International Journal of Geo-Information

MDPI

Article

Spatial Distribution of Pension Institutions in Shanghai Based on the Perspective of Wisdom Grade

Qiaoxing Li [1,2] and Qinrui Tian [1,*]

[1] School of Management, Guizhou University, Guiyang 550025, China; qxli@gzu.edu.cn
[2] Research Center of Development Strategy in Karst Region, Guizhou University, Guiyang 550025, China
* Correspondence: gs.qrtian21@gzu.edu.cn; Tel.: +86-130-1115-3923

Abstract: The academic research on the spatial distribution of pension institutions is mostly from the perspective of constructing or improving spatial analysis methods. It is not considered that with the development of social science and technology, the facilities and services of elderly care institutions will develop in the direction of intelligence. Exploring the intelligence level and spatial distribution of Shanghai's elderly care institutions has important practical significance for improving and optimizing the service facilities and resource allocation of Shanghai's pension institutions. The spatial scale and cluster distribution of pension institutions in Shanghai are described by means of standard deviation ellipse, kernel density analysis, spatial autocorrelation analysis, and spatial hotspot analysis. The Gini coefficient of intelligent bed is proposed to describe the comprehensive allocation of resources of pension institutions. Additionally, correlation analysis is used to explore the spatial fairness distribution of pension institutions in Shanghai. The results show that the development of pension institutions in various districts of Shanghai is uneven; the distribution of pension institutions is concentrated in the central urban area; the intelligent facilities, service resources, and the number of beds of pension institutions in the suburbs are better than those in the central urban area. Based on the analysis results, policy suggestions are put forward, such as optimizing the allocation of bed resources in pension institutions and focusing on building a more equitable and rationally structured smart pension institution.

Keywords: pension institutions; intelligent pension; fairness distribution; gini coefficient; ArcGIS

Citation: Li, Q.; Tian, Q. Spatial Distribution of Pension Institutions in Shanghai Based on the Perspective of Wisdom Grade. *ISPRS Int. J. Geo-Inf.* **2023**, *12*, 265. https://doi.org/10.3390/ijgi12070265

Academic Editors: Wolfgang Kainz and Godwin Yeboah

Received: 10 April 2023
Revised: 9 June 2023
Accepted: 15 June 2023
Published: 3 July 2023

1. Introduction

China's population aging has become an important trend of social development. According to the China Statistical Yearbook 2022, China has the largest elderly population in the world. The population of people aged 65 and over is 200 million, accounting for 14.2% of the total population. Additionally, the Fifth Plenary session of the 19th CPC Central Committee proposed to "implement the national strategy to actively deal with the aging of the population". Shanghai is the first city in the country to enter the aging society, the scale of its elderly population has continued to expand in recent years, and the proportion of the elderly population in the total population is also increasing year by year. The 14th five-year Plan for the Development of the Cause of the Elderly in Shanghai puts forward that "we should actively comply with the trend of intellectualization and acceleration of innovation for the cause of the elderly and speed up the reshaping of the service system for the elderly and the development and reform of the industry for the elderly". Pension institutions are the key elements of the development of pension undertakings and the pension industry, while the intelligent pension model expands and promotes the service model of traditional pension institutions. Therefore, the research on the spatial distribution of pension institutions from the perspective of wisdom level is of great practical significance to promote the improvement and optimization of service facilities and resource allocation of pension institutions in Shanghai.

The academic research on the spatial distribution of pension institutions is mostly from the perspective of constructing or perfecting spatial analysis methods. There are only two ways to divide the types of pension institutions: one is divided into private and public from the point of view of the nature of management, and the other is divided into self-care, nursing, and nursing from the perspective of the combination of medical care and maintenance. However, it does not take into account that with the development of social science technology, the facilities and services of pension institutions will develop in the direction of intelligence. As the relevant research on intelligent pension institutions at home and abroad is still in the exploratory stage, the intelligence level of pension institutions still lacks a unified definition standard. We divide the pension institutions according to the degree of wisdom and analyze their scale distribution, spatial agglomeration distribution, and spatial inequality, in order to provide a reference for the follow-up research on the intelligence level and spatial distribution of pension institutions.

