The spatial distribution of traditional intangible cultural heritage medicine of China and its influencing factors

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Abstract

Intangible cultural heritage (ICH) of traditional Chinese medicine is a vivid testimony to the continuous inheritance of Chinese civilization. The study of ICH of traditional Chinese medicine from the perspective of the geographical environment, spatial relationships and diachronic development is of great significance for understanding objectively the reasons for the formation of spatial distribution patterns of ICH and the pathways and extent of its spread; as a consequence, such information can help us improve our understanding of the integrity and historical continuity of culture. From a geography perspective, this study seeks to explore the spatial patterns of traditional Chinese medicine ICH based on knowledge concerning the extent of spreading of traditional Chinese medicine ICH. At the same time, the spatial analysis technique ArcGIS is used to express the spatiotemporal development of traditional Chinese medicine ICH in a simple, clear and visual way. Also, the factors influencing the spatial distribution of traditional Chinese medicine ICH are analyzed. The main findings are as follows: (1) The spatial distribution of traditional Chinese medicine ICH practices is cohesive as a whole, with a tendency to aggregate and strong imbalance in distribution. (2) There are significant differences in the classification and number of traditional Chinese medicine ICH. (3) Traditional Chinese medicine ICH practices have obvious differentiation in time and space distribution when factoring in their announcement in batches. (4) Traditional medicine practices have significant spatial autocorrelation. Appreciation of the aforementioned features allows us to gain consensus on the development and evolution of traditional Chinese medicine ICH, and hence can justify how we allocate funds to promote traditional Chinese medicine ICH projects, paying particular attention to researching the historical context, and preserving the extraction of the local characteristics of traditional Chinese medicine ICH.

Keywords Traditional intangible cultural heritage medicine, Spatial distribution, Innovative protection

Introduction

With the continuous acceleration of urbanization, globalization, and rapid development of modern technology, cultural diversity is tending to fade. Intangible cultural heritage is a specific manifestation of cultural diversity, an important guarantee for sustainable development [1], and a crucial factor in measuring a country or nation's creativity and comprehensive competitiveness in the international community. The protection of intangible cultural heritage has become a worldwide issue since the 21stcentury. UNESCO is the leader to protect world intangible cultural heritage. 2003 UNESCO convention has gradually built up a complete system for the protection of intangible cultural heritage, and has facilitated it to become more and more mature and perfect through listing intangible cultural heritage, raising public awareness, inheriting and educating, international cooperation

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Nie *et al. Heritage Science*   (2023) 11:90

Page 2 of 14

and assistance, and guiding the formulation of relevant laws, regulations and administrative measures.

The rich and colorful intangible cultural heritage is an important component of traditional Chinese culture, reflecting the unique spiritual values and cultural vitality of the Chinese nation, and playing an important role in enhancing the understanding of the integrity and historical continuity of Chinese culture. However, with the profound economic and social changes, the continuous development of new media and technologies, China's cultural ecology has undergone drastic changes, and the survival environment of intangible cultural heritage has been strongly impacted. Strengthening the protection of intangible cultural heritage is an urgent task. How to scientifically, reasonably and effectively recognize, develop, and protect intangible cultural heritage has become a focus of attention for governments and scholars around the world. Currently, domestic and foreign scholars have conducted extensive research on the concepts, connotations, and characteristics of intangible cultural heritage, as well as protection and inheritance paths [2–4]. The research perspective is mainly focused on folklore, ethnology, cultural studies, [5–8] etc., simultaneously, further research focuses on the theoretical construction of intangible cultural heritage, value assessment, tourism development and tourism experience, educating in heritage values[3, 9–13]. Re-innovation of intangible cultural heritage [3, 14]. These phased studies explored the extension and connotation of ICH from the external level to the internal level [15–17], while the geographical perspective is relatively less studied. According to the search results from CNKI (China National Knowledge Infrastructure), as of December 30th, 2022, the number of articles on the topic of "intangible cultural heritage" in the field of geography only accounts for about 0.5% of the total number of articles, indicating that it is a weak area in the research of intangible cultural heritage.

Existing geographical research on intangible cultural heritage mainly focuses on the development and utilization of intangible cultural heritage tourism resources and the spatial patterns and influencing factors of intangible cultural heritage. There is still little research on the spatial distribution characteristics of intangible cultural heritage related to traditional Chinese medicine. Research regions are mainly at the provincial, city, county, and cultural ecological protection zone levels [18, 19], and there is relatively little research on the spatial patterns of traditional Chinese medicine intangible cultural heritage at the national level, which does not meet the research and protection needs of traditional Chinese medicine intangible cultural heritage.

In fact, studying the spatial structure of traditional Chinese medicine intangible cultural heritage is of great significance for objectively understanding the reasons for the formation of the spatial distribution pattern and the transmission path, which can help improve the objective understanding of cultural integrity and historical continuity. In addition, by revealing the differences in the spatial distribution of traditional Chinese medicine intangible cultural heritage, it can help understand the development of traditional Chinese medicine intangible cultural heritage, determine the location of cultural core areas, promote the excavation and protection of traditional Chinese medicine intangible cultural heritage, and formulate targeted protection measures.

Therefore, this article attempts to focus on the spatial distribution characteristics of traditional Chinese medicine intangible cultural heritage from a geographical perspective. The goal is to deconstruct traditional Chinese medicine intangible cultural heritage from a spatial perspective, in order to reflect the concentration of national-level traditional Chinese medicine intangible cultural heritage, local cultural identity, and regional consistency. The article compiles data from the 182 national-level intangible cultural heritage projects announced in China's five batches, and attempts to use ArcGIS spatial analysis technology to present this feature in a simple, clear, and visual way. The article also attempts to analyze the influencing factors of the spatial distribution of traditional Chinese medicine intangible cultural heritage using both qualitative and quantitative methods, in order to further enrich the achievements of geographic research on intangible cultural heritage, expand research methods and means, more clearly understand the distribution patterns, types, characteristics, and development processes of traditional Chinese medicine intangible cultural heritage, and provide valuable references for exploring new ideas and policies for the protection and development of traditional Chinese medicine intangible cultural heritage.

