

# Evaluation on the Equity of Traditional Chinese Medicine Resource Allocation in Tianjin

Ning He<sup>1</sup> and Yanhui Nie<sup>1,\*</sup>

<sup>1</sup>School of Management, Tianjin University of Traditional Chinese Medicine, Tianjin, 301617, China

\*Corresponding author. Email:nieyanhui51@126.com

## ABSTRACT

This paper aims to provide suggestions for the resource allocation of Traditional Chinese Medicine (TCM) during the 14th Five-Year Plan period by analyzing the fairness degree in Tianjin from 2011 to 2019. We used descriptive analysis to study the allocation of TCM health resource in different districts of Tianjin, conducted the Gini coefficient and Theil index on the fairness research. Since the geographical equity of TCM resource allocation in Tianjin was lower than its population equity, and the regional difference was obvious, it is suggested to increase financial input in health to underdeveloped areas, include geography as an important factor in health planning, promote the sharing of resource and strengthen the construction of basic TCM institution.

**Keywords:** Tianjin, Traditional Chinese Medicine, Health resource, Analysis of equity

## 1. INTRODUCTION

Allocation of TCM resource is the prerequisite factor of health service. At present, the research on TCM resource is mostly focused on the configuration of health technician which is based on cross-section data. Compared with previous studies, this study is going to conduct a dynamic and comprehensive evaluation by means of the panel data of multiple health resource, and break the former single method of research.

## 2. DATA AND METHODOLOGY

### 2.1. Data Source

The geographical area and resident population were from Statistical Yearbook in Tianjin. The number of TCM institution and actual bed, as well as health technician were from Health Statistics Data in Tianjin.

### 2.2. Research Methodologies

Develop a descriptive analysis of TCM resource allocation in Tianjin. Calculate the fairness degree of the overall allocation of TCM resource by Gini coefficient and Theil index.

### 2.3. Statistical Tools

Set up a database and conduct descriptive analysis by EXCEL2016. Calculate the Gini coefficient through SPSS25.0. Analyze Theil index through STATA15.1.

## 3. DESCRIPTIVE ANALYSIS

### 3.1. Geographical area and population of Tianjin

The sixteen administrative districts of Tianjin grouped into three group by geography. The geographical area of urban districts is 174.92 square kilometers, the geographical area of districts around the city is 1921.06 square kilometers, and the geographical area of districts in outer suburb is 9580 square kilometers. Table 1 shows the permanent resident population of each region of Tianjin from 2011 to 2019.

**Table 1.** The number of permanent resident population in each region of Tianjin (ten thousand people)

Year	Urban Districts	Districts around the city	Districts in the outer suburb	Summation
2011	464.80	281.67	648.25	1394.72
2012	472.10	283.02	659.02	1414.14
2013	490.91	293.68	687.62	1472.21
2014	504.69	304.38	707.74	1516.81
2015	488.12	333.56	725.27	1546.95
2016	492.53	337.22	732.37	1562.12
2017	490.87	336.09	729.91	1556.87
2018	492.93	338.81	727.86	1559.60
2019	493.67	339.55	728.60	1561.83

### 3.2. Distribution of TCM Resource in Tianjin

From 2011 to 2019, the number of TCM institution, actual bed and health technician in all regions of Tianjin has increased significantly, but the growth range varies greatly. As shown in table 2, the increase of TCM institution was larger, the increase of actual bed and health technician was relatively slow, and the largest increase was in exurb districts and districts around the city respectively. The

number of TCM institution in urban districts was 89.47% and the growth rate of the number of actual bed was 54.82% which were lower than the average growth rate. The growth rate of the number of actual bed in districts around the city was 46.14% and lower than the average growth rate of 73.87%; the growth rate of health technician in exurb districts was 55.56% and lower than the average growth rate of 73.43%. Although the growth rate of TCM resource in urban districts is slightly slow, the total amount of TCM resource is much higher than other two areas.

