

Leveraging Geographic Information Big Data for Assessing Elderly Care Facility Accessibility: A Dongguan City Case Analysis

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Abstract: As the global population continues to age, the strategic placement of elderly care facilities becomes increasingly important for the fulfillment of the Healthy China initiative and ensuring a healthy and supportive lifestyle for the senior demographic. This paper focuses on the Point of Interest (POI) data of Dongguan City's elderly care facilities to examine their spatial distribution, hotspot clusters, and service accessibility. Utilizing a range of analytical techniques, including kernel density, hotspot, and accessibility analyses, the study uncovers several key findings: 1) Dongguan City's elderly care facilities exhibit a notable clustering tendency, predominantly located near residential zones, major transportation routes, and commercial hubs; 2) Two pronounced hotspots for these institutions have emerged across the city, with no significant cold spots detected; 3) Despite a generally high accessibility level for elderly care facilities in Dongguan City, there are considerable internal variations, forming a strip-like distribution; 4) A comparative analysis indicates a misalignment between the distribution of elderly care facilities and the elderly population in Dongguan City.

Keywords: POI data, elderly care facilities, kernel density analysis, hot spot analysis, spatial distribution, accessibility.

1 Introduction

Among the many challenges faced worldwide in the 21st century, the rapid aging of the population is particularly notable, and China, being the country with the largest elderly population in the world, is experiencing an accelerating aging process [1]. Taking Dongguan City in Guangdong Province as an example, according to data from the seventh national population census in 2021, the city has a total population of 10.466 million, with 5.47% aged 60 and older, which is 572,000 people; the population aged 65 and older accounts for 3.54%, approximately 370,020 people. At the same time, more than 180 million elderly people in China suffer from chronic diseases, with 75% of the elderly population having at least one chronic disease, and a large number of elderly people with disabilities or partial disabilities, about 40 million; especially the elderly with disabilities, living alone, and empty nesters, whose elderly care needs have become a core issue in the development of China's social welfare services and have also brought a huge market demand for the continuous development of elderly care facilities.

The application of geographical perspectives in the study of public service facilities has become increasingly significant, especially by using POI big data analysis to study urban spatial patterns and hot spot distributions, which has yielded fruitful results. Researchers including Zeng Wenjing have utilized nighttime light POI data for the inventory and planning of outdoor recreational resources [2]. Chun Fu and colleagues have delineated and described the production-living-ecological spaces in Wuhan's central urban area using POI data [3]. Miao Ruomu and team have examined the spatial patterns and functional zoning of Beijing through Sina Weibo's POI data [4]. Additionally, Zhang Xucai and associates have explored the influence of nearby service amenities on urban vibrancy with data from Tencent's location services [5]. While POI data have been extensively applied in spatial distribution studies for a range of public amenities, including healthcare, sports, evacuation spots, and green spaces, there is a dearth of research focusing on elderly care facilities [6].

Considering the varied and evolving requirements for elderly care services, this study delves into the Point of Interest (POI) data for Dongguan City's elderly care facilities from the year 2023. Utilizing kernel density, hotspot, and accessibility analyses, the research systematically examines the spatial distribution of these institutions within Dongguan City. The objective is to offer a data-driven foundation for enhancing the strategic spatial arrangement of elderly care facilities in the city, thereby fostering an equitable and efficient allocation and development of resources dedicated to the elderly care sector.

The essence of strategic planning for elderly care infrastructure lies in addressing the multifaceted and evolving needs of the aging population. In this regard, this study has chosen to analyze the Point of Interest (POI) data for Dongguan City's elderly care facilities from the year 2023. By employing a combination of kernel density, hotspot, and accessibility analyses, the research aims to provide a comprehensive understanding of their spatial distribution. This analysis is intended to inform the optimization of the city's elderly care infrastructure, with the goal of achieving a harmonious and balanced distribution of services and resources for the aging population.

2 Study area

2.1. Overview of the research area

This study utilizes the address information of Elderly Care Institutions publicly released by the Dongguan Municipal People's Government in 2023, generating a detailed spatial dataset through coordinate conversion technology to accurately display the geographical distribution of various elderly care facilities. The POI (Point of Interest) data includes a variety of elderly care facilities, such as welfare homes, nursing homes, nursing homes registered as limited companies, specialized nursing homes, and nursing centers within hospitals.

The map data are sourced from high-definition map resources authoritatively published by the National Basic Geographic Information Center. We have further vectorized these data to precisely delineate the specific boundaries of each street and administrative region in Dongguan City.

According to data from the Dongguan City Development and Reform Bureau in 2021, Dongguan City has 52 diversified, officially licensed elderly care facilities, which together

provide approximately 12,200 elderly care beds. This translates to a bed availability rate of 35.27 per thousand elderly population, reflecting the overall scale and structural characteristics of Dongguan City's elderly care service provision. In the future, in-depth analysis of these spatial and statistical data will help to gain a more comprehensive understanding and optimize the allocation and service effectiveness of Dongguan City's social elderly care resources.

