



## Research on spatial pattern and accessibility of traditional Chinese medicine tourism resources in Shenzhen, China

BY

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### Abstract

*The study of spatial pattern and accessibility of tourism resources is an important prerequisite for the development of regional tourism resources, and the development of traditional Chinese medicine tourism resources is a new hotspot of tourism development. Taking Shenzhen as the study area, this paper used the nearest neighbor index method, kernel density analysis method, and accessibility measurement method to explore the spatial pattern and accessibility of traditional Chinese medicine tourism resources in Shenzhen. The results show that: (1) There are 110 TCM tourism resources in Shenzhen, which are mainly concentrated in the cultivation of the body, TCM diagnosis and treatment, TCM institutions, and TCM R&D, with great development potential. (2) In terms of spatial distribution, it generally presents the characteristics of "dense in the west and sparse in the east", mainly distributed in the western part of Shenzhen; All kinds of tourism resources also present the form of multi-core centers and sub-centers. (3) In terms of accessibility, the average travel time of resource points is 1.446h, which is highly accessible. The most accessible areas are located in the center of Shenzhen, concentrated in the west of Longhua District, Futian District, Luohu District, and Longgang District, and the travel time shows a trend of increasing from the city center to the east and west. This study provides a reference for the development and optimization of the layout of traditional Chinese medicine tourism resources in Shenzhen.*

**Keywords:** traditional Chinese medicine tourism resources; spatial pattern; accessibility; Shenzhen

## 1. Introduction

The "14th Five-Year Plan for the Development of Traditional Chinese Medicine" proposes to "improve the relevant standard system of traditional Chinese medicine health tourism and promote the high-quality development of traditional Chinese medicine health tourism", which provides an opportunity for all localities to tap traditional Chinese medicine tourism resources and develop traditional Chinese medicine health tourism. In addition, with the rapid development of social economy, the living habits and work characteristics of urban people have undergone profound changes, and health problems such as sub-health, occupational diseases, and chronic diseases have become more and more prominent (Yu, 2021). As an international metropolis, Shenzhen's people's consumption level has been steadily improving, the demand for health tourism is increasing day by day, and traditional

Chinese medicine tourism has become an important way of life and form of consumption. According to the "14th Five-Year Plan for the Development of Shenzhen's Tourism Industry", Shenzhen will further promote "tourism +" and "+ tourism", vigorously develop new business formats such as urban shopping tourism and research tourism, and improve the supply level of high-quality tourism products and services (Shenzhen Municipal Bureau of Culture, Radio, Tourism, and Sports, 2022). Shenzhen's "traditional Chinese medicine + tourism" has ushered in new opportunities.

At the same time, more and more scholars have begun to conduct research on TCM travel. Among them, Gan(2017) has studied the consumer preferences of TCM travel and the development strategy of TCM tourism products, and Liu(2016) has made a detailed classification of TCM tourism resources, but there are few studies on the spatial distribution



and accessibility of TCM tourism resources. Studying the spatial distribution characteristics and accessibility of different types of TCM tourism resources is helpful to identify high-quality resources (Ji et al., 2018), clarify the travel time cost in different regions, guide the development direction of regional TCM tourism industry, and provide decision-making basis for government departments to improve the transportation network and optimize the layout of TCM tourism resources (Zhang & Li, 2010). In this paper, 110 POIs of traditional Chinese medicine tourism resources were selected as data elements, and the spatial analysis method was used to explore the spatial characteristics and accessibility of traditional Chinese medicine tourism resources in Shenzhen, in order to provide a reference for optimizing the planning and layout of traditional Chinese medicine tourism resources in Shenzhen and regulating the traditional Chinese medicine tourism market.

## 2. Overview and data source of the study area

### 2.1 Study area overview

Located in the southern part of Guangdong Province, Shenzhen is bordered by Daya Bay and Mirs Bay to the east, the Pearl River Estuary and Lingdingyang to the west, the Hong Kong Special Administrative Region to the south and Dongguan and Huizhou to the north. It is one of the core engine cities of the Guangdong-Hong Kong-Macao Greater Bay Area. The city has jurisdiction over 9 districts with a total area of 1,997.47 square kilometers (see Figure 1). It is located in the south of the Tropic of Cancer, between 113°43' to 114°38' east longitude and 22°24' to 22°52' north latitude. It has a subtropical monsoon climate with pleasant humidity and abundant rainfall. The terrain of the whole territory is high in the southeast, low in the northwest, mostly hilly. By the end of 2023, the permanent resident population is 17,661,800, and the urban population density is 8,842 people /km<sup>2</sup>, which is a mega-city. In 2021, Shenzhen's GDP will reach 3,066.485 billion yuan, becoming the third city in China with a regional GDP exceeding 3 trillion yuan, accounting for 24.7% of the province's total economic output, ranking first in the Guangdong-Hong Kong-Macao Greater Bay Area city cluster and fourth in Asia. The main transportation network of Shenzhen as a whole presents the characteristics of "sparse in the west and east" and "concentrated around the city and dispersed in the center". Shenzhen's subway network is concentrated in the southwest, and by 2023, there will be 16 lines in operation in Shenzhen, with a total operating mileage of 500 kilometers and 340 stations. Shenzhen has a total of 14 expressways, including Meiguan Expressway, Jihe Expressway, and Yanba Expressway, which spread evenly throughout the city and open to other cities (see Figure 2).