**Table 2.** Distribution of TCM resource in different districts of Tianjin

Sort	Area	2011	2012	2013	2014	2015	2016	2017	2018	2019	Growth Rate(%)
Institution (unit)	Urban districts	57	62	66	78	92	95	98	101	108	89.47
	Around-city	7	9	12	14	20	22	23	22	25	257.14
	Exurb	14	17	21	24	27	32	38	42	49	250
	Summation	78	88	99	116	139	149	159	165	182	133
Actual bed (sheet)	Urban districts	3446	3486	3923	4234	4850	4893	5003	5019	5335	54.82
	Around -city	635	679	725	740	772	818	862	911	928	46.14
	Exurb	1043	1210	1366	1742	1835	1918	2013	2148	2646	153.69
	Summation	5124	5375	6014	6716	7457	7629	7878	8078	8909	73.87
Health technician (person)	Urban districts	4513	5274	5303	5664	6012	7700	7056	7115	7944	76.02
	Around -city	830	987	1041	1126	1135	1232	1398	1510	1751	110.96
	Exurb	2399	2667	2998	2917	2926	3008	3091	3163	3732	55.56
	Summation	7742	8928	9342	9707	10073	11940	11545	11788	13427	73.43

There were great differences in capita TCM resource in different regions. Although the number of TCM institution per 10,000 people in districts around the city and exurb districts increased by 250% from 2011 to 2019 which only increased by 78.47% in urban districts, but the number of TCM institution per 10,000 people in districts around the city and exurb districts was only 0.07. The number of actual bed per 10,000 people in urban districts reached to 10.81, and it in exurb districts exceeded 3 in 2019, while it

in districts around the city remained at a low level. In terms of the number of health technician per 10,000 people, districts around the city had the largest growth rate with 74.92%. Although the growth rate of TCM resource in urban districts was slightly slower than it of districts around the city, it's quantity of health technician per 10,000 people in 2019 reached 16.09, while it in districts around the city was only 5.16. As shown in table 3.

**Table 3.** Distribution of capital TCM resource in different districts of Tianjin (per 10,000 people)

Sort	Area	2011	2012	2013	2014	2015	2016	2017	2018	2019	Growth Rate(%)
Institution (unit)	Urban districts	12.26	13.13	13.44	15.46	18.85	19.29	19.96	20.49	21.88	78.47
	Around-city	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.06	0.07	250
	Exurb	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.07	250

Actual bed (sheet)	Urban districts	7.41	7.38	8.00	8.39	9.94	9.93	10.19	10.18	10.81	45.88
	Around-city	2.25	2.40	2.47	2.43	2.31	2.43	2.56	2.69	2.73	21.33
	Exurb	1.61	1.84	1.99	2.46	2.53	2.62	2.76	2.95	3.63	125.47
Health technician (person)	Urban districts	9.71	11.17	10.80	11.22	12.32	15.63	14.37	14.43	16.09	65.71
	Around-city	2.95	3.49	3.54	3.70	3.40	3.65	4.16	4.46	5.16	74.92
	Exurb	3.70	4.05	4.36	4.12	4.03	4.11	4.23	4.35	5.12	38.38

## 4. EQUITY ANALYSIS

### 4.1. Equity Analysis based on Gini Coefficient

Based on the permanent resident population, the Gini coefficient of TCM resource in Tianjin was calculated as shown in table 4. From 2011 to 2019, the Gini coefficient of TCM resource allocation by population decreased in the fluctuation, and all of them were lower than 0.4 which was in a reasonable state. On the whole, the Gini coefficient of health technician was higher than institution and actual bed which indicated that the equity of health technician allocation was lower than institution and actual bed. From the change trend, the Gini coefficient of institution decreased from 0.309 in 2011 to 0.288 in 2019; the Gini coefficient of actual bed decreased from 0.241 in 2011 to 0.218 in 2019; the Gini coefficient of health technician decreased from 0.362 in 2011 to 0.331 in 2019. The Gini coefficient of institution allocation by population fluctuated greatly, with the smallest decrease; the Gini coefficient of actual bed increased slightly during 2016-2017, but then showed a general downward trend; although the Gini coefficient of health technician has been decreasing year by year, it was still at a high level and its fairness needs to be enhanced.

