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Review Article

Equality of Medical Health Resource Allocation in China Based on the Gini Coefficient Method

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Abstract

Background: The Chinese government is trying to achieve the goal of "universal access to basic health care services". However, the inequality of the distribution of health care resources across the country is the biggest obstacle. This paper aims to explore these inequalities and the extent to which the method of analysis influences the perception.

Methods: The indicators of health care resource distribution studied consisted of the number of health care institutions, the number of beds in health care institutions and the number of medical personnel. Data were obtained from the *China Statistical Yearbook 2014*. The extent of equality was assessed using the Lorenz Curve and Gini Coefficient Method.

Results: Health care resource distribution in China demonstrates inequalities. The demographic Gini Coefficients based on the Lorenz Curves for the distribution of health care institutions, beds in health care institutions and medical personnel are 0.190, 0.070 and 0.070 respectively, while the corresponding Coefficients based on geographical areas are 0.616, 0.639 and 0.650.

Conclusion: The equality of China's demographically assessed distribution of health care resources is greater than that of its geographically measured distribution. Coefficients expressed by population imply there is ready access to healthcare in all regions, whilst the Coefficients by geographical area apparently indicate inequality. This is the result of the sparsity of population.

Keywords: Health care resources, Inequality, Lorenz curve, Gini coefficient

Introduction

Great changes have taken place in China's health care industry since 1949. There are increasing numbers of health care resources for the Chinese to choose from, and most people are living longer lives, in better health. However, there is still a marked disparity in the distribution of China's health care resources, which has led to some social conflicts.

Such a situation is contrary to the ethos of the Communist Party of China and China is trying her best to solve this problem. During its 17th National Congress, the Communist Party of China made it clear that "universal access to basic health care services" is the goal of China's medical and health care development. In 2010, Wen Jiabao, the then premier of the People's Republic of China, wrote in one of his papers that, by 2020, China should establish a basic medical and health service system which comprehensively covers both the urban and rural areas, and that all Chinese should be able to enjoy basic health care services.

It is particularly relevant to carry out research on the inequalities in the distribution of health care resources in China in order to enable the country to allocate her finite health care resources to include areas where these could ensure the maximum social benefits.

Literature review

Researchers are very focused on the equality of health care resource distribution. The literature shows that there are three distinct approaches to this research:

Firstly, many researchers start from a medical viewpoint, studying the health care resources based on medical knowledge, especially in respect of the distribution of health care resources relevant to particular diseases, while less attention is paid to research based on economics. For example, previous studies (1-3) explored the inequality of health care resource distribution in the fields of cancer, children's health and mal-nutrition, and musculoskeletal issues, respectively.

Secondly, some researchers have paid greater attention to the factors, which influence the extent of inequality of medical, and health resource distribution. For example, Asante (4) studied the factors affecting the equality of health care resource distribution in Ghana, while other scholars (5) probed the factors that influence the level of utilization of medical and health resources in Australia. Further research into the decision criteria for health care resource distribution was conducted by Lalla A da Guindo (6).

Although some research exists on the equality of health care resource distribution in developing countries, such as that of Vivian Welch (7), most studies have concentrated on developed countries, with there being only limited study of developing countries such as China and India.

Therefore, thirdly, although research conducted by Zhang Xiaoyan et al. (8-11) has related to medical and health care resource distribution in China, their research has been from the viewpoint of a single province or city, and has not looked at the country as a whole.

As to research methods, most literature uses quantitative indicators as the analysis instruments for the equality of health care resource distribution. These include the Atkinson index (12), the Theil index (13), the coefficient of variation (14) and the Gini Coefficient (15).

In this paper, we measured the degree of inequality of the demographic and geographic distribution of health care resources in China, by analyzing them using a Lorenz Curve and Gini Coefficient approach.

Data resources and research methods

Data resources

To inform our proposed research methods and purposes, we collected data on the total populations, geographic areas, the number of health care institutions, the number of beds in health care institutions and the number of medical personnel for 31 provinces (autonomous regions and municipalities) in China. Because of data inconsistence, the Hong Kong and Macao Special Administrative Regions and Taiwan province were not included. All of the data were taken from *China Statistical Yearbook 2014*.

Comparison of methods for measuring inequality

1) The statistical distribution method

One of the most important methods for measuring inequality is the Statistical Distribution Method. According to Chen Jiandong (16), there are two kinds of statistical distribution function. One is the type of distribution function with no more than two parameters; the other is that with more than two parameters. The Pareto distribution (17), Lognormal distribution (16), Gamma distribution (18), Weibull distribution (19), Log-logistic distribution (20) and Lomax distribution (21) are the most common distribution functions with only two parameters. The Pareto-lognormal distribution (22), Log-gamma distribution (23), Generalized beta distribution of the second kind (24) and the Dagum distribution (25)

are the most common distribution functions available for working with more than two parameters.
Although several varieties of distribution function exist, and each has its advantages, few of them can be used effectively to fit all the different types of resource distributions, which imply that the practical application of the methods described above is limited.

