

Availability and equity analysis of innovative drugs after national drug price negotiation in China: analyses of nationally cross-sectional data

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Background

- Health inequity is attracting increasing attention in health systems research, and the persisting health disparity worldwide has been emphasized as one of the most critical public health threats of the century¹.
- With economic development and the progress of medical technology, the demand for innovative drugs in clinical settings, from both doctors and patients alike, is steadily rising². Therefore, improving accessibility of innovative treatments and reduce it inequity will be a key goal for health policymakers in the future³.
- To reduce the prices of high-cost innovative drugs and enhance their accessibility, the Chinese government has been working on establishing a dynamic update mechanism for China's National Reimbursement Drug List (NRDL) since 2017.
- In China, when a drug is included in NRDL, it does not necessarily mean that patients can access it at any hospital. Other studies have indicated that the availability rate of part of drugs in NRDL is very low in specific provinces⁴, regions^{5,6}, or healthcare facilities⁷.
- However, the evidence regarding nationwide availability level and whether patients in different provinces have a fair opportunity to receive innovative drug treatments is limited.

Objective

- Our study aims to estimate the equity of drugs allocation in the NRDL (2017-2022) through the WHO/HAI standardized method, Gini coefficient and Thiel index.

Methods

Data resources and sample selection

- We collected data from the National Medical Insurance Service Platform (NMISP)⁸.
- We gathered two types of data from this platform. The first dataset includes the number of secondary and tertiary healthcare facilities in each province. The second dataset pertains to drug availability.
- Our study concentrated on drugs that were included in the NRDL between 2017 and 2022.

Availability analysis:

- We used WHO/HAI standardized approach⁹ to evaluate the availability of innovative drugs in NRDL.

Equity analysis:

- In this study, we used the total number of healthcare facilities equipped with drugs of every drug as the healthcare resource index.
- The Gini coefficient is the optimal tool to assess the equity of health resource allocation in terms of demographic and geographical aspects¹⁰. In this study, we introduced the number of healthcare institutions as the X variable. The Gini coefficient is derived from the Lorenz curve.
- We used Theil index to analysis the inequity of source allocation among different regions and provinces.

Formula

Availability analysis	WHO/HAI standardized approach
	Drug availability rate=(Number of healthcare facilities equipped with drug / Total number of healthcare facilities)*100%
	Overall drug availability rate= $\sum_{i=1}^k Drug\ availability\ rate_i / k_1$
Equity analysis	Healthcare resource measures
	$S = \sum_{i=1}^k N_i$
	Gini coefficients and Lorenz curves
	$G = 1 - \sum_{i=0}^k (Y_{i+1} + Y_i)(X_{i+1} - X_i)$
	Theil index
	$T = \sum_{i=1}^n P_i \log(P_i/E_i) = T_{intra} + T_{inter}$

Annotation:

- k₁: total number of drugs
- S: healthcare resource index
- N_i: the number of healthcare facilities that equipped drug i
- G: Gini coefficient
- Y_i: Cumulative proportion of the index S
- X_i: Cumulative proportion of population or healthcare facilities of different province
- k₂:total number of provinces
- T: value of the total Theil index
- P_i: percentage of population or healthcare facilities of each province
- E_i: percentage of the index S of each province

Results

Characteristics of drugs

- The data from NMISP include 342 drugs that were included in the NRDL between 2017 and 2022, the details are shown in Table 1.