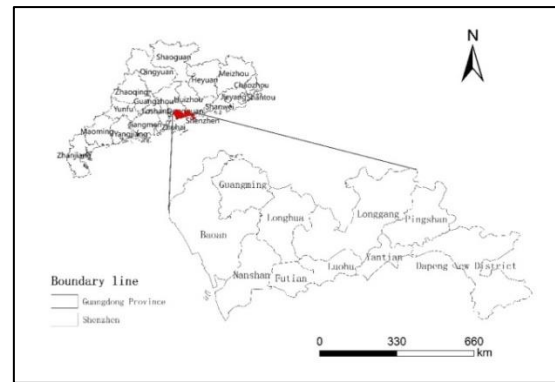


FIG.1 Administrative zoning map of Shenzhen City (Source: Author)

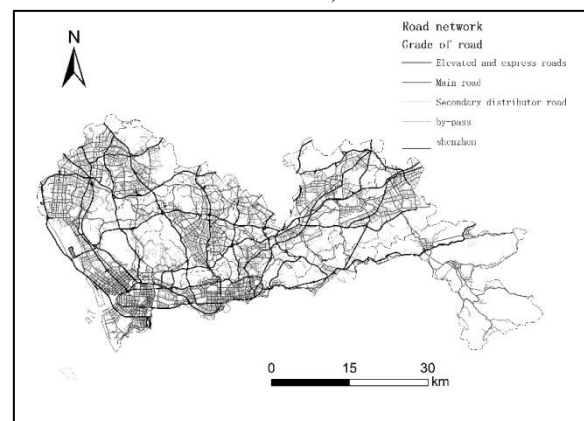


FIG.2 Road network distribution map of Shenzhen (Source: Author)

### 2.2 Data Sources

The main data used in this study are as follows. POI data points of traditional Chinese medicine tourism resources in Shenzhen, road data, and administrative division map data of Shenzhen; The main types of standards for reference are: tourism classification standards, traditional Chinese medicine tourism resources classification standards, and highway engineering technical standards. The latitude and longitude coordinates of POI data are derived from AutoNavi map, and a total of 110 POI data are obtained by comprehensive screening. In addition, the POI data obtained were reclassified with reference to the existing tourism classification standards and the traditional Chinese medicine tourism resources classification standards (Song, 2020; Yang, 2018). The data of the administrative division map of Shenzhen Province are from the National Earth System Science Data Sharing Platform (<http://www.geodata.cn>). The data of Shenzhen's road network comes from OSM (<http://www.openstreetmap.org>) In accordance with the provisions of the Technical Standards for Highway Engineering (JTGB01-2014) (Beijing: People's Communications Press, 2014), the driving speed of elevated and expressway roads, urban trunk roads, urban secondary trunk roads, and urban branch roads is set at 80km/h, 60km/h, 40km/h and 30km/h respectively. According to the driving speed of different traffic roads, the corresponding time cost is calculated.

### 3. Research Methods

#### 3.1 Spatial feature analysis methods

##### 3.1.1 Nearest Neighbor Index Analysis

The nearest neighbor statistics calculates the nearest neighbor index (R) for each feature based on its average distance from its nearest neighbor (Li et al., 2022). The Average Nearest Neighbor tool measures the distance between the centroid of each feature and the centroid location of its nearest neighbor and then calculates the average of all nearest neighbor distances. The spatial distribution characteristics of point-like features can be divided into three types: uniform, random, and clustered. The nearest neighbor index usually discerns the type of distribution of attractions. The formula is (Xiao et al., 2022):  $R = \frac{r_p}{r_E} = \frac{r_p}{\sqrt{1/2n/A}}$

R is the nearest neighbor index,  $r_p$  is the average of the sum of the actual nearest neighbor distances of each attraction (unit: km),  $r_E$  is the average of the sum of the theoretical nearest neighbors of each attraction, n is the number of traditional Chinese medicine tourist attractions in Shenzhen, and A is the area (unit:  $[\text{km}]^2$ ). When  $R > 1$ , the point-like targets tended to be evenly distributed; When  $R = 1$ , the point targets were randomly distributed; When  $R < 1$ , point-like targets tended to be clustered.

