper aimed at evaluating and discussing the equality in health institutions allocation in Beijing, China. Data sources/study setting: The data was collected from 16 districts of Beijing, not including the military hospitals. For government planning purposes and the functional difference, the 16 districts were divided into four divisions in this paper. Data collection/extraction methods: In this study, we evaluated and measured the equality in health institutions allocation in Beijing, extracting data from *Beijing Regional Statistical Yearbook 2017*. We used the methods of Lorenz Curve, Gini coefficient and Theil L index to measure the equality at within and between the divisions. Principal findings: As the population density, the Gini coefficient for all health institutions was 0.21, for hospital was 0.11, and for primary health center was 0.17, showing perfectly equitable. But there was less equality in the density of geographical area. Compared with all health institutions and primary health center, hospital allocation was less equitable. The Thiel L index showed the inequalities of hospital allocation were mainly from the four divisions. Conclusions: The results showed that the health institutions allocation in Beijing was perfectly equitable in population size, but imbalanced in geographical area size. All health institutions and primary health center were generally equitable in the allocation in Beijing, but hospital allocation should be paid more attention. Governments needed to think more carefully about current distribution of health institutions, especially the hospital, at both the sub-provincial level and provincial level.

1. Introduction

The Sustainable Development Goals (SDGs), which is built on the success of the Millennium Development Goals (MDGs) and aim to eradicate the poverty and promote the equality, has been issued in 2016 [1]. Poverty and inequality are the two critical issues that almost every country attempt to eliminate and are looked as implicit part of the social welfare and social security system [2-3]. The inequality in health resources, which is influenced the effectiveness, accessibility and sustainability of health services and medical system, is one of the most important aspects of health care systems [4-6]. In recent years, the Chinese government has been emphasizing the accessibility

and equity of health resources and services, and has taken the accessibility and equity of health resources and services as important indicators to measure the effectiveness of health system [7-8].

In China, residents mainly go to hospitals and primary medical institutions for treatment. At present, China mainly implements a hierarchical diagnosis and treatment system to reasonably divert patients. According to the basic medical insurance system for residents, residents need to go to the primary health institutions for diagnosis and treatment firstly, if the primary medical institutions can not diagnosis and treatment, and then they would be referred to the superior hospital. Under such a health system, primary care institutions can play a more crucial role in preventing the basic health and promoting regional health equity due to their large number and better accessibility [9]. However, compared with hospitals, many grassroots health institutions in China are short of resources, and the lack of resources leads to the low level in diagnosis and treatment and the poor quality of health services [10]. Some primary health institutions, such as community health service stations, are imbalanced, and their service radius fails to truly cover the residents in their community, resulting in a long distance for residents to go to primary health institutions for diagnosis and treatment. Many residents prefer to go to large hospitals for treatment even if they suffer from minor or common diseases. Therefore, in the evaluation of the equity of health material allocation, we should not only analyze the equality of hospital distribution, but also consider the equity of primary health institution.

As the capital of China, Beijing is an important political center and one of the more developed cities in China. Its medical resources and medical service level are also more advanced and concentrated than other cities. Taking Beijing as the research object for equality analysis can provide a reference for the allocation of medical resources in other developing cities and also provide a basis for the optimization of Beijing's own health material, so as to better protect the health and medical treatment rights of Beijing residents under the current medical insurance system. The health workforce distribution should not be similar translated into the perfectly equitable distribution in number among different districts or divisions. We should more stress the equitable distribution according to health coverage or the density of population and geographical area. So what about the equality in health material allocation of Beijing—that is the theme this article attempted to investigate and discuss.

2. Methods

In this study, we evaluated and measured the inequality in health material allocation in Beijing by extracting data from *Beijing Regional Statistical Yearbook 2017*. We used methods from the economics literature including the Lorenz Curve, Gini coefficient and Theil L index.

2.1. Setting

Beijing is the capital of China with a population of 21,729,000 and a geographic area of 16,410.54 square kilometers in 2016. Beijing has 16 districts, for government planning purposes and the functional difference, the 16 districts are divided into four divisions [11], Dongcheng and Xicheng belong to the Capital Core Functional Area, Chaoyang, Fengtai, Shijingshan and Haidian are contained by the Urban Function Extension Area, then the Urban Development New Area (Fangshan, Shunyi, Tongzhou, Changping, Daxing), and Ecological Conservation Area (Mentougou, Huairou, Miyun, Pinggu, Yanqing). Totally, there were 10,618 health institutions (without the military hospital) in Beijing in 2016, including hospitals, community health centers, clinics, centers for disease control and prevention, and other health related institutions.