Table 1. Characteristics of drugs in NRDL

	All drugs	Year of NRDL					p value
		2017-2018	2019	2020	2021	2022	
n	342(100%)	29(8.48%)	55(16.08%)	96(28.07%)	72(21.05%)	90(26.32%)	
Drug type							<0.001
Western drug	273(79.82%)	24(82.76%)	37(67.27%)	62(64.58%)	68(94.44%)	82(91.11%)	-
Traditional Chinese drug	69(20.18%)	5(17.24%)	18(32.73%)	34(35.42%)	4(5.56%)	8(8.89%)	-
Company							0.179
International	126(36.84%)	15(51.72%)	21(38.18%)	28(29.17%)	30(41.67%)	32(35.56%)	-
Domestic	216(63.16%)	14(48.28%)	34(61.82%)	68(70.83%)	42(58.33%)	58(64.44%)	-
ATC (Western Drug)							0.126
A	33(12.09%)	1(4.17%)	7(18.92%)	11(17.74%)	3(4.41%)	11(13.41%)	-
B	31(11.36%)	2(8.33%)	6(16.22%)	8(12.90%)	3(4.41%)	12(14.63%)	-
C	20(7.33%)	2(8.33%)	3(8.11%)	1(1.61%)	8(11.76%)	6(7.32%)	-
D	4(1.47%)	0(0.00%)	0(0.00%)	2(3.23%)	1(1.47%)	1(1.22%)	-
G	1(0.37%)	0(0.00%)	0(0.00%)	0(0.00%)	1(1.47%)	0(0.00%)	-
H	2(0.73%)	1(4.17%)	0(0.00%)	1(1.61%)	0(0.00%)	0(0.00%)	-
J	43(15.75%)	1(4.17%)	6(16.22%)	7(11.29%)	15(22.06%)	14(17.07%)	-
L	83(30.40%)	15(62.50%)	8(21.62%)	18(29.03%)	22(32.35%)	20(24.39%)	-
M	5(1.83%)	0(0.00%)	0(0.00%)	2(3.23%)	1(1.47%)	2(2.44%)	-
N	24(8.79%)	0(0.00%)	2(5.41%)	7(11.29%)	9(13.24%)	6(7.32%)	-
R	14(5.13%)	0(0.00%)	3(8.11%)	4(6.45%)	1(1.47%)	6(7.32%)	-
S	7(2.56%)	2(8.33%)	2(5.41%)	1(1.61%)	1(1.47%)	1(1.22%)	-
V	6(2.20%)	0(0.00%)	0(0.00%)	0(0.00%)	3(4.41%)	3(3.66%)	-
ATC (Traditional Chinese Drug)							0.067
A	55(79.71%)	2(40.00%)	17(94.44%)	27(79.41%)	3(75.00%)	6(75.00%)	-
C	6(8.70%)	3(60.00%)	1(5.56%)	2(5.88%)	0(0.00%)	0(0.00%)	-
D	2(2.90%)	0(0.00%)	0(0.00%)	0(0.00%)	1(25.00%)	1(12.50%)	-
G	3(4.35%)	0(0.00%)	0(0.00%)	2(5.88%)	0(0.00%)	1(12.50%)	-
I	3(4.35%)	0(0.00%)	0(0.00%)	3(8.82%)	0(0.00%)	0(0.00%)	-

Availability analysis

- The overall availability rate in nationwide was very low and the difference of availability between secondary and tertiary facilities is very significant (Figure 1).
- The overall availability rate at both the tertiary and secondary healthcare facilities varies greatly among different provinces and ATC Classification (Figure 2)

