

# How is China's Health Development During 2012 to 2017? A Longitudinal Study Based on Comprehensive Evaluation and Linear Growth Model

**Gangming Zhang**

Wuhan

**kelifa Mohammedosman Mohammedamid**

Wuhan University

**Fang Tang**

Wuhan University

**Jiaye Xu**

Wuhan University

**Bhawana Shrestha**

Wuhan University

**Peigang Wang** (✉ [wpg926@whu.edu.cn](mailto:wpg926@whu.edu.cn))

Wuhan University, China <https://orcid.org/0000-0003-4398-0689>

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## Research article

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# Abstract

**Background:** Since 2012, China has come into a new period of health development. This paper comprehensively described China's health development and explored associated influencing factors during the last 6 years (2012-2017).

**Methods:** Data for this study came from statistics yearbook and analysis unit were provincial regions. Comprehensive evaluation (principal component analysis and entropy weight method) was employed to calculate the comprehensive health index to evaluate the health. Then linear growth model was applied to explore factors that influenced the development.

**Results:** Results showed that, since 2012, China's health had a sustainable growth but inequities among provincial regions were still existing and becoming larger. For influencing factors, time was always a significant positive predictor ( ) and it was affected by geographical distributions ( ) and distance to Beijing ( ), which indicated that regions in central or far from Beijing had a lower growth. Among socioeconomics variables, urbanization level was the final factor ( ) that promoted China's health development and caused development inequalities. Besides, health level was also influenced by the distance to Beijing ( ), regions near to Beijing had a higher health level.

**Conclusion:** Time effect was the results of policy, during 2012 to 2017, China's sustainable health development was brought by the policy effect and growth of urbanization level. Thus, it is crucial for one country to introduce suitable health policies and narrow the urban-rural gaps to improve its health. Distance to Beijing represented the potential political influence on health of one country's capital due to the policy execution level which means that supervisions need to be strengthened for regions far from the capital. Besides, supports and supervisions also need to be enhanced in central regions. They were one of the reasons that caused development inequalities.

## Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

## Tables

**Table 1 Index system of provincial-level health**

Indicators	Unit	Type
<b>Health condition</b>		
Maternal Mortality Rate	1/100000	Negative
Infant Mortality Rate	‰	Negative
Perinatal mortality Rate	‰	Negative
Expectation of life	year	Positive
Infectious disease morbidity	1/100000	Negative
<b>Health workforce</b>		
Density of general practitioner	1/10000	Positive
Density of certified doctor	1/1000	Positive
Density of certified nurse	1/1000	Positive
Density of medical technological personnel	1/1000	Positive
Density of traditional Chinese medicine personnel	1/1000	Positive
<b>Health service availability</b>		
Average number of hospital visits	Person-time	Positive
Average number of traditional Chinese medicine hospital visits	Person-time	Positive
<b>Health facility</b>		
Density of general hospital	1/100000	Positive
Density of primary healthcare institution	1/10000	Positive
Density of public health institution	1/100000	Positive
Density of traditional Chinese medicine hospital		Positive
General hospital bed density	1/1000	Positive
Primary healthcare institution bed density	1/1000	Positive
Public health institution bed density	1/1000	Positive
Total expenditure on health as a percentage of gross domestic product	%	Positive
Per capita total expenditure on health	CNY	Positive
<b>Environment health</b>		
Average area of urban green space	m <sup>2</sup>	Positive
Emission intensity of industrial waste	-	Negative
Emission intensity of exhaust gas	-	Negative
Emission intensity of ammonia nitrogen in exhaust water	-	Negative

**Table 2. Average value of provincial-level CHI from 2012 to 2017**

Years	2012	2013	2014	2015	2016	2017
CHI	48.2157	51.6772	52.7700	54.1344	56.0014	58.0418
PCA_CHI	47.7543	48.8561	48.9800	49.4270	51.0686	52.4669
EWM_CHI	48.6770	54.4983	56.5601	58.8419	60.9342	63.6166
CHI SD	10.3755	12.7654	10.0528	10.4866	10.8912	11.0452
Years	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	
CHI Growth Rate	7.18%	2.11%	2.59%	3.45%	3.64%	

Note: CHI: Comprehensive health index, PCA\_CHI: Comprehensive health index calculated by principal component analysis, EWM\_CHI: Comprehensive health index calculated by entropy weight method, and CHI SD: Standard deviations of comprehensive health index.