2.2. Data

The main data sources for this analysis were collected from *Beijing Regional Statistical Yearbook 2017* [12] in Chinese. Beijing Municipal Bureau of Statistics recorded the health data on the number of all health institutions, hospitals and primary health centers (here means the community health centers and clinics), which were chosen to evaluate the equality of the health material allocation in Beijing. As the data had always been updated, we chose the data of *Beijing Regional Statistical Yearbook 2017* which was updated in 2018.

2.3. Measures of Equality

The paper firstly calculated the densities of all health institutions, hospitals, and primary health centers per 10,000 populations and per square kilometers across the four divisions. The Lorenz curve was drawn considering the cumulative percentage of the four divisions, the Gini coefficient was calculated. The Lorenz curve and Gini coefficient were chosen to investigate the inequality in the densities of all health institutions, hospitals, and primary health centers. The Gini coefficient took the values between 0 and 1, with higher values indicating higher levels of inequality [13]. The Gini coefficient was defined mathematically based on the Lorenz curve, a cumulative frequency curve which compares the distribution in income or other resources among different groups or divisions [14]. The Gini coefficient was always calculated and compared between groups or divisions with different population size or different geographical area size. It's well known that the Gini coefficient had four levels for its value: below 0.2 (perfectly equitable), between 0.2 and 0.3 (rather equitable), between 0.3 and 0.4 (proper equitable) and beyond 0.4 (warning of unfair) [15]. Meanwhile, in this paper we used the Theil L index, to measure the sources of inequality. The Theil L index consisted of two components, the between-group component and the within-group component. The between-group component measured the inequality due solely to variations in health institution density across groups (in this case, across the divisions), the within-group component measured the inter-unit variations (in this case, across the districts in each division).

The Lorenz curve and Gini coefficient were performed by Excel 2007. The Theil L index was calculated by MATLAB 2014a.

3. Results

Table 1 shows the descriptive statistics of health material allocation in Beijing, with the total number and densities of all health institutions, hospitals, and primary health centers at the divisional level. For the general number of all health institutions, the Urban Development New Area has the largest number of health institutions (4086), then the Urban Function Extension Division (3291), the Ecological Conservation Division (2005), and the Capital Core Functional Division (1236). But when it comes to the densities of all health institutions, hospitals, and primary health centers, the results show different. For the densities of all health institutions, hospitals, and primary health centers per 10,000 populations, the Ecological Conservation Division takes the highest ratio in all health institutions and primary health center, and the Capital Core Functional Division takes the highest ratio in hospitals. But according to the results of the densities per square kilometers, it shows that the Capital Core Functional Division is in the absolute advantage status, compared with other divisions.

Table 1: Numbers and densities of health material in Beijing, 2016

Region	Numbers			Density (per 10,000 population)			Density (per square kilometre)		
	All Health Institutions	Hospital	Primary health center	All Health Institutions	Hospital	Primary health center	All Health Institutions	Hospital	Primary health center
Capital Core Functional Divison	1236	115	161	5.78	0.54	0.75	13.38	1.22	1.74
Urban Function Extension Divison	3291	341	706	3.18	0.33	0.68	2.58	0.25	0.54
Urban Development New Divison	4086	188	807	5.59	0.26	1.11	0.65	0.03	0.12
Ecological Conservation Divison	2005	50	323	10.28	0.26	1.66	0.23	0.01	0.04

The Lorenz curve in Figure 1 shows the cumulative share of all health institutions, hospitals, and primary health centers against the cumulative share of population and geographical area, the four divisions are ranked with the densities of health material from lowest to highest. The equality line represents a perfectly equal distribution of health material (i.e. the division contains 20% of the general population size or geographical area size has 20% of the general health material). The closer the curve is to the equality line, the more equitable the health institutions distribution is. Figure 1 shows that at the divisional level all categories of health institutions remain quite flat when considering the population size, but there are some noticeable inequalities in health institutions allocation, especially hospital, when considering the geographical area size.