Research data and methods
Data sources
The subject of this study is the national intangible cultural heritage of traditional Chinese medicine, and the relevant data come from the China Intangible Cultural Heritage Website · Digital Museum of China Intangible Cultural Heritage (https://www.ihchina.cn/) and the relevant information from the national intangible cultural heritage list issued by the State Council of China. By 2022, a total of 182 intangible national traditional medical traditions were counted, distributed across 30 provincial administrative regions of China. To present the spatial location, the geographical coordinates of the traditional medicine practice have been pinpointed to specific conservation units such as institutes, folk associations

Nie *et al. Heritage Science*   (2023) 11:90

Page 3 of 14

Table 1 Research model

Research dimension	Geographical model	Indicator description
Balance of spatial layout	Geographic concentration index $G = \sqrt{\sum_{i=1}^{n}\left(\frac{X_i}{T}\right)^2} \times 100$	G is geographic concentration index; X_i is the number of traditional medicine traditions in the i-th provincial administrative region; T is the total number of intangible cultural heritage projects involving traditional Chinese medicine; n is the total number of provincial administrative regions in China
	Gini coefficient $G = \frac{-\sum_{i=1}^{n} P_i \ln P_i}{\ln N}$	G is the spatial Gini coefficient; P_i is the proportion of nationally identified traditional medicine projects in each region to the total number of projects in the i-th provincial administrative region; N is the total number of provincial administrative regions in China
	Disequilibrium index $S = \frac{\sum_{i=1}^{n} Y_i - 50(n+1)}{100 \times n - 50(n+1)}$	n is the total number of provincial administrative regions in China; Y_i is the cumulative percentage of traditional medicine ICH projects in the i-th position in descending order of the total number of ICH items in China by province
Spatial distribution type	Index of nearest proximity $R = \frac{\bar{r}}{\bar{r_i}}$	$\bar{r}$ is the actual average distance between the nearest intangible cultural heritage sites; $\bar{r}$ is the average distance when ICH locations are Poisson distributed in geographic space, calculated as $\bar{r_i} = \frac{1}{2\sqrt{n/A}} = \frac{1}{2\sqrt{D}}$ n is the number of national traditional medicine ICH in China, A is the area of the Chinese region, and D is the point density
Spatial aggregation analysis	Nuclear density analysis $f(x) = \frac{1}{nh}\sum_{i=1}^{n} k\left(\frac{x-X_i}{h}\right)$	$f(x)$ is called the kernel function; $h > 0$ is the bandwidth; $x - X_i$ denotes the distance from the valuation point x to the event X_i
Spatial distribution correlation	Global Moran index $I = \frac{n\sum_{p=1}^{n}\sum_{q=1}^{n} W_{pq}(x_p-\bar{x})(x_q-\bar{x})}{S^2 \sum_{p=1}^{n}\sum_{q=1}^{n} W_{pq}}$ Local Moran index $I = \frac{(x_p-\bar{x})}{S^2} \times \sum_{q=1}^{n} W_{pq}(x_q-\bar{x})$	n is the total number of provincial administrative regions in China; x_p and x_q are the attribute values of the study area p and q sites; W is the space weight, $\bar{x}$ is the average of x. $S^2 = \frac{1}{n}\sum_{p=1}^{n}(x_p-\bar{x})^2$

and hospitals. Baidu Maps is used to obtain the latitude and longitude of the location of the conservation units, a 1:4,000,000 vector map of China is used as the base map in the China National Basic GIS Database [20], and Arc-GIS 10.2 is used to match the geospatial location of the declared units to establish a database of traditional medicine practices identified as national intangible cultural heritage.

Research methods

The paper explores the spatial distribution characteristics of 182 Chinese national traditional medicine traditions in 5 batches using ArcGIS 10.2 software and the following research models (Table 1).

The geographic concentration index [21–23]judges the degree of spatial agglomeration of the research object, which can distinguish whether they trend towards aggregation or dispersion in spatial distribution.

The Gini coefficient [24, 25]is used to describe the differences in the geographical distribution of research factors between regions. Gini is between 0 and 1. When Gini is close to 0, it indicates that the distribution tends to be balanced, which means the number of intangible cultural heritage sites in each region is equal. When it

is close to 1, it indicates that intangible cultural heritage sites are concentrated in a certain region.

The disequilibrium index [26] is used to measure the equilibrium degree of the research object in each spatial region. S is between 0 and 1. When S = 1, it indicates that intangible cultural heritage traditions are concentrated in a region; otherwise, they are evenly distributed.

The nearest proximity index [27, 28] represents the degree of proximity between intangible cultural heritage sites in the study area. When R > 1, the spatial distribution type of intangible cultural heritage sites tends to be uniform; when R = 1, intangible cultural heritage points are randomly distributed; and when < 1, intangible cultural heritage points are clustered distribution.

The kernel density method [29–31] is used to measure the degree of spatial agglomeration which can directly reflect where intangible traditions have gathered. The larger the value of f(x), the greater the density of intangible cultural heritage on the space.

The global Moran index and the local Moran index [32–34]are two ways of representing spatial autocorrelation. The Moran index can judge whether a certain geographical attribute has aggregation characteristics in space. I > 0 is positively spatially correlated, I < 0 is negatively spatially correlated and I = 0 is not spatially correlated. The latter pinpoints the area where the attribute is

Nie *et al. Heritage Science*   (2023) 11:90

Page 4 of 14

clustered. the local Moran index tool of ArcGIS10.2, and the Local Indicators of Spatial Association map and significance level map of intangible cultural heritage value were produced. Spatial autocorrelation means that some variables in the same distribution area have a certain correlation, and the closer the relationship between the two variables is, the closer their spatial relationship.