2) Indicator methods

Using indicators is a very broad approach to measuring inequality, as this can include both absolute and relative indicators. According to Wan Guanghua (26), the Kolm index (27) is the best known of the absolute indicators, while, of the relative indicators, the Atkinson index, Theil index, coefficient of variation and the Gini Coefficient are those, which are familiar to most people.
The main feature of the Kolm index is that its value is closely connected with the units of measurement. Given this, it is essential to conduct nondimensionalization when we analyze data using the Kolm index. If not, large deviations will occur.
One of the main features of the Atkinson index is its ability to reveal the inequality of resource distribution. However, when we analyze data with the Atkinson index, the social welfare function corresponding with it simply takes into consideration the quantity of the resources shared by the whole population, without considering the relative position of each person on the ladder of possession of resources.
The Theil index ranges in value from 0 to 1. The smaller the value, the fairer the distribution of resources, and vice versa. Compared with the Gini Coefficient, the Theil index is more likely to overestimate inequality.
The coefficient of variation is the ratio of the standard deviation to the mean, and is used to reflect the degree of dispersion. The bigger its value is, the higher the degree of dispersion, and vice versa. Unfortunately, the main drawback of the coefficient of variation is that it fails to describe the dispersion within groups adequately.

3) Lorenz Curve and the Gini Coefficient Method

The Gini Coefficient is frequently used as an index to reflect the inequality of income distribution. The value of the Gini Coefficient varies from 0 to 1. A region with complete equality will have a value of 0 while a region with no equality will be denoted by 1. According to general international standards, a Gini Coefficient that is smaller than 0.3 represents a particularly equitable condition, 0.3-0.4 is the normal condition, while greater than 0.4 raises concern, and a value greater than 0.6 indicates a dangerous state.
The Lorenz Curve (28) was first developed by the America statistician Max O. Lorenz in 1905, as a graphical representation of income distribution. The X-axis represents the cumulative percentage of the population, ranked in increasing order of income - that is, beginning with those people with the lowest incomes and ending with those with the largest. The Y-axis represents the cumulative percentage of the income of the corresponding percentage of the population. The line between the origin of the coordinates and the corresponding vertex is the line of perfect equality. The actual extent of inequality is reflected by the area between Lorenz Curve and the line of perfect equality. Thus, the less deviation from the line of perfect equality, the more even the distribution.
The Gini Coefficient calculated based on the Lorenz Curve is an ideal index for measuring the extent of inequality. In this paper, the Lorenz Curve and Gini Coefficient have been chosen to study the equality of health care resource distribution across China, as they are truly able to reflect the current situation in this respect.

Comparative analysis of inequality in health care resource distribution within China

For this paper, 31 regions (provinces, autonomous regions and municipalities) in China were studied and the number of health care institutions, the number of beds in health care institutions, and the number of medical personnel were used as the indicators of health care resources in each region.

Table 1: Basic information on health care resource distribution in China

Region	Population (10,000 persons)	Geographic area (10,000 square km)	Number of health care institutions (unit)	Number of beds in health care institutions (10,000 beds)	Number of medical personnel (individuals)
Beijing	2115	1.68	9683	10.4	263146
Tianjin	1472	1.13	4689	5.77	106527
Hebei	7333	18.77	78485	30.35	492012
Shanxi	3630	15.63	40281	17.26	283860
Inner Mongolia	2498	118.3	23257	12.01	195952
Liaoning	4390	14.59	35612	24.19	338443
Jilin	2751	18.74	19913	13.32	200184
Hei Longjiang	3835	45.48	21369	18.92	279122
Shanghai	2415	0.63	4929	11.43	192333
Jiangsu	7939	10.26	30998	36.83	551113
Zhejiang	5498	10.2	30063	23.01	427072
Anhui	6030	13.97	24645	23.6	353799
Fujian	3774	12.13	28175	15.61	261784
Jiangxi	4522	16.7	38902	17.43	269819
Shandong	9733	15.38	75426	48.97	819348
Henan	9413	16.7	71464	42.98	716306
Hubei	5799	18.59	35631	28.82	411184
Hunan	6691	21.18	62210	31.41	442224
Guangdong	10644	18	47835	37.84	708036
Guangxi	4719	23.6	33943	18.72	334849
Hainan	895	3.4	5011	3.21	63468
Chongqing	2970	8.23	18926	14.74	197667
Sichuan	8107	48.14	80037	42.66	596001
Guizhou	3502	17.6	29177	16.67	221575
Yunnan	4687	38.33	24264	21.01	265531
Tibet	312	122.8	6725	1.1	24653
Shaanxi	3764	20.56	37137	18.51	321908
Gansu	2582	45.44	26697	11.61	160695
Qinghai	578	72.23	6020	2.95	44685
Ningxia	654	6.64	4231	3.11	47609
Xinjiang	2264	166	18663	13.73	189578

Data source: *China Statistical Yearbook 2014*

Overall comparative analysis of three zones (East, Central and West)

The basic situation regarding the distribution of health care resources in China is shown in Table 1. In order to compare the differences, we allocated the 31 regions into those of the eastern, central and western zones. Thus, the overall situation is shown in Fig. 1.