**Table 4.** The Gini coefficient of TCM resource allocation by population in Tianjin

Year	Institution	Actual bed	Health technician
2011	0.309	0.241	0.362
2012	0.309	0.237	0.360
2013	0.307	0.236	0.355
2014	0.299	0.231	0.348
2015	0.307	0.228	0.340
2016	0.308	0.218	0.337
2017	0.299	0.237	0.360
2018	0.287	0.236	0.355
2019	0.288	0.218	0.331

Based on geographical area of each region in Tianjin, the Gini coefficient of TCM resource distribution was calculated. As shown in table 5, the Gini coefficient of TCM resource allocation by geography were all higher than the warning line of 0.4 during nine years, showing poor fairness. Among them, the allocation equity of health technician was the worst, with the Gini coefficient exceeded 0.5; the second is TCM institution, with the Gini coefficient

approaching 0.5; the equity of actual bed allocation is relatively good. From the change trend, the Gini coefficient of actual bed and health technician decreased yearly, and the Gini coefficient of TCM institution decreased from 2011 to 2018, then increased slightly in 2019. From 2011 to 2019, the Gini coefficient of TCM institution decreased from 0.497 to 0.483, decreased by 0.014; the Gini coefficient of actual bed decreased from 0.471 to 0.428, decreased by 0.043; the Gini coefficient of health technician decreased from 0.595 to 0.565, decreased by 0.03. The decreasing range of the Gini coefficient of TCM resource was in the order of actual bed, health technician and TCM institution.

**Table 5.** The Gini coefficient of TCM resource allocation by geography in Tianjin

Year	Institution	Actual bed	Health technician
2011	0.497	0.471	0.595
2012	0.494	0.449	0.595
2013	0.494	0.444	0.587
2014	0.493	0.438	0.585
2015	0.490	0.438	0.580
2016	0.489	0.431	0.577
2017	0.484	0.439	0.572
2018	0.480	0.428	0.569
2019	0.483	0.428	0.565

### 4.2. Equity analysis based on Theil index

#### 4.2.1. Index

From 2011 to 2019, the total Theil index of TCM institution, actual bed and health technician allocation in Tianjin all decreased to varying degrees, indicating that the overall fairness is improving, and the fairness of TCM resource distribution according to population and geographical area, as well as the fairness between and within different regions is continuously increasing. The change trend of the total Theil index of TCM institution, actual bed and health technician were basically the same, with increasing yearly from 2011 to 2014 and decreasing yearly from 2014 to 2019. In 2019, the largest difference in the allocation of TCM resource was health technician, TCM medical institution, and actual bed in turn.

**Table 6.** Total Theil index of TCM health resource allocation in Tianjin

Year	Institution	Actual bed	Health technician
2011	0.0319	0.0329	0.0546
2012	0.0368	0.0384	0.0587
2013	0.0394	0.0413	0.0622
2014	0.0421	0.0445	0.0665
2015	0.0253	0.0259	0.0499
2016	0.0244	0.0248	0.0482
2017	0.0236	0.0236	0.0433
2018	0.0232	0.0231	0.0391
2019	0.0231	0.0222	0.0389

#### 4.2.2. Contribution rate analysis

From 2011 to 2019, the TCM institution's contribution rate of inter-regional difference was 54.73%~71.99%, and the TCM institution's contribution rate of intra-regional difference was 28.01%~45.27%;the actual bed's contribution rate of inter-regional difference was 57.51% ~ 72.66%, and the actual bed's contribution rate of intra-regional difference was 27.34% ~ 42.46%;the health technician's contribution rate of inter-regional difference was 66.68%~75.49%, and the health technician's contribution rate of intra-regional difference was 24.5%-33.32%.In other words, the contribution rate of inter-regional difference of the three types of TCM resource are all greater than that of intra-regional difference, indicating the regional difference was the main reason for the unfair allocation of TCM resource in Tianjin, and the fairness in exurb suburb was lower than urban districts and districts around the city. As shown in table 7.