Research results and analysis

The study of ICH from the perspective of the geographical environment, spatial relationships is of great significance for understanding objectively the reasons for the formation of spatial distribution patterns of ICH and the pathways and extent of its spread; as a consequence, such information can help us improve our understanding of the integrity of Chinese culture. From a geography perspective, this study seeks to explore traditional Intangible Cultural Heritage Medicine of China.

Distribution structure of identified protected traditional medicine traditions in China

To carry out the work of protecting intangible cultural heritage, the relevant departments of the Chinese government have classified traditional medicine traditions of China several times. The classification methods are mainly as follows: the eight division method of the State Administration of TCM,[1] the nine division method of "Chinese Intangible Cultural Heritage Census Manual",[2] the thirteen division method of "The Preliminary Proposal for Safeguarding Chinese Traditional Medicine
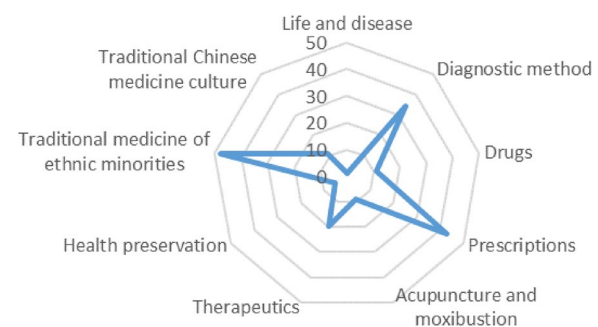
Fig. 1 Type structure of the national intangible cultural heritage of traditional medicine

as part of Global Intangible Cultural Heritage",[3] and the twenty-three division method of "The Intangible Cultural Heritage List".[4] Due to the limitations of the above methods, this paper draws on the findings of Wang Weijie's [35] to classify traditional Chinese medicine into nine categories: life and disease, diagnosis, medicine, prescriptions, acupuncture, therapy, health, traditional medicines of ethnic minorities and Chinese medicinal culture (Fig. 1). The categories are divided into three tiers: the first tier is traditional medicine of ethnic minorities (48 items), which accounts for approximately 26.37% and prescriptions (43 items), which accounts for approximately 23.63%; the second tier is diagnosis (34 items), which accounts for approximately 18.68% and therapies (20 items), which accounts for approximately 10.99%; the third tier has more categories, including medicine (11 items), Chinese medicinal culture (11 items), life and disease (1 item), health (5 items) and acupuncture (9 items), accounting for 6.04%, 6.04%, 0.55%, 2.75% and 4.95% of the current total, respectively.

Temporal distribution of identified protected traditional medicine practices in China

The distribution of the five batches[5] of national traditional medicine ICH items varies considerably across Chinese provinces. According to Fig. 2, the first batches of identified protected traditions are more concentrated, mainly in Beijing, with 10 items, accounting for 77% of the total, while the remaining three items are evenly

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[1] In 2004, the National Administration of Traditional Chinese Medicine of China classified Traditional Chinese Medicine (TCM) knowledge into eight categories as part of the results of the major project, "Protection and Research on Traditional Chinese Medicine Knowledge": life knowledge, health preservation knowledge, disease knowledge, diagnosis knowledge, therapy knowledge, acupuncture knowledge, prescription knowledge and medicine knowledge.

[2] In Chapter 16 of The Chinese Intangible Cultural Heritage Survey Manual, "Traditional Medicine" is divided into nine categories, including "Cognitive Methods Of Life And Disease, Health Preservation, Diagnosis, Therapy, Acupuncture, Prescriptions, Medicines, Medical Practices and Folk Customs, and Medical Literature".

[3] According to "The Preliminary Plan to Apply for World Intangible Cultural Heritage Protection for Chinese Traditional Medicine", Traditional Chinese Medicine should include two major parts: physical resources and intangible resources. On this basis, it is further divided into two levels. The physical resources include TCM Ancient Books, TCM Atlas, TCM Utensils, TCM Relics, TCM Figures, TCM Special Marks; Nonmaterial resources include Basic Theories Of TCM, Diseases, TCM Health Care, Therapy, Acupuncture, TCM Prescriptions, and TCM.

[4] At the time of the designation of Intangible Cultural Heritage, traditional medicine was divided into 23 categories. These categories included Cognitive Way Of Life And Disease Of TCM, Chinese Medicine Diagnosis And Treatment Method, The Processing Of TCM, TCM Preparation Method, Acupuncture, Chinese Medicine Bonesetting Therapy, Tongren Tang (TRT) Chinese Medicinal Culture, Huqingyu Tang TCM Culture, TCM Health Cultivation, TCM Culture and Minority Medicine, includ-

Footnote 4 (continued)

ing Tibetan,Mongolian, She, Yao, Miao, Dong, Hui, Zhuang, Yi, Dai, Uygur, Buyi, and Kazak traditions.

[5] The Representative Items List of national intangible Cultural heritage is a list of intangible cultural heritage established by the Ministry of Culture and Tourism and approved and published by The State Council of the People's Republic of China. By August 2022, The State Council of China had announced five batches of 1,557 national intangible heritage representative projects.