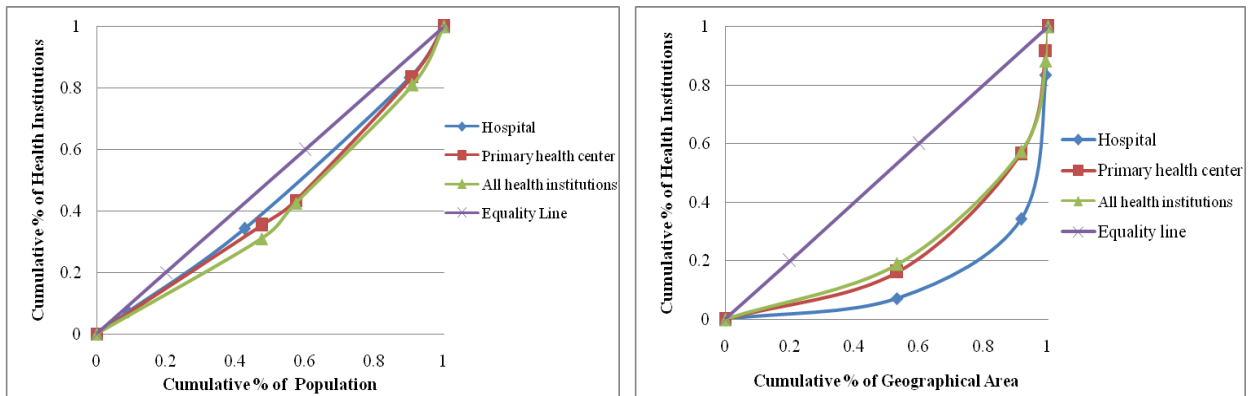


Figure 1: Lorenz curve showing the distribution of health institutions

As the density for per 10,000 populations, the Gini coefficient for all health institutions is 0.21, for hospital is 0.11, and for primary health center is 0.17, showing perfectly equitable (Gp in Table 2). However, the Gini coefficient value in the density for per square kilometers are very high, which are 0.39 for all health institutions, 0.48 for hospital and 0.42 for primary health center, indicating the unfair status of health institutions allocation (Gg in Table 2).

Table 2 shows the decomposition of health institutions inequalities based on the Theil L index. The result of Theil L index also shows the less equality in hospital allocation as the result of Gini coefficient. The inequality in hospital allocation between divisions is much higher than that within divisions. And based on the Theil L index of primary health center and all health institutions, the allocation of the two indicators is in good equality. Moreover, for the inequality within each

division, the Urban Function Extension Area's Thiel L index is higher than other divisions, which means, the inequality within this division is more serious.

Table 2: Equality of health institutions allocation across divisions and districts

Health Institutions	Gp	Gg	Thiel L index	For each division				Across districts (%)	Across divisions (%)
				Capital Core Functional Area	Urban Function Extension Area	Urban Development New Area	Ecological Conservation Area		
Hospital	0.11	0.48	0.336	0.001	0.079	0.041	0.008	0.129 (35%)	0.234 (65%)
Primary health center	0.17	0.42	0.178	0.002	0.040	0.015	0.036	0.093 (52%)	0.085 (48%)
All health institutions	0.21	0.39	0.114	0.000	0.055	0.006	0.010	0.071 (62%)	0.043 (38%)

4. Discussion

As the capital of China, Beijing has more abundant medical, health, political and economic resources than other regions, and its urban development level is relatively high. The analysis on the distribution equality of health institutions in Beijing can provide reference for other cities in China and even similar regions in developing countries around the world. The results showed that the distribution in health institutions in Beijing was perfect equitable in population size, but unfair in geographical area size. All health institutions and primary health center were generally equitable in the allocation in Beijing, but hospital allocation should be paid more attention.

The Gini coefficient in the density of population size for all health institutions, hospital and primary health center was less than 0.2, which showing the perfect equality. But given the result of Gini coefficient in the density of geographical area size, the paper found that the health institutions were allocated imbalanced, especially hospital (0.48) and primary health center (0.42). The geographically proper allocation of health institutions is vital for the accessibility and effectiveness of health service supply. When the residents could not get necessary health care service in primary health center or the primary health center is too far to visit doctor in short time, then the resident is tend to seek health service in the hospital which is near to them. Moreover, if the hospital is not allocated equitably, then the resident may directly go to the best hospital for the imbalance of medical related information. Hence, the patients' flow is disordered, the hospital, especially the big and famous hospital, would take heavy burden for limited health resources and increasing patients. Futhermore, the patients could not get the reimbursement with their current basic health insurance, for the ratio of reimbursement of their medical expense is in accordance with the level of the health institutions, when the resident has some minor illness which could be treated in the primary health center, but they might go to visit doctor in some big hospitals for they could not find health service close to their home caused by the unfair distribution of health institutions.

