

Is the health workforce distribution in Beijing, China perfectly equitable?

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Abstract

Background: The quantity and distribution of the health workforce is one of the most important aspects of a health care system. Inequality in the distribution of the health workforce is common in China and in many developing countries. This paper aimed to evaluate and discuss inequality in the distribution of the health workforce in Beijing, China, and explain the sources of the inequality.

Methods: The study described and measured inequality in the distribution of the health workforce in Beijing using data from the *Beijing Regional Statistical Yearbook 2017*. The 16 districts of Beijing are divided into four divisions and the paper used methods from the economics literature, including the Lorenz curve, Gini coefficient and Theil L index, to measure inequality in the distribution of the health workforce at sub-provincial level in Beijing for three categories of health workers: doctors, nurses and all health workers.

Results: There are inequalities in the densities of health workers at the district and division levels. In terms of the densities of all health workers, doctors and nurses, the Capital Core Functional Division is 3.95 times, 3.82 times and 4.13 times, respectively, higher than the Urban Development New Division. All the Gini coefficients are between 0.2 to 0.3, which means that the health worker distribution is rather equitable. The Theil L index shows that the inequalities mainly come from the differences between the four divisions, and that nurses are more unequally distributed between divisions (0.28 for Gini coefficient and 0.380 for the Theil L index).

Conclusions and recommendations: According to the study findings, the inequalities in health workforce distribution in Beijing could be addressed by increasing investment in the numbers and quality of nurses, as well as by establishing additional policies to attract more health workers to work in remote areas. Chinese governments need to think more carefully about the current distribution of health workers at the sub-provincial level. [*Ethiop.J. Health Dev.* 2019; 33(1):22-27]

Key words: Health workforce distribution, equality, Beijing, health resources

Introduction

The quantity and distribution of the health workforce, which influences the effectiveness, accessibility and sustainability of health services and the medical system, is the most important aspect of a health care system (1-3). In 2013, the World Health Organization (WHO) warned that the world will be short of 12.9 million health care workers by 2035 (4), and at the threshold of 44 health workers per 10,000 people. The shift towards chronic diseases in epidemiological transition is occurring in China (5). The *2014 report on Chinese resident's chronic disease and nutrition* shows that 533 out of every 100,000 Chinese residents died from a chronic disease in 2012, accounting for 86.6% of all deaths, with cardio-cerebrovascular disease, cancer and chronic respiratory disease as the main causes. (6) With the shift towards chronic diseases in epidemiological transition and the increasing health needs of ageing populations, shortages and inequalities in health workforce could become more problematic.

The inequality in health workforce distribution exists in many developing countries, while in China the inequality commonly lies in the concentration of the health workforce in large hospitals in urban areas(7,8), and the intervention policies that the government has used to attract more health workers to work in rural grassroots and remote health institutions have always gotten unsatisfactory results for many reasons, such as poor economic conditions in the areas, and a lack of promotion and career prospects. Regions which have a better socioeconomic environment and offer career

prospects attract more health workers (9,10). In China, inequality in the distribution of the health workers is found mainly between the urban and the rural areas, and between the eastern China and the western China (11,12). However, research on inequality in the health workforce distribution within regions of China is quite rare.

As the capital of China, Beijing is the political and economic center of the country. More health resources are invested there, and more health workers prefer to work there. The high concentration of the health workforce seems not relieve the workloads of health workers in Beijing; on the contrary, inequality in the health workforce makes their workloads heavier. For example, the health personnel in Xicheng District of Beijing undertake heavy or busy work; approximately three quarters feel that there is no break during their work or that their work requires high concentration levels; and two-thirds report feeling stressed due to work overload (13). The heavy workload of Beijing doctors is probably caused by the inconsistency in population size and health workforce among different districts or divisions. The equitable health workforce distribution should not be similar translated into the absolute fair distribution in number among different districts or divisions. We believe that the equality of health workforce allocation under different population densities needs to be taken into account in the development of health resource allocation policies.