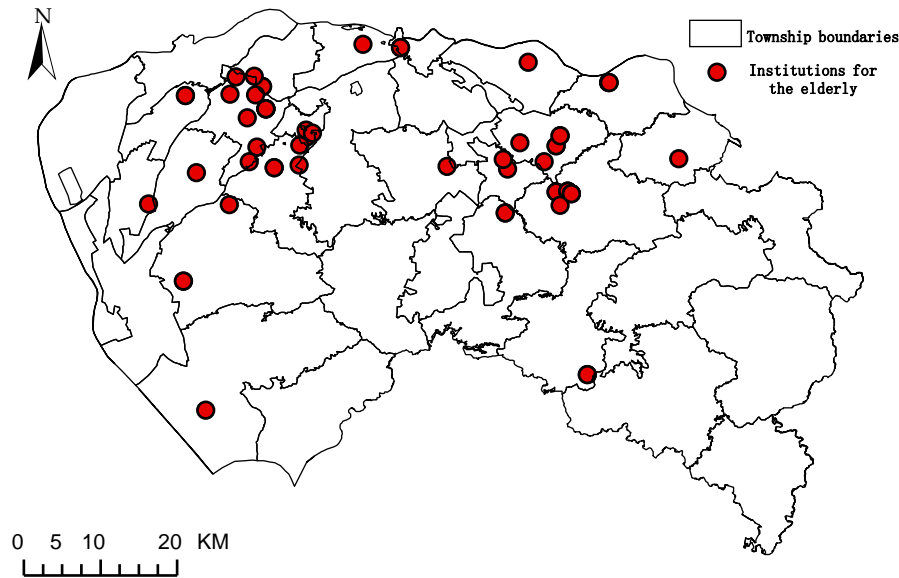


Figure 1. Distribution map of elderly care facilities in Dongguan City.

2.1.1 Favorable conditions for institutional pension promoted by Dongguan City

A. Strong economic strength provides a solid material foundation for universal care for the elderly

Capitalizing on its strategic position at the heart of Guangdong Province's Pearl River Delta, Dongguan has amassed significant economic power through swift growth following its policy of reform and opening-up. The city's dedication to fostering excellence in economic and social progress underpins the development of extensive and top-tier facilities for elderly care. With the rising expectations and needs of its residents, the city's leadership has prioritized the enhancement of elderly care services, focusing on the strategic placement of these institutions to ensure they are readily available and convenient for the public. This has emerged as a key governmental priority in response to the challenges posed by an aging demographic..

B. The change in the concept of the mass value provides an ideological basis for the national pension

With the economic and social development of Dongguan and changes in its demographic structure, people's needs for a living environment, quality of life, and social security are constantly changing. For local farmers, with the acceleration of urbanization in Dongguan, most local farmers have, in tandem, bid farewell to the millennia-old agricultural lifestyle, as they

transition from tilling the land. Traditional notions such as 'land recovery' and 'land pension' have gradually faded. Gleichzeitig, there are many 'only child' and 'dual only child' families as a result of family planning, and due to this peculiar family structure, the era of 'raising children as a safeguard for old age' in the past has gone. As living standards continue to increase, some people in their prime years are strategically planning a comfortable and stable elderly life, marking the end of an era where the concept of 'raising children for old age' is no longer applicable. This change in mindset provides a solid foundation for Dongguan to advance in the realm of institutional care for the elderly.

2.1.2. Challenges and Dilemmas

A. The overall supply, consumption, and operation mechanism of elderly care is imperfect

In Dongguan City, there are currently prominent issues such as the insufficient supply of elderly care services, low willingness to receive such services, and the need to improve the operational environment. Furthermore, not all streets have a community elderly care service institution with comprehensive functions. There is little coverage of community daycare institutions. Furthermore, specifications related to service, management, and technical issues and relevant construction and operation policies are inappropriate. The supply of elderly products and their consumption is not strong. Supporting the consumption and guaranteeing elderly care services are inadequate. Furthermore, the consumption and payment abilities of the elderly are low and the advantages of the commercial insurance, welfare and assistance associated with the long-term care security system cannot be leveraged.

B. Elderly care facilities have complex business models

This topic through a geographic big data analysis of the distribution of Dongguan City's elderly care facilities found that there are outstanding problems such as insufficient supply supply, incomplete pension service consumption policy, and the need to improve the operating environment of Dongguan City. At present, not all streets have a community pension service agency with comprehensive functions; the coverage rate of community day care institutions is not high; related services, management, technology, and other specifications, as well as incomplete construction and operation policies. Additionally, the supply of elderly supplies is insufficient, the consumption capacity of the elderly is poor, and the support for the consumption support for the elderly care services is not perfect. The consumption payment capacity of the elderly is low, and the long-term care guarantee system advantages of commercial insurance, benefits, and assistance have not been able to give play to the advantages of the connection between commercial insurance, benefits, and assistance.

C. Uneven spatial distribution of elderly care facilities

The distribution between pension institutions is uneven (Table 1), and the elderly care facilities in Dongguan City are concentrated in the central urban area of Dongguan.

D. Homogeneity and Uneven Distribution of Elderly Care Facilities

Table 1 data suggests that Dongguan City's existing elderly care infrastructure exhibits a certain uniformity and unevenness in its distribution. The primary categories of elderly care establishments encompass welfare institutions, nursing facilities, corporate-run nursing homes, specialized care homes, and hospital-affiliated nursing centers. A deeper examination uncovers

notable imbalances in the distribution of the overall elderly care facilities in Dongguan City, with nursing homes and privately owned nursing services holding a larger share, indicating a market-driven dominance.