Nie *et al. Heritage Science*   (2023) 11:90

Page 5 of 14

Fig. 2 Time-series spatial pattern of national traditional medicine ICH of China

distributed in Zhejiang Province, Sichuan Province and the Tibet Autonomous Region. In this batch of identified traditional medicine practices, categories other than health are involved and distributed evenly. The second batch of identified traditional medicine practices increased in size greatly compared with the first batch, including all provinces except the city of Beijing. The number of ICH projects in the southwest has increased significantly with 11 projects, accounting for 28% of the total. This batch of projects is dominated by the traditional medicine practices of ethnic minorities and prescriptions, with a total of 24 items, accounting for approximately 60%. The third batch is also mainly in the category of the traditional medicine of ethnic minorities and prescriptions, with a total of 26 items, accounting for approximately 72%, which are distributed more widely in each province with little difference in quantity. The fourth batch displayed a surge in the number of declared regions and is distributed more evenly across 25 provinces. The number of protected traditions is the highest among the five batches, mainly in the category of prescriptions and diagnosis methods, with 31 items, accounting for 64%. The fifth batch is distributed with highest number of concentrated traditions in Beijing, with a total of 5 items, accounting for 11%, while the remaining provinces have a more balanced distribution, mainly in the categories of diagnosis and prescriptions, with a total of 20 items, accounting for 44%. In summary, although the third and fifth batches of national declarations of protection have

slightly decreased in number compared with the previous ones, they still show an overall increasing trend. The development of protections for traditional medicine traditions in the first batch was more concentrated in the north than the south and in individual provinces, but the later supplementation and expansion made the difference between north and south decrease, and the number of provinces with identified traditions increased. In the first batch, the categories of medicinal practice are evenly distributed, and in the remaining batches, prescription projects occupy a large proportion. In addition, in the early stage, the traditional medicine of ethnic minorities was the main focus, while in the last two batches, more attention was given to the excavation and application of prescription projects.

Spatial distribution characteristics of protected traditions of traditional medicine in China

Spatial distribution of traditional medicine practices

In ArcGIS10.2, the average nearest neighbor tool has been used to process a total of 182 national traditional medicine practices in five batches to obtain the nearest neighbor index table (Table 2).

There are three types of spatial distributions for point features: uniform, random, and aggregated. When the nearest neighbor index R = 1, the point distribution is considered random; when R > 1, the point features tend to be uniformly distributed; when R < 1, the point features tend to be aggregated. By querying the geographic

Nie *et al. Heritage Science*　　　(2023) 11:90

Page 6 of 14

Table 2 The nearest neighbor index of national traditional medicine practices of China

| Batch	NNObserved/m	NNExpected/m	ANN(R)	Z	P[a]
1	2.476	2.349	1.054	0.374	0.709
2	0.832	1.767	0.471	− 6.404	0.000
3	1.652	2.598	0.636	− 4.180	0.000
4	1.739	2.215	0.785	−2.847	0.004
5	1.761	2.137	0.824	−2.261	0.024

[a] P-value (Probability, Pr) represents probability. It reflects the likelihood of an event occurring. In spatial correlation analysis, the P-value indicates the probability that the observed spatial pattern is created by a random process. That is, assuming that the data at hand is randomly generated and has no pattern, this random process is considered as the null hypothesis

coordinates of the protection units of traditional Chinese medicine intangible cultural heritage projects using Baidu Maps, generating point coordinates in GIS software, and using the nearest neighbor index analysis function, the conclusions are shown in Table 2. The analysis shows that the R value of the first batch of projects is greater than 1, indicating that they are in a state of uniform distribution in space. The R values of the later four batches of traditional Chinese medicine intangible cultural heritage projects are all less than 1. Among them, the probability of clustering patterns caused by random factors is less than 1% for the second, third, and fourth batches of projects with P < 0.01, and less than 5% for the fifth batch of projects with P < 0.05. The Z-test indicates that the spatial distribution type of China's national-level traditional Chinese medicine intangible cultural heritage projects is generally cohesive. In terms of batches, the projects in the second and third batches are more cohesive, while the projects in the fourth and fifth batches are weakly cohesive.

Spatial agglomeration characteristics of traditional medicine practices

Through ArcGIS 10.2 software, we obtained a spatial distribution map of the nuclear density of national traditional medicine practices (Fig. 3). Overall, national traditional medicine practices are distributed in groups, forming two high-density clusters, one with Beijing and Tianjin as the core and the other with Zhejiang and Shanghai as the core. In essence, intangible cultural heritage is a living culture, and its spread and expansion mainly depend on human activities. Therefore, from the beginning of its formation, it has a tendency to spread around. The radiation area of the Beijing-Tianjin traditions includes most of Hebei and northwestern Shandong. The radiation area of the Zhejiang-Shanghai traditions includes southern Jiangsu and southeastern Anhui. In addition to the two aforementioned core circles, four other areas with a high density of traditional medicine practices include Shanxi Province, Tibet Autonomous Region, Guizhou Province and Guangdong Province, which are subdensity gathering areas. Due to the earlier historical development of traditional medicine than that of modern medicine, many traditional medical treatment methods have not been recognized that have strong local characteristics and strong regional, clustered distributions.
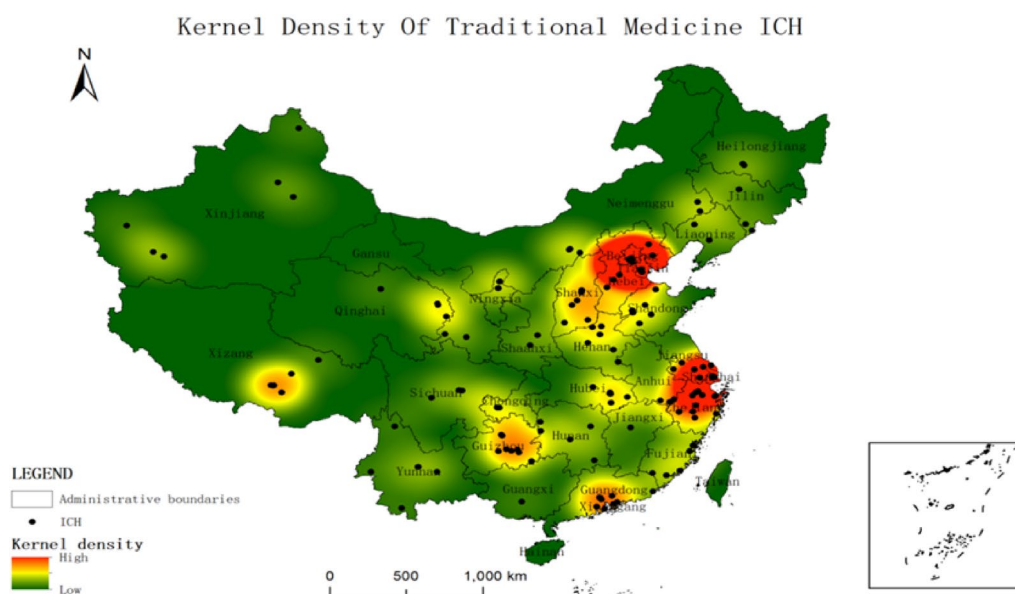
Fig. 3 Distribution of nuclear density of national traditional medicine ICH of China