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Methods

Setting: Beijing, the capital of China, had a per capita gross domestic product (GDP) of 118,000 yuan (RMB) in 2016 and a population of 21,729,000. Beijing has 16 districts, which are divided into four divisions (14), Capital Core Functional Division (Dongcheng, Xicheng), Urban Function Extension Division (Chaoyang, Fengtai, Shijingshan, Haidian), Urban Development New Division (Fangshan, Shunyi, Tongzhou, Changping, Daxing), and Ecological Conservation Division (Mentougou, Huairou, Miyun, Pinggu, Yanqing). In terms of the relative levels of regional GDP, the Urban Function Extension Division is the highest (1,234.54 billion yuan) and the Ecological Conservation Division is the lowest (121.38 billion yuan). The population size of Urban Function Extension Division is the highest, with 10.338 million people; Ecological Conservation Division has the smallest population, with 1.951 million people.

In total, there were 10,637 health institutions in Beijing in 2016, including hospitals, community health centers, clinics, centers for disease control and prevention, and other health-related institutions. A total of 233,778 health workers (not including the health workers of military hospitals) were employed in Beijing in 2016, including 89,428 doctors and 98,048 nurses. Health workers included doctors, nurses, pharmacists, technicians, and other technical staff. Doctors were those who had passed a licensing examination and were registered at a county or higher-level health authority as either licensed doctors or licensed assistant doctors; nurses were those who had obtained nursing certification and were registered in the official information system (15). The Chinese government finances and provides the majority of health services, and most health workers are employed by the health institutions run by the government. Privately-run health institutions account for a small proportion of all health institutions. This paper used data collected from both the public and private health institutions.

Data: The main data sources for this analysis were extracted from the *Beijing Regional Statistical Yearbook 2017* (16). Beijing Municipal Bureau of Statistics records data on the number of all health workers (including licensed doctors, assistant doctors, registered nurses, pharmacists, examination technicians, midwives, imaging technicians and other health professionals), health institutions, and financial investments. The numbers of doctors and nurses, as well as the numbers of total health workers, were chosen to assess the inequality of health worker distribution in Beijing.

Measures of inequality: The researchers first calculated the densities of all health workers, doctors and nurses per 10,000 people across the four divisions. The Lorenz curve was drawn considering the distribution of the four divisions; the Gini coefficient as calculated; and the Theil L index was analyzed by

separately using the number of all health workers, doctors and nurses in each province, autonomous region and municipality. The Gini coefficient and Theil L index were chosen to investigate the inequality in the densities of health workers, doctors and nurses. The Gini coefficient and Theil L index both took values between 0 and 1, with higher values indicating higher levels of inequality (17,18). The Gini coefficient is 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 (19). The Gini coefficient is always calculated and compared between groups or divisions with different sizes of populations or geographical areas. For the data limits, we calculated the Gini coefficient based on the population density of different districts and divisions in Beijing. The Gini coefficient has four value levels: below 0.2 (perfectly equitable), between 0.2 and 0.3 (rather equitable), between 0.3 and 0.4 (proper equitable), beyond 0.4 (warning of unfair) (20). The Gini coefficient could only calculate the general inequality, not explain the sources of the inequality (between the divisions or within the divisions). Hence, we used another method, the Theil L index, to measure the sources of inequality. The Theil L index consists of two components: the between-group component and the within-group component. The between-group component measures the inequality due solely to variations in health worker density across groups (in this case, across the divisions). The within-group component measures the inter-unit variations (in the case, across the districts).

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

Results

Table 1 shows the descriptive statistics of the health workforce distribution in Beijing, with the total number and densities of nurses, doctors and all health workers at the divisional level. From the densities of health workers in each division, the ratio of health workers in Beijing is higher than the threshold of 44 health workers per 10,000 people set by the WHO. The Capital Core Functional Division has a high overall level, with 284.43 health workers per 10,000 people, 104.94 doctors per 10,000 people, and 121.06 nurses per 10,000 people. However, the Urban Development New Division, which consists mainly of remote districts, has far fewer nurses and doctors compared to all other divisions, with 71.94 health workers per 10,000 people, 27.46 doctors per 10,000 people and 29.30 nurses per 10,000 people. In terms of the densities of all health workers, doctors and nurses, the Capital Core Functional Division is 3.95 times, 3.82 times and 4.13 times higher, respectively, than the Urban Development New Division. For the 16 districts, the highest ratio of all health workers is Dongcheng District (295.97), which is more than 4 times higher than Tongzhou District (66.08).