Figure 1. Overall availability rate of NRDL drugs

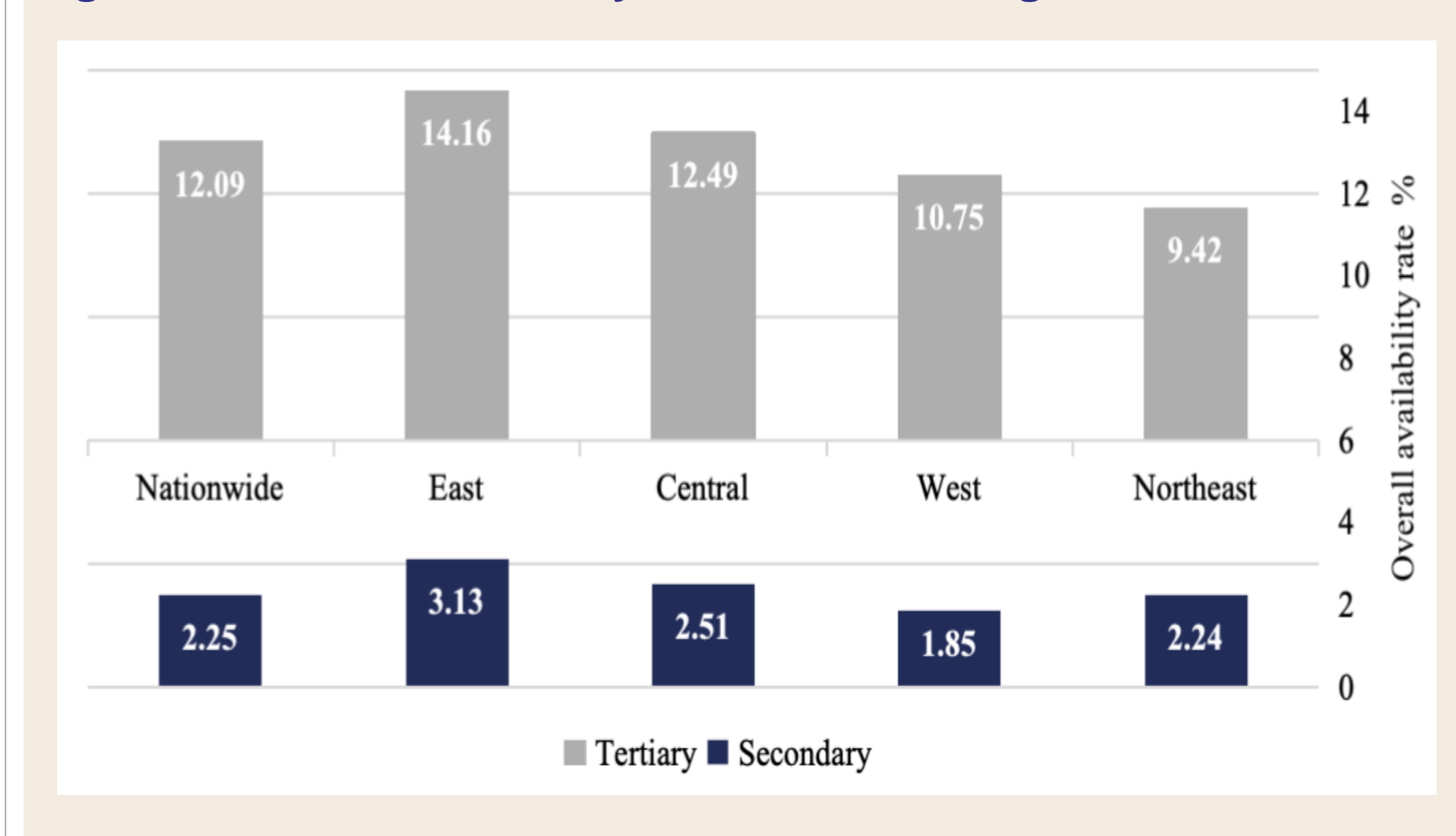
