Research Paper

Differentiation of family medical resources use of "new citizens" from the perspective of health equity

Take Tianjin as an example

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Abstract

In the late stage of China's rapid urbanization, a large number of "new citizen" families flooded into large and medium cities. Due to the "disadvantage of outsiders" in economic and social status, "new citizens" often lack the ability to obtain social attention and social capital, and thus face higher health risks, and it is difficult to obtain fair health rights. This study constructs an evaluation system of medical resource utilization potential from the two dimensions of existing medical resource supply and "new citizen" family medical convenience, analyzes spatial differentiation characteristics through GIS, and uses correlation and differentiation index to explore differentiation mechanism. The study found that: (1) in the central urban area and in the suburbs, there are obvious differences in the use characteristics of family medical resources for "new citizens" in Tianjin; (2) in the central urban area, the difference in the dominant type of medical resources is significantly related to the spatial location of the subway lines; (3) The distribution of middle-level medical resources plays a significant role in alleviating regional differences. On this basis, the countermeasures to promote medical and health fairness are put forward, which provides useful support for the "pre-evaluation" process of urban medical facilities planning.

Keywords

health equity, new citizen families, medical resources, spatial differentiation, Tianjin city

1. Introduction

In the late stage of China's rapid urbanization, a large number of migrants have flooded into cities, settled in cities and integrated into urban life, gradually becoming an important part of the urban population. These groups are collectively referred to as "new citizens". "New citizens" generally refer to groups who move their individuals or families into cities through various means and obtain relatively stable jobs or residences(Chen *et al.*, 2018). Existing studies have shown that, compared with urban aborigines, “new citizens” are often more vulnerable to marginalization or even social exclusion due to lack of opportunities and capabilities to obtain mainstream information and social capital in urban society(Chen,

Mou and Yuan, 2008; Huang, 2010). The inequity of resources obtained by the "new citizens" group is mainly concentrated in job opportunities, living environment, income, social security, and working environment(Xue *et al.*, 2018). The combination of the above factors leads to the disadvantaged position of “new citizens” in work and life, which in turn increases the possibility of them facing higher health risks(Liu, 2005). Therefore, it is of great significance to carry out the health equity research of the "new citizens" group in space and explore their advantages or disadvantages in the use of medical resources compared with the urban aborigines.

In terms of the choice of living space, most of the "new citizens" groups have not yet established themselves economically and have a low degree of social integration. They are more dependent on urban public transportation in the choice of travel tools, resulting in the spatial differentiation of their "living-work" places, that is, people tend to choose low-rent housing under the same area conditions (mostly in the suburbs of cities), and they expect to find jobs that match or exceed expectations in job selection (mostly in urban centers)(Huang, Zhou and Xie, 2012; Gu and Li, 2016). As an important tool to connect the main functional areas of the city and organize the urban structure, urban rail transit has alleviated to a certain extent the "living-work" space-time mismatch problem caused by extremely poor rents. The cost of living of a citizen' family. The surrounding area of subway stations has become a favored location for “new citizen families” to choose housing(Kong, 2017). As a municipality directly under the Central Government, Tianjin's rail transit system has developed relatively maturely. The station layout has covered six districts in the city center, four districts around the city, as well as important city-level functional areas and the main urban area of Binhai New Area. Therefore, taking the surrounding area of Tianjin rail transit station as the research unit, and taking the rail transit coverage as the research area, it can reflect the location needs of "new citizens" family housing choices more comprehensively.

2. Background

Since the release of the "Healthy China 2030" Outline, research on the physical and mental health of "new citizens" has gradually increased, mainly involving research hotspots such as mental health, social support, health risks, and psychological integration. In recent years, it has gradually been extended to research on health equity(Zhang, Gao and Yao, 2021). Health equity means reducing disparities in access to health resources among individuals, and that this most basic right should not be affected by individual social factors, namely social class, income and wealth, education level, and geographic location(Chen *et al.*, 2018). It is generally believed that the research scope of health equity includes three aspects, namely, the equity of health service utilization, the equity of health financing, and the equity of health outcomes, and the former is an important factor affecting the improvement of residents' health(Gao and Yang, 2014; Jian, 2016; Chen *et al.*, 2018). Conducting research on the fairness of medical resources use among the "new citizens" group will help to understand the spatial differentiation characteristics of the current health equity rights, and then call on the society to pay attention to this "vulnerable group".