Fig. 1 shows that the east obviously has advantages over both the central and western zones, whether it is in the number of health care institutions, the number of beds in health care institutions or the number of medical personnel. The mean level of health care resources in the east is 1.274 times that in the central area, and 1.386 times that in the west. Fig. 1 also clearly shows that, in respect of the number of medical personnel, the west is especially lacking, some regions of the latter zone having up to 1.623 times fewer. Overall, the central zone is superior to the west in all respects, although the difference between the two zones is barely 1.083 times in average.

Comparative analysis of per capita health care resource distribution in different regions

In order to have a better understanding of the situation of per capita health care resource distribution in different regions, we calculated the per capita resources, and sorted the data by the number of health care institutions per 10,000 persons. The data are given in Table 2.

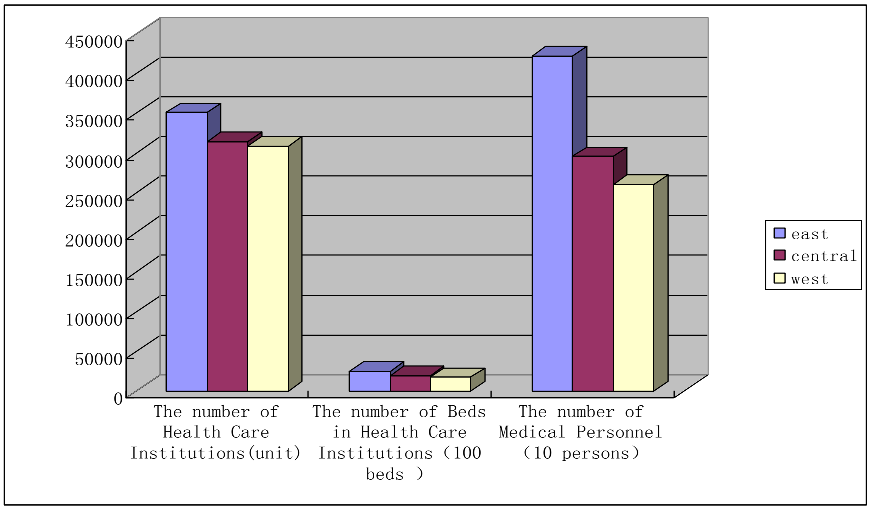

Fig. 1: Differences in health care resource distribution among eastern, central and western zones of China

Table 2: Per capita health care resource distribution in different regions in 2013

Region	Number of health care institutions per 10,000 persons	Number of beds in health care institutions per person	Number of medical personnel per 10,000 persons
Shanghai	2.041	0.005	79.636
Tianjin	3.185	0.004	72.359
Jiangsu	3.904	0.005	69.414
Anhui	4.087	0.004	58.675
Guangdong	4.494	0.004	66.52
Beijing	4.579	0.005	124.431
Yunnan	5.177	0.004	56.657
Zhejiang	5.468	0.004	77.678
Hei Longjiang	5.572	0.005	72.782
Hainan	5.597	0.004	70.892
Hubei	6.144	0.005	70.906
Chongqing	6.372	0.005	66.555
Ningxia	6.468	0.005	72.775
Guangxi	7.193	0.004	70.958
Jilin	7.238	0.005	72.76
Fujian	7.466	0.004	69.365
Henan	7.592	0.005	76.095
Shandong	7.749	0.005	84.179
Liaoning	8.112	0.006	77.094
Xinjiang	8.242	0.006	83.725
Guizhou	8.331	0.005	63.267
Jiangxi	8.603	0.004	59.666
Hunan	9.298	0.005	66.096
Inner Mongolia	9.312	0.005	78.456
Shaanxi	9.866	0.005	85.523
Sichuan	9.873	0.005	73.517
Gansu	10.339	0.004	62.232
Qinghai	10.419	0.005	77.338
Hebei	10.704	0.004	67.099
Shanxi	11.097	0.005	78.203
Tibet	21.552	0.004	79.006

From the perspective of the number of health care institutions per 10,000 persons, we can roughly divide the regions into four groups. Those regions with 5 or fewer institutions per 10,000 persons are classified into the first group. The second group was greater than 5 but less than 10. Similarly, the third group was from 10 to 20. The number of Tibet is greater than 20, and Tibet falls into the fourth group. We can see from the above data, that the number of health care institutions per 10,000 persons ranges chiefly from 5 to 10, and this includes 2/3 of the regions. Meanwhile, what can also be seen is that the differences between regions are extremely significant. Shanghai is the most salient case, having the fewest institutions per 10,000 persons (2.041), while Tibet has the most institutions per 10,000 persons (21.552), the latter figure being more than 10 times larger. Based on the per capita number of beds in health care institutions, chiefly between 4 and 6, the disparity between the different regions is not as great. That means, the distribution of beds in health care institutions across the regions is relatively fair. From the standpoint of the number of medical personnel per 10,000 persons, mainly between 60 and 80, the differences between the 31 regions are generally significantly smaller than the differences in the number of health care institutions per 10,000 persons.