The paper is organized as follows. In Section 2, we describe the spatial distribution and intelligence level of elderly care institutions and determine the spatial distribution method. In Section 3, we first introduce the overview of the study area (Shanghai), then classify pension institutions in Shanghai according to their level of intelligence, and finally, introduce the spatial analysis method used in this paper. In Section 4, we analyzed the spatial distribution of various pension institutions and obtained the research results. At last, we summarized and put forward the results and suggestions and then pointed out the future works.

2. Literature Review

2.1. Spatial Distribution of Pension Institutions

The research direction of the spatial distribution of pension institutions mainly includes four aspects: spatial allocation optimization, spatial accessibility distribution, medical facilities distribution, and spatial equity distribution. First, from the perspective of spatial configuration optimization, Zhou et al. conducted an empirical study on the evolution characteristics and degree of mismatch of the geographical pattern of health resources in China based on the competition state model and spatial mismatch index [1]. Yang et al. analyzed the basic personal situation, illness, and health service needs of the elderly in pension institutions based on a questionnaire survey and put forward suggestions for optimizing the allocation of pension institutions [2]. Jiang and Li put forward the optimization scheme of the spatial design of the medical system of pension institutions based on the operation mode of "intelligent community" [3]. Zhao et al. analyzed the current situation of population aging and pension institutions in Chongqing and used the Leslie model to predict and analyze the population growth and population structure changes in Chongqing in the next 10 years. Second, based on the perspective of spatial accessibility distribution, relevant scholars mainly use different spatial analysis methods to calculate the spatial accessibility of pension institutions and put forward corresponding suggestions [4]. Huang et al. used an improved Gaussian 2-step floating catchment area search method [5]. Yin and Liu adopted the average nearest neighbor index, kernel density analysis, mean ratio, and improved two-step mobile search method [6]. Yang et al. used ArcGIS and SPSS software to analyze the spatial characteristics and influencing factors of elderly care service institutions in Shijiazhuang [7]. Wang et al. used the nearest neighbor index method and kernel density estimation method to analyze the spatial distribution characteristics of elderly care institutions and used the improved potential model to analyze the accessibility and influencing factors of elderly care institutions within a single service radius and the two-step floating catchment area method. Third, based on the perspective of medical facility distribution [8]. Han et al. used maximum likelihood estimation to measure the fairness of health resource allocation in the target area of the grid [9]. Ji and Zhang used standard deviation ellipse, kernel density estimation, and spatial hot spot analysis to analyze the spatial distribution of medical and nursing care resources in Beijing [10]. Qin and Zhou constructed four typical allocation modes of medical space of pension institutions

according to the influencing factors of medical space allocation. Finally, based on the spatial fairness distribution perspective [11]. Yu et al. evaluated the distribution of primary medical facilities within the built-up area of Lhasa city by GIS spatial network analysis method and used the location-distribution model to optimize its allocation [12]. Wang et al. used the Gini coefficient, Lorentz curve, and LISA method to identify the areas of significant imbalance between supply and demand with high demand but low allocation problems [13]. Cai et al. predicted the changing trend of equity in the allocation of medical and health resources in Shanghai based on the perspective of population equity and geographical equity and used Mann–Kendall nonparametric test [14]. Hu et al. introduced the potential model of the comprehensive service capacity factor and used the Lorentz curve and coverage to measure the layout balance of institutional pension facilities in the central urban area of Changchun [15]. Ding et al. used Gini the coefficient, location entropy, and Theil index to measure the allocation of unfair resources and regions based on the data of pension institutions [16]. Kang et al. used the government and social capital cooperation (PPP) model to analyze the influencing factors and mechanisms of the fairness of pension service supply [17]. Hu et al. assessed the equity and efficiency of the spatial distribution of basic public health service facilities in the metropolitan area of Nanjing [18]. Cheng et al. investigated the distribution of the three types of ecological capital in Tianjin through the analysis of the status quo, accessibility analysis, Lorenz curve and Gini coefficient analysis, and spatial autocorrelation analysis [19].