##### 3.1.2 Kernel density analysis method

Kernel density analysis can accurately express the spatial distribution characteristics of point features and line features (Xu et al., 2016), which is continuous and not affected by the length of the selected interval. The kernel spatial density analysis method can intuitively express the core area in the distribution characteristics of traditional Chinese medicine tourist attractions, and identify the areas of high density, medium density, and low density. The formula is (Lu & Pan, 2023):  $f(x) = \frac{1}{Nh} \sum_{i=1}^N K(\frac{x-x_i}{h})$

where N is the number of tourist attractions studied, h is the bandwidth, and  $i=1,2,\dots,N$ ,  $K(\frac{x-x_i}{h})$  is the kernel function of random estimation. The higher the density value, the higher the degree of core.

#### 3.2 Methods for measuring accessibility

There are many methods of reachability analysis, commonly used are minimum distance method (Ma, 2022; Kan, 2019), utility model method (Ma, 2022), cumulative cost distance grid operation method (Zhang et al., 2023), and so on. The reachability analysis in this paper uses the minimum distance method to analyze the reachability (Kan, 2019) of resource points by analyzing the size of the shortest linear distance between resource points. That is, Chinese medicine tourism resource points are obtained mainly based on the crawled POI data, and the accessibility of Chinese medicine tourism resources is analyzed by calculating the average travel time of a certain resource point to other resource points. The calculation formula is as follows (Ye, 2022):

$$A_i = \frac{1}{n} \sum_{j=1}^n T_{ij}$$

where: i and j are the tourism resource points in the study area, and  $T_{ij}$  is the shortest travel time for resource point i in the study area to reach the resource point through the

transportation network; n is the number of resource points;  $A_i$  is the average travel time (unit:h) of resource point i, and the smaller its value is, the better the accessibility of the resource point, and vice versa.

In addition, in order to compare the relative level of accessibility of each resource point in the study area, the accessibility coefficient was used on the basis of the above formula. The calculation formula is as follows (Ye, 2022):

$$A_i' = \frac{A_i}{(\sum_{i=1}^n A_i/n)}$$

Where:  $A_i'$  is the accessibility coefficient of resource point i;  $A_i$  is the average passing time of the resource point i (unit is h); n is the number of resource points. The lower the value of  $A_i$ , the better the accessibility of the resource point i. When  $A_i' > 1$ , the accessibility level of the stated resource point was lower than the average accessibility level of all resource points in the study area; Conversely, when  $A_i' < 1$ , the accessibility level of the indicated resource point i is higher than the average accessibility level of all resource points in the study area.

This paper extracts four levels of roads, namely, elevated and express road, urban trunk road, urban sub-trunk road, and urban branch road, and carries out topological check on the extracted road network to ensure the accuracy and integrity of the extracted road network. The OD cost matrix is established through the constructed road network and resource points. After the  $A_i$  and  $A_i'$  were calculated, the results were sorted out and summarized to obtain the average traffic time and accessibility coefficient table of each resource point in Shenzhen. This paper only discusses the theoretical accessibility, and does not consider the complex reality.

## 4. Results and analysis

### 4.1 Types and overall spatial distribution characteristics of TCM tourism resources in Shenzhen

Based on Gaode map, relevant spatial attributes were obtained through Gaode map API, and POI data of 110 TCM tourism resources in Shenzhen were obtained after comprehensive selection. Then, the data points were imported into ArcGIS 10.8 software, and the spatial attribute database of traditional Chinese medicine tourism resources in Shenzhen was constructed, and the spatial distribution map of traditional Chinese medicine tourism resources was drawn (Fig. 3). Moreover, in accordance with the "Classification, Investigation and Evaluation of Tourism Resources" (GB/T 18972-2017) (Institute of Geographic Sciences and Resources, Chinese Academy of Sciences, 2017) and the classification standards for traditional Chinese medicine tourism resources (Song, 2020; Yang, 2018) and considering the specific situation of traditional Chinese medicine tourism resources in Shenzhen, the traditional Chinese medicine tourism resources in Shenzhen are divided into three main categories and nine subcategories: traditional Chinese medicine cultural tourism resources, traditional Chinese medicine tourism resources, and traditional Chinese medicine tourism resources, and the number and proportion of various resources are listed (see Table 1).