**Table 3 CHI of Eastern, Central and Western Regions During 2012 to 2017**

Years	2012	2013	2014	2015	2016	2017	Average
<b>Eastern Region</b>	56.53	62.27	60.81	63.19	65.34	67.66	62.63
<b>Central Region</b>	44.95	46.30	48.54	49.48	50.90	52.34	48.75
<b>Western Region</b>	42.77	45.55	48.23	48.94	50.85	53.02	48.23
<b>Whole Country</b>	48.22	51.68	52.77	54.13	56.00	58.04	53.47

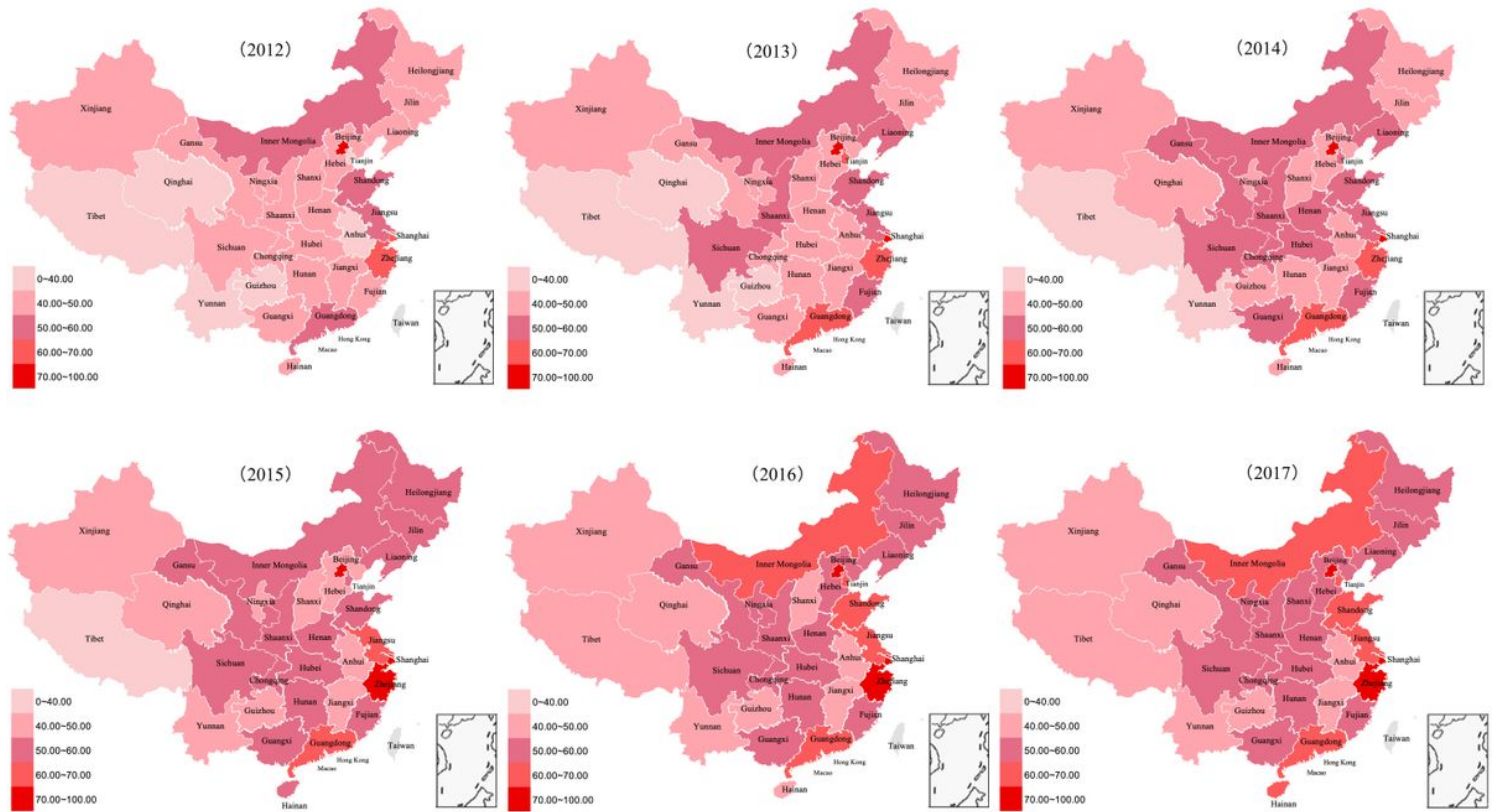
Note: Eastern region includes Beijing, Tianjin, Hebei, Shanghai, Shandong, Jiangsu, Zhejiang, Guangdong, Liaoning, Fujian and Hainan; Central region includes Heilongjiang, Jilin, Henan, Shanxi, Anhui, Hunan, Hubei and Jiangxi; Western region includes Inner Mongolia, Shaanxi, Xinjiang, Tibet, Qinghai, Gansu, Ningxia, Guizhou, Yunnan, Sichuan, Chongqing and Guangxi.