Based on the comprehensive analysis of the above studies, this paper decides to use three types of spatial analysis methods: spatial scale distribution, spatial clustering distribution, and spatial fairness distribution. Spatial scale distribution is mainly used to analyze the population density of the elderly and the distribution of various pension institutions. Spatial cluster distribution is mainly used to analyze the aggregation, concentration, dispersion, or directional trends of various pension institutions and calculate the density of pension institutions. Spatial fairness distribution is mainly used to analyze the fairness and uniformity of the spatial distribution of elderly care institutions and the resource allocation of pension institutions in various districts in Shanghai.

2.2. Intelligent Pension Institutions

The UK Life Trust first proposed the concept of smart pension [20], then academic circles continued to discuss smart pension, but scholars in different periods still have different understandings of the connotation of smart pension. Based on the Internet of Things, Zheng believes that smart elderly care is to make full use of technologies, such as cloud computing and mobile Internet, to achieve comprehensive and comprehensive elderly care services [21]. Sui and Peng proposed that the core concept of smart elderly care is to use the elderly as the center and use Internet information technology to meet the various service needs of the elderly with the rapid development of science and technology [22]. Pires et al. believes that smart elderly care is to let the elderly stay in a comfortable environment and use smart devices to realize remote monitoring and health services for the elderly at low cost [23]. Majumder et al. believes that the elderly home life is the basic starting point, and an efficient and intelligent integrated service mode is formed through the external sensor information system and the Internet data structure platform [24]. Since 2012, China has explored a new path for smart elderly care and has intensively introduced several policies, such as the "Action Plan for the Development of Smart Healthy Senior Care Industry (2021–2025)", and elaborated on the concept content, product types, and business models of smart healthy senior care. At present, the academic circle mainly discusses the evaluation system of smart elderly care from the perspectives of home-based elderly care [25], Pension Evaluation [26], and elderly care system [27], but has not yet involved the evaluation system of smart elderly care institutions. Therefore, this paper constructs the evaluation system of intelligent pension institutions and discusses the classification of wisdom levels of pension institutions and analyzes the spatial distribution of pension institutions in Shanghai from the perspective of wisdom level.

3. Materials and Methods

3.1. Study Area

Shanghai, located in East China, is the center of China's economy, culture, international finance, shipping trade, and scientific and technological innovation. Its geographical location is 120°52′–122°12′ E and 30°40′–31°53′ N. The overall topography of Shanghai is high in the middle, low in the periphery, and relatively flat (Figure 1). The city has jurisdiction over 16 districts, a total area of 6340 km^2, and built-up area of 1237.85 km^2. By the end of 2021, the resident population of Shanghai was 24 million, of which 5,815,462 were aged 60 and above, accounting for 23.4%. The central urban areas of Shanghai include Huangpu District (a), Xuhui District (b), Changning District (c), Jing'an District (d), Putuo District (e), Hongkou District (f), and Yangpu District (g). The suburbs include Minhang District (h), Baoshan District (i), Jiading District (j), Pudong New Area (k), Jinshan District (l), Songjiang District (m), Qingpu District (n), Fengxian District (o), and Chongming District (p).