Nie *et al. Heritage Science*   (2023) 11:90

Page 7 of 14

Table 3 Statistics of the proportions of protected traditional medicine practices in China

Province	Amount	Percent (%)	Cumulative percentage (%)	Province	Amount	Percent (%)	Cumulative percentage (%)
Beijing	22	12.09	12.09	Qinghai	6	3.30	79.12
Zhejiang	12	6.59	18.68	Hubei	6	3.30	82.42
Shanghai	11	6.04	24.73	Hebei	5	2.75	85.16
Guangdong	10	5.49	30.22	Ningxia	4	2.20	87.36
Xizang	9	4.95	35.16	Chongqing	4	2.20	89.56
Shanxi	8	4.40	39.56	Jilin	3	1.65	91.21
Guizhou	8	4.40	43.96	Anhui	3	1.65	92.86
Tianjin	8	4.40	48.35	Sichuan	3	1.65	94.51
Xinjiang	7	3.85	52.20	Heilongjiang	2	1.10	95.60
Neimenggu	7	3.85	56.04	Liaoning	2	1.10	96.70
Yunnan	6	3.30	59.34	Shaanxi	2	1.10	97.80
Jiangsu	6	3.30	62.64	Gansu	2	1.10	98.90
Fujian	6	3.30	65.93	Jiangxi	1	0.55	99.45
Henan	6	3.30	69.23	Guangxi	1	0.55	100.00
Shandong	6	3.30	72.53	Hainan	0	0.00	100.00
Hunan	6	3.30	75.82	Total	182	100.00	200.00

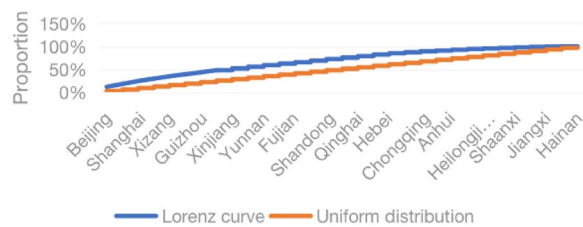### Balance of spatial distribution of traditional medicine practices

1. Concentration degree analysis:

Since China is a vast country, the geographical environment and climate vary greatly from province to province, and the economic level also develops differently so that the medicinal culture in each place also has its own characteristics. The differences in geographical distribution are more obvious (Table 3).

Through analysis and sorting, it can be found that there are 182 national traditional medicine protected practices in China and 31 provincial administrative regions (excluding the Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan Province). According to the formula of the geographic concentration index, the index $G = 22.05$ for the national traditional medicine practices, and assuming that the 182 protected traditional medicine practices are evenly distributed in each province of China, the optimal geographic concentration index $G' = 17.96$ can be calculated. $G > G'$, indicating that at the provincial level, the traditional medicine practices are clustered and distributed mainly in Beijing, Zhejiang Province, Shanghai and other provinces. In particular, Beijing has a total of 22 national traditional medicine protected practices, accounting for approximately 12.09%. Because of the changing times and the development of the pharmaceutical industry,

the recognition of traditional medical practices has decreased. As a result, fewer traditional medicines can be passed down. In ancient times, recognized practices of traditional medicine were concentrated in the hands of rulers and compiled into books. In addition, Beijing has had rich resources for traditional Chinese medicine, which have brought together many famous hospitals, departments, doctors and medicines. Traditional medicine has unique conditions for development. The number of intangible cultural traditions in the area was abundant, including Tong Ren Tang, which was the "official medicine contractor", He Tian Tang, which had the cultural connotation of "regulating the vital energy and nurturing harmony", and through the succession of five generations of imperial doctors and modern practitioners, the practice of Palace Bone Setting, which was characterized by "the machine touching outside, the skill born inside, the hand moving with the heart, the method coming out of the hand." In addition, the natural environment of Zhejiang and Shanghai was rich in medical resources, which had nurtured many traditional medicine practices. In addition, government agencies at all levels and related professional societies attached great importance to the excavation, collation, protection and innovation of traditional medicine practices. Because strong protection initiatives were made, the distribution of practices in the region was also dense, which was based on various types of treatment methods and orthopedic therapy.