Comparative analysis of health care resource distribution in different geographical areas

In order to analyze further, the situation in respect of health care resource distribution in different regions, we considered the actual geographical area, computed the resources per unit area, and then sorted the data by the number of health care institutions per unit area, as shown in Table 3.

Table 3: Health care resource distribution in different provinces in 2013

Region	Number of health care institutions per 10,000 square kilometers	Number of beds in health care institutions per square kilometer	Number of medical personnel per 10,000 square kilometers
Tibet	54.76	0.01	200.76
Qinghai	83.34	0.04	618.65
Xinjiang	112.43	0.08	1142.04
Inner Mongolia	196.59	0.1	1656.4
Hei Longjiang	469.85	0.42	6137.25
Gansu	587.52	0.26	3536.42
Yunnan	633.03	0.55	6927.5
Ningxia	637.2	0.47	7170.03
Jilin	1062.59	0.71	10682.18
Guangxi	1438.26	0.79	14188.52
Hainan	1473.82	0.94	18667.06
Guizhou	1657.78	0.95	12589.49
Sichuan	1662.59	0.89	12380.58
Anhui	1764.14	1.69	25325.63
Shaanxi	1806.27	0.9	15657
Hubei	1916.68	1.55	22118.56
Chongqing	2299.64	1.79	24017.86
Fujian	2322.75	1.29	21581.53
Jiangxi	2329.46	1.04	16156.83
Liaoning	2440.85	1.66	23196.92
Shanxi	2577.16	1.1	18161.23
Guangdong	2657.5	2.1	39335.33
Hunan	2937.2	1.48	20879.32
Zhejiang	2947.35	2.26	41869.8
Jiangsu	3021.25	3.59	53714.72
Tianjin	4149.56	5.11	94271.68
Hebei	4181.41	1.62	26212.68
Henan	4279.28	2.57	42892.57
Shandong	4904.16	3.18	53273.6
Beijing	5763.69	6.19	156634.5
Shanghai	7823.81	18.15	305290.5

What we can see from the table is that the differences are dramatic, regardless of whether we consider them from the perspective of the number of health care institutions per 10,000 square kilometers, the number of beds in health care institutions per square kilometer or the number of medical personnel per 10,000 square kilometers. Simply focusing on the number of health care institutions per 10,000 square km; it is not hard to see that Tibet has the fewest, with a value of 54.76, while the largest value belongs to Shanghai, with 7823.81, the latter value being 143 times greater. For the number of beds in health care institutions per square kilometer, the corresponding maximum value is 1850 times greater than the minimum. In the case of the number of medical personnel per 10,000 square kilometers, the disparity is 1520 times. This means that difference in health care resource distribution, by geographical area, between the different regions is exceedingly large, and the distribution of health care resources per unit area shows significant inequality.

Although such comparative analysis means that we can readily appreciate the marked disparity of health care resource distribution across the different regions, it is inevitable that there is bias due to the simple comparison of single indicators. For a more thorough understanding of this inequality, we can investigate it more deeply by using the analysis tools, which have been developed to research income inequality in economics - the Lorenz Curve and the Gini Coefficient.

Relative theory on measuring inequality of health care resource distribution with the Lorenz Curve and Gini Coefficient Method

Different methods of calculating the Gini Coefficient

The general algorithm for calculating the Gini Coefficient uses the area enclosed by the Lorenz Curve and the line of perfect equality, A, and the area located to the bottom right of the Lorenz Curve, B, as shown in Fig. 2.

Here, the Gini Coefficient $G = \frac{A}{A+B}$

where $A+B = \frac{1}{2}$

The X-axis represents the cumulative percentage of the population ordered in relation to the factor under investigation, and the corresponding Y-axis represents the cumulative percentage of the factor under investigation.