We also found that the distribution of hospital was less equitable in Beijing, which showed the centrality in the Capital Core Functional Area. The centrality of hospitals might cause the more and more resource, such as financial investment and workforce, flowed into those comprehensive famous hospitals, and less and less resources given to the small and unfamous hospitals and primary health institutions, this is a vicious circle. In a market economy, the flow of resources sometimes does not well-ordered and sustainable, so the ajustment and reallocation of current health resources should be condecuted by the government. Considering the current allocation of health institutions in Beijing, the government should give the priority to the hospital distribution in the four divisions and pay more attention to the balance of health resources between the four districts within the Urban

Function Extension Area, whose inequalities across districts contributed highest to the total across districts Theil L index.

5. Conclusions

In this study, the Lorenz curve, Gini coefficient, and Theil L index were used to discuss equalities in health institutions allocation in Beijing, capital of China. The Gini coefficient was analyzed both in population size and geographical size. The Theil L index was used to separate out inequalities between groups (across divisions) and within groups (across districts). This study found that, the allocation of health institution was not perfect equitable, even though the result showed equitable in population size, and the allocation of hospital need to be balanced further.

We also should take into consideration the limitations of the data in this study. We used the number of health institutions, population and geographical area data directly from the statistics yearbook, which did not contain the data from military hospitals. And this study chose Beijing, which is one of most developed cities in China, as subject, it could not represent and reflect the national level in China.

Acknowledgements

We highly appreciate the support of the Major Program of Beijing Municipal Social Science Fund (No. 17ZDA16).

References

- [1] United Nations. (2015) *Transforming our world: the 2030 Agenda for Sustainable Development*. Available at: <https://sustainabledevelopment.un.org/post2015/transformingourworld>.
- [2] Fosse E. (2013) *The politics of poverty in Norway*. *Soc Altern*, 32,31–5.
- [3] Singh GK, Daus GP, Allender M, Ramey CT, Martin EK, Perry C, Reyes AAL, Vedamuthu IP. (2017) *Social Determinants of Health in the United States: Addressing Major Health Inequality Trends for the Nation, 1935-2016*. *International Journal of MCH and AIDS*, 6(2), 139-164.
- [4] World Health Organization. (2006) *The World Health Report 2006*. Available at: http://www.who.int/whr/2006/whr06_en.pdf?ua=1.
- [5] Narasimhan, V., Brown, H., Pablos-Mendez, A., et al. (2004) *Responding to the global human resources crisis*. *Lancet*, 363,1469–72.
- [6] Wiseman, V., Lagarde, M., Batura, N., et al. (2017) *Measuring inequalities in the distribution of the Fiji Health Workforce*. *Int J Equity Health*, 16(1),115.
- [7] The State Council, The People's Republic of China. (2016) *National health conference was held in Beijing on Oct. 19 and 20*. Available at: <http://www.gov.cn/xinwen/20>.
- [8] The State Council, The People's Republic of China. (2017) *Health Planning for the 13th Five-Year Plan*. Available at: http://www.gov.cn/zhengce/content/2017-01/10/content_5158488.htm
- [9] Kreng VB, Yang C-T. (2011) *The equality of resource allocation in health care under the national health insurance system in Taiwan*. *Health Policy*,100,203–10.
- [10] Zhang T, Xu Y, Ren J, Sun L, Liu C. (2017) *Inequality in the distribution of health resources and health services in China: hospitals versus primary care institutions*. *Int J Equity Health*,16(1),42.
- [11] Beijing Municipal Bureau of Statistics and the Survey Office of the National Bureau of Statistics in Beijing. (2017) *Beijing Statistical Yearbook 2017*. Available at: <http://tjj.beijing.gov.cn/nj/main/2017-tjn/jzk/indexeh.htm>.
- [12] Beijing Municipal Bureau of Statistics and the Survey Office of the National Bureau of Statistics in Beijing. (2017) *Beijing Regional Statistical Yearbook 2017*. Available at: <http://www.bjstats.gov.cn/nj/qxnj/2017/zk/indexch.htm>.
- [13] Litchfield, J. (1999) *Inequality methods and tools, text for World Bank's site on inequality, poverty and socio-economic performance*. Available at: <http://www.worldbank.org>.
- [14] Yitzhaki, S. (1979) *Relative deprivation and the Gini coefficient*. *Q J Econ*, 1,321–4.
- [15] Zhou Y, Qin Y. (2012) *Empirical analysis on income inequality of Chinese residents*. Springer, 25. Available at: <https://link.springer.com/content/pdf/10.1007%2F978-3-642-24952-5.pdf>.