2. Equilibrium degree analysis

Nie *et al. Heritage Science* (2023) 11:90

Page 8 of 14

Fig. 4 Lorentzian curve of the spatial distribution of TCM practices

The Gini coefficient Q=0.94 was calculated for the national traditional medicine practices, which is very close to 1. This indicates that national traditional medicine practices are unevenly distributed spatially and highly concentrated. Traditional medicine practices are inextricably linked to medical resources and regional economic development levels. In terms of the distribution of medical resources for traditional Chinese medicine (TCM), the eastern region of China has a larger share, and the provinces of Beijing, Shanghai and Zhejiang have absolute advantages in cultivating education, scientific research, TCM culture and foreign exchange. The evaluation results of "The Blue Book of TCM Inheritance and Innovation: Report on the Development of TCM Inheritance and Innovation in China (2021)" show that Beijing and Zhejiang Province have the highest interprovincial competitiveness in TCM among all 31 provinces. In addition, Shanghai has the highest efficiency of TCM medical treatment in China. Therefore, the above three regions have the most concentrated distribution of protected traditional medicine practices.

The imbalance index of national traditional medicine practices is S=0.30, which indicates that practices are unevenly distributed in each province in China. Based on the data in Table 3 and the Lorentz curve (Fig. 4), we can further confirm the unevenness of the spatial distribution and concentration of the traditions. Further analysis shows that nearly 50% of traditional medicine practices are distributed in only eight provinces and cities (Beijing, Zhejiang, Shanghai, Guangdong, Tibet Autonomous Region, Shanxi, Guizhou, and Tianjin).

Spatial distribution correlation of traditional medicine practices

1. Global autocorrelation analysis

To further investigate the spatial distribution characteristics of traditional medicine practices and analyze the differences among different regions, ArcGIS10.2 software is used to conduct global autocorrelation analysis, and the global Moran index value of TCM practices is calculated to be 0.070880; the normal statistic Z value is 2.257147, the P value is 0.023999, which is less than 0.05, and the Moran index value is positive. The spatial distribution of TCM practices has a significant spatial autocorrelation with a confidence level of 95%, which means that provinces adjacent to provinces with more practices also have more practices, and vice versa.

2. Local autocorrelation analysis

To further detect the specific location of the spatial clustering of traditional medicine and to study the degree of local spatial clustering in depth, ArcGIS 10.2 software is used to calculate the local correlation index of each region in China, and a four-level hotspot map is formed according to the statistical values (Fig. 5). From Fig. 5, it can be seen that traditional ICH medicine shows the distribution pattern of hot spots (0.173107 to 1.614836)—secondary hot spots (− 0.977059 to 0.173106)—secondary cold spots (− 1.896840 to 0.977060)—and cold spots (− 3.100868 to 1.896841).

The hot spots are mainly located in Tibet, Inner Mongolia, the Beijing-Tianjin-Hebei region and the Northeast, or in other words, are generally concentrated in northern China, with large differences between the north and the south. Secondary hot spots are mainly located in the Yangtze River Delta economic belt, the riparian provinces of the Yellow River basin, such as Qinghai, Sichuan, Ningxia, Shaanxi, Shanxi, and Shandong provinces, and Yunnan Province. The secondary cold spot is mainly located in the eastern coastal region and Henan Province, with more pronounced differences in the east–west distribution. Cold spot areas are mainly found in southern China, such as Hubei, Hunan, Guizhou, Guangdong and Guangxi.

Factors affecting the spatial distribution of traditional ICH medicine in China

The above analysis shows that the spatial distribution of traditional ICH medicine practices is aggregated and uneven, which is largely influenced by the intersection of physical geography and socioeconomic development. By superimposing the spatial distribution characteristics of ICH with the characteristics of physical geography and human geography, the main factors affecting the distribution of traditional ICH medicine can be intuitively understood from a more macroscopic level and a larger geographical unit. By sorting out relevant studies on the spatial distribution of Chinese ICH and its influencing factors and combining them with the actual situation of the distribution of traditional ICH medicine, this paper condenses 11 specific factor indicators from the two dimensions of physical geography and social economy

Fig. 5 Spatial distribution hotspots of traditional ICH medicine in China

(Table 4). Then, GeoDetector software is used to reveal the intensity of various influencing factors on the spatial distribution of traditional ICH medicine. Geodetector is a new statistical method to detect spatial stratified heterogeneity and reveal the driving factors behind it. This method with no linear hypothesis has elegant form and definite physical meaning. Here is the basic idea behind Geodetector: assuming that the study area is divided into several subareas. The study area is characterized by spatial stratified heterogeneity if the sum of the variance of subareas is less than the regional total variance; and if the spatial distribution of the two variables tends to be consistent, there is statistical correlation between them. Q-statistic in Geodetector has already been applied in many fields of natural and social sciences which can be used to measure spatial stratified heterogeneity, detect explanatory factors and analyze the interactive relationship between variables [36].

The q-value of the influencing dimensions and indicators is obtained through GeoDetector software. The analysis shows that different dimensions and indicators influence the differences in the spatial distribution of traditional ICH medicine differently, and the degree of influence of socioeconomic factors is greater than that of natural geographical factors. The measurement of the

influence of socioeconomic factors fully illustrates the importance of human agency in the development of ICH.

Geographical environmental factors

The formation of different regional cultures is closely related to the natural geographical environment of the region. Topography and geomorphology will have an impact on population aggregation and cultural exchange and then affect the spatial distribution of traditional ICH medicine. Flat and open locations are more likely to cause population aggregation, and cultural exchange intensity will be greater, which makes it easier to develop ICH traditions. Closed terrain blocks human interaction and cultural integration, but it can also protect the local culture from the impact of outsiders, which completely protects the authenticity of culture and is also conducive to the formation of ICH traditions. Therefore, the impact of topography on the gathering of ICH traditions cannot be simply characterized as promotion or hindrance. Table 4 shows that elevation (0.188), as a natural geographical factor, has a certain but small influence on the spatial distribution of traditional ICH medicine. River systems not only provide fertile soil for the continuation of human life but also promote human interaction and cultural exchange. Since ancient times, rivers have been