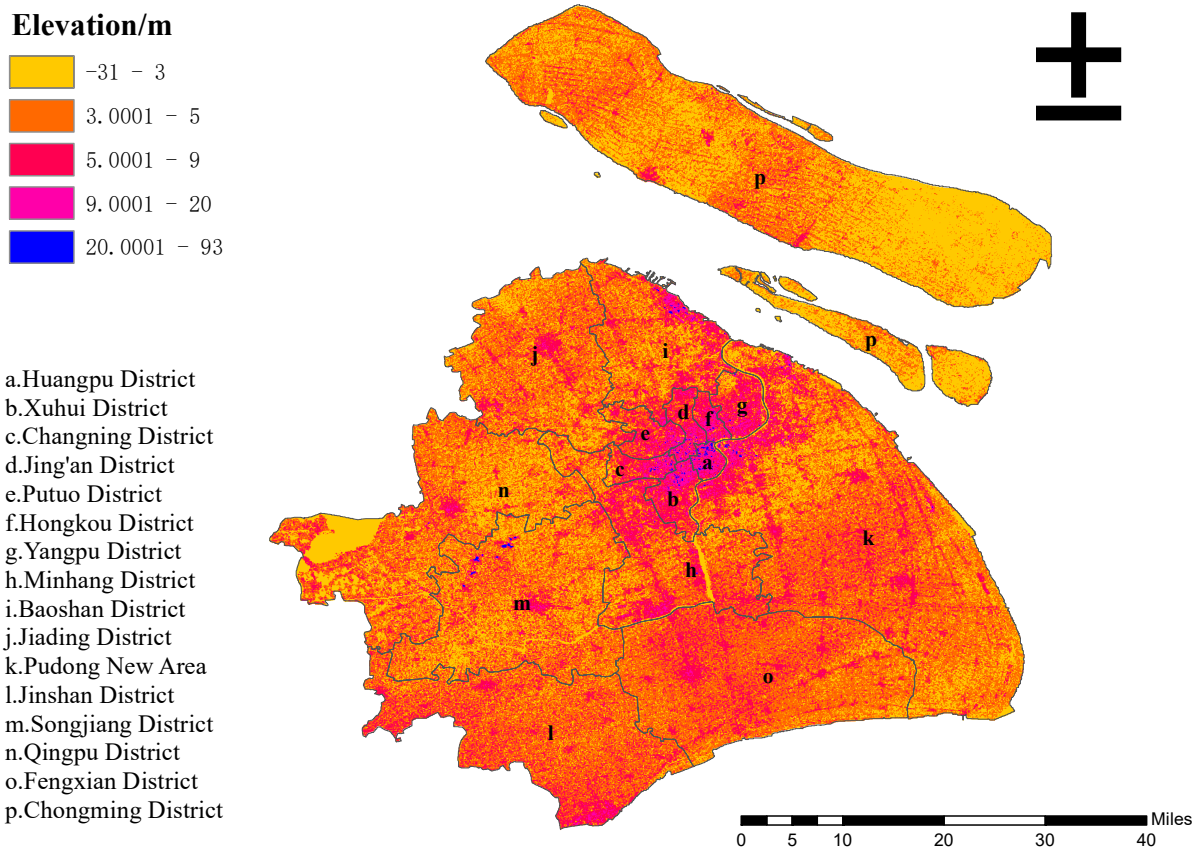

Figure 1. Study area.

3.2. Multi-Source Data Acquisition and Processing

3.2.1. Index Construction

This paper refers to the relevant literature [28,29] and policy documents of smart elderly care institutions, "Action Plan for the Development of Smart and Healthy Elderly Care Industry (2021–2025)" to evaluate the level of intelligence of elderly care institutions. There are a total of 11 secondary indexes in three aspects, including infrastructure, management, and service, as shown in Table 1.

Table 1. The evaluation system of the intelligence level of pension institutions.

Category	Variable	Description
Infrastructure (A_1)	Smart Devices (B_1)	Intelligent testing equipment, automatic washing and maintenance equipment, and other equipment installation.
	Network facilities (B_2)	Coverage of wireless networks, optical fiber, imaging equipment, and other facilities.
	Environmental facilities (B_3)	Installation of barrier-free facilities, intelligent temperature sensing equipment, fresh air system, etc.
	Emergency facilities (B_4)	Improvement of water/fuel/smoke leakage detection system, automatic alarm system, etc.
	Medical facilities (B_5)	Installation of physical examination all-in-one machine, guided inquiry machine, nursing equipment, and other facilities.
Management (A_2)	Intelligent Supervision (B_6)	Coverage of facilities, such as IP cameras and real-time positioning systems.
	Health data (B_7)	Establishment, update, and data visualization of health file information
	Human Resources (B_8)	Number of professional doctors and professional nursing staff.
Service (A_3)	Medical Services (B_9)	The advanced degree of medical services, such as telemedicine system and monitoring physiological indicators.
	Psychological Services (B_{10})	The arrangement of psychological services, such as online psychological counseling and education for the elderly.
	Life Services (B_{11})	Convenience of life styles, such as medical care, shopping, diet, entertainment, etc.