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

Region	Gross Domestic Product (billion yuan)	Numbers			Total Population (10,000 people)	Density (per 10,000 people)		
		All Health Workers	Doctors	Nurses		All health workers	Doctors	Nurses
Capital Core Functional Division	566.42	60,783	22,426	25,871	213.7	284.43	104.94	121.06
Dongcheng District	206.18	25,986	10,123	10,575	87.8	295.97	115.30	120.44
Xicheng District	360.24	34,797	12,303	15,296	125.9	276.39	97.72	121.49
Urban Function Extension Division	1,234.54	103,765	40,034	44,581	1,033.8	100.37	38.73	43.12
Chaoyang District	517.10	47,382	18,610	20,418	385.6	122.88	48.26	52.95
Fengtai District	129.70	18,635	6,975	7,989	225.5	82.64	30.93	35.43
Shijingshan District	48.21	7,813	3,009	3,315	63.4	123.23	47.46	52.29
Haidian District	539.52	29,935	11,440	12,859	359.3	83.31	31.84	35.79
Urban Development New Division	542.34	52,541	20,056	21,398	730.3	71.94	27.46	29.30
Fangshan District	60.66	9,656	3,644	3,855	109.6	88.10	33.25	35.17
Tongzhou District	67.48	9,436	3,593	3,609	142.8	66.08	25.16	25.27
Shunyi District	159.16	7,759	3,291	2,886	107.5	72.18	30.61	26.85
Changping District	75.34	14,177	5,260	6,419	201.0	70.53	26.17	31.94
Daxing District	58.32	11,423	4,629	4,629	169.4	67.43	25.19	27.33
Ecological Conservation Division	121.38	16,689	6,912	6,198	195.1	85.54	35.43	31.77
Mentougou District	100.94	3,532	1,225	1,478	31.1	113.57	39.39	47.52
Huairou District	15.79	3,373	1,437	1,129	39.3	85.83	36.56	28.73
Pinggu District	25.94	3,747	1,549	1,498	43.7	85.74	35.45	34.28
Miyun District	21.83	3,594	1,666	1,188	48.3	74.41	34.49	24.60
Yanqing District	25.11	2,443	1,035	905	32.7	74.41	31.65	27.68

The Lorenz curve in Figure 1 shows the cumulative share of all health workers, doctors and nurses against the cumulative share of population. The four divisions are ranked with the densities of health workers from lowest to highest. The equality line represents a perfectly equal distribution of health workers (e.g. those with a low population density, such as a division with a population density of 20% of the total, would have 20% of the total health workers). The closer the

curve is to the equality line, the more equitable the health workforce distribution is. Figure 1 shows that, at the divisional level, all categories of health workers remain quite flat but there are some slight inequalities. The Gini coefficient for all health workers is 0.26, 0.25 for doctors, and 0.28 for nurses (Table 2). All the Gini coefficients are between 0.2 to 0.3, which mean the health worker distribution is rather equitable.

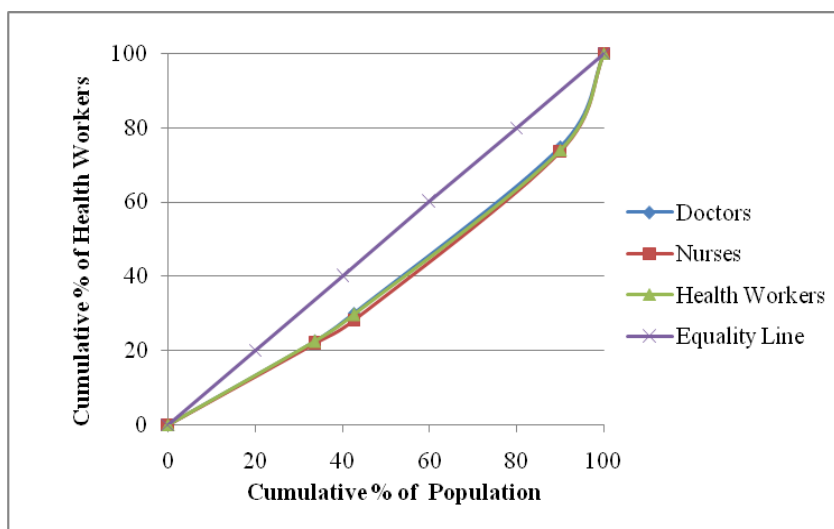


Figure 1: Lorenz curve showing the distribution of health workers according to population size at the divisional level

Table 2 shows the decomposition of health workforce inequalities using the Theil L index. Overall inequality in the distribution of the health workforce between the divisions is much higher compared to overall inequality within the divisions. For example, for doctors, the Theil L index is 0.083 across the districts, but

0.253 across the divisions. Moreover, for the inequality within each division, the Urban Function Extension Division's Theil L index is higher than other divisions, which means the inequality within this division is more significant.