Table 1 Classification of TCM tourism resources in Shenzhen

Main Categories	Subclass	Quantity	Specific Gravity	Name
Traditional Chinese medicine cultural tourism resources	Popular science base	1	0.9%	Shenzhen Traditional Chinese Medicine Modernization Science Base
	Museum	1	0.9%	Shenzhen Museum of Traditional Chinese Medicine
	Museum	1	0.9%	Longgang Traditional Chinese Medicine Exhibition Hall
	TCM Theory	2	1.8%	Traditional Chinese Medicine Diagnosis and Treatment Method (Jia's Acupoint Therapy), Traditional Chinese Medicine Osteopathy (Pingle Guo's Osteopathy)
Traditional Chinese medicine cultural tourism resources	Shape (Body)	29	26.4%	Pure Chinese Medicine Beauty and Body, Airui Chinese Medicine Beauty, Ai Meixin Chinese Medicine Beauty Salon, Yameisi Chinese Medicine Hair Salon, Yameisi Chinese Medicine Hair Salon, Yalexuan Beauty and Health Center, Ganoderma Lucidum Chinese Medicine Beauty (Kangle Garden Store), Anti-Aging Beauty and Health (Appearance Miracle), Yi Xiutang Chinese Medicine Beauty and Health, Hao Ziqing Chinese Medicine Hair Care Hall (Yixiangge Community Store), Shenghong Chinese Medicine Hair Care Hall, Shenghong Chinese Medicine Hair Care Hall (Dahe Road Store), Hao Ziqing Chinese Medicine Hair Care Hall (Hengyu Jiacheng Store), Old Chinese Medicine Skin Care and Beauty Salon, Xin Teng Foot Road Chinese Medicine Foot Soak Chinese Medicine, Traditional Chinese Medicine Yao Bath Beauty and Health Center, Pure Natural Chinese Medicine Beauty and Body, Chinese Medicine Beauty Shop (Lin Li Office Store), Shanjiayan Traditional Chinese Medicine Beauty (Tianfu Trade City Store), Zhen Yu Butterfly Chinese Medicine Head Therapy SPA, Hao Qingsi Chinese Medicine Hair Maintenance, Moxibustion Health (Jingtian Store), Hao Ziqing Chinese Medicine Hair Care Center, Chinese Medicine Herbal Hair Care (Lily Star City Phase I Store), Jiang Kang (Shen) Pure Chinese Medicine Hair Therapy and Hair Care Center, Yan Li Chinese Medicine Tea Drum Head Therapy Museum, Wushou Chinese Medicine Hair Care (Citygate Shopping Plaza Store), Source Chinese Medicine Hair Care (Jixin Famous City Store), Wushou Hair Traditional Chinese medicine hair care (Shenzhen Xingsecheng Shopping Center store), Shunxiu Tea Drum Hair Care and Health Center (Guangdong Province head office Jinglong Xincun store)
	Traditional Chinese medicine diagnosis and treatment	22	20.0%	Zhuangjia Ancient Chinese Medicine Health Center, Tian Zhiyuan Traditional Chinese Medicine Health Center (Loucun Store), Xinyikang Blind Massage Shop, Huikang Health Care Center (Xitou Branch), Dasheng Driving to Pediatric Massage (Zhengda Store), Health Therapy, Dongjing Yuan Blind Massage (Houhai Store), Meridian Health Care (Liantang Store), Ancient Kung Fu Shoulder and Neck (Natural Beauty Golden Mile Blue Bay Store), Hongfang Zhenggu Massage Hall (Funing. Shangwei Hospital-style Community Store), Xin Teng Foot Road Traditional Chinese Medicine Foot Soak Chinese Medicine, Jiu Jiu Health Care. Cinema foottrack. SPA (Nanshan Store), Jingxin Zen Monastery (Excellent Victoria Harbour Store), Chinese Medicine Foot Soaking, Huang Zizhen Chinese Medicine Fumigation Hall, Chinese Medicine Ten Yuan Foot Soak Shop, Kanyi Chinese Medicine, Xuezhi Huakou Chinese Medicine Health Bar, Chinese Medicine Foot Bath, Golden Finger Chinese Medicine Blind Massage Parlor, Chinese Medicine Foot Soak

