

Entropy Weight Method

EWM is a commonly used weighting method that measures value dispersion in decision making. A greater degree of dispersion is associated with a greater degree of differentiation; consequently, more information can be derived, and a higher weight should be given to the index^①. This method avoids the defects of the subjective assignment method in the weight calculation for each subsystem and index. In this study, we set an index to evaluate the level of health insurance development in China and calculated the overall scores from 2012 to 2022.

First, the data for each indicator were standardized to ensure comparability. The data are represented as x'_{ij} , where i is the index of the decision-making unit (in this case, regions in China), and j represents the indicators (such as health insurance coverage and benefits). The standardized value x'_{ij} for positive indicators was calculated as follows:

$$x'_{ij} = \frac{X_{ij} - \min(X_{1j}, X_{2j}, \dots, X_{nj})}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} \quad (1-1)$$

The standardized value x'_{ij} for negative indicators was calculated as follows:

$$x'_{ij} = \frac{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - X_{ij}}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} \quad (1-2)$$

This normalization step ensures all data values are on a comparable scale.

Second, we calculated the p-value for the indicator weights. The following calculation formula for weight P_{ij} of the i -th sample in indicator X_j was used:

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^n x_{ij}}, \quad i = 1, \dots, n, j = 1, \dots, m \quad (1-3)$$

Third, we calculated the information entropy. In the EWM, the entropy value E_i

^① Zhu Y, Tian D, Yan F. Effectiveness of entropy weight method in decision-making. Math Probl Eng. 2020;2020:3564835.

of the i th index was defined as

$$e_j = -k \sum_{i=1}^n p_{ij} \ln(p_{ij}), i = 1, \dots, n, j = 1, \dots, m \quad (1-4)$$

Fourth, information entropy redundancy was calculated as follows:

$$d_j = 1 - e_j, j = 1, \dots, m \quad (1-5)$$

Fifth, the weight of each metric was determined using the entropy theory, reflecting the importance of the metric in the evaluation system. The range of entropy value E_i was $[0, 1]$. Larger E_i values are associated with greater degree of differentiation of index i ; consequently, more information can be derived, and a higher weight should be assigned to the index.

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j}, j = 1, \dots, m \quad (1-6)$$

Sixth, we obtained the comprehensive score for weight, as follows:

$$S_i = \sum_{j=1}^m W_j \cdot X_{ij} \quad (1-7)$$

Table S1. Provincial Spatiotemporal Variation in Basic Health Insurance Development Scores (2012–2022)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
China	0.2091	0.2176	0.2464	0.2303	0.2440	0.2542	0.2704	0.2901	0.2952	0.3237	0.3419
Beijing	0.2016	0.2264	0.2702	0.3202	0.3614	0.3811	0.5310	0.5041	0.4946	0.5997	0.5915
Tianjin	0.1115	0.1290	0.1750	0.2183	0.2599	0.3093	0.3230	0.3419	0.3337	0.3569	0.3712
Hebei	0.2398	0.2485	0.2636	0.2707	0.2216	0.2405	0.2541	0.2786	0.2802	0.3048	0.3248
Shanxi	0.2425	0.2379	0.2161	0.2285	0.2277	0.2292	0.2461	0.2574	0.2680	0.2993	0.3103
Inner Mongolia	0.1835	0.1988	0.2147	0.2356	0.2438	0.2346	0.2501	0.2688	0.2855	0.3090	0.3443
Liaoning	0.1845	0.2034	0.2139	0.2152	0.2271	0.2352	0.2192	0.2372	0.2644	0.2816	0.2876
Jilin	0.2517	0.2501	0.2517	0.2368	0.2638	0.2480	0.2510	0.2780	0.2900	0.2997	0.3004
Heilongjiang	0.1958	0.1916	0.2071	0.2141	0.2323	0.2159	0.2404	0.2578	0.2979	0.3007	0.3136
Shanghai	0.2032	0.2313	0.2454	0.2550	0.3517	0.4338	0.4756	0.4901	0.4897	0.5719	0.5804
Jiangsu	0.1947	0.2111	0.2149	0.2269	0.2391	0.2387	0.2668	0.2862	0.2887	0.3224	0.3369
Zhejiang	0.2315	0.2465	0.2576	0.2336	0.2469	0.2793	0.3030	0.3307	0.3455	0.3821	0.4071
Anhui	0.2485	0.2603	0.2590	0.2655	0.2894	0.2895	0.2608	0.2957	0.2813	0.3076	0.3271
Fujian	0.1969	0.2110	0.2240	0.2282	0.2177	0.2442	0.2578	0.2705	0.2689	0.2901	0.3090
Jiangxi	0.2446	0.2725	0.2820	0.3096	0.3057	0.2775	0.2960	0.3045	0.3131	0.3223	0.3329
Shandong	0.2286	0.2127	0.1788	0.1895	0.2080	0.2205	0.2617	0.2782	0.2666	0.2962	0.3174
Henan	0.2369	0.2520	0.2498	0.2551	0.2735	0.2555	0.2495	0.2648	0.2741	0.3001	0.3060
Hubei	0.2333	0.2343	0.2328	0.2638	0.2749	0.2431	0.2557	0.2778	0.3034	0.3080	0.3266
Hunan	0.1967	0.2054	0.2236	0.2368	0.2522	0.2550	0.2745	0.2808	0.2868	0.3050	0.3264
Guangdong	0.1756	0.1885	0.2009	0.2181	0.2333	0.2389	0.2510	0.2659	0.2671	0.3063	0.3368
Guangxi	0.3023	0.3000	0.3114	0.3230	0.3651	0.2854	0.3150	0.3183	0.3214	0.3314	0.3418
Hainan	0.2085	0.2231	0.2270	0.2383	0.2529	0.2736	0.2679	0.2892	0.2770	0.3307	0.3496
Chongqing	0.2160	0.3234	0.2095	0.2260	0.2344	0.2382	0.2748	0.2883	0.2955	0.3204	0.3436