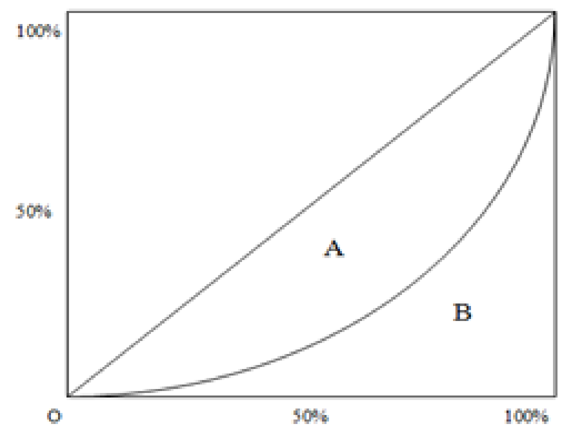

Fig. 2: Areas used in the general algorithm for calculating the Gini Coefficient

According to Zhou Qinghua (29), algorithms for obtaining the Gini Coefficient can be roughly classified into three types, the slab method, the curve fitting method and the bow area method.

We can estimate the Gini Coefficient with any of the three methods above, yet the accuracy of estimation differs, depending on the method used. For the slab method, the more segmented the small parts are, the higher the agreement of the estimated and actual values. Furthermore, the accuracy of estimation is related to the gentleness of the Lorenz Curve. The gentler the Curve, the more accurate the estimate. For the curve fitting method, the accuracy of estimation depends on the merits of the fitted curve, so, the better the curve function Y, the more accurate the estimate. For the bow area method, the calculated Gini Coefficient becomes more accurate the greater the curvature of the Lorenz Curve.

Basic idea for assessment of health care distribution with the Lorenz Curve and Gini Coefficient

With the help of this concept, we take the cumulative percentage demographically (or by geographic area) as the X-axis and take the cumulative percentage of health care resources as the Y-axis.

Then we plot the Lorenz Curve with the cumulative percentage demographically (or by geographic area) ranked by the level of health care resources against the cumulative percentage of health care resources corresponding to the population (or geographic area) values, to indicate the equality of health care resource distribution demographically (or by geographic area).

As discussed, we are able to construct a Lorenz Curve based on units of population (or by geographic area) and the health care resources available. Supposing the area B is divided into *n* parts by the aid of the integral thought with each part being regarded as a small rectangle. We can then obtain the Gini Coefficient from:

$$G = \frac{A}{A+B}$$

where $A + B = 0.5$

$$B = \frac{1}{2}\sum_{i=1}^{n}(Y_i + Y_{i+1})(X_{i+1} - X_i)$$

where Y_i is the cumulative percentage of health care resources, and X_i is the cumulative percentage of the population (A corresponding approach can be used to obtain the Gini Coefficient in respect of distribution by geographic area).

Analysis based on the Lorenz Curve and Gini Coefficient Method

The Lorenz Curve of health care resource distribution assessed against population

Based on the data in Table 1, we computed the number of health care institutions per 10,000 persons. Then we ranked the regions by this indicator and calculated the cumulative population, the cumulative number of health care institutions, the cumulative percentage of the population and the cumulative percentage of health care institutions. The results are shown in Table 4.

Table 4: Distribution of the cumulative percentage of health care institutions by the cumulative percentage of population across the different regions of China in 2013

Region	Number of health care institutions per 10,000 persons	Number of cumulative population,(10,000 persons)	Number of cumulative health care institutions (unit)	Cumulative percentage of population	Cumulative percentage of health care institutions
Shanghai	2.04	2415	4929	1.78	0.51
Tianjin	3.19	3887	9618	2.87	0.99
Jiangsu	3.9	11827	40616	8.73	4.17
Anhui	4.09	17857	65261	13.18	6.7
Guangdong	4.49	28501	113096	21.03	11.61
Beijing	4.58	30615	122779	22.59	12.6
Yunnan	5.18	35302	147043	26.05	15.09
Zhejiang	5.47	40800	177106	30.11	18.18
Hei Longjiang	5.57	44635	198475	32.94	20.37
Hainan	5.6	45530	203486	33.6	20.88
Hubei	6.14	51329	239117	37.88	24.54
Chongqing	6.37	54299	258043	40.07	26.48
Ningxia	6.47	54954	262274	40.55	26.92
Guangxi	7.19	59673	296217	44.03	30.4
Jilin	7.24	62424	316130	46.06	32.44
Fujian	7.47	66198	344305	48.85	35.34
Henan	7.59	75611	415769	55.79	42.67
Shandong	7.75	85345	491195	62.98	50.41
Liaoning	8.11	89735	526807	66.22	54.06
Xinjiang	8.24	91999	545470	67.89	55.98
Guizhou	8.33	95501	574647	70.47	58.97
Jiangxi	8.6	100023	613549	73.81	62.97
Hunan	9.3	106714	675759	78.75	69.35
Inner Mongolia	9.31	109211	699016	80.59	71.74
Shaanxi	9.87	112975	736153	83.37	75.55
Sichuan	9.87	121082	816190	89.35	83.76
Gansu	10.34	123665	842887	91.25	86.5
Qinghai	10.42	124242	848907	91.68	87.12
Hebei	10.7	131575	927392	97.09	95.18
Shanxi	11.1	135205	967673	99.77	99.31
Tibet	21.55	135517	974398	100	100