Traditional Chinese Medicine Institutions	30	27.3%	Shanghai Medical Skin Traditional Chinese Medicine Hospital, Zhongguang Hetang Traditional Chinese Medicine Hospital (Shenzhen Shekou Branch), Shenzhen Dongjin Traditional Chinese Medicine Hospital, Pingshan District Traditional Chinese Medicine Hospital (Kengzi Campus), Pingshan District Traditional Chinese Medicine Hospital (Main Campus), Shenzhen Traditional Chinese Medicine Hospital (Futian Campus), Luohu Traditional Chinese Medicine Hospital, Shenzhen Bao'an Traditional Chinese Medicine Hospital (Group), Bao'an Traditional Chinese Medicine Hospital, Shenzhen Bao'an Traditional Chinese Medicine Hospital (East Branch), Bao'an Traditional Chinese Medicine Hospital - Shenzhen Third Traditional Chinese Medicine Hospital, Shenzhen Third Traditional Chinese Medicine Hospital, Shenzhen Bao'an Traditional Chinese Medicine Hospital (Group) Acupuncture Hospital, Bao'an Traditional Chinese Medicine Hospital West Campus, Shenzhen Traditional Chinese Medicine Hospital, Shenzhen Dapeng New Area Hospital of Traditional Chinese Medicine, Guangyuyuan Health Boutique Chinese Medicine (Yifang City Shopping Center West District Store), Guangyu Yuan Health Boutique Chinese Medicine (Yifang City Shopping Center West District Store), Xiaoxiao Chinese Medicine Store, Hong Qiulin Chinese Medicine Hall Herbal Tea (Heping Store), Chinese Medicine Hall, Li Shizhen Chinese Herbal Medicine, Guangyuyuan Health Boutique Chinese Medicine, Luohu Hospital Group Traditional Chinese Medicine Experience Hall, Mohs Nourishing Health Care Chinese Medicine Store, Health Boutique Chinese Medicine, Xikangtang Chinese Medicine Store, Guangyu Yuansheng Boutique Chinese Medicine, Intelligent Chinese Medicine Pharmacy, Guangyu Yuan Boutique Health Chinese Medicine ( Qiaoxiang Mansion Store) Tongrentang	
<b>Traditional Chinese medicine tourism resources</b>	Cultivation of medicinal herbs	2	1.8%	Beijing Science and Technology Union Traditional Chinese Medicine Modern Industrial Base, Heshuntang High-quality Traditional Chinese Medicine Production Base
	R&D of traditional Chinese medicine	22	20.0%	Shenzhen Xiyu Traditional Chinese Medicine Research Co., Ltd., Jingshijia Traditional Chinese Medicine R&D Shenzhen Co., Ltd., Jiushengtang Traditional Chinese Medicine Health Co., Ltd., Shangutang Traditional Chinese Medicine Biotechnology (Shenzhen) Co., Ltd., Guangming International Traditional Chinese Medicine Port, Beijing Science and Technology Union Traditional Chinese Medicine Modernization Industrial Base, Gufang Chinese Medicine Research Institute, Shenzhen Gufang Traditional Chinese Medicine Research Institute, Beijing Boguo Guoji Traditional Chinese Medicine Research Institute Shenzhen Branch, Runlintang Traditional Chinese Medicine Research Institute (Shenzhen Branch), Beijing Jingshi Skin Purifying International Chinese Medicine Research Institute Shenzhen Branch, Beijing Huifu Institute of Traditional Chinese Medicine Shenzhen Branch, Shenzhen Kangqiao Institute of Traditional Chinese Medicine Gout, Guangdong-Hong Kong-Macao Greater Bay Area Institute of Traditional Chinese Medicine and Agriculture, Taiheyuan (Shenzhen) Zhongpan Research Institute, Chinese Medicine Research Center Building, Shenzhen Institute of Traditional Chinese Medicine Inheritance and Development, Shenzhen Beijing University of Chinese Medicine Research Institute, Guangzhou University of Chinese Medicine Shenzhen Research Institute, Guangzhou University of Chinese Medicine South China Acupuncture Research Center, Shenzhen Hospital of Traditional Chinese Medicine Science and Education Center, Shenzhen Institute of Traditional Chinese

(Source: Author)

As can be seen from Table 1, the traditional Chinese medicine tourism resources in Shenzhen are concentrated in four sub-categories, namely nourishing (body), TCM diagnosis and treatment, TCM institutions, and TCM research and development, accounting for 26.4%, 20.0%, 27.3%, and 20.0% respectively. While the other subcategories (science popularization base, museum, exhibition hall, TCM theory, and medicinal material planting) accounted for only 6.3%. This shows that traditional Chinese medicine tourism resources in Shenzhen are mainly concentrated in the real economy, and are relatively scarce in the aspects of science popularization and cultural publicity. Figure 2 shows that, in terms of space, TCM tourism resources are mainly distributed in the western part of Shenzhen, showing the overall characteristics of "west Michigan and east sparse". All districts except Yantian District have the distribution of traditional Chinese medicine tourism resources, among which Baoan District and Longgang District have the most distribution, with 28 locations, followed by Futian District with 17 locations, and the rest are evenly distributed in Guangming District, Longhua District, Luohu District, Nanshan District, and Pingshan District. The number of tourism resources in the top three districts accounted for

66.4% of the total number in the study area, while the number of tourism resources in the other five districts accounted for only 33.6%.