Nevertheless, the city faces a shortage in the quantity of other elderly care services, including residential care homes, senior service centers, social welfare institutes, standalone welfare facilities, in-hospital nursing units, specialized care homes, and hospitals offering integrated medical services. This deficiency underscores that Dongguan City has significant potential for growth and a need to address the demand for a more varied and all-encompassing elderly care service network. Consequently, there is a pressing requirement for strategic planning and a well-thought-out distribution of elderly care facilities to cater to the evolving needs of the senior demographic and to ensure an equitable distribution and effective use of social security resources.

Table 1. Current Status of Elderly Care Facilities in Dongguan City (2021).

Category of Elderly Care Facilities	Nursing Homes	Private Care Companies	Elderly Care Homes	Elderly Centers	Social Welfare Centers	Welfare Homes	Hospital Nursing Centers	Nursing Homes	Hospitals
Number of Facilities	28	10	3	1	1	1	1	1	1

2.2. Demographic Changes in Dongguan City

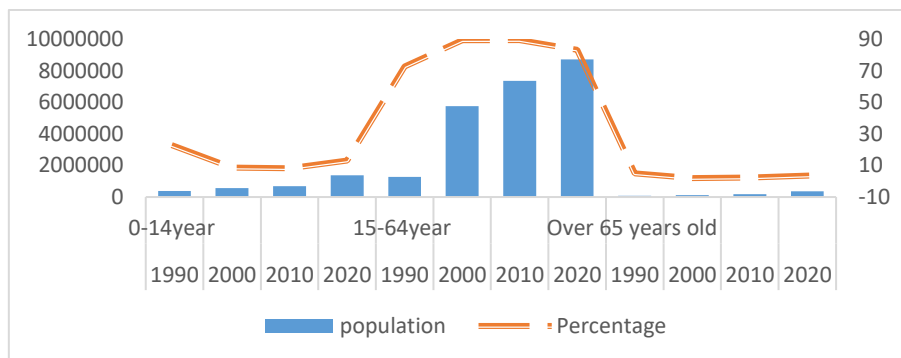


Figure 2. Dongguan Census Permanent Population and Population Structure Change Map.

The previous section mainly and briefly analyzed the population distribution of Dongguan City and summarized that the population of Dongguan City is growing; however, the population growth rate fluctuates, which is consistent with the social situation of the serious aging population of China. Therefore, in this section, we analyze the data from four censuses in Dongguan City. From the perspective of the population structure, the data were analyzed to provide a reference for the implementation of the pension policy in Dongguan.

Figure 2 shows that the number of people aged 0–14 years shows an increasing trend, with the largest increase between 2010 and 2020. From a proportional perspective, this age group shows the trend of 'first declining and then rising', trend, which is in line with the recent policy of

encouraging fertility in China. The number of people aged 15 to 64 years increased in number; however, their proportion fluctuated and began to decline in 2010. The number and proportion of people over 65 years of age are increasing, indicating that the proportion of the aging population of China is increasing; therefore, studying the aging of the population is imperative.

2.3. Data Sources

In this research, the Point of Interest (POI) data were sourced from the addresses of Guangzhou's retirement homes, as disclosed by the Dongguan Municipal Government. These addresses were transformed into coordinate form, creating spatial data that captured information on Dongguan's retirement facilities for the year 2023. The map data utilized in this study were procured from the National Basic Geographic Information Center. The resulting administrative district map, which is officially sanctioned, offers a comprehensive view of Dongguan's streets. Presently, Dongguan comprises 4 streets and 28 towns.

3 Research method

Our study employs both kernel density and hotspot analysis techniques to assess the spatial distribution and clustering tendencies of elderly care facilities in Dongguan City. Building upon these analyses, we further conducted accessibility and correlation analyses for a thorough spatial evaluation of these facilities. The process began with the acquisition of Point of Interest (POI) data for Dongguan's elderly care facilities, which was then subjected to kernel density analysis. This analysis helped us to establish the overall density of these institutions' spatial distribution and pinpoint areas with high kernel density values. We confirmed that the administrative division map was detailed down to the street block level, and hotspots were identified using the Getis-Ord G_i^* tool within ArcGIS. To conclude, we utilized the Origin-Destination (OD) cost matrix to compute the average accessibility between the POI and residential zones, which allowed us to categorize the accessibility levels of each street in Dongguan into distinct grades.

3.1. Kernel density analysis

The following kernel functions were used in kernel density analysis:

$$D = \frac{3(1 - scale^2)^2}{\pi r^2} \quad (1)$$

Kernel density estimation is a method used in probability theory to estimate density functions, which is a nonparametric test method [7, 8]. In equation (1), 'r' is the radius of search, and scale refers to the ratio of the distance from the center point of the grid to the point and line object to the radius of search.

3.2. Application of Getis-Ord G_i^* Hotspot Analysis

The Getis-Ord G_i^* G method, commonly referred to as hotspot analysis, is utilized to identify the spatial clustering patterns of particular features within a geographic area [9]. This G_i^* statistical approach enables the mapping of both coldspots and hotspots, which are regions exhibiting significant spatial autocorrelation. The analysis yields Z and P values, where a smaller Z value corresponds to a larger P value. Conversely, a higher degree of spatial clustering

is indicated by a lower degree of agglomeration [10]. In the context of the analysis, areas with high values are designated as hotspots, while those with low values are known as coldspots. The G-value, which is a measure of spatial clustering, is calculated using the following formula:

$$G(d) = \frac{\sum \sum w_{ij}(d) x_i x_j}{\sum \sum x_i x_j} \quad (2)$$

where $w_{ij}(d)$ is the spatial weight defined according to the distance rule, and x_i and x_j represent observations at the i th and j th spatial locations, respectively.