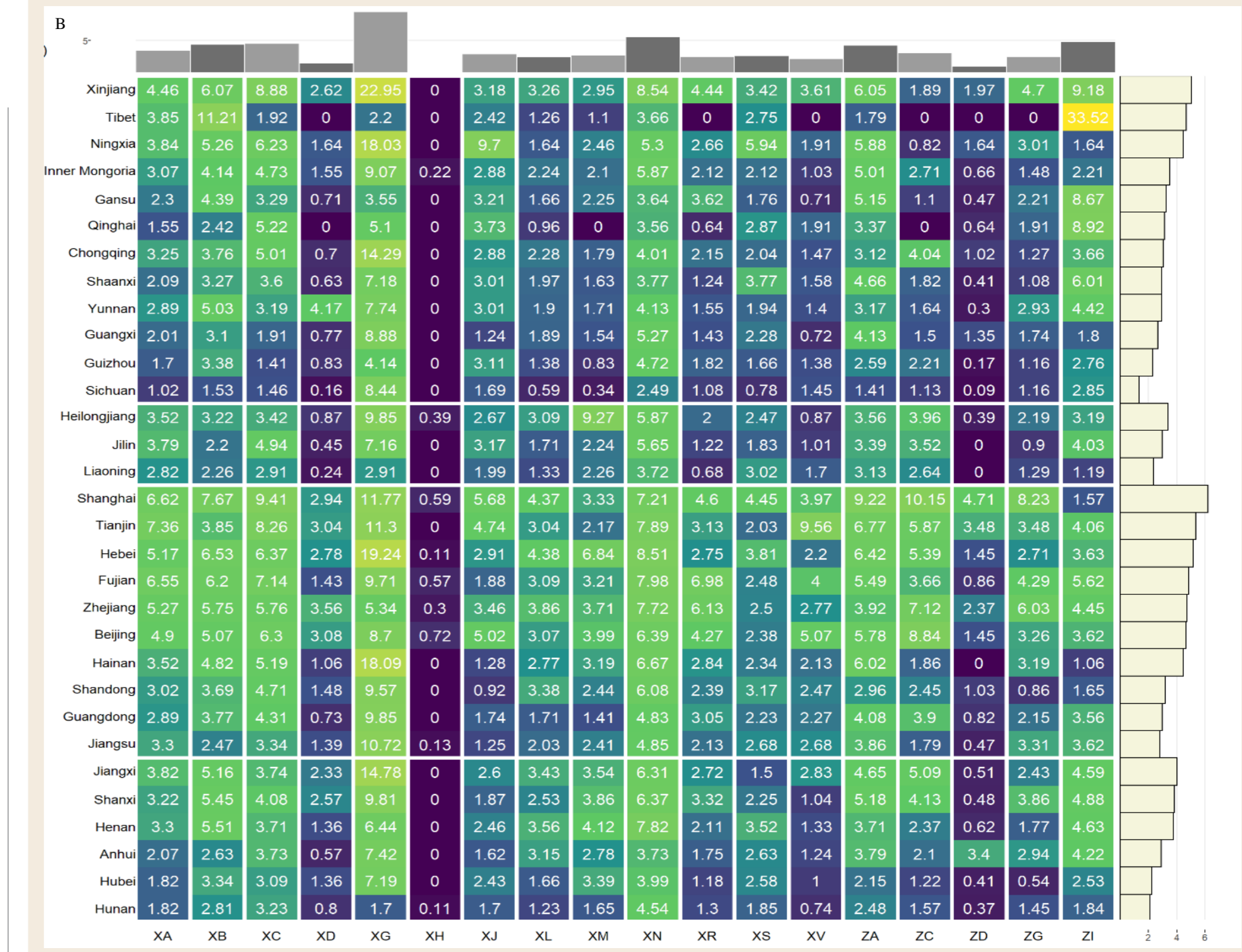
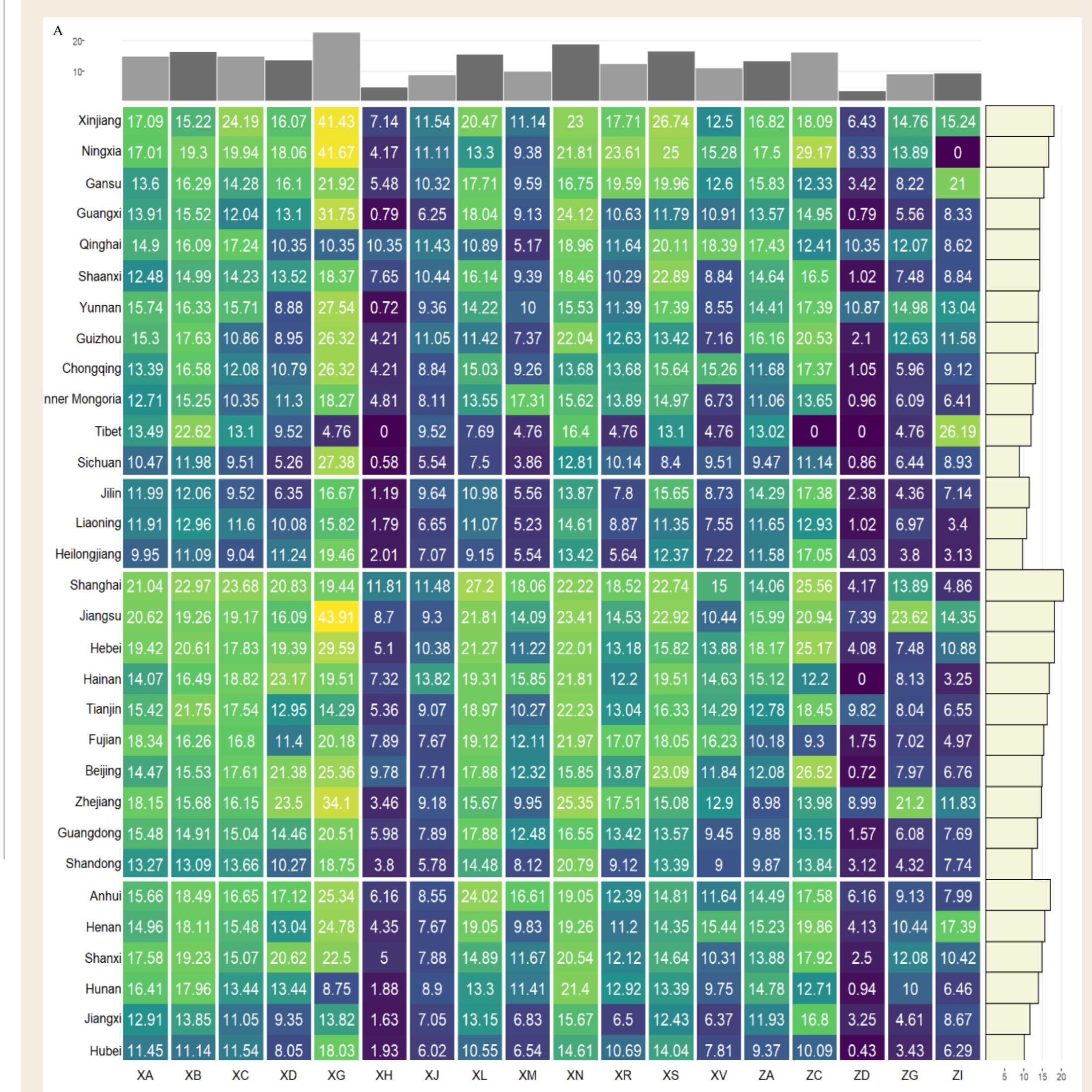