The infrastructure level mainly describes whether intelligent equipment, network facilities, environmental facilities, emergency facilities, and medical facilities can achieve the environmental security, medical convenience, and facility completeness required by smart pension institutions. The management level mainly describes whether intelligent regulation and health data are supported by big data and cloud computing and whether the ability of data analysis can meet the standards of practicality, authenticity, and integrity of smart pension institutions. The service level is divided into four aspects: human resources, medical services, psychological services, and life services, to measure the soft power of intelligent pension institutions. It mainly describes the distribution of institutional nursing and medical professional skill, and whether the advanced degree of medical services, such as telemedicine systems and monitoring physiological indicators, meets the intelligent positioning of pension institutions. Additionally, whether psychological services and life services for the elderly can build a bridge between the elderly and the information society to promote the elderly to adapt to the rapid development of science and technology in modern society and the skilled use of intelligent facilities.

3.2.2. Data Source

This paper inquires about pension institutions through the "Information of National Pension institution" published by the Ministry of Civil Affairs as of 31 December 2022. After removing the pension institutions with repeated records and an abnormal number of beds, a total of 825 pension institutions in Shanghai were obtained, such as area, name, address, and the number of beds. This paper is based on the data from relevant indicators, such as "yanglao.com (accessed on 3 January 2023)", "anyang100.com (accessed on 3 January 2023)", and the official websites of major pension institutions. Considering the availability and quantification of the data, this paper uses the LIKERT five-component table method to judge its value, namely, excellent, good, general, fair, and poor. If the pension institution is unable to score due to the lack of an index, the index will be treated with a score of 0. This paper finally obtains effective data from 710 pension institutions.

3.2.3. The Wisdom Grade Distribution of the Pension Institutions in Shanghai

Based on the artificial fuzzy recognition method, we identify the text introduction and picture information of pension institutions, extract useful information as data, and divide

the wisdom level by calculating the score of the intelligence level of pension institutions. The specific process is as follows:

Step 1: Data preprocessing. The evaluation index data x of the intelligence level of pension institutions is normalized. Where x_{ik} and x'_{ik} represent the values before and after normalization of the k index data of the i pension institution, respectively.

$$x'_{ik} = \frac{x_{ik} - \min(x_k)}{\max(x_k) - \min(x_k)}$$

Step 2: Calculate the wisdom coefficient. S_i represents the wisdom coefficient of the i pension institution, and competition represents the index weight of index k.

$$S_i = \sum_{i=1}^{n} \omega_k P_k * x'_{ik}$$

Step 3: Divide the level of wisdom. The intelligence level is divided according to the score range; that is, $S \geq 0.6$ is the wisdom pension institution, $0.4 \leq S < 0.6$ is the semi-wisdom pension institution, and $S < 0.4$ is the non-wisdom pension institution. Finally, the wisdom level distribution of 710 pension institutions in various districts and counties of Shanghai is shown in Table 2, in which the total number represents the number of pension institutions announced by the Ministry of Civil Affairs, and the number sample indicates the number of pension institutions that have collected data and information. The calculation results show that 10% of Shanghai's intelligent pension institutions, 36.9% of semi-intelligent pension institutions, and 53.1% of non-intelligent pension institutions account for 10%, 36.9%, and 53.1%, respectively, indicating that the level of intelligence of their pension institutions is low and there is much room for improvement.

Table 2. Intelligence level distribution of pension institutions in Shanghai.