**FIG.3 Distribution of TCM tourism resources in Shenzhen (Source: author)**

**4.2 Spatial distribution characteristics of different types of traditional Chinese medicine tourism resources**

**4.2.1 Nearest Neighbor Index Analysis**

The average nearest neighbor tool in ArcGIS was used to calculate the average sum of the actual nearest distance and the theoretical nearest distance between the main class resource points respectively (see Table 2). As can be seen from Table 2, the distribution of the three kinds of traditional Chinese medicine tourism resources are all clustered. In order to further analyze the differences in their  $R > 0.6$  spatial distribution characteristics, they are defined as  $R = 0$ . mild clustered distribution, as moderate clustered distribution  $R < 0.6$ , and severe clustered distribution (Li et al., 2022). According to this definition, Chinese medicine tourism resources and Chinese medicine tourism resources are heavily concentrated distribution, while Chinese medicine cultural tourism resources are mildly concentrated distribution.

**Table 2 Nearest neighbor index table**

Resource point Types	$\bar{r}_E$ (Theory)	$\bar{r}_p$ (Practical)	R(Nearest proximity Index)	Spatial features
overall	2293.00	1325.193	0.58	Mildly clustered distribution
Traditional Chinese medicine culture tourism resources category	3257.58	1820.41	0.56	Mildly clustered distribution
TCM tourism resources category	3277.65	2589.51	0.79	Heavy agglomeration distribution
Chinese medicine tourism resources category	4164.64	3521.95	0.85	Heavy concentration distribution

(Source: Author)

**4.2.2 Kernel Density Analysis**

The kernel density analysis tool of "ArcToolbox-Spatial Analyst-Density Analysis" in ArcGIS 10.8 was used to estimate the kernel density of traditional Chinese medicine tourism resources in Shenzhen, and the spatial distribution and agglomeration area of the traditional Chinese medicine tourism resources in Shenzhen was explored. The bandwidth selection scale is 5km, 10km, 15km, and 20km, and after many attempts, the optimal search bandwidth h is determined to be 15km, and the visualization results of kernel density analysis of traditional Chinese medicine tourism resources are generated with the help of kernel density analysis tool, and the

higher the kernel density value, the higher the degree of agglomeration, as shown in Figure 4.

**1) TCM cultural tourism resources**

The spatial distribution of TCM cultural tourism resources in Shenzhen has a polycentric trend, which is mainly distributed in the northern part of Shenzhen, and there are significant differences in different regions of the city, and the overall performance is the distribution pattern of "three-core center and sub-center agglomeration", and the high-density agglomeration areas of TCM cultural tourism resources are distributed in Guangming District, Bao'an District, Longhua District and Longgang District. The sub-high-density

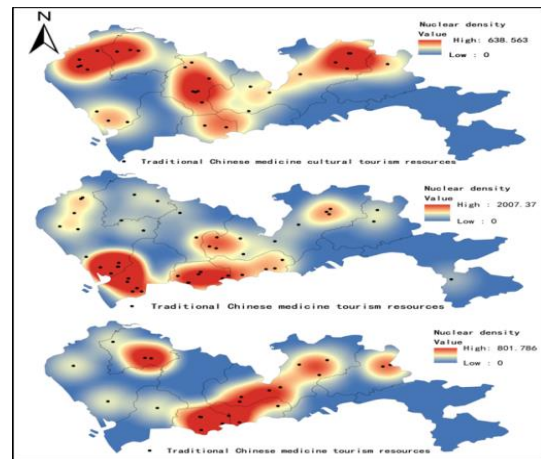
agglomeration areas are distributed in Bao'an District and Futian District, and there is no distribution of tourism resources in Dapeng New Area. Among them, the Shenzhen Traditional Chinese Medicine Modernization Science Base, the Shenzhen Museum of Traditional Chinese Medicine, and the Traditional Chinese Medicine Exhibition Hall are all located in Longgang District, so the district has a profound cultural atmosphere of traditional Chinese medicine.

**2) Traditional Chinese medicine tourism resources**

In terms of spatial agglomeration, the traditional Chinese medicine tourism resources in Shenzhen are clustered in the south and dispersed in the north, and the spatial distribution difference is also significant, and the overall distribution pattern is "two core centers and sub-center agglomerations", and the high-density agglomeration of traditional Chinese medicine tourism resources is distributed in Bao'an District, Nanshan District, and Futian District. The sub-density is mainly distributed in Longhua District, Longgang District, and Luohu District. Dapeng New Area has the least TCM tourism resources, with only one.