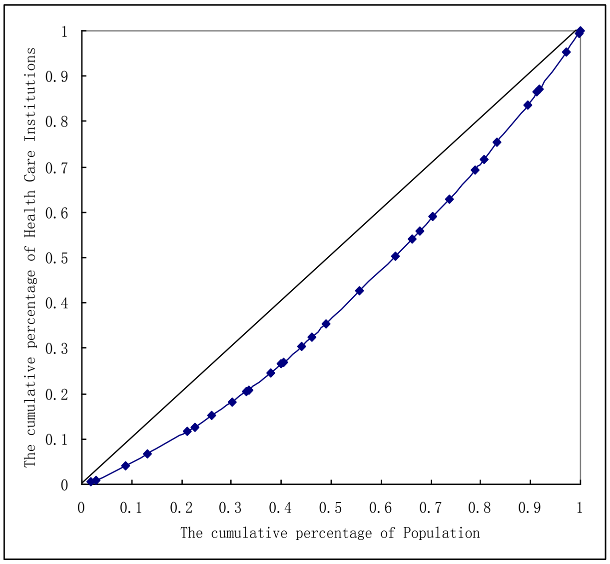

Fig. 3: Lorenz Curve of the distribution of the number of health care institutions by population

As shown in Fig. 3, we can construct a Lorenz Curve for these figures by defining the X-axis as the cumulative percentage of the population and defining the Y-axis as the cumulative percentage of health care institutions. Similarly, Lorenz Curves for the distribution of the number of beds in health care institutions and for the distribution of medical personnel per unit of population can be drawn, as shown in Fig. 4 and Fig. 5 respectively.

Figures 3, 4 and 5 show that the separate Lorenz Curves of the distribution of health care institutions, beds in health care institutions, and medical personnel per unit of population, are all located below the line of perfect equality and that the areas between the Lorenz Curve and the line of perfect equality are all relatively small, which illustrates further the relative equality of the distribution of health care resources by population.

Lorenz Curve of distribution of health care resources by geographic area

Based on the data in Table 1, and using a similar approach to that in the previous section, the number of health care institutions per 10,000 square kilometers, the cumulative areas, the cumulative number of health care institutions, the cumulative percentage of areas and the cumulative percentage of health care institutions can be found. The results of sorting these data by the number of health care institutions per 10,000 square kilometers are shown in Table 5.

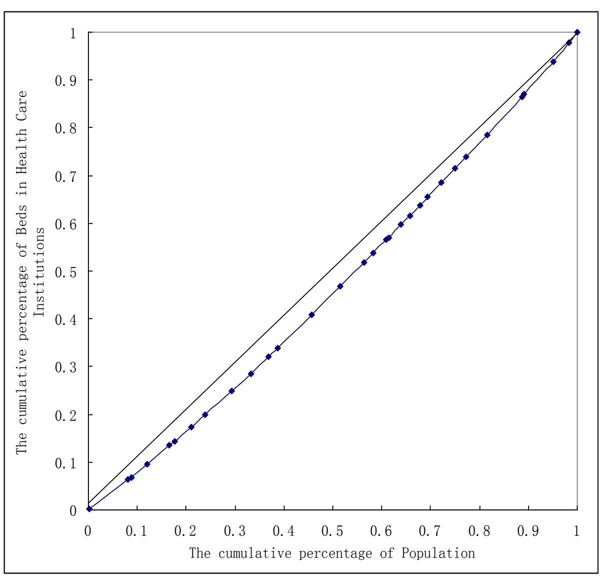

Fig. 4: Lorenz Curve of the distribution of the number of beds in health care institutions by population

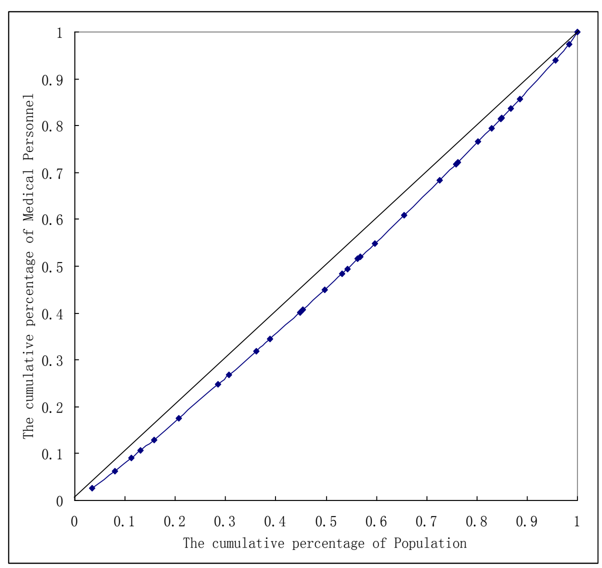

Fig. 5: Lorenz Curve of the distribution of the number of medical personnel by population