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sichuan	0.2371	0.2517	0.2831	0.2715	0.2585	0.2599	0.2966	0.3068	0.3173	0.3406	0.3584
Guizhou	0.2251	0.2265	0.2182	0.2758	0.2850	0.3128	0.2829	0.3134	0.3198	0.3507	0.3655
Yunnan	0.1838	0.1896	0.1985	0.2147	0.2398	0.2648	0.2899	0.3092	0.3220	0.3432	0.3507
Shanxi	0.2669	0.2340	0.2274	0.2484	0.2527	0.2668	0.2667	0.2778	0.2956	0.3091	0.3563
Gansu	0.1952	0.1972	0.2160	0.2282	0.2514	0.2340	0.2446	0.2681	0.2879	0.3248	0.3435
Qinghai	0.2257	0.2123	0.2230	0.2394	0.2458	0.2724	0.3291	0.3607	0.3760	0.3970	0.4231
Ningxia	0.1887	0.2000	0.1996	0.2045	0.2251	0.2435	0.2726	0.2924	0.2963	0.3220	0.3780
Xinjiang	0.1863	0.2141	0.2236	0.2448	0.2631	0.2682	0.2741	0.2939	0.3037	0.3415	0.3522

Table S2. Dagum-Gini coefficient decomposition results of health insurance coverage in China (2012–2022)

year	Total	Inner-region				Inter-region						Contribution (%)		
	Gini	Eastern	Central	Western	Northeastern	Eastern-Western	Eastern-Central	Eastern-Northeastern	Western-Central	Western-Northeastern	Central-Northeastern	Intra-regional	Inter-regional	Travariation intensity
2012	0.09	0.09	0.04	0.09	0.07	0.09	0.08	0.09	0.08	0.09	0.06	27.23	37.54	35.23
2013	0.09	0.08	0.05	0.09	0.06	0.09	0.08	0.08	0.08	0.09	0.06	27.88	33.82	38.30
2014	0.07	0.08	0.05	0.07	0.04	0.08	0.07	0.08	0.07	0.07	0.06	28.38	19.87	51.76
2015	0.07	0.07	0.05	0.07	0.02	0.07	0.07	0.07	0.07	0.07	0.06	28.43	31.56	40.02
2016	0.08	0.10	0.05	0.06	0.03	0.08	0.09	0.09	0.06	0.06	0.06	28.33	17.50	54.17
2017	0.08	0.12	0.04	0.05	0.03	0.09	0.10	0.11	0.05	0.05	0.05	28.11	39.31	32.58
2018	0.09	0.14	0.04	0.05	0.03	0.10	0.12	0.14	0.05	0.06	0.04	27.05	54.01	18.95
2019	0.09	0.13	0.03	0.05	0.04	0.09	0.10	0.12	0.05	0.06	0.04	26.97	53.26	19.77
2020	0.08	0.13	0.03	0.04	0.03	0.09	0.10	0.11	0.04	0.04	0.03	27.51	39.81	32.69
2021	0.09	0.14	0.01	0.04	0.01	0.10	0.11	0.13	0.04	0.04	0.02	26.68	56.28	17.04
2022	0.08	0.13	0.02	0.03	0.02	0.08	0.10	0.12	0.04	0.05	0.03	24.33	58.47	17.21