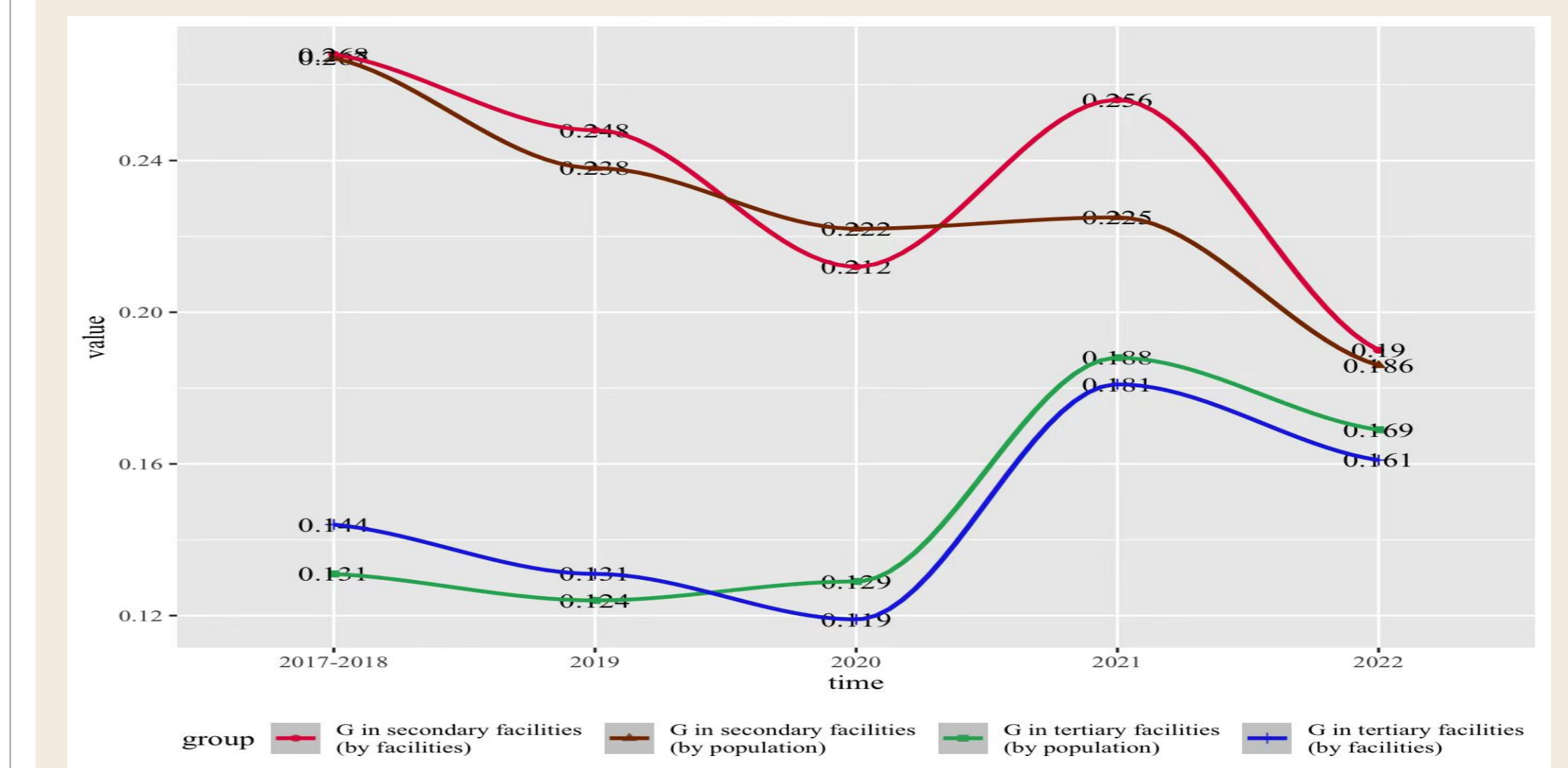
Figure 2. Availability rate in different levels of healthcare facilities across Different Provinces