Table 5: Distribution of cumulative percentage of health care institutions by cumulative percentage of geographic areas in different regions in 2013

Region	Number of health care institutions per 10,000 square kilometers	Cumulative areas	Cumulative number of health care institutions	Cumulative percentage of areas	Cumulative percentage of health care institutions
Tibet	54.76	123	6725	12.78	0.69
Qinghai	83.34	195	12745	20.29	1.31
Xinjiang	112.4	361	31408	37.57	3.22
Inner Mongolia	196.6	479	54665	49.88	5.61
Hei Longjiang	469.9	525	76034	54.61	7.8
Gansu	587.5	570	102731	59.34	10.54
Yunnan	633	609	126995	63.33	13.03
Ningxia	637.2	615	131226	64.02	13.47
Jilin	1063	634	151139	65.97	15.51
Guangxi	1438	658	185082	68.42	18.99
Hainan	1474	661	190093	68.78	19.51
Guizhou	1658	679	219270	70.61	22.5
Sichuan	1663	727	299307	75.62	30.72
Anhui	1764	741	323952	77.07	33.25
Shaanxi	1806	761	361089	79.21	37.06
Hubei	1917	780	396720	81.14	40.71
Chongqing	2300	788	415646	82	42.66
Fujian	2323	800	443821	83.26	45.55
Jiangxi	2329	817	482723	85	49.54
Liaoning	2441	831	518335	86.52	53.2
Shanxi	2577	847	558616	88.15	57.33
Guangdong	2658	865	606451	90.02	62.24
Hunan	2937	886	668661	92.22	68.62
Zhejiang	2947	896	698724	93.28	71.71
Jiangsu	3021	907	729722	94.35	74.89
Tianjin	4150	908	734411	94.47	75.37
Hebei	4181	927	812896	96.42	83.43
Henan	4279	943	884360	98.16	90.76
Shandong	4904	959	959786	99.76	98.5
Beijing	5764	960	969469	99.93	99.49
Shanghai	7824	961	974398	100	100

We can draw a Lorenz Curve for the cumulative percentage of health care institutions by defining the X-axis as the cumulative percentage of the areas and defining the Y-axis as the cumulative percentage of health care institutions according to the data above, and this is shown in fig. 6. Similarly, the Lorenz Curve for the distribution of the number of beds in health care institutions by geographic area and the distribution of medical personnel by geographic area can be drawn, as shown in figures 7 and 8 respectively.

Fig. 6, 7 and 8 show that the Lorenz Curves of the distribution of health care institutions, beds in health care institutions, and medical personnel by geographic area are all located below the line of perfect equality and that the areas between the Lorenz Curve and the line of perfect equality are all much larger than in fig. 3, 4 and 5, means that there is much greater inequality in the geographic distribution of health care resources than there is by actual population.

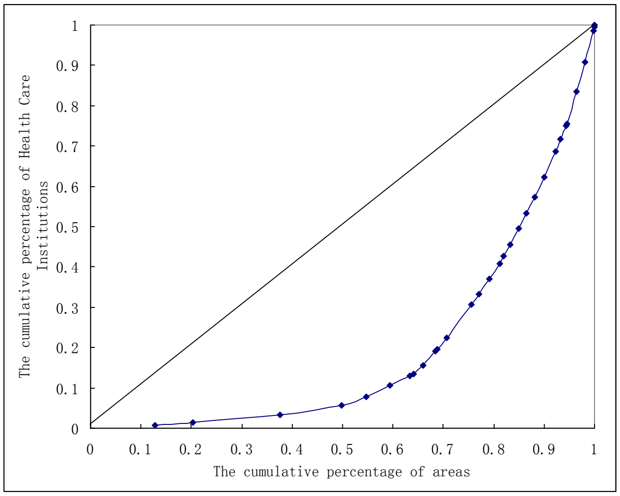

Fig. 6: Lorenz Curve of distribution of the number of health care institutions by geographic area

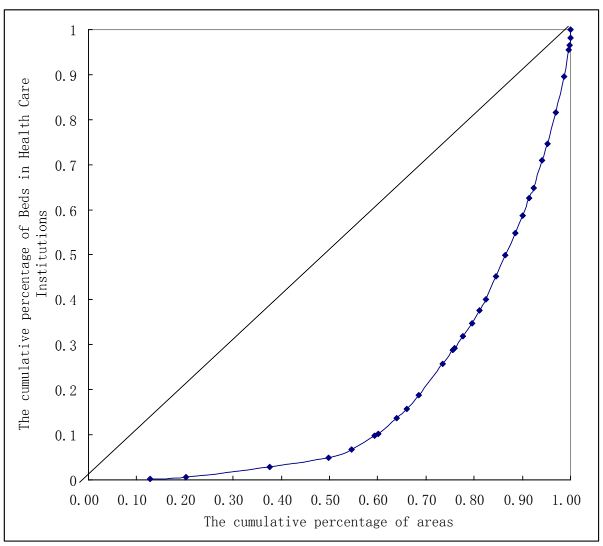

Fig. 7: Lorenz Curve of distribution of the number of beds in health care institutions by geographic area