Note: The total contribution in some years was higher than 100%.

**Tabel S3 China's Health Insurance Coverage Rates in
Different Provinces (Municipalities, and Autonomous) (2022)**

Region	Coverage rate for the Permanent resident population	Coverage rate for the local hukou population	Difference coverage rate (Resident-hukou)
Shanghai	80.39	132.30	-51.91
Beijing	87.02	133.31	-46.29
Zhejiang	84.80	109.13	-24.33
Guangdong	88.12	110.98	-22.86
Tianjin	86.31	101.30	-14.99
Xinjiang	90.18	101.16	-10.99
JiangSu	95.36	103.14	-7.79
FuJian	92.25	97.55	-5.30
Hainan	89.67	93.55	-3.88
Ningxia	91.04	94.71	-3.66
LiaoNing	89.32	90.56	-1.24
Shandong	94.79	94.94	-0.15
Qinghai	94.05	93.68	0.37
Inner Mongolia	90.37	89.47	0.91
Shanxi	92.58	90.97	1.61
Yunnan	97.16	94.41	2.76
Shaanxi	92.73	89.65	3.08
Hebei	94.61	90.53	4.08
Hubei	95.70	91.22	4.49
Chongqing	99.80	93.93	5.87
Jilin	96.36	88.75	7.61
Sichuan	100.24	92.57	7.67
Hunan	98.78	90.46	8.32
Heilongjiang	89.31	80.06	9.25
Jiangxi	102.65	92.24	10.42
Gansu	102.53	91.99	10.54
GuangXi	103.07	90.58	12.49
Henan	102.25	87.50	14.75
Anhui	106.20	91.38	14.82
Guizhou	109.47	91.14	18.33

Data Sources: China Statistical Yearbook (2023), China Population and Employment Statistical Yearbook (2023)

Note: Ranked in descending order of the difference (coverage of resident population - coverage of local-hukou population)

Tabel S4 The Proportion of the Local Permanent Resident Population Whose Household Registration is in another Province

(Based on the Seventh National Population Census,2020)

Region	Household Registration in other Provinces	Region	Household Registration in other Provinces	Region	Household Registration in other Provinces
Shanghai	42.14%	Inner Mongolia	7.01%	Gansu	3.06%
Beijing	38.45%	Chongqing	6.84%	Guizhou	2.97%
Tianjin	25.49%	Liao Ning	6.69%	Jiang Xi	2.83%
Zhejiang	25.07%	Shaanxi	4.89%	Guangxi	2.71%
Guang Dong	23.51%	Yunnan	4.72%	Heilongjiang	2.60%
Xinjiang	13.12%	Shanxi	4.64%	Anhui	2.54%
Jiang Su	12.16%	Hebei	4.23%	Hunan	2.37%
FuJian	11.77%	Jilin	4.16%	Henan	1.28%
Hainan	10.79%	Shandong	4.07%		
Ningxia	9.37%	Hubei	3.90%		
Qinghai	7.04%	Sichuan	3.10%	nation	8.86%

Note: Descending order by value, excluding the national total.