The statistical test for General G was performed using the following formula:

$$Z = \frac{G - E(G)}{\sqrt{Var(G)}} \quad (3)$$

3.3. Reachability analysis

The spatial accessibility of public service facilities, such as Elderly care Institutions, is a crucial foundation for achieving the equalization of public services. The implementation steps involve vectorizing the original traffic map, assigning road grade and related processing, considering the long-term care institution as the target source point, using ArcGIS 10.5 to establish a network dataset, calculating the average accessibility between points of interest and settlements with the OD cost matrix, and generating the comprehensive accessibility level of each street in the area. The specific formula is as follows.

$$C_i = \sum_{j=1}^n T_{ij} / n \quad (4)$$

where A_i is the reachability of node i , i and j are the points in the area, n is the number of nodes, and T_{ij} is the shortest travel time from point i to point j .

4 Spatial Characteristics Analysis of elderly care facilities

4.1. Spatial Distribution Patterns of elderly care facilities

Employing the kernel density analysis tool within ArcMap 10.5, we conducted an in-depth examination of the spatial distribution of nursing homes to gain insights into the layout characteristics of elderly care facilities in Dongguan City (refer to Figures 1 and 3).

The spatial distribution of Dongguan City's elderly care facilities exhibits a dual-centric clustering pattern (as depicted in Figure 3). The primary agglomeration area is the central area where Wanjiang Street and Wancheng Street are located. Another agglomeration area gradually extends outward at the junction of Hengli and Changping. In addition to these two main agglomeration areas, an additional distribution of pension institutions is found in Shijie Town, Shilong Town, and Chashan Town in the north, Houjie Town in the southwest region, Tangxia Town in the southeast region, and Huangjiang Town in the southeast.

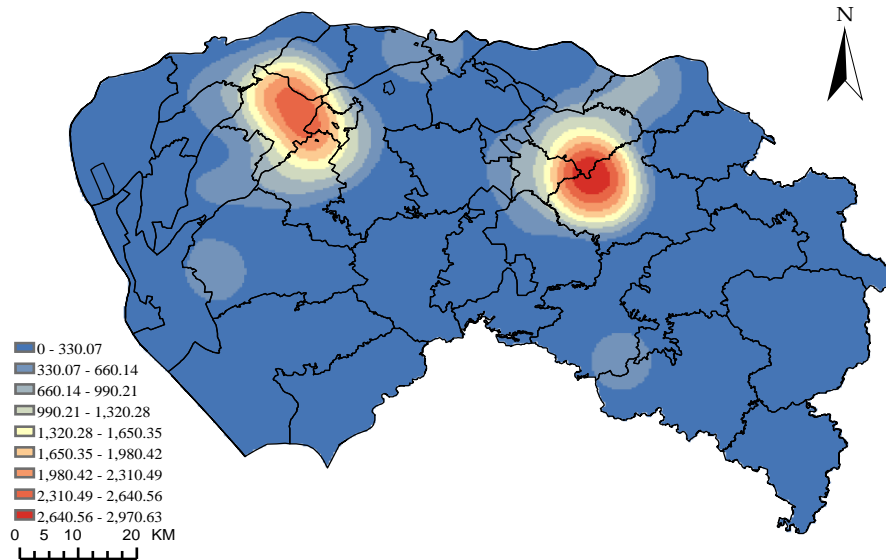


Figure 3. Kernel Density Analysis of elderly care facilities in Dongguan.

As shown in Figure 3, the kernel density values of the elderly care facilities in Dongguan City exemplify the characteristics of a two-center agglomeration distribution. The central area where Wanjiang Street and Guancheng Street are located is the aggregation area with the highest kernel density value. The central area of Wanjiang Street extends step by step. In addition to the two agglomeration areas mentioned above, the nuclear density values at the junction of Shijie Town, Shilong Town, and Chashan Town in the north exhibit a significant magnitude. The kernel density values at the intersection of Houjie in the southwest region, Tangxia in the southeast region, and Huangjiang Town surpass those observed in most of the regions.

The spatial arrangement of elderly care facilities in Dongguan City exhibits a dual-core concentration pattern. These establishments are densely packed, with their concentration tapering off as one moves from the city center to the outskirts. The kernel density, which serves as a central indicator, shows a steady decline towards the city's boundaries. Moreover, the kernel density of these care institutions indicates a pattern of dispersed point clustering. Notably, the kernel density at the intersections of different counties is observed to be higher compared to adjacent regions.