Nie *et al. Heritage Science*   (2023) 11:90

Page 10 of 14

Table 4 Influencing factors and the explanatory power of factors

Dimension	Index	Evaluation index	Data sources	q value
Physical geography	Topography	Elevation	ArcGIS data Processing	0.188
	River system	Surface water resource	China environmental statistics yearbook	0.222
Social economy	Economic development level	GDP per capita	China statistical yearbook	0.301
		Urbanization rate	China statistical yearbook	0.240
	Transport conditions	Rail density, road density	China urban construction statistical yearbook	0.437
	Population	Population density	China urban construction statistical yearbook	0.020
	Minorities	Number of ethnic groups	Official website of provincial ethnic affairs committees	0.522
	Medical and health care conditions	TCM medical institutions	Statistical bulletin on the development of health services	0.379
		Number of people working in TCM	Statistical bulletin on the development of health services	0.221
	Traditional medicine culture of China	TCM medical institutions	Statistical bulletin on the development of health services	0.233
		TCM cultural promotion base	Statistical Bulletin on the development of health services	0.216

regarded as the birthplace of human civilization and a dense area for the distribution of ICH. The influence of water systems on the spatial distribution of ICH in the traditional medicine category is 0.222, with a positive correlation and good coupling.

Social and human factors

Intangible cultural heritage is a living cultural heritage centered on people, created by human beings, and developed by human beings. Therefore, social and economic behavior has a great influence on the spatial distribution of ICH traditions. As seen from Table 4, the socio-economic dimension indicators are ranked in order of influence: number of ethnic groups (0.522) > traffic density (0.437) > TCM medical institutions (0.379) > GDP per capita (0.301) > urbanization rate (0.240) > TCM research institutions (0.233) > TCM industry employees (0.221) > TCM cultural promotion bases (0.216) > population density (0.020).

The number of ethnic groups has the greatest influence on the spatial distribution of traditional ICH medicine. There are 56 ethnic groups in China. Due to the differences in the natural environment, production, lifestyle, and other conditions for the spread of disease in each ethnic group, the creation of medicine and the accumulation of medical knowledge are also different. The influence of transportation density on the spatial distribution of traditional ICH medicine is second to the number of ethnic groups living in the country. Transportation networks are an important route and channel for cultural exchange. Areas with dense

transportation networks can create convenient conditions for cultural influx and prosperity, and at the same time, they enable more people to have the opportunity to understand and experience ICH, enhancing the vitality of these traditions and facilitating the transmission and innovation of traditional ICH medicine. The number of TCM medical institutions has a strong influence on the spatial distribution of traditional ICH medicine. The number of medical institutions reflects the amount of medical resources and the level of medical care in the region. Areas with a dense distribution of medical resources are more conducive to the formation and development of traditional ICH medicine. GDP per capita and the urbanization rate also have a certain influence on traditional ICH medicine. Cultural ecology believes that the development of culture presupposes the ability to satisfy the needs for material means of living, which is the same assumption as the materialistic view of history. As an important part of culture, traditional ICH medicine practices are a higher level of cultural pursuit after the economic conditions have matured and the basic material needs of life have been met, and it is an important element of national spiritual construction. The urbanization rate can respond to the progress of social productivity and cultural science in the region. The determination of traditional ICH medicine requires much research, application and sorting work in the early stage, which is closely related to the urbanization level of the city. The number of TCM research institutions, the number of TCM practitioners and the number of TCM culture promotional bases have little influence on the spatial distribution of

Nie *et al. Heritage Science*   (2023) 11:90

Page 11 of 14

traditional ICH medicine, and the population density has the least influence.

Summary of the spatial distribution of traditional ICH medicine in China and discussion of its protection and development

Understanding the spatial variation of ICH is essential for protecting and utilizing heritage resources. Initially, we analyzed the spatial variation of traditional ICH medicine with different categories using GIS spatial analysis and other technologies. Subsequently, we used the geodetector statistical method to explore local factors influencing traditional ICH medicine concentrations in various cities along China. The results show that the distribution of traditional ICH medicine resources in different categories was unbalanced among focal cities. Although socioeconomic factors have important impacts on the spatial distribution of ICH, the local geographic environments remain important in forming and developing traditional ICH medicine resources. This study provides an important reference for traditional ICH medicine resource systematic regeneration and utilization plans along China.

Summary of the spatial distribution of traditional ICH medicine in China

Through ArcGIS 10.2 software, this paper analyzes the spatial distribution characteristics of 182 national traditional ICH medicine practices and the influences on their spread, as identified in 5 batches in China and draws the following conclusions:

(1) China has a large number of types of national traditional ICH medicine practices, and the number of each type is unevenly distributed, forming a structure characterized by the predominance of ethnic traditions and prescriptions, followed by diagnostic methods and therapies and lastly medicine, Chinese medicinal culture, health and life, acupuncture, and disease.

(2) The chronological and spatial distributions of the national ICH medicine traditions are distinctly differentiated. The first batch of announced types is more evenly distributed, with significant differences in regional distribution as approximately 77% of the projects are distributed in Beijing. The second and third batches of projects are mainly about prescriptions and the traditional medicine practices of ethnic minorities, while the fourth and fifth batches are mainly about prescriptions and diagnostic methods. In terms of spatial distribution, the second, third

and fourth batches are concentrated in Southwest China and North China. The fifth batch is more evenly distributed, and the difference in quantity between regions is reduced.[6]

(3) The spatial distribution of national ICH medicine is generally cohesive, with a clustered distribution and strong unevenness, forming two high-density clusters in the Beijing-Tianjin region and the Zhejiang-Shanghai region, four subdensity agglomerations and several small agglomerations in Shanxi Province, Tibet Autonomous Region, Guizhou Province and Guangdong Province.

(4) The spatial distribution of national ICH medicine has significant spatial autocorrelation. The regions with more or less intangible cultural heritage show the characteristics of spatial aggregation. Further investigation of the specific location of spatial aggregation shows that the local spatial distribution pattern of TCM practices is hotspot zone-secondary hotspot zone-secondary cold spot zone—cold spot zone.

