Equalization of Public Health Services Coupling and Coordination Analysis with New Urbanization: Verification Based on Panel Data of Henan Province

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Abstract—There is an interaction between the equalization of public medical services and the level of new urbanization. Scientifically measuring and evaluating the relationship between them is of great significance to promote regional coordinated development. In this paper, the mean square deviation decision-making method and linear weighting method are used to measure the comprehensive score of the two systems, and the coupling coordination relationship of two systems is quantitatively analyzed by using the coupling coordination degree model. The study found that the level of new urbanization and equalization of medical and health services in Henan were continuously improved from 2010 to 2019; the coupling of the two systems has gradually transitioned from the uncoordinated period to the transitional period, but has not yet ushered in the development of high-level coordination. Finally, relevant suggestions are put forward.

Keywords- New urbanization; Basic medical and health public services; Coupling coordination analysis; Coordinated development of urban and rural areas

1 Introduction

With the continuous advancement of new urbanization, great changes have taken place in the production and lifestyle of urban and rural residents, the population structure and disease spectrum have changed, and the problem of aging has emerged. Therefore, there is a new demand for medical and health public services. Therefore, the 13th five-year plan for health in Henan Province also puts the development of health and health in an important position in the overall economic and social development.

According to relevant theories, there is interaction between urbanization promotion and public service provision, but at present, academic research mainly focuses on the current situation and development level measurement of urbanization and basic public service provision [1,2], and there is little quantitative research on the interaction between them. Therefore, taking Henan Province, a populous province, as a case area, based on the discussion of the interaction mechanism between the equalization of public health services and the development of new urbanization, this paper constructs the evaluation index system of two systems, measures the change of the coupling coordination relationship from 2010 to 2019 by using the mean square deviation decision-making method and the coupling coordination degree model, and analyzes the problems in the development process of the two systems, The corresponding development suggestions are of reference significance for China's provinces and cities to improve the level

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of new urbanization and promote the equalization of public services.

2 Research Method

2.1 Construction of index system

Considering the availability, scientificity and authenticity of data, combined with the meaning of the two target subsystems, referring to the relevant indicators in previous studies and the suggestions of experts in the field, this paper constructs the evaluation index system shown in Table 1.

2.2 Research methods

The weight of the index is calculated by the mean square deviation decision-making method based on the principle of information entropy, so as to avoid the adverse effect of subjective judgment. Then, the comprehensive development degree of new urbanization and equalization of medical and health public services is calculated by the linear weighting method. Finally, the coupling degree of the two is quantitatively analyzed with reference to the capacity coupling coefficient of physics. The specific model formula is as follows:

$$C = 2\sqrt{\frac{U_1 * U_2}{(U_1+U_2)(U_1+U_2)}} \tag{1}$$

Where C represents the coupling degree of the two subsystems, U1 represents the comprehensive development level of the new urbanization system, U2 represents the development index of medical and health public service level. The value of coupling degree C is between 0 and 1, the closer C is to 1, the better the benign resonant coupling between systems.

$$T = \alpha * U_1 + \beta * U_2 \tag{2}$$

$$D = \sqrt{C * T} \tag{3}$$

Of which: α and β The sum of the two is 1, and the mean value is 0.5 in this paper; T is the comprehensive harmonic index of the two systems; D is the final coupling co scheduling. Through the calculation of the coupling coordination degree of the two systems of new urbanization and equalization of medical and health public services in Henan Province over the years, it is divided into three categories, four subcategories and ten levels [3-4], and specific classification types have been omitted.

2.3 Data sources

In terms of data sources, most of the original data in this paper come from *China Statistical Yearbook, Henan statistical yearbook* and *Henan health and family planning statistical yearbook* from 2010 to 2019. Due to the different attributes of various indicators, the range standardization processing is carried out on the original data through normalization standardization, and the calculation formula is as follows:

$$X_{ij}{}' = \frac{X_{ij} - minX_{ij}}{maxX_{ij} - minX_{ij}} \text{ (Positive index)} \tag{4}$$

$$X_{ij}' = \frac{maxX_{ij} - X_{ij}}{maxX_{ij} - minX_{ij}} \text{ (Negtive index)} \quad (5)$$

X_{ij}' is the normalized value, X_{ij} is the original value of the j-th indicator of the i-th unit; $maxX_{ij}$,$minX_{ij}$ is the maximum and minimum value of the original value of the index in the evaluation period.