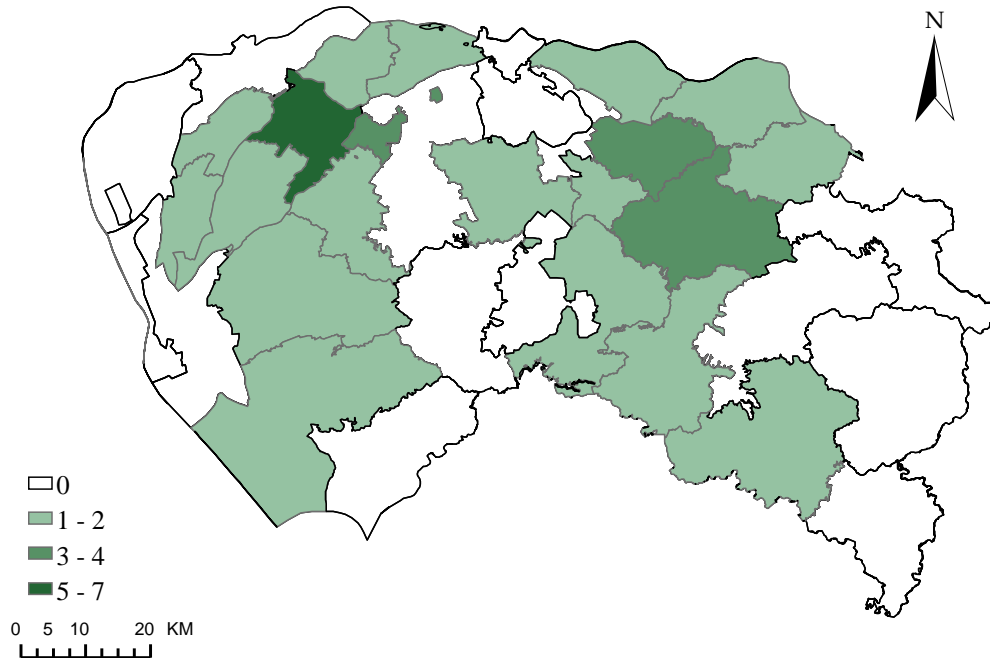


Figure 4. Distribution map of Elderly Care Facility numbers in Dongguan city.

From a sheer numerical perspective of elderly care facilities (see Figure 4), the overall distribution continues to exhibit a clustering tendency. The three areas of Wanjiang Street, Hengli Town, and Changping Town boast the highest count of elderly care facilities. These three areas, along with their surrounding regions, collectively constitute a high-value area for the number of elderly care facilities, delineating a pattern of extensive clustering in the distribution of long-term care facilities. Furthermore, as shown in Figure 3, 13 towns in Dongguan lack elderly care facilities, indicating potential problems in the planning of such facilities in the area.

4.2 Characteristics of Spatial Agglomeration in elderly care facilities

For this analysis, we meticulously integrated the administrative maps of Dongguan City with the distribution maps of key points of interest for the elderly care facilities. Utilizing the spatial connectivity capabilities of ArcMap 10.5, we accurately counted the number of elderly care facilities across different streets and urban blocks. With this information, we employed the Getis-Ord G_i^* hotspot analysis tool to generate a comprehensive map that highlights the concentration of elderly care service institutions in Dongguan City (refer to Figure 5).

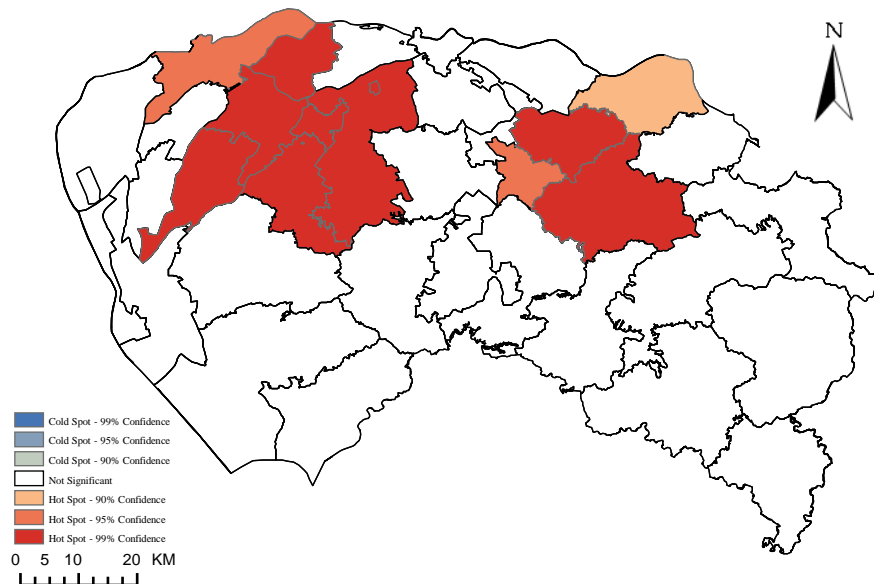


Figure 5. presents the Hot Spot Map of Elderly Care Facilities in Dongguan City.

The analysis depicted in this map uncovers the presence of two major cluster hubs within the city, predominantly situated in the central urban streets and the vicinities of Hengli and Changping. The findings align with the kernel density analysis, indicating a complete correspondence between regions of peak kernel density and the identified hot spot zones. This indicates that not only do these areas have a large number of elderly care facilities, but the surrounding areas also have a similarly dense distribution of such facilities. It is evident that elderly care facilities in Dongguan City exhibit distinct spatial clustering characteristics, and it is noteworthy that no cold spot phenomena are observed in the distribution of medical institutions throughout the city.