**Table 4 Factors influencing provincial-level health development**

Variables	Model 1	Model 2	Model 3	Model 4
Intercept	58.0067(1.9805)***	67.4357(2.6297)***	44.7950(5.3109)***	26.0916(7.1580)***
Time	1.8134(0.113)***	1.9215(0.186)***	2.4012(0.4781)***	2.222(0.4336)***
Western		-14.3612(3.6407)***	-3.0437(3.5304)	-0.7746(3.4673)
Central		-14.9954(4.0527)***	-7.481(3.5403)	-5.4883(3.4826)
Time*Western		0.0177(0.2575)*	-0.0706(0.2992)	-0.4261(0.2775)
Time*Central		-0.4452(0.2866)*	-0.2570(0.2938)	-0.5628(0.2697)*
PerGDP			0.9666(0.4473)*	0.4084(0.4182)
Distance			3.0149(1.3759)*	1.7918(1.3837)*
Time*Distance			-0.3081(0.1197)*	-0.2661(0.1066)*
PopuDensity			0.005(0.002)*	0.0023(0.002)
UrbanPopu				0.4284(0.11)***
<b>Random effects parameters</b>				
Variance (intercept)	120.11(31.3955)***	74.5925(20.3318)***	41.4175(12.3497)***	39.51(11.4312)***
Variance (time)	0.2347(0.1043)*	0.2192(0.1037)*	0.1945(0.1034)*	0.1152(0.0787)
Covariance (intercept, time)	0.1009(1.2714)	-0.5337(1.0184)	-0.8458(0.8449)	1.4118(0.7661)
Variance (residual)	2.8232(0.3585)***	2.8232(0.3585)***	2.7385(0.3487)***	2.7957(0.3573)***
-2LL	918.1	891.9	873.5	864.0
AIC	926.1	899.9	881.5	872.0
BIC	931.8	905.7	887.3	877.7

Note: \* P<0.05, \*\*P<0.01, \*\*\*P<0.001

## Figures



**Figure 1**

Space distribution of China's CHI from 2012 to 2017. This map showed the space distribution of China's CHI during 2012 to 2017. As we can find in this map, deeper of the color (red) represented a higher CHI score. From 2012 to 2017, scores of most provincial regions showed a growth trend and were also higher in eastern regions. Provincial regions near Beijing, China's capital, also were higher than those far from it. Central regions, like Anhui and Jiangxi, had evident lower growth rate than others. Data was only limited for mainland China, there was no data for Taiwan, Hong Kong and Macao (the color were grey). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.