Equity analysis by Gini coefficient

- The drugs allocation in secondary and tertiary facilities are both equitable from the perspectives of population and the number of healthcare facilities distribution.
- The equity of drugs allocation in tertiary facilities is better than that in secondary facilities in terms of ATC classification.
- The Gini coefficient trends from 2017 to 2022 is shown in Figure 3.

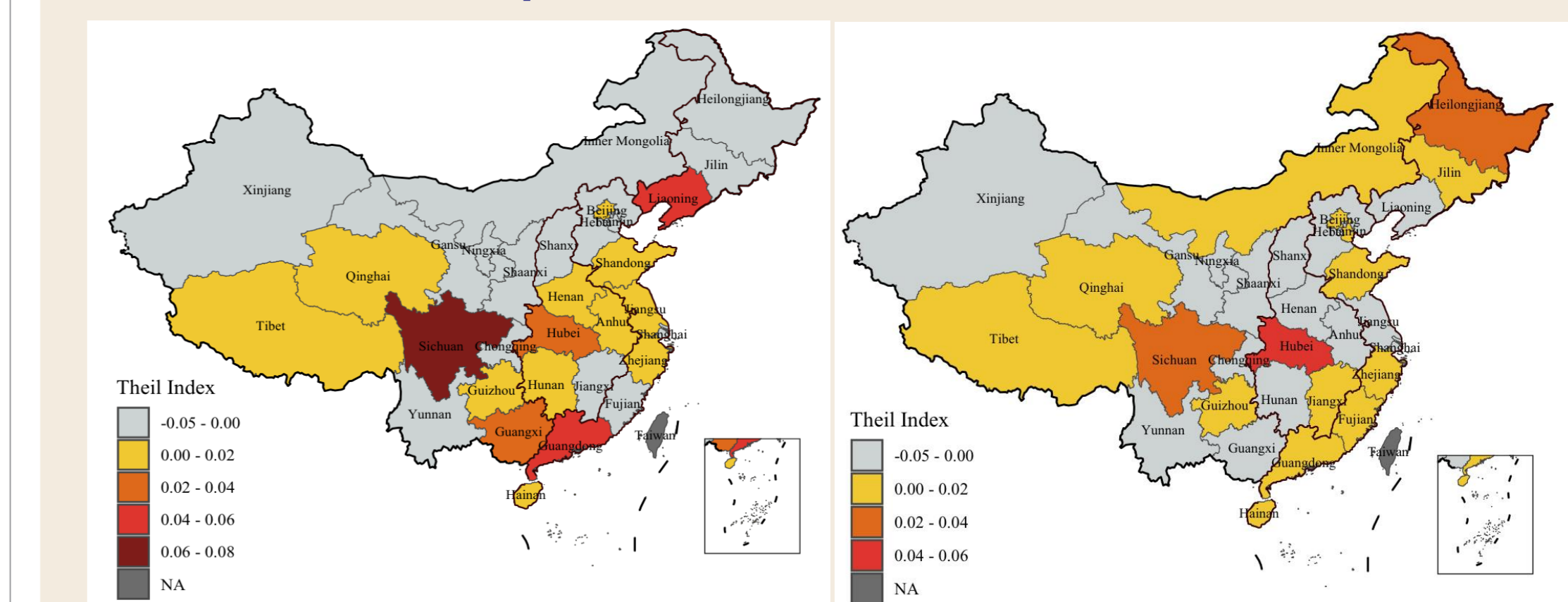
Figure 3. Gini coefficient trends from 2017 to 2022



Equity analysis by Theil index

- The Tail index based on facilities number is higher than the one based on population in secondary healthcare facilities.
- The main source of inequity in both the Tail indexes based on population and the facilities number is from intra-regional Theil indexes.
- The greatest inequity in drugs allocation was found in East and West region, while Northeast had the lowest inequity in drug allocation.

Figure 4. The value of log(P_i / E_i) in T_{intra} in tertiary healthcare facilities in different provinces



Conclusions

- The allocation rate at the national level is low, and the rate of secondary healthcare facilities is significantly lower than that of tertiary healthcare facilities. There are obvious differences between different regions and provinces. The equity of secondary healthcare facilities is obviously worse than that of tertiary healthcare facilities, and the inequity mainly comes from intra region.

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