At the same time, the process of "new citizens" integrating into urban life is not only the integration of individuals, but also the social integration of the entire family. Due to the higher medical and health needs of the “new citizens” group of the elderly and children, when the “new citizens” enter an environment that is completely different from the original society, the elderly and children who are relocated are more likely than middle-aged people. Due to the lack of intimate social network, daily companionship and external communication, subjective well-being is reduced, and it is more difficult to adapt to a new social environment, and it takes longer, which is more likely to lead to physical and mental health problems(Li and Yu, 2012; Zhang, Gao and Yao, 2021). The fragmentation of social networks also leads to a lack of social capital, making it difficult to provide information, resources, spiritual support and shelter, as well as security, spiritual security, and respect and security functions for

migrant families(Guo and Xie, 2009; Liu, 2011; Qian and Shen, 2011). Although the medical and health needs of new immigrant children are weaker than those of the elderly, they are more prone to physical and mental health problems than children from urban aboriginal families(Qiu and Yang, 2006). Therefore, taking "new citizen" families as the research group can more realistically reflect the actual medical needs of this group.

To sum up, the "new citizen" group has become the "vulnerable group" concerned by urban renewal and spatial equity research due to the "outside disadvantage" in terms of economic and social status. From the perspective of health equity, study the characteristics of spatial distribution differences in the use of medical resources by "new citizen" families, and explore whether existing medical resources separate this group from urban aborigines, or exclude them, and whether they are excluded to what extent. This study is a useful complement to the "pre-evaluation" process of urban medical service facility renewal and medical facility planning.

3. Data resource

3.1.Household rental data of "new citizens"

The data comes from the Anjuke website (https://tianjin.anjuke.com). The POI data of the rental properties to be renovated around the subway station is obtained through Python. The content of the fields involves the WGS84 latitude and longitude coordinates of the residential area data, the area of the house type (m^2), and the average price of the house (yuan/m^2). Screening to remove abnormalities Values, duplicates, and mean summarization of all data with the cell name field for a total of 1051 entries.

3.2.Tianjin medical resource data

The fields of medical insurance designated hospital grade (third, second and first) and type (comprehensive, specialist, etc.) fields in this data are derived from the "Tianjin Medical Insurance Designated Medical Institution Layout Plan (2019-2025)", according to The hospital type field filters out the comprehensive category, geriatric specialty, and children's hospital data.

Tianjin classifies the city's medical resources, and divides all medical insurance designated medical resources into two categories, namely medical insurance designated hospitals and medical insurance designated pharmacies.

Medical insurance designated hospitals can be further divided into general hospitals and specialized hospitals based on the scope of admission. Among them, general hospitals are usually the main regional medical institutions, which can meet the comprehensive medical needs of various groups of people; specialized hospitals are hospitals that target specific groups of people and treat specific types of diseases. In terms of grading, hospitals are divided into three levels. Among them, the third-level hospital has a cross-regional nature and can serve the whole city. It has the highest level of medical service capabilities and can meet all the medical needs of residents; the second-level hospital has a cross-community nature. Serving the local area, with high-level medical service capabilities, it can meet most of the medical needs of residents; first-level hospitals are grassroots hospitals that directly provide the community with comprehensive services of medical treatment, prevention, rehabilitation, and health care, and can only meet the basic needs of residents.

Medical insurance designated pharmacies, as the smallest medical institutions, can only meet the minimum level of medical needs of residents.

Based on the classification and grading of designated medical institutions for medical insurance, this study took into account the actual family structure and medical needs of the "new citizens" group, and

integrated the data of geriatric specialized hospitals, children's specialized hospitals and general hospitals in the specialized hospital category. Since the number of designated medical insurance pharmacies is small and cannot reflect the actual basic medical needs of the "new citizens" group, the data of all pharmacies in the city is used as a substitute, and all medical insurance pharmacies and non-medical insurance pharmacies are included in the data category.

In order to more specifically reflect the relationship between the medical service capacity and the needs of "new citizens", the designated hospitals at all levels of medical insurance and the city's pharmacies are divided into three levels of medical service capacity: high, medium and low. High-level medical service capabilities include the city's third- and second-level hospitals, which can meet all the medical needs of "new citizens" families; medium-level medical service capabilities are represented by first-level hospitals, which can meet basic medical needs; low-level medical service capabilities are based on All pharmacies in the city are mapped and can meet basic medical needs.