Further analysis of the spatial autocorrelation report in Figure 6 reveals that the Moran I index is 0.348135, which is significantly higher than the expected value, strongly indicating that the distribution of elderly care facilities in Dongguan City exhibits strong spatial autocorrelation. Interpreting of the Z-value and the P-value confirms that the distribution of elderly care facilities in Dongguan City generally shows a significant clustering pattern rather than a scattered or random distribution. With a P-value less than 0.05 and a Z-value reaching 4.29, it further substantiates the clustering characteristics and the highly significant effect of the distribution of elderly care facilities in Dongguan City, reflecting to some extent the uneven geographical distribution of long-term care service resources in the city.

In summary, the areas with the highest kernel density of elderly care facilities in Dongguan City's central urban area correspond to the recognized hot-spot regions. When evaluating the total number of healthcare establishments, a significant number of these elder care institutions exhibit a similar pattern of spatial clustering. Consequently, it is clear that the overall distribution of elderly care facilities in Dongguan City follows a distinct clustering pattern, which is of significant importance.

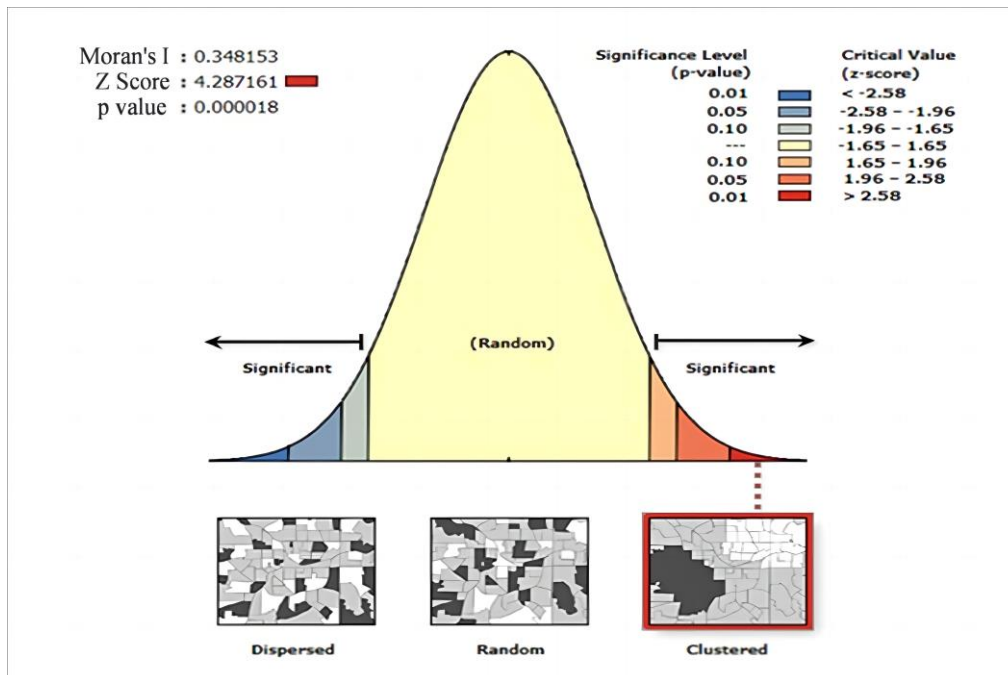


Figure 6. Spatial autocorrelation report.

5 Accessibility evaluation of elderly care facilities

5.1. Accessibility Analysis of elderly care facilities

In addressing the growing demand for convenient elderly care, the accessibility of elderly care facilities has become a key consideration. It is essential to ensure that these facilities are at a high level to effectively reduce the transportation barriers for the public to access services. To explore this problem, we conducted a systematic evaluation of the accessibility of elderly care facilities on various streets of Dongguan City, and the evaluation results were divided into six levels. We use advanced Arc GIS 10.5 technology for visual presentation (Figure 7).

The data presented in Figure 7 indicates substantial variations in the citywide accessibility of these centers, which manifest as a pronounced linear distribution pattern. Overall, the accessibility of senior care facilities in Dongguan City is considered to be quite satisfactory. However, it is crucial to acknowledge the variances that exist among different regions within the city. Notably, the most accessible regions are predominantly situated in the western area of Machong Town, offering travel times between 0.02 and 13.18 minutes, reflecting a high level of transportation convenience. Subsequently, the next level of accessibility is observed in regions that stretch broadly along the north-south axis of Wanjiang Street, Guancheng Street, and Chashan Town. In tandem with the kernel density analysis, it is evident that areas with elevated kernel density values, such as those found in Wanjiang Street, Guancheng Street, and Nancheng Street, are accurately positioned within the second-tier accessibility zones. This reveals that the concentrated distribution of elderly care facilities in these areas has good

connectivity to transport,, which is beneficial for public travel.