District	Pension Institution		Types of Pension Institutions		
	Total	Sample (n, %)	Intelligent (n, %)	Semi-Intelligent (n, %)	Non-Intelligent (n, %)
a	28	23 (82.14)	1 (4.35)	6 (26.09)	16 (69.57)
b	56	48 (85.71)	7 (14.58)	16 (33.33)	25 (52.08)
c	40	36 (90.00)	5 (13.89)	9 (25.00)	22 (61.11)
d	37	32 (86.49)	5 (15.63)	11 (34.38)	16 (50.00)
e	58	46 (79.31)	4 (8.70)	15 (32.61)	27 (58.70)
f	47	41 (87.23)	4 (9.76)	16 (39.02)	21 (51.22)
g	74	59 (79.73)	4 (6.78)	15 (25.42)	40 (67.80)
h	71	59 (83.10)	4 (6.78)	24 (40.68)	31 (52.54)
i	56	49 (87.50)	8 (16.33)	18 (36.73)	23 (46.94)
j	34	31 (91.18)	2 (6.45)	13 (41.94)	16 (51.61)
k	151	128 (84.77)	8 (6.25)	59 (46.09)	61 (47.66)
l	34	30 (88.24)	2 (6.67)	8 (26.67)	20 (66.67)
m	36	33 (91.67)	5 (15.15)	11 (33.33)	17 (51.52)
n	25	22 (88.00)	6 (27.27)	7 (31.82)	9 (40.91)
o	35	32 (91.43)	3 (9.38)	15 (46.88)	14 (43.75)
p	43	41 (95.35)	3 (7.32)	19 (46.34)	19 (46.34)
Average	51.56	44.38 (86.06)	4.44 (10.00)	16.38 (36.90)	23.56 (53.10)

In parentheses is the proportion of various types of institutions. sample% = number of samples/total, and pension institutions% = number of various types/samples.

3.3. Research Methods

The pension institution can be abstracted as a location point in space. The distribution pattern analysis of its spatial location points can reveal the spatial process hidden under the representation of the spatial pattern. We mainly analyze the spatial point data of pension institutions based on ArcGIS10.8 software, and the methods include standard deviation ellipse, kernel density analysis, spatial correlation analysis, spatial hot spot analysis, and

spatial inequality analysis. The purpose of each method is different, and the combination of the above methods can achieve the desired results. The specific method is shown in Figure 2.