4. Research methods

4.1. Evaluation of family medical needs of "new citizens"

Considering the differences in the number and age structure of different families, among the "new citizen" family groups with similar economic and social status, the elderly and families with more children tend to have greater medical needs. Therefore, this paper adopts the analytic hierarchy process to determine the weight of medical needs of families with different numbers and ages by means of expert scoring.

Table 1 The weight of medical needs of families with different structures

Number of households	*family structure*	*Family medical needs weight*
6 people and above	2 elderly, 2 middle-aged, 2 young	0.3347
4-5 people	2 elderly, 2 middle-aged, 1 young	0.2535
	1 old, 2 middle-aged, 2 young	0.1298
	1 old, 2 middle-aged, 1 young	0.1176
2-3 people	2 middle-aged, 2 young	0.0926
	2 middle-aged, 1 young	0.0566
	2 middle-aged	0.0153

Considering the demand for medical treatment at the family level, this study divides the cluster samples into 6-person, 4-5-person and 2-3-person households according to the research results of per capita housing area and household-level housing area demand in Tianjin. Different types of family structures were used as middle-level elements of decision-making and analyzed by hierarchy process. The results passed the consistency test to obtain the weight of each type of family's medical needs (Table 1).

4.2.Evaluation of comprehensive utilization ability of medical resources

Based on the accessibility of each family to medical institutions and the level of medical service ability, a scoring system is constructed to study the matching relationship between supply and demand of medical resources.

Considering that most of the travel groups when seeking medical treatment are the elderly in the family or with children, the travel circles are set as walking distances of 300m, 500m and 800m. Based on the geographic location of the community where the rentable source data is located, a multi-ring buffer is constructed according to the classification of different households.

On this basis, combined with the level of medical service resources at all levels in each circle, a supply and demand evaluation system is constructed, that is, the potential use of medical service capabilities by "new citizens" family groups. There are three premises here.

Medical service resources with higher service capabilities are compatible with lower levels, that is, high-level medical service resources can replace low-level functions;

When constructing the evaluation system, the influence of the quantity of medical resources in each circle is not considered, but only the availability of a certain type of medical service resources in a circle;

Under the premise that individual medical needs can be met, people tend to look for medical service resources that are closer to themselves, rather than higher-level ones;

On this basis, a five-level scale method was used to construct an evaluation scale for the use potential of medical service resources (Table 2), and the evaluation results of the potential use of medical resources in the communities where each family was located were obtained, as well as the average evaluation score of each type of family. According to the weight of each type of family's medical needs, with the name of the subway station as the field, the evaluation results are summarized and weighted, which reflects the overall medical resource utilization potential of the "new citizen" family groups renting around each subway station.

Table 2 Evaluation of Medical Resource Utilization Potential

	High-level medical resources	***Middle-level medical resources***	***low-level medical resources***
5 minutes walking distance	9 points	7 points	5 points
10 minutes walking distance	7 points	5 points	3 points
15 minutes walking distance	5 points	3 points	1 point

4.3.Calculation of spatial differentiation index

In order to explore the spatial differentiation mechanism of medical resource utilization potential and its influencing factors, the absolute spatial differentiation index was used to measure the degree of differentiation of each element relative to the average distribution pattern (Table 4). The calculation formula refers to the existing research and practice of domestic scholars(Feng and Zhong, 2018):

$$I_d = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{X_i}{\sum_{i=1}^{n} X_i} - \frac{1}{N}\right|$$

Among them, I_d represents the absolute spatial differentiation index, *N* represents the number of research units, and X_i represents the index value of the i-th research unit. If the calculation result is greater than 0.4, it can be regarded as having obvious spatial differentiation characteristics.

5. Spatial differentiation characteristics and mechanisms of medical resource utilization potential

Based on the evaluation results, a differentiation study of medical resource utilization potential was conducted. The spatial autocorrelation analysis method is used to study the spatial distribution of the overall medical resource utilization potential, as well as the contribution of each level of medical service resource utilization potential to the overall score. The correlation between them, as well as the characteristics and mechanisms of spatial differentiation.

5.1. Spatial differentiation characteristics of medical resource utilization potential

Based on the overall situation and the evaluation results of the potential use of high, medium and low-level medical resources, the differentiation characteristics were studied. First, the global autocorrelation index was used to judge the degree of autocorrelation and the agglomeration-dispersion characteristics, and it was found that the four types of scores all showed obvious spatial agglomeration patterns. On this basis, the local autocorrelation is further analyzed, and the spatial distribution and the clustering characteristics of high and low values are studied.