**3) Traditional Chinese medicine tourism resources**

The high-density area of traditional Chinese medicine tourism resources in Shenzhen is distributed in a strip along the "Futian-Luohu-Longgang", and in addition, it is also concentrated in Guangming District. Traditional Chinese medicine tourism resources mainly include the cultivation of medicinal materials and the research and development of traditional Chinese medicine, which belong to the high-tech industry. Futian is located in the central part of Shenzhen, which is the center of Shenzhen's administration, finance, culture, commerce, and foreign exchanges, with strong financial resources and a wide range of talents, so many R&D bases and biopharmaceutical companies are distributed in Futian. Luohu District, close to Futian District, is one of the central urban areas of Shenzhen and a major area for the research and development of traditional Chinese medicine. Guangming District, located in the west of Shenzhen, has abundant resources of mountains, rivers, forests, fields, and lakes, with relatively low population density, and has the advantage of space resources, which is suitable for the cultivation of modern Chinese medicine industries, such as the Beijing Federation of Science and Technology Traditional Chinese Medicine Modern Industrial Base, and the same is true in Pingshan area.



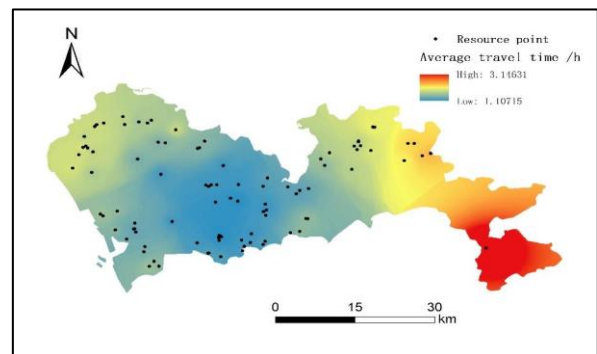
**FIG.4 Distribution of kernel density of traditional Chinese medicine tourism resources in Shenzhen (source: author)**

(a. Traditional Chinese Medicine Cultural Tourism Resources b. Traditional Chinese Medicine Tourism Resources C. Traditional Chinese Medicine Tourism Resources)

**4.3 Spatial accessibility of medical tourism resources**

**4.3.1 Spatial characteristics of overall resource accessibility**

The extracted roads in Shenzhen are classified into four levels: elevated and express roads, urban trunk roads, urban sub-trunk roads, and urban branch roads. Based on the function of ArcGIS, the road network was constructed through the steps of extracting the center line, merging the four types of roads, and topology inspection. The constructed road network and 110 resource points were used for network analysis, that is, the OD cost matrix was established, the average travel time and accessibility coefficient of each resource point were calculated, and the figure was finally drawn (see Figure 5).



**FIG.5 Accessibility distribution of TCM tourism resources in Shenzhen (Source: author)**

The calculation results show that the average travel time of 110 TCM tourism resource points in Shenzhen ranges from 1.107 to 3.146h, and the average travel time is 1.446h. On the whole, the average travel time of TCM tourism resource points is low, and the overall accessibility is good. In addition, the number of resource points within 1.5h was the largest, accounting for about 62.7%; Followed by resource points between 1.5 and 2h, accounting for about 31.8%; The rest are

outside 2h, accounting for about 5.5%. From the above, it can be seen that there are significant differences in the accessibility of TCM tourism resource points, but from the perspective of the overall travel time of resource points, the internal differences in accessibility are small. In terms of accessibility coefficient, Xinyikang Blind Massage Shop had the lowest accessibility coefficient (0.766), and the best accessibility; The highest is Shenzhen Dapeng New District Hospital of Traditional Chinese Medicine, the accessibility coefficient is 2.176, the worst accessibility, the above two  $A_i > 1$  results are consistent with the highest and lowest travel time. Among them, there are 46 resource points with accessibility coefficient, accounting for about 41.8%, and 64 resource points with accessibility coefficient, accounting for about 58.2%. Therefore, the accessibility of more than half of TCM tourism resource  $A_i < 1$  points in Shenzhen is higher than the average level. On the whole, the accessibility of TCM tourism resource points in Shenzhen shows a weakening distribution pattern from the center to the east. The best accessibility areas are located in the center of Shenzhen, concentrated in Longhua District, Futian District, Luohu District, and the west of Longgang District, while the worst areas are located in Pingshan District and Dapeng New District in the east.