(5) The spatial distribution of traditional ICH medicine is the result of the combined effect of physical and socioeconomic factors. Socioeconomic factors are the dominant influences on the spatial pattern of traditional ICH medicine. Factors such as the number of ethnic groups living in the country, traffic density, the number of ICH medical institutions and GDP per capita are more influential, while physical geography is relatively less influential but still cannot be ignored in the development of traditional ICH medicine.

Methods of traditional ICH medicine protection and development
Strengthen transportation infrastructure to empower the development of ICH

With the advent of the "Information Era", the development of an integrated infrastructure, which involves the integration of traditional transportation infrastructure and informatization development, has become a new impetus for economic growth [37]. Transportation is an important carrier of cultural communication and exchange. The powerful radiation effect of transportation networks can provide unique development opportunities for traditional ICH medicine. Convenient transportation

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[6] The geographical division of China here adopts the four division method, that is, China can be divided into four geographical regions based on the characteristics of geographical location, physical geography and human geography, namely, the North, the South, the Northwest and the Qinghai-Tibet region.

Nie *et al. Heritage Science*   (2023) 11:90

Page 12 of 14

not only expands the communication and dissemination of traditional ICH medicine in depth and breadth but also influences and changes the production and lifestyle of people and enhances the creativity of ongoing practices of ICH. As an important policy tool for urban economic development, transportation infrastructure development can influence the environmental loads and economic performances of cities. So that, we should make efforts on the supply side when building cities, placing transportation infrastructure construction on the same level as ecological environmental protection to achieve high-quality urban development [38].

Strengthen the construction of TCM medical institutions and improve clinical practice ability

Chinese medicine is a discipline developed from practice and tested in practice. The ancestor of medicine, Shennong, personally tasted about one hundred herbs to invent medicines to cure diseases and save lives. Over the years, generations of TCM practitioners have continued to improve their practice, resulting in the formation of a profound and sophisticated tradition. Therefore, the protection of Chinese ICH medicine is inseparable from the clinical practice of TCM. If traditional Chinese culture is the root of Chinese medicine, the clinical practice of Chinese medicine is the nourishment for its development. With roots, Chinese medicine can survive; with nutrients, it can flourish. Both are indispensable and mutually reinforcing. Therefore, if the clinical practice of TCM is neglected in the course of the protection of Chinese ICH medicine and the cultural connotations of Chinese medicine are one-sidedly emphasized, it will be impossible to achieve true protection, inheritance and development. Clinical research is becoming increasingly popular in Europe at a growth rate much higher than expected, although traditionally thought to be the purview of academic health centers, clinical research to evaluate new drugs, devices and medical practices are being done more and more in healthcare organizations with little or no academic affiliation. By managing a new infrastructure and centralizing resources and demands, Clinical Research Unit (CRU) has become an effective mechanism for hospital research [39]. Therefore, the country and society need create and structure a CRU to provide academic or industry-sponsored research support in clinical research.

Promote the digitization of ancient Chinese medicine books and inject the spirit of the times into them

The intangible national wealth is understood as knowledge, level of culture and etc. Intangible heritage—the non-material benefits created by the previous generations and being of value in the modern society. To the objects of intangible heritage refer knowledge, traditions, customs, non-material objects of culture and etc. The intangible property of the state, in our opinion is a set of the relations concerning the non-material objects, which represent a certain value for society [40].

Ancient books of traditional Chinese medicine carry the theoretical knowledge of TCM and the summary of medical practice experience created by thousands of years of ancestors in the process of fighting against diseases. They are the "source of living water" for the inheritance, innovation and development of traditional medicine.

"Digitization of ancient books" is a way of regenerating and preserving ancient Chinese medicine books by widely disseminating and sharing them through online platforms, which can allow the knowledge to be more widely applied. At present, the digitization of ancient Chinese medical books has made certain achievements, but there are still shortcomings. The digitization of ancient books is the continuation, inheritance and innovation of the discovery, protection and utilization of ancient books. It is a basic and contemporary project of humanities and academic research. It is of great significance to protect and inherit precious ancient books. Through the investigation and analysis of the research literatures on digitization of ancient books, uses the combination of quantitative and qualitative methods to study and summarize the research scope, research characteristics and development trend. For example, at present, the development of ancient Chinese medical databases is still mostly at the level of documentation services, lacking in knowledge mining and analysis, which makes it difficult to share academic materials in the field and has certain limitations for the research and development of the discipline.

Implementing cultural reconstruction and promoting the innovative development of intangible cultural heritage related to traditional medicine

Traditional medicine has developed over thousands of years and inevitably contains elements that are relatively out of step with modern civilization. The scientific and rational realization of the conservation of traditional ICH medicine requires us to treat the contents correctly, adapt it to the changing times, reconstruct it, remove the falsehoods and preserve the authenticity, and avoid its consolidation into museum collections lacking social context. The inheritors of traditional medicine culture can diversify their experience, combining the ancient with the modern, refreshing consumers and winning with "wonder". Traditional medicine culture should be innovated on the basis of inheritance and integrated with

Nie *et al. Heritage Science*   (2023) 11:90

Page 13 of 14

modern science and technology with an open and inclusive attitude. TCM culture should also be inclusive and complementary, promoting the creative transformation and innovative development of traditional ICH medicine.

Availability of data and materials
All data generated or analysed during this study are included in this published article.

Declarations

Ethical approval and consent to participate
There is no studies involving human participants, human data or human tissue are reported.

Consent for publication
Not applicable.

Competing interests
There is no competing interests in this manuscript.

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Nie *et al. Heritage Science*   (2023) 11:90

Page 14 of 14

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