(1) Spatial differentiation characteristics of the overall use potential of medical resources

The overall score shows high-value clustering distribution characteristics within the third ring, and low-high clustering characteristics in urban-level business and commercial concentration areas, urban leisure and cultural centers, and the overall score of medical resource utilization potential in the above areas It is significantly lower than the surrounding area, showing a local spatial differentiation phenomenon (Figure 1, Figure 2). Combined with the core density map of the distribution of high, medium and low medical service resources in the city, it is found that the distribution density of high and low medical resources in the three regions is at a relatively low level. The distribution density of medium-level medical resources in the area where the central area is located is relatively high, which indicates that the reason for the low scores of these two areas is the lack of high- and low-level medical service resources.

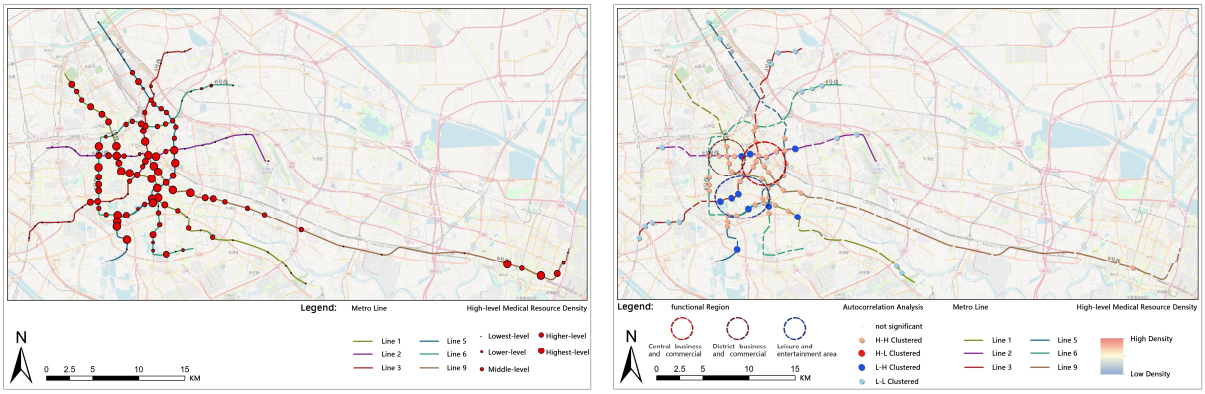

Figure 1,2 Spatial distribution characteristics of overall score of medical resource utilization potential

(2) Spatial differentiation characteristics of medical resource utilization potential at all levels

The use potential of medical resources at each level and their contribution to the overall score also showed diversified differentiation characteristics. The study found that the spatial distribution of high-level medical resource utilization potential scores showed obvious differences (Figure 3). In the city-level business and commercial core areas and their surrounding areas, there are obvious low-high-value clustering characteristics, which is related to the fact that the area is located in the old urban area of the city and the surrounding commercial office land is concentrated. The reason why the area where the urban leisure and cultural center is located has the characteristics of low and high value clustering is that there are three large urban parks in the area, which has a great segmentation impact on the pedestrian accessible area, which in turn leads to high-level medical care. The potential for resource use declines. There are high-level medical resources around some areas, but they still show low-high clustering characteristics. The reason is that there are relatively dense medical resources around the area, or a large area of land is divided in the area, resulting in the low-scoring characteristics of the area.

The spatial differentiation characteristics of the middle-level medical resource utilization potential scores were relatively insignificant (Fig. 4). The clustering characteristics of low and high values in the area where the urban leisure and cultural center is located, further indicates that the reason for the low score