**Table 7.** Contribution rate of inter-regional and intra-regional differences in allocation of TCM health resource in Tianjin (%)

Year	Institution		Actual bed		Health technician	
	Inter-regional	intra-regional	Inter-regional	intra-regional	Inter-regional	intra-regional
2011	0.0175	0.0144	0.0189	0.0140	0.0364	0.0182
2012	0.0231	0.0137	0.0249	0.0135	0.0409	0.0178
2013	0.0274	0.0120	0.0289	0.0125	0.0454	0.0168
2014	0.0303	0.0118	0.0323	0.0125	0.0502	0.0163
2015	0.0157	0.0096	0.0161	0.0098	0.0341	0.0158
2016	0.0155	0.0089	0.0158	0.0090	0.0341	0.0141
2017	0.0153	0.0083	0.0153	0.0083	0.0318	0.0115
2018	0.0152	0.0080	0.0151	0.0080	0.0280	0.0111
2019	0.0152	0.0079	0.0148	0.0074	0.0279	0.0110

## 5. RESULTS AND PROBLEMS

### 5.1. The Equity Degree of TCM Resource Allocation Has Been Improved, but the Regional Difference Is Still Obvious

As the main place to provide TCM service, more than 60% of TCM institution were located in urban districts which made the TCM service in districts around the city and exurb districts at a low level, also resulted in huge challenge that to provide multi-level and diversified TCM service for residents. The gap between urban and rural areas is large, the overall efficiency is difficult to achieve, and can not meet the needs of rural residents.

### 5.2. The geographical equity of TCM resource allocation is lower than the population equity

The geographical area of urban districts accounts for less than 1.5% of the geographical area of the whole city, but the number of TCM institution, actual bed and health technician were doubled higher than districts around the city and exurb suburbs. This may be related to the fact that the allocation of health resource is based on the per capita medical and health resource ownership, with little consideration of geographical distribution for a long time[1].

### 5.3. Regional Difference Is the Main Reason for the Unfair Allocation of TCM Resource

Theil index showed that the unfairness of TCM resource allocation in Tianjin was caused by intra-regional difference and inter-regional difference which due to the unbalanced economic development and large population difference among administrative regions[2].The regional allocation of health resource is a comprehensive and complex social

system engineering, which needs multi-departments to carry out multi-dimensional unified optimization layout.

## 6. SUGGESTIONS

### ***6.1. Increase Financial Input in Health to Underdeveloped Areas***

Increasing financial input is an important way to solve the gap of regional TCM resource [3]. It's necessary to optimize the structure and scale of financial input on the basis of increasing financial input, since rational distribution of health resource fully reflect the fairness of health input, so the main responsibility of the government should be clarified, at the same time the excessively market-oriented pattern of health resource allocation should be broken, and the health policy of primary medical institution should be reasonably guided to invest in the field of TCM.

### ***6.2. Include Geography As an Important Factor in Health Planning***

In the formulation of regional health planning, in addition to the total population of each district, a scientific system configuration mode should be established according to regional area, population density and other influencing factors[4]. While narrowing the between regional difference, we should also take the fairness of internal resource allocation into account. Focusing on intra-regional synergy, allocating and integrating regional TCM resource in accordance with the principles of fairness, rationality and efficiency, so as to drive the coordinated development of the whole region [5].

### ***6.3. Promote the Sharing of Resource and Strengthen the Construction of Basic TCM Institution***

Improving the internal imbalance of TCM resource should be by focusing on promoting the sharing of TCM resource among regions and strengthening the construction of basic TCM institution. It is suggested that the government should integrate the superior resource of each region, adjust the total amount, layout and structure of TCM institution at all levels and various types, and pay attention to creating a fair, just and open competitive environment. Through the establishment of TCM medical association or TCM hospital group, etc., regional medical information collaboration and sharing can be realized to promote TCM institution to give full play to their advantages[6].

## 7. CONCLUSION

Scientific and rational allocation of TCM resource is an important guarantee to improve the quality of social welfare level. In general, the total amount of TCM resource in Tianjin is large, but there are significant differences in the allocation of TCM resource among regions. Influenced by various factors such as economic development level, the allocation of TCM resource was mainly inclined to the economically developed areas, especially the allocation of health technician. The allocation of TCM resource is affected by many factors, and governments at all levels and relevant departments should take comprehensive consideration in the allocation of TCM resource.

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