Socure: China Population Census Yearbook(2020)

The “*Reform Plan for the Division of Fiscal Authority and Expenditure Responsibility between Central and Local Governments in the Field of Healthcare*” designates the fiscal subsidies for the Urban and Rural Resident Basic Medical Insurance (URRBMI) as a shared fiscal responsibility between the central and local governments. Both central and local finances jointly bear the expenditure responsibilities, providing premium subsidies for URRBMI in accordance with established regulations. The central government allocates subsidy funds to 31 provinces (autonomous regions and municipalities) based on a tiered sharing approach according to specified standards. The regional tiers and sharing ratios by the central financial transfer are as follows:

Tabel S5 Tiered Sharing Ratios of Central Government Subsidies for Urban and Rural Resident Basic Medical Insurance

Class	Regions	Shared by Central Financial Transfer
Class I	Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	80%
Class II	Hebei, Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Hainan	60%
Class III	Liaoning (excluding Dalian), Fujian (excluding Xiamen), Shandong (excluding Qingdao)	50%
Class IV	Tianjin, Jiangsu, Zhejiang, Guangdong; and the five separately planned cities—Dalian, Ningbo, Xiamen, Qingdao, and Shenzhen	30%
Class V	Beijing Shanghai	10%

Table S6 shows the central government’s subsidies for the Urban and Rural Resident Basic Medical Insurance (URRBMI) in 2022, which overall align with the tiered regional classification. In some regions, the central government’s contribution even exceeds half of the total funding standard, indicating a high level of fiscal dependency.

Tabel S6 Central Financial Subsidies to Urban and Rural Resident Basic Medical Insurance in Various Regions in 2022

District	Central government subsidies for URRBMI (billion yuan)	Number of URRBMI enrollments (10,000 population)	Per capita financing (yuan)	Per capita payment from central finance (yuan)	Percentage of central finance in the national fiscal subsidy standard for the year	Share of central finance in total financing	Percentage of URRBMI enrollments	Financial subsidy class
National	3704.76	98349.1	960	376.69	61.75%	39.24%	73.07%	
Beijing	2.42	404.3	2785	59.86	9.81%	2.15%	21.27%	Class V
Shanghai	2.49	365.8	2735	68.07	11.16%	2.49%	18.39%	Class V
Tianjin	9.58	533.8	947	179.47	29.42%	18.95%	45.38%	Class IV
Jiangsu	85.74	4731	1123	181.23	29.71%	16.14%	58.27%	Class IV
Guangdong	117.75	6297.2	1012	186.99	30.65%	18.48%	56.46%	Class IV
Zhejiang	51.07	2721.4	1583	187.66	30.76%	11.85%	48.80%	Class IV
Fujian	85.08	2891.3	954	294.26	48.24%	30.85%	74.84%	Class III
Liaoning	63.98	2167.7	845	295.15	48.39%	34.93%	57.83%	Class III
Shandong	210.8	7134.8	955	295.45	48.43%	30.94%	74.07%	Class III
Jilin	57.71	1717.5	616	336.01	55.08%	54.55%	75.91%	Class II
Hainan	24.15	670.3	923	360.29	59.06%	39.03%	72.79%	Class II
Hebei	213.97	5782	858	370.06	60.67%	43.13%	82.36%	Class II
Heilongjiang	70.08	1877.5	896	373.26	61.19%	41.66%	67.83%	Class II
Jiangxi	155.33	4002.2	926	388.11	63.62%	41.91%	86.10%	Class II
Shanxi	98.67	2483.5	939	397.30	65.13%	42.31%	77.06%	Class II
Hubei	173.49	4352.6	904	398.59	65.34%	44.09%	77.82%	Class II
Anhui	220.28	5443.4	932	404.67	66.34%	43.42%	83.66%	Class II

District	Central government subsidies for URRBMI (billion yuan)	Number of URRBMI enrollments (10,000 population)	Per capita financing (yuan)	Per capita payment from central finance (yuan)	Percentage of central finance in the national fiscal subsidy standard for the year	Share of central finance in total financing	Percentage of URRBMI enrollments	Financial subsidy class
Hunan	224.43	5470.6	886	410.25	67.25%	46.30%	83.86%	Class II
Henan	364.8	8698.2	905	419.40	68.75%	46.34%	86.17%	Class II
Xinjiang	73.95	1671.7	922	442.36	72.52%	47.98%	71.66%	Class I
Shanxi	138.16	2948.1	958	468.64	76.83%	48.92%	80.37%	Class I
Guangxi	211.51	4471.5	859	473.02	77.54%	55.07%	85.96%	Class I
Sichuan	306.85	6426.7	921	477.46	78.27%	51.84%	76.56%	Class I
Gansu	105	2174.2	947	482.94	79.17%	51.00%	85.09%	Class I
Chongqing	116.21	2398.2	943	484.57	79.44%	51.39%	74.79%	Class I
Inner Mongolia	77.01	1583.1	991	486.45	79.75%	49.09%	72.96%	Class I
Yunnan	193.52	3975.8	918	486.74	79.79%	53.02%	87.19%	Class I
Ningxia	24.62	500.4	927	492.01	80.66%	53.08%	75.50%	Class I
Guizhou	183.92	3727.2	924	493.45	80.89%	53.40%	88.30%	Class I
Qinghai	22.04	443.3	1015	497.18	81.50%	48.98%	79.22%	Class I