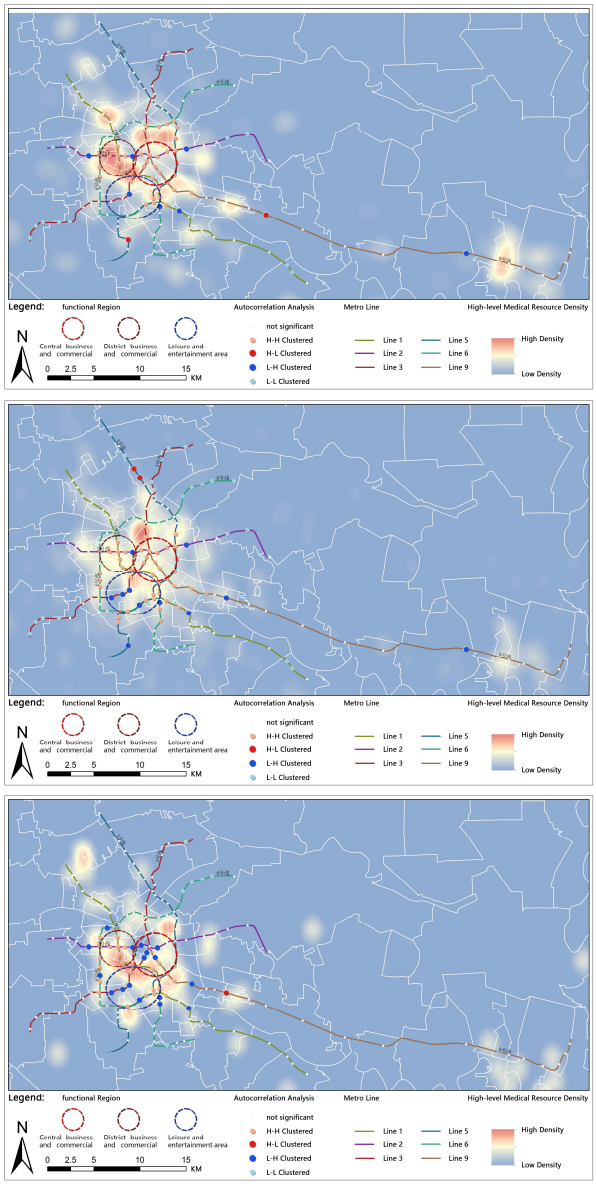

Figure 3,4,5 Autocorrelation characteristics of high, medium and low-level medical resource use potential

in this area is the segmentation of accessibility by large parks and green spaces and the quantitative constraints on the layout of medical resources.

Due to the insufficient allocation of medical resources in the peripheral areas of the city, the outer suburbs of the city outside the third ring road generally show low-value clustering characteristics. The appearance of some high and low clustering characteristic areas is due to the proximity of areas with dense distribution of medical resources.

The low-level medical resource use potential scores did not show obvious spatial differentiation characteristics (Figure 5). The area within the third ring road only has differentiation characteristics around a local single site. In the area outside the third ring road, there are low-value clusters similar to the distribution of high- and medium-level medical resource scores. Resources can generally meet the needs of "new citizens" family groups, but it is difficult to meet the needs of all families outside the Third Ring Road.

(3) Spatial differentiation characteristics of regional leading medical resources

On the basis of the above analysis, the score contribution of medical resources is analyzed, and the dominant and most potential medical resource categories in the surrounding area of subway stations are studied. The potential score of medical resource utilization in the surrounding area of each subway station is determined by the three levels of medical resource scores: high, medium and low. are the most potential medical resource categories in the region (Figure 6).

The analysis results show that, in the metro station area dominated by high-level medical resources, Metro Line 1 and Line 6 account for the most and are located within the Third Ring Road. It is related to the earlier and passing through the old urban area with sound medical resources; Metro Line 6 within the Third Ring Road shows the characteristics of local aggregation but overall scattered distribution, and shows obvious high-level medical resources in many areas and the distribution is relatively concentrated, which is related to its location in the old urban area of the city and the gathering area of medical resources.

Regions dominated by medium-level medical resources showed obvious differentiation characteristics. The medium-level dominated areas of Metro Lines 1, 6, and 9 are mostly distributed outside the Third Ring Road. These areas are mostly newly built residential areas on the fringes of the central city, or located in the old city, or in the Binhai New Area. The distribution of medical resources in these areas The number is large and homogeneous, and there is a lack of high-level medical resources of a certain scale;

the medium-level medical resources of Lines 2, 3, and 5 are mostly located in the Third Ring Road, and some district-level commercial centers have this feature because of the lack of area in the area. Larger medical and health land, or the existence of a large area of urban public green space, has a certain impact on the accessibility and the number and scale of medical and health land.