Taken together, the area between the Lorenz Curves for health care resource distribution by population and the line of perfect equality is much smaller than the areas between the Lorenz Curves for health care resource distribution by geographic area and the line of perfect equality. Therefore, we can expect that the Gini Coefficients obtained per unit of population will be far lower than the Gini Coefficients obtained in relation to the geographic area. In order accurately to represent the degree of inequality of health care resource distribution by population and by geographic area, we shall therefore now apply the Gini Coefficient to the study of the inequality of health care resource distribution in China to see this situation in detail.

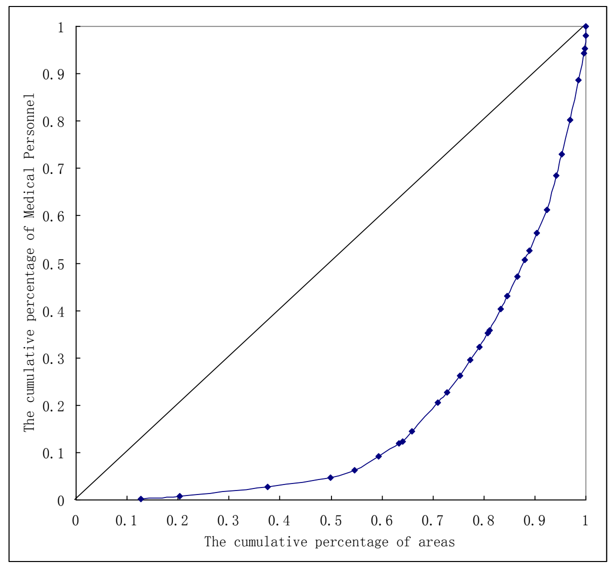

Fig. 8: Lorenz Curve of distribution of the number of medical personnel by geographic area

Calculation of Gini Coefficients for inequality in health care resource distribution in China

Based on the Lorenz Curve of the distribution of health care resources by population and by geographic area, we calculated the respective Gini Coefficients. For example, the Gini Coefficient determined by the Lorenz Curve of the distribution of health institutions per unit of population is 0.19. The corresponding calculation for the distribution of health care institutions by geographical area provides a Gini Coefficient of 0.616. Similarly, we can obtain the Gini Coefficient according to the Lorenz Curve of the distribution of beds in health care institutions and of the numbers of medical personnel by both unit of population and by geographic area, as shown in Table 6.

Table 6: Gini Coefficients of health care resource distribution

	Number of health care institutions	Number of beds in health care institutions	Number of medical personnel
by population	0.19	0.07	0.07
by geographic area	0.616	0.639	0.65

Discussions

On basis of the above methods, which use Lorenz Curves to derive the Gini Coefficients, this paper reports on a comparative analysis of the inequality of health care resource distribution in China. It shows that health care resource distribution appears equal when considered in demographic terms than when presented in terms of geographic distribution. All the Gini Coefficients for health care resource distribution by population are below 0.2, the Gini Coefficients for the number of health care institutions, of beds in health care institutions and of numbers of medical personnel being 0.19, 0.07 and 0.07 respectively. However, the Gini Coefficients for health care resource distribution by geographic area are 0.616, 0.639 and 0.65 respectively, which means that the geographic distribution of health care resources in China exhibits a high level of inequality.

We should not say either the demographic or the geographic approach provides a more useful picture separately. They are both useful for investigation on the equality of medical healthcare resource allocation in China. The paper shows that coefficients expressed by population imply there is ready access to healthcare in all regions, whilst the Coefficients by geographical area apparently indicate inequality. However, this simply is the result of the sparsity of population-there is little point in providing significant resources where few people live.

This situation does affect the access to healthcare by those scattered people more or less. We are glad to see that Chinese government is trying to allocate more medical healthcare resource to these areas- not because of inequality of medical healthcare resource allocation, but for better medical and health conditions for Chinese people.

Conclusion

Based on the analysis conducted in this paper, we find that the equality of China's demographically assessed distribution of health care resources is greater than that of its geographically measured distribution. Coefficients expressed by population imply there is ready access to healthcare in all regions, whilst the Coefficients by geographical area apparently indicate inequality. This simply is the result of the sparsity of population. Most of China's health care resources are distributed within the developed provinces, especially in large cities and in large hospitals; while, in the remote and developing provinces, fewer health care resources are allocated.

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