Table 2: Theil L index of health workers' distribution across divisions and districts

Health workforce	Gini Coefficient	Theil L index	For each division				Across districts (%)	Across divisions (%)
			Capital Core Functional Division	Urban Function Extension Division	Urban Development New Division	Ecological Conservation Division		
Doctors	0.25	0.336	0.001	0.078	0.003	0.001	0.083 (25%)	0.253 (75%)
Nurses	0.28	0.380	0.004	0.077	0.008	0.001	0.090 (24%)	0.290 (76%)
All health workers	0.26	0.348	0.003	0.074	0.005	0.001	0.082 (24%)	0.266 (76%)

Discussion

The results showed that the distribution of health workers was rather equitable, and that the ratio of health workers in Beijing was greater than the threshold of 44 health workers per 10,000 people. However, findings from the study also highlighted that the distribution of health workers was not perfectly equitable in Beijing.

The Gini coefficient and the Theil L index both reflect that nurses were less equitably distributed between different divisions compared with doctors and all health workers. For nurses, the Gini coefficient is 0.28 and the Theil L index is 0.380. Inappropriate policy in health resource planning between the different divisions, and the attractiveness of regions that have a better socioeconomic environment and career prospects, could be the main causes of the inequality. Another possible cause may be the shortage of nurses. According to *Beijing Regional Statistics Yearbook 2017*, the ratio of doctors to nurses was 1:1.17, which is lower than the Chinese threshold of 1:2. The shortage of nurse is not only a problem in Beijing or China as a whole; it is also a serious problem across the world. The shortage of nurses makes them have less stability in some hospitals, as they could choose to work in a better hospital with a higher salary. At the same time, the shortage of nurses could increase nurses' workloads, trigger job-hopping, or lower nurses' employment intentions. An inappropriate health policy could lead to the long-term adverse effects, such as health talent loss and a decrease in public welfare (21). Given this, the Chinese government needs to invest more in expanding the number and quality of nurses, as well as establish more policies to attract more nurses to work in remote areas.

Although some studies have been carried out on the equality of the distribution of health workforces by using Gini coefficient and Theil L index, among them national studies, some researchers found that demographic distribution of the obstetric and gynecological workforce was the least equitable regarding the distribution of live births, and most of the inequality was inner-regional (within the division) (22). Some studies certified the very severe inequality in geographic distribution of the pediatric workforce across China, and that the inner-regional (within the division) inequalities were the main sources of the pediatric workforce distribution inequality (23). And Zhou *et al.*'s study found the overall inequality in the distribution of health workers in all regions of China was mostly due to inequality at the urban-rural level (15). There are very few studies on the equality of distribution of health workers in urban settings. In the current study, using the Theil L index decomposition, we found that the source of the inequalities was mainly from variations across the divisions. The inequalities in doctors, nurses and all health workers across divisions contributed 75%, 76% and 76%, respectively, to the total Theil L index. For each division, the inequality between the districts in the Urban Function Extension

Division was most significant. The remote divisions had a much smaller health workforce compared to the central divisions.

Inequality in health workers could lead to less accessible health services and more patient flow into big hospitals. Too many patients crowded in some big hospitals causes heavy workloads for health workers, which could contribute to less work satisfaction and deteriorate the health professional-patient relationship. Chinese governments should think more carefully about the current distribution of health workers, and balance the health workforce distribution according to the population size, health service coverage and health needs at the sub-provincial level.

Limitations of the study

We used the health worker density and population data directly from the statistics yearbook, which did not contain the data from military hospitals.

Conclusions

This study used the Lorenz curve, Gini coefficient and Theil L index to discuss inequalities in health workforce distribution in Beijing, China. The Gini coefficients showed the health worker distribution in Beijing was rather equitable. The Theil L index was used to separate out inequalities between groups and within groups. In this study, the main inequality observed in the distribution of all categories of health workers was between groups (across divisions). In short, inequality in the health workforce distribution is not just about the disparities between different regions, but also within regions, at a sub-provincial level.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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