#### 4.3.2 Spatial accessibility characteristics of different types of TCM tourism resources

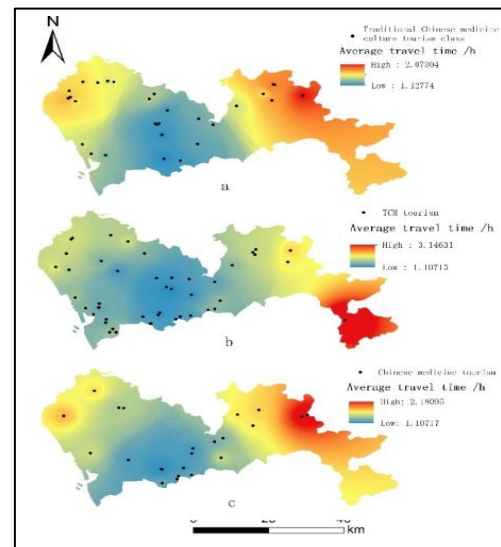
The spatial distribution maps of the average travel time of the three main types of resource points were successively made by using the spatial interpolation function of ArcGIS (see Figure 6).

(1) The accessibility distribution of TCM cultural tourism is consistent with the distribution pattern of overall tourism resource points (see Figure 6-a). Low accessibility is mainly concentrated in the northeast, where there are only two TCM cultural tourism resource points, which are the only resource points with an average travel time of more than 2h, and have the worst accessibility. Secondly, there are two resource points with an average travel time of 1.725h and 1.639h in the northwest of Shenzhen, which have poor accessibility. The remaining resource points are concentrated in the central and southern part of Shenzhen.

(2) The accessibility distribution of TCM tourism still showed a pattern of weakening from the middle to the east (see Figure 6-b), but the low accessibility was concentrated in the eastern part of Shenzhen, with three resource points with an average travel time of more than 1.9h, among which the highest average travel time was about 3.146h, while the other resource points were more evenly distributed in the rest of Shenzhen. Therefore, the accessibility distribution of TCM tourism is low in the eastern region and more even in the other regions.

(3) The accessibility distribution of TCM tourism is consistent with the distribution pattern of TCM tourism resources (see Figure 6-c). High accessibility is concentrated in the southern part of Shenzhen, while there are two low

accessibility resource points in the northeast, with an average travel time of 2.180h and 2.125h respectively.



**FIG. 6 Accessibility distribution of TCM tourism resources in different categories in Shenzhen (Source: author)**

(a. TCM cultural tourism resources b. TCM tourism resources c. TCM tourism resources)

## 5. Acknowledgment

Based on the road network in Shenzhen, this paper analyzes the spatial distribution and accessibility of TCM tourism resource points by using the spatial interpolation function and network analysis function in ArcGIS. The results show that:

(1) The distribution of TCM tourism resources in Shenzhen presents the characteristics of "west Mi sparse east", and the resource points are concentrated in the western part of Shenzhen. In terms of types, TCM tourism resources accounted for 47.3% of the total, followed by TCM cultural tourism resources accounted for 30.9% of the total, and TCM tourism resources accounted for 21.8%. It can be seen that the traditional Chinese medicine tourism resources in Shenzhen are concentrated in the real economy, such as research and development enterprises, health care (body) business and traditional Chinese medicine institutions, etc., while the science popularization and cultural publicity are relatively scarce.

(2) In terms of the spatial distribution pattern of resources, the three main categories all show certain clustering characteristics. The spatial distribution of traditional Chinese medicine cultural tourism resources is similar to that of traditional Chinese medicine tourism resources, showing a polycentric trend. The difference lies in the fact that the two have different concentrated distribution areas of resource points, and the latter is more concentrated distribution than the former. The distribution of TCM tourism resources along the "Futian - Luohu - Longgang" is banded and the distribution is sub-concentrated in Guangming District, which is a heavy concentrated distribution.



(3) The overall accessibility character of traditional Chinese medicine tourism resources in Shenzhen is shown as the center weakens to the east and west, and the accessibility gradually deteriorates. The average passage time of each major resource point is as follows: the resource point of TCM cultural tourism is about 1.502h, the resource point of TCM tourism is about 1.423h, and the resource point of TCM tourism is about 1.411h; The average passing time of the overall resource point is 1.446h, and the overall accessibility is good. However, the difference between the highest and lowest travel time is nearly 2.84 times, and the difference of accessibility is obvious. The accessibility characteristics of each major category are basically consistent with the overall pattern, but the low accessibility of traditional Chinese medicine cultural tourism is concentrated in the northeast, the low accessibility of traditional Chinese medicine cultural tourism is concentrated in the east, and the low accessibility of traditional Chinese medicine tourism and traditional Chinese medicine cultural tourism is concentrated in the northeast, but the high accessibility is different, mainly concentrated in the south.

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