Table 1 Index system and weight of subsystem of new urbanization and equalization of medical and health public services in Henan Province

Systems	Primary indicators	Secondary indicators	Unit	Effect	Weight
New urbanization development system	N1 Economic development level	N11 GDP per capita	Yuan	+	0.0191
		N12 Proportion of secondary and tertiary industries in GDP	%	+	0.0285
		N13 Investment in fixed assets	Yuan	+	0.0261
		N14 Consumption level of residents	Yuan	+	0.0206
	N2 Population urbanization	N21 Population urbanization rate	%	+	0.0178
		N22 Natural growth rate	%	+	0.0125
		N23 Number of urban employees	10000 persons	+	0.0144
		N24 Population with college degree or above	Person	+	0.1347
	N3 Spatial Urbanization	N31 Land urbanization rate	%	+	0.0163
		N32 Proportion of built-up area	%	+	0.0192
		N33 Urban population density	Person/km²	+	0.0221
	N4 Urbanization of social life	N41 Number of buses per 10000 people	Vehicle	+	0.0258
		N42 Per capita urban road area	M²	+	0.0222
		N43 Urban gas penetration rate	%	+	0.0190
		N44 per capita consumption expenditure of residents	%	+	0.0297
		N45 per capita expenditure on education, culture and entertainment	Yuan	+	0.0236
		N46 public library collections per capita	Volume	+	0.0270
		N47 per capita disposable income in urban and rural areas	Yuan	+	0.0165
	N5 Resource environment	N51 power consumption of the whole society	kwh	+	0.0131
		N52 total energy consumption	T / Standard coal	-	0.0319
		N53 urban daily sewage treatment capacity	10000 m³	+	0.0304
		N54 harmless treatment rate of domestic waste	%	+	0.0187
		N55 greening coverage of built-up area	%	+	0.0309
Medical and health public service equalization	F1 Medical and health resource investment	F11 proportion of medical and health expenditure in general public budget expenditure	%	+	0.0162
		F12 number of medical and health institutions per 10000 people	Pcs.	+	0.0352

system		F13 per capita expenditure for basic public health services	Yuan	+	0.0246
		F14number of beds in medical and health institutions per 10000 people	Pieces	+	0.0185
		F15 number of health technicians per 10000 people	Person	+	0.0213
		F16 Average medical expenses of outpatients	Yuan	-	0.0172
		F17 proportion of people undergoing health examination	%	+	0.0088
		F18 hospital bed utilization rate	%	+	0.0147
		F21 emergency mortality in medical and health institutions	%	-	0.0078
		F22 diagnosis and treatment person times per 100 medical and health institutions	Freq.	+	0.0127
	F2 Effect of medical and health services	F23 number of class A and B legal infectious diseases per 10000 people	Person	-	0.0215
		F24 under 5 mortality	%	-	0.0193
		F25 Ratio of discharge to admission in hospital	%	+	0.0127
		F26 population aging	%	-	0.0166
		F27 routine immunization report vaccination rate	%	+	0.0100
	F3 Equalization of medical and health services in urban and rural areas	F31 ratio of medical and health care expenditure of urban and rural residents	%	-	0.0094
		F32 ratio of diagnosis and treatment times between hospitals and health centers	%	-	0.0138
		F33 ratio of beds per 1000 people in hospitals and health centers	%%	-	0.0104
		F34 ratio of medical institutions per 10000 people in urban and rural areas	%	-	0.0381
		F35 ratio of health technicians per 1000 people in urban and rural areas	%	-	0.0142
		F36 Ratio of average length of stay of patients discharged from hospital to health center	%	+	0.0275
		F37 popularization rate of harmless sanitary toilets in rural areas	%	+	0.0095

3 Research results

The calculation of relevant indicators of the coupling system requires the comprehensive development level of each subsystem. In this paper, the comprehensive evaluation indexes of the two subsystems are calculated by the linear weighting method, and the evolution curve of two subsystems from 2010 to 2019 is obtained, as shown in Figure 1-3:

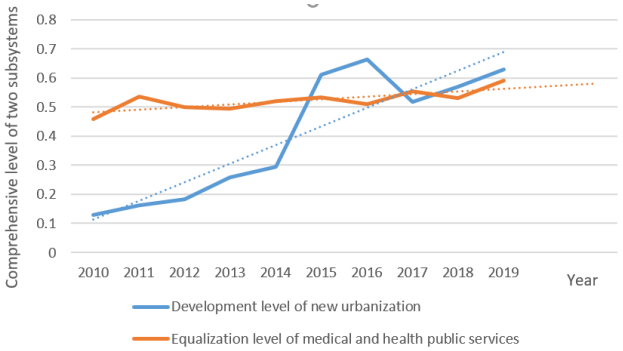

Figure 1 Evolution of new urbanization and equalization of medical and health services