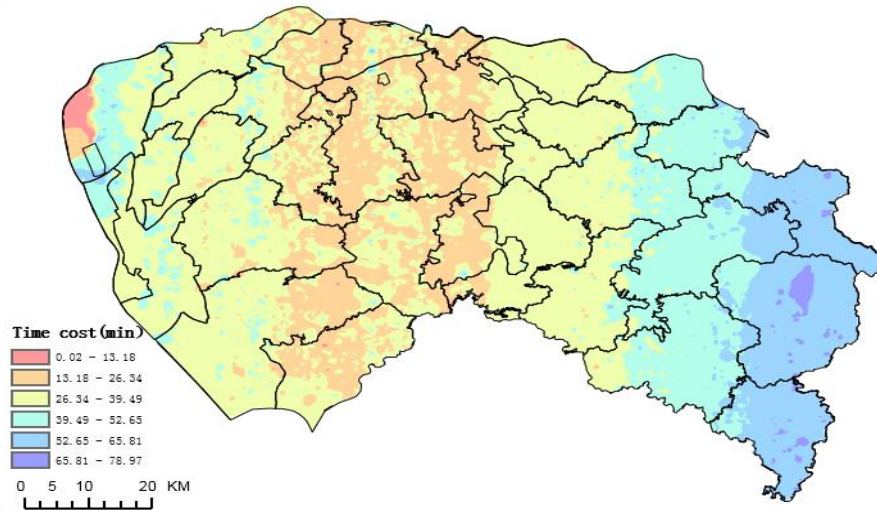


Figure 7. Assessment of Accessibility for Senior Care Facilities in Dongguan City.

Nevertheless, the eastern part of the city exhibits the least accessible transportation, akin to the regions with high accessibility, which also display a strip-like pattern extending from the south to the north. Concurrently, despite the intersection of Hengli and Changping cities having a high kernel density value, signifying a concentrated area for elderly care facilities, its transportation accessibility ranks only in the third to fourth tier. This indicates that, in contrast to the densely populated area of Wanjiang Street, this region's transportation convenience is comparatively lower, potentially impacting the efficiency of travel time and the overall experience for residents visiting elderly care facilities.

Furthermore, the differences in transportation accessibility between various streets largely reveal the serious imbalance in the distribution of various resources in Dongguan City, which is closely related to factors such as the economic level, population density, and policy orientation of each street. The main urban area, with its long-term accumulated economic and population advantages, still maintains the best accessibility performance in the city, once again demonstrating the importance of population movement and the layout of the residential area for accessibility. However, in the intersection area of Hengli and Changping towns, which is also densely populated with elderly care facilities, the uneven distribution of transportation resources leads to relatively lower accessibility values.

5.2. Correlation Analysis of elderly care facilities

In delving into the spatial distribution characteristics of elderly care facilities and their interrelationships with various related factors, we first focused on the impact of the proportion of the elderly population aged 60 and older on the layout of elderly care facilities in Dongguan City. From the correlation analysis of elderly care facilities in Dongguan City shown in Figure 8, we can observe that the city's elderly population ratio exhibits a distinct clustering effect across different areas, with significant differences between them. Specifically, the areas with the

highest proportion of elderly population are mainly concentrated in the northwest region, followed by the surrounding areas of the northwest and northeastern region.

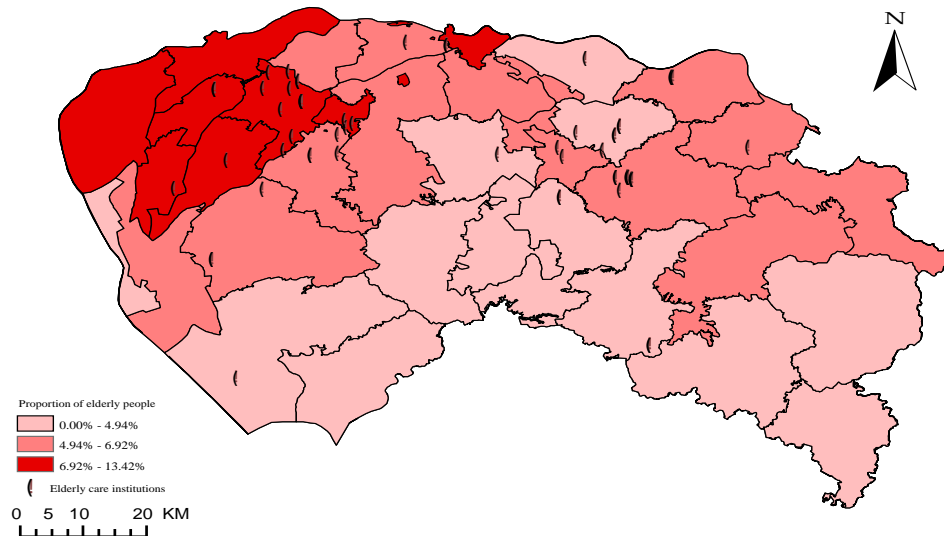


Figure 8. Correlation Analysis of elderly care facilities in Dongguan City.

Figure 8 reveals that the proportion of elderly people in Dongguan City shows a clustering characteristic in certain areas, with significant variations. However, in terms of the correlation between the distribution of elderly care facilities and the elderly population, Dongguan City exhibits asymmetric distribution characteristics. Although the areas with the densest elderly population are located in the northwest, the concentrated layout of elderly care facilities is located in central urban areas, specifically around Wanjiang Street and Guancheng Street. Combined with the accessibility analysis conducted earlier, it can be observed that these areas have relatively convenient transportation conditions, indicating that long-term care resources are to some extent dependent on a well-planned transportation network layout.

Further analysis shows that despite the fact that the Northeast region has a higher proportion of the elderly population, elderly care facilities are sparsely clustered at the junction of Hengli and Changping towns, where the level of accessibility to transportation is relatively low. This highlights the imbalance in the allocation of elderly care resources within Dongguan City: areas with a high proportion of elderly people do not have a corresponding number of elderly care facilities, especially in the eastern region, where the allocation of long-term care resources is particularly scarce. In other areas with a lower proportion of the elderly population, elderly care facilities are scattered in a point-like layout, also reflecting an imbalance in resource allocation.