Note: The annual government subsidy standard announced by the State in 2022 is 610 yuan/person/year, and the data for each location, except for the country as a whole, are listed in column 5 (per capita central financial subsidy/550*100%) from low to high. In addition, for the convenience of calculation and comparison, the subsidy values of the five separately planned cities of Dalian, Ningbo, Xiamen, Qingdao, and Shenzhen in the fourth column have been merged into the provinces in which they are located, so that the values of Dalian and Qingdao are reflected in the third column, and the values of Ningbo, Xiamen, and Shenzhen are reflected in the fourth column.

Data sources: central government transfers from the Budget Department of the Ministry of Finance, resident health insurance participation and actual financing from the 2023 China Healthcare Security Statistical Yearbook, and the rest calculated by the authors.

Table S7 Factors influencing of health insurance coverage (SAR Model)

	(1)	(2)	(3)	(4)
	Total	West	Middle	East(except Beijing, Shanghai)
W_				
coverage	0.142 (1.60)	-0.0303 (-0.22)	-0.100 (-0.74)	0.0151 (0.13)
Main				
Elderly dependency ratio	-0.177 (-1.07)	-0.383 (-1.42)	0.858 (1.42)	-0.770* (-2.07)
Child dependency ratio	0.333 (1.48)	0.223 (1.07)	0.157 (0.26)	0.107 (0.21)
Population movement	-0.558*** (-3.44)	-0.513** (-2.97)	0.394 (0.77)	-1.471*** (-4.40)
Per capita fiscal revenue	-1.801 (-0.87)	5.712* (2.21)	-9.408+ (-1.89)	3.774 (0.82)
Health technician density per 1,000 population	-0.393 (-0.96)	-0.591 (-1.04)	-2.161 (-1.09)	1.082 (0.77)
Percentage of tertiary hospitals	0.637** (2.88)	0.743* (2.34)	-0.134 (-0.24)	0.345 (0.76)
_cons	5.265*** (25.65)	3.027*** (15.55)	6.614*** (14.82)	5.022*** (12.41)
Province fixed effects	control	control	control	control
<i>N</i>	360	132	120	84
<i>R</i> ²	0.520	0.393	0.187	0.502

Table S8 Factors influencing of health insurance benefit (SAR Model)

	(1)	(2)	(3)	(4)
	Total	West	Middle	East(except Beijing, Shanghai)
W_				
benefit	0.106 (1.44)	0.0984 (0.92)	0.326*** (5.35)	0.266*** (3.94)
Main				
Elderly dependency ratio	52.49*** (9.08)	11.39 (1.23)	20.78** (3.08)	47.14*** (7.62)
Child dependency ratio	5.938 (0.78)	3.566 (0.52)	-12.60+ (-1.80)	-21.76* (-2.52)
Population movement	-4.406 (-0.81)	21.85*** (3.82)	-4.221 (-0.73)	-25.89*** (-4.35)
Per capita fiscal revenue	429.5*** (5.79)	5.276 (0.06)	173.3** (2.99)	543.8*** (6.83)
Health technician density per 1,000 population	-12.58 (-0.88)	130.6*** (6.78)	66.88** (3.06)	22.75 (0.88)
Percentage of tertiary hospitals	13.62+ (1.83)	-22.05* (-2.09)	5.881 (0.94)	-12.14 (-1.61)
_cons	176.4*** (25.68)	100.9*** (15.55)	73.77*** (14.78)	83.14*** (12.36)
Province fixed effects	control	control	control	control
<i>N</i>	360	132	120	84
<i>R</i> ²	0.300	0.519	0.284	0.247