Areas dominated by low-level medical resources are scattered. The reason for this feature in the suburban areas of some cities is that their location is relatively remote, lack of high- and medium-level medical service resources within the accessibility range, or the surrounding area is mostly idle land, which leads to the level of accessibility and the scale of the number of medical and health land. The medical needs of residents can only be met through pharmacies.

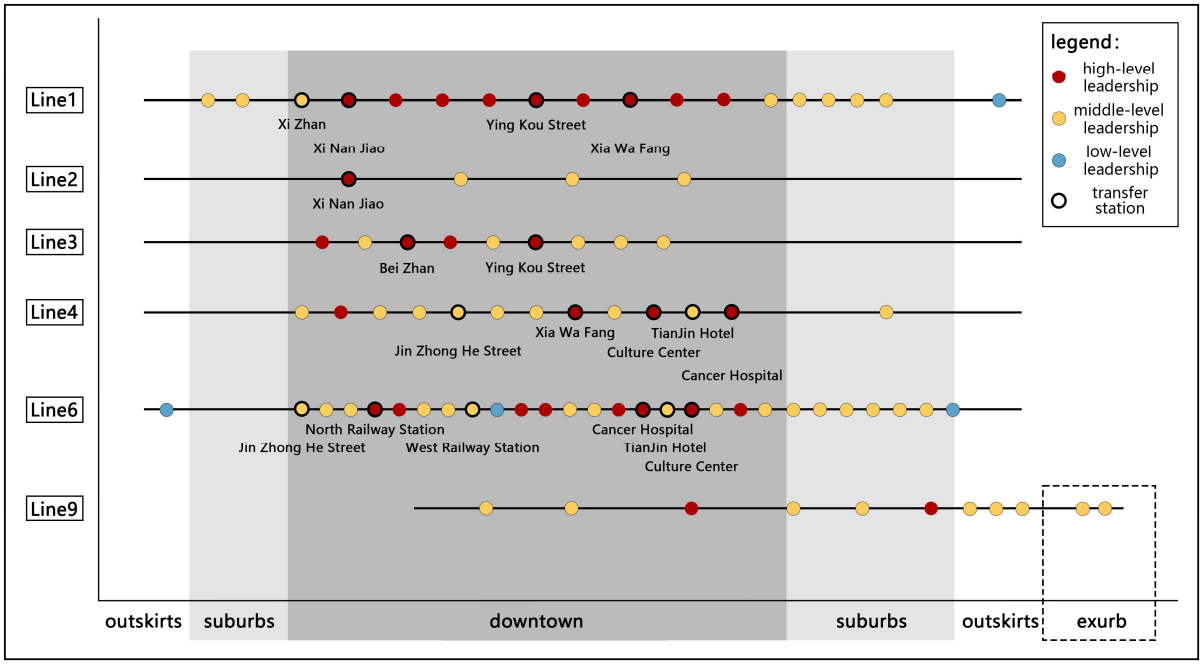

Figure 6 Spatial distribution characteristics of metro stations dominated by different levels

5.2. Spatial differentiation mechanism of medical resource utilization potential

Table 3 Correlation analysis results

		Travel resistance	*Average rental price for a family of 2-3*	*Average rental price for a family of 4-5*	Average rental price for families with more than 6 members
Overall score of medical resource use potential	Pearson	-0.341**	0.635**	0.827**	0.594**
High-level medical resource use potential	Pearson	-0.331**	0.502**	0.551**	0.391**
Middle-level medical resource use potential	Pearson	-0.316**	0.622**	0.820**	0.590**
Low-level medical resource use potential	Pearson	-0.327**	0.561**	0.730**	0.460**

In order to further explore the factors that affect the overall level and the potential level of medical resources use at all levels, this study uses the travel resistance of subway stations and the average rental price of households (yuan/m^2) as the influencing factors for correlation analysis. In the acquisition of relevant influencing factor indicators, the travel resistance value of each subway station is calculated from the travel impedance of the subway network, which can reflect the degree of resistance of "new citizens" family members from the place of residence to the place of work; the average price of household rent is affected by housing. The source area is affected, so it is discussed separately according to the household category.

The results of correlation analysis show that the potential score of medical resources is negatively and weakly correlated with the travel resistance of subway stations, and has a relatively obvious positive correlation with the average rental price of various types of households. The ease of use of resources is also higher (Table 3).

There is a positive correlation between the contribution level of medical resources at all levels and the average rental price of each type of family, which shows that most families in areas with high average rental prices can often obtain various levels of medical service levels. The score level of resource use potential has the strongest correlation with the average rental price of 4-5 households.