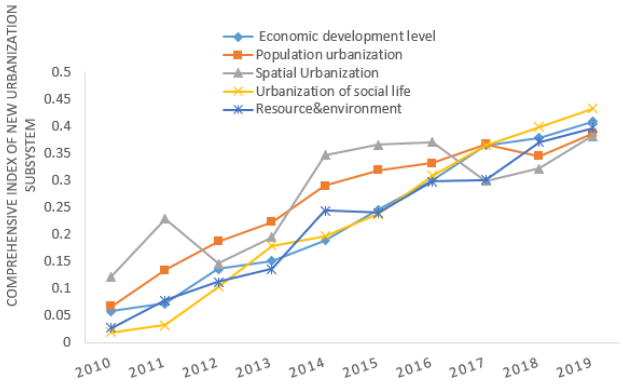

Figure 2 Comprehensive level of new urbanization subsystem

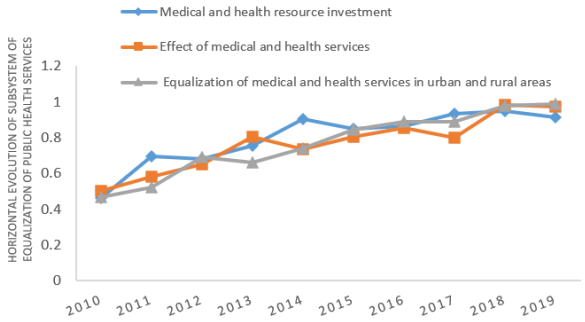

Figure 3 Comprehensive level of Medical and health public service equalization subsystem

3.1 Evolution of development level of new urbanization in Henan Province.

As can be seen from the figure, the overall level of new urbanization in Henan Province shows a growth trend, and the comprehensive urbanization index has increased from 0.129 in the initial stage to 0.629, with an annual growth rate of about 5%. Especially since the State Council issued

the *National new urbanization plan (2014-2020)* in 2014, prefecture level cities and county-level cities such as Luoyang City and Yuzhou City in Henan Province have been included in the pilot list. With the attention of policies, the level of new urbanization in Henan Province showed a rapid growth from 2014 to 2016. From the perspective of the five subsystems, it has generally experienced a development trend from population development urbanization and spatial urbanization to social life urbanization, economic development urbanization and resource and environment urbanization.

3.2 Evolution of equalization level of medical and health public services in Henan Province

It can be seen from the figure that the development level of equalization of medical and health public services in Henan Province maintained a relatively stable slow growth trend from 2010 to 2019, and the comprehensive index increased from 0.459 in the initial stage to 0.591, with an annual growth rate of about 1.3%. From the results of the three subsystems, it has generally experienced the development characteristics of the initial stage from the investment of medical resources to the joint leadership of the effect of medical and health services and the equalization of medical service levels in urban and rural areas. In recent years, the main reasons for the slow growth of the equalization level of medical and health public services in Henan Province are the large population base, the large demand for medical services, and the insufficient total amount of medical and health resources. In 2015, there were 5.16 beds in medical and health institutions, 2.1 practicing (Assistant) doctors and 2.17 registered nurses per 1000 permanent residents in Henan Province, and the national average in the same period was 5.11, 2.21 and 2.36 respectively.

3.3 Analysis on the coupling and coordination between the construction of new urbanization and the equalization of medical and health public services in Henan Province.

Through the calculation of the above results, the coupling coordination between the two systems of new urbanization construction and equalization of medical and health public services in Henan Province from 2010 to 2019 is further measured, and the types of coupling coordination degree are divided. The results are shown in Table 2.

Table 2 Coupling and coordination evaluation of new urbanization and equalization of medical and health public services in Henan Province from 2010 to 2019

Year	N	F	T	C	D	Coupling Coordination Types	level
2010	0.129	0.459	0.129	0.404	0.229	Severe disharmony (low level coupling)	Moderate disorder
2011	0.163	0.535	0.249	0.646	0.283	Severe disharmony (low level coupling)	Moderate disorder
2012	0.183	0.500	0.341	0.685	0.350	Basic disharmony (resistance stage)	Mild disorder
2013	0.259	0.494	0.377	0.850	0.498	Basic disharmony (resistance stage)	Verge of disorder
2014	0.295	0.521	0.408	0.961	0.526	Basic coordination (run-in stage)	Reluctantly coordinate
2015	0.611	0.533	0.572	0.998	0.655	Basic coordination (run-in stage)	Primary coordination
2016	0.662	0.509	0.585	0.999	0.696	Basic coordination (run-in stage)	Primary coordination