In summary, there is a clear imbalance between the configuration of the elderly care facilities and the distribution of the elderly population in Dongguan City. This manifests itself as an insufficient number of elderly care facilities in areas with a dense elderly population and an overconcentration of these facilities in central urban areas such as Wanjiang Street and Guancheng Street. Additionally, there is an urgent need to increase the planning and construction of elderly care facilities in the eastern region, where the elderly population is concentrated. By

considering the aforementioned transportation accessibility, we recognize that the over-concentration of elderly care facilities can impact the convenience of residents' travel, which is not conducive to the elderly's rapid and efficient access to long-term care service institutions.

Therefore, in addressing the current issue of the uneven distribution of elderly care resources in Dongguan City, it is recommended to plan and increase the establishment of elderly care facilities in areas with a dense elderly population, ensuring that the quantity and coverage of long-term care services meet actual demands. At the same time, the layout of the transportation network should be reasonably optimized to enhance accessibility for residents, especially the elderly, thereby promoting a more rational and efficient allocation of elderly care resources in Dongguan City.

6 Conclusions

The spatial distribution of elderly care facilities in Dongguan City, China, is characterized by significant clustering and unevenness in different areas. The study used advanced analytical methods such as kernel density analysis, spatial autocorrelation, hotspot analysis, and accessibility analysis using 2021 data on the facilities of the elderly care facilities in the city.

Key findings include:

(1) In Dongguan, elderly care facilities exhibit a pattern of aggregation, significantly influenced by elements such as transportation infrastructure, demographic distribution, and commercial zones. They are often found along residential zones, key transportation arteries, and commercial epicenters.

(2) The concentration of elderly care facilities' hotspots is observed around the central streets and in the cities of Hengli and Changping, which is suggestive of a link to economic growth and policy impacts. The absence of cold spots points to a general unevenness in their distribution across the city.

(3) The accessibility of these facilities at the street level corresponds to the kernel density distribution of elderly care facilities. Despite the dense concentration in the Wanjiang Street area, there is a noted lack of accessibility at the intersection of Hengli and Changping towns, highlighting disparities in resources that are associated with the economic status, population density, and policy focus of each street.

(4) There exists a discrepancy between the distribution of elderly care facilities and the demographic distribution of the elderly population. Regions with a higher elderly population have a lower density of facilities, while they are more densely clustered in central areas near Wanjiang and Guancheng streets. Conversely, the eastern and southern parts of the city, despite a substantial elderly population, exhibit a lack of facilities or a dispersed distribution.

Based on the research findings and the current challenges facing elderly care, this study proposes the following recommendations.

(1) Align the Location of Senior Care Facilities with the Demographics of the Elderly:

To address the existing disparity between the availability of long-term care resources and the distribution of the elderly in Dongguan City, it is advised that upcoming planning efforts take

into account the genuine requirements of the senior demographic. This will help ensure that the development of elderly care facilities is better matched with the locations where older adults reside.

(2) Develop Elderly Care Centers in Accessibility-Enhanced Locations:

Considering the existing pattern of dual-centric clustering of elderly care facilities, there is a proposal to modify the current layout strategy. This involves establishing comprehensive long-term care hubs in areas that offer easy transportation access and extensive coverage. This approach would support the balanced growth across multiple key areas and mitigate the scarcity of resources in areas that are distant or difficult to reach.

(3) Establish a long-term care insurance system and advance the legalization process:

To address the prevalent issue of elderly individuals with disabilities or limited mobility in China, it is imperative to implement a robust long-term care insurance mechanism and enhance the associated legal infrastructure. The goal is to safeguard the well-being and dignity of the elderly with disabilities, ease the caregiving burden on families, and optimize the allocation of social welfare resources.

(4) Utilize idle public assets to build elderly care service facilities:

The government should thoroughly review idle public buildings and land resources and encourage private institutions to transform them into elderly care facilities through preferential policies. At the same time, formulate relevant policies to attract private capital from places like Guangdong, Hong Kong, Macao and Taiwan to invest in the construction of elderly care facilities in our city, further improving and popularizing elderly care service facilities.

(5) Promote the "time bank" mutual aid elderly care model:

Drawing on the experience of countries like Switzerland, advocates for party members to take the lead in participating in the "time bank," allowing healthy elderly people to provide services for those in need, accumulating exchangeable time savings, and thus building a social support system for mutual aid elderly care.

(6) Create interactive intergenerational learning centers for the elderly and young:

Referring to the successful case of Seattle, USA, try to establish intergenerational learning centers combined with nursing homes and kindergartens in our city to enhance communication and understanding between people of different ages and alleviate the loneliness of the elderly.

(7) Improve and innovate the "Internet + shared elderly care" model:

Leveraging the benefits of home-based elderly care in conjunction with internet technologies, develop a hybrid online-offline service system tailored to contemporary requirements. This system will facilitate easy access for seniors to a wide array of daily services, social activities, and healthcare resources.

In summary, this paper has conducted a preliminary exploration of the spatial distribution and accessibility of elderly care facilities in Dongguan City, but more in-depth research is still needed. This includes a detailed analysis of different types of elderly care facilities, introducing a temporal dimension to compare historical changes, and continuing to deepen research in this field with sufficient funding support.

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