In the correlation analysis between the use potential score of medical resources at each level and the average rent price, the use potential of medical resources at the middle level is higher than that at the low level and the high level, which means that for each type of family, it is in the area with the higher the average rent price. The more potential it has to use the middle-level medical resources, the lower the potential for the use of high-level medical resources. Families with 6 or more members may be located in areas with higher average rental prices, but their potential to use medical resources at all levels is lower than other families. There is a weak negative correlation between all the potential indicators of medical resource use and the travel resistance of subway stations, which indicates that in a relatively remote station area, it is difficult to obtain medical resources at all levels.

Table 4 Absolute Differentiation Index Calculation Results

index	Absolute Spatial Differentiation Index
Overall score of medical resource use potential	0.36
High-level medical resource utilization potential	0.64
Middle-level medical resource utilization potential	0.38
Potential use of low-level medical resources	0.42
Average rental price for a family of 2-3	0.29
Average rental price for a family of 4-5	0.36
Average rental price for families with more than 6 members	0.70

Further use the spatial differentiation index to analyze the contribution of medical resources and the differentiation mechanism of the overall use potential (Table 4). The results show that the high-level medical resource use potential elements show obvious spatial differentiation characteristics. Combined with the correlation analysis results, it shows that in some areas with high overall medical resource use potential scores, "new citizens" family groups are more likely to use the medical resources. It is the medical resources at the middle and low levels, but there is a big difference for the high-level medical resources. The use potentials of middle and low-level medical resources show insignificant spatial differentiation characteristics. Combined with the local autocorrelation analysis results of the two types of scores, it is found that the two types are more homogeneous at the regional overall level, but at the local regional scale. the spatial differentiation characteristics. There is a mismatch between the average rental price of "new citizens" families with 6 or more members and the difference in the overall score of

medical resource utilization potential, which is due to the small number of housing listings in this category and the uneven spatial distribution itself. feature related. The other two categories of families did not show significant spatial differentiation in the average rental price, which was consistent with the overall score of medical resource use potential and the spatial differentiation characteristics of the middle and low-level medical resource use potential levels.

6. Discussion and Conclusion

(1) The overall use potential of medical resources by "new citizen" family groups does not show obvious spatial differentiation characteristics in the overall scope, but there are differences at the local regional scale. There is a local low-value agglomeration phenomenon within the third ring road. The reason is mostly related to the insufficient quantity and accessibility of medical resources caused by the nature of land use in the region. For example, urban-level business and commercial areas and urban leisure and cultural areas, because other types of land The occupation of land for middle-level medical resources results in a low overall score; the areas outside the third ring road show local low-value agglomeration characteristics, because they are located in the old urban area, lack of high-level medical resources and the distribution of middle- and low-level medical resources is homogeneous, or located in areas with imperfect medical facilities outside the city.

(2) The differentiation degree of high-level medical resource utilization potential is higher than that of middle-level and low-level medical resources, and there is a clear clustering trend in local areas. The reason is that most of them are located in densely populated areas, with obvious scarcity, and it is difficult to cover the whole area uniformly, and the uneven distribution in a small range in space will be magnified in the impact on the actual score; the distribution of medium-level medical resources is mostly related to community distribution, the number of which is relatively large and is uniformly allocated by the government, which can cover most areas to a certain extent; compared with the high-level and middle-level medical resources allocated by the government, the market has a greater impact on the allocation of low-level medical resources, and its spatial layout features are: After the high-level and intermediate-level medical resources occupy the market, the result of the free choice of the market assumes the function of "filling the seam". Its distribution also shows the characteristics of homogenization, which in turn shows that the medical service system composed of high-level and middle-level medical resources has weakened the spatial differentiation power of high-level medical resources to a certain extent.

(3) The dominant medical resources show regional distribution characteristics. Within the scope of the Third Ring Road, the areas dominated by high-level medical resources account for the majority, while outside the Third Ring Road, areas dominated by medium-level medical resources are dominant. And there are obvious differences between different subway lines.

(4) High-level medical resource utilization potential is obviously differentiated, while middle-level and low-level are relatively homogeneously distributed. This shows that "new citizens" family groups can fairly use middle and low-level medical resources to meet basic medical needs, and there is obvious inequity in the use of high-level medical resources.

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