2017	0.517	0.553	0.535	0.999	0.731	Basic coordination (run-in stage)	Intermediate coordination
2018	0.569	0.531	0.550	0.999	0.742	Basic coordination (run-in stage)	Intermediate coordination
2019	0.629	0.591	0.610	0.9910	0.781	Basic coordination (run-in stage)	Intermediate coordination

On the whole, according to the classification of coupling coordination evaluation levels by existing scholars [5-6], the construction of new urbanization and the equalization of public health services in Henan Province have experienced the evolution process from uncoordinated period to transition period, which can be divided into three stages.

3.3.1 Severe disharmony period (0<D ≤0.3) low level coupling stage: 2010-2011.

At this stage, the level of new urbanization and equalization of public health services is low, and the comprehensive development level of urbanization is relatively lower than the average level during the study period. In the early stage of urbanization, the government paid more attention to the development speed and the construction of large and medium-sized cities, and lacked attention to the development quality of urbanization and small cities and rural areas, resulting in the unequal distribution of public service resources, so the two systems were in a state of unbalanced development.

3.3.2 Basic uncoordinated period (0.3<D ≤ 0.5) antagonistic stage: 2012-2013.

At this stage, it mainly experienced two different periods from mild imbalance in 2012 to near imbalance in 2013, but the equalization level of public health services is generally higher than the development level of new urbanization. During this period, in 2012, the general office of Henan Province successively issued the "12th Five Year Plan" for health development in Henan Province and the implementation opinions of the general office of Henan Provincial People's Government on Further Strengthening the construction of rural doctors, paying more attention to medical security and coordinated development between urban and rural areas, Therefore, the degree of coupling and coordination between the new urbanization system and the equalization system of medical and health public services has been improved.

3.3.3 Basic coordination (0.5<D ≤ 0.8) running in stage: from 2014 to 2019

it mainly experienced the transition stage from reluctant coordination to primary coordination and intermediate coordination, and showed the trend that the level of healthy cities lags behind the development of urbanization. From 2014 to 2019, the government successively issued a number of strong policies, such as the implementation opinions of the general office of Henan Provincial People's Government on integrating the basic medical insurance system for urban and rural residents and the implementation opinions of Henan Provincial People's Government on promoting the action of health in the Central Plains, which strengthened the equalization level of medical and health public services in Henan Province in many aspects.

Generally speaking, Henan Province has experienced the development stage from uncoordinated period to transition period in the past 10 years. Although it has not yet ushered in a highly coordinated period between the two, with the official introduction of the three-year action plan for improving the public health service capacity of Henan Province (2020-2022) in 2020, it has promoted the construction of a more perfect public health service system, Henan

Province is about to enter a stage of using the development of new urbanization to promote the realization of equalization. At the same time, the improvement of equalization level also creates conditions for the development of urbanization, so as to realize coordinated development.

4 Conclusions and Countermeasures

4.1 Main conclusions

Through the mean square deviation weighting method and the coupling coordination degree model, the comprehensive development index of new urbanization and the equalization level index of medical and health public services in Henan Province from 2010 to 2019 are measured, and then the coupling coordination relationship between the two systems is analyzed. The results are as follows.

From 2010 to 2019, the new urbanization level and the equalization level of medical and health public services in Henan Province are generally in a stage of continuous improvement; from 2010 to 2019, the new urbanization level and the equalization level of medical and health public services in Henan Province have experienced the evolution process from uncoordinated period to transition period.

On the whole, this paper constructs the evaluation index system and coordination analysis theoretical framework of new urbanization construction and equalization of medical and health public services, which provides a reference for the evaluation of other provinces and cities. However, considering the availability and integrity of index data, the index system in this paper is not perfect, and the spatial research on Henan regional data has not been carried out, resulting in insufficient research. Future research can improve the evaluation index system and refine the research objects, so as to make the evaluation results more scientific and comprehensive.

4.2 Countermeasure analysis

According to the previous conclusions and the problems existing in the new urbanization and equalization of medical and health public services in Henan Province, the Countermeasures of this paper are analyzed as follows. First of all, the government should continue to increase investment in basic public health services in view of the lack of overall financial investment; secondly; We should pay more attention to the development quality of new urbanization and constantly promote the development of urban-rural integration. Finally, we should pay more attention to the mutual promotion between new urbanization and the equalization of public health services and promote their benign and coordinated development.

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