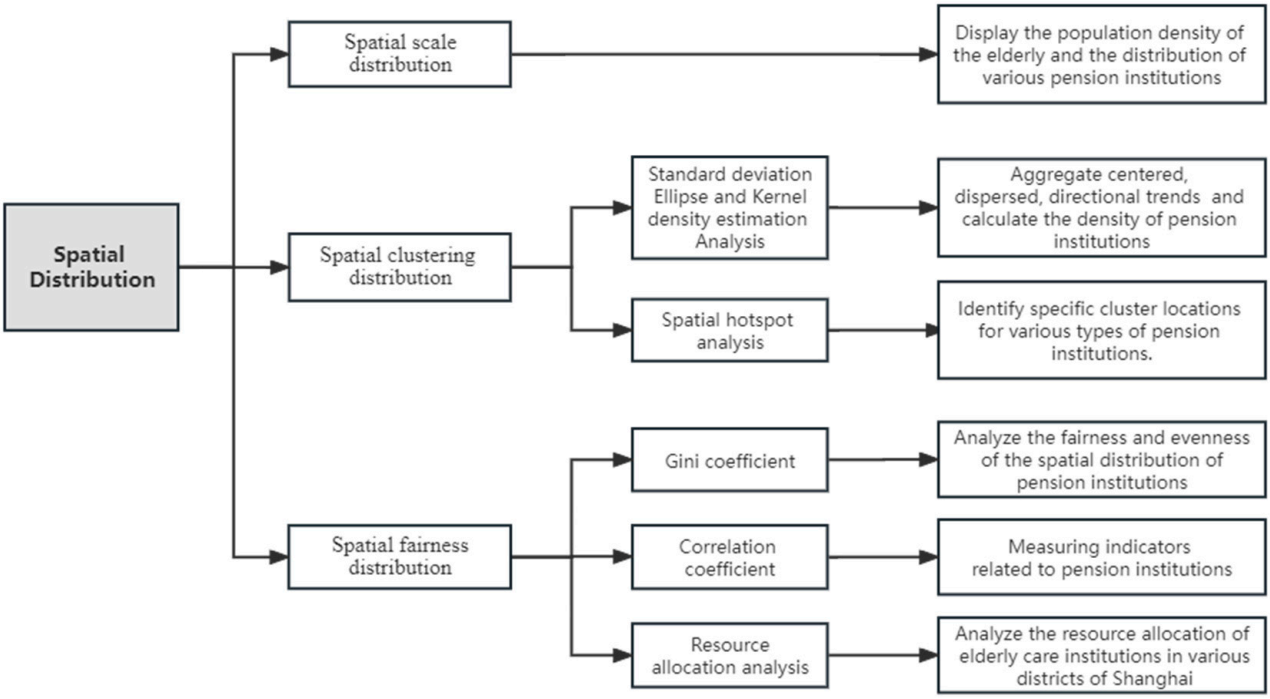

Figure 2. Flowchart of spatial analysis method.

3.3.1. Spatial Density Analysis

The standard deviation ellipse is a common method used to measure the trend of a group of points or regions. In this method, the axis of an ellipse containing all elements is defined by calculating the standard distance in the x and y directions, where the center of the ellipse represents the center position of the whole data. The long axis of the ellipse represents the distribution direction of the data, and the short axis represents the distribution range of the data, and the shorter the short axis means the more obvious centripetal force presented by the data, and the longer the short axis means the greater the degree of dispersion of the data. In other words, the larger the flatness, the more obvious the directivity of the data, while the closer the length and length of the semi-axis, the less obvious the directivity of the data [30].

Kernel density estimation is a statistical method to realize the transformation from a discrete object model to a continuous field model by calculating the density around elements to construct a smooth surface [31]. Kernel density estimation can realize the visualization of the spatial distribution of elements, and the higher the density, the more concentrated the spatial distribution of elements. In this paper, the natural breakpoint method is used to divide density values into five levels: low-density area, medium–low density area, medium density area, medium-high density area, and high-density area.

3.3.2. Spatial Cluster Analysis

Global Moran's tool measures spatial autocorrelation according to feature location and feature value [32]. Given a set of elements and related attributes, the tool evaluates the significance of the index by calculating Moran's I index value, z score, and p value and divides it into three categories: clustering pattern, a discrete pattern, and random pattern.

The Getis-Ord Gi* tool can calculate the z score and p value for each element in the data set to get the spatial clustering location of high-value or low-value elements [33]. Gi* > 0 showed that the study area showed a high-value aggregation area, that is a, "hot

spot", and Gi* < 0 showed that the study area showed low-value cluster area, that is a, "cold spot". In this paper, the z score is used to infer the results of Gi*. If the difference is not statistically significant, it is considered that the observations are randomly distributed in the study area [34].

3.3.3. Spatial Inequality Analysis

In this paper, the pension institutions are taken as the analysis unit and the wisdom coefficient and the number of beds of pension institutions are taken as the core index. The Gini coefficient is used to analyze the fairness and evenness of the spatial distribution of pension institutions. In this paper, the Gini coefficient of smart beds in pension institutions is defined as the comprehensive allocation of smart infrastructure, smart management, smart service, and the number of beds. The Gini coefficient < 0.3 indicates the optimal resource allocation; 0.3–0.4 indicates that resources are properly configured; 0.4–0.5 indicates a large difference in resource allocation; 0.5–0.6 indicates resource allocation alert; Gini coefficient > 0.6 indicates the risk of resource allocation [35]. G_1 represents the intelligent Gini coefficient of pension institutions; G_2 indicates the Gini coefficient of beds in nursing institutions; G_3 represents the Gini coefficient of smart beds in elderly care institutions; Y_i represents the cumulative proportion of the number of the first i pension institution in the spatial analysis unit; S_i represents the wisdom coefficient of pension institutions; C_i is the number of beds in the nursing home. The calculation formula of the Gini coefficient of pension institutions is as follows:

$$G_1 = 1 - \sum_{i=1}^{n} (Y_i - Y_{i-1})(S_i - S_{i-1});$$

$$G_2 = 1 - \sum_{i=1}^{n} (Y_i - Y_{i-1})(C_i - C_{i-1});$$

$$G_3 = 1 - \sum_{i=1}^{n} (Y_i - Y_{i-1})(C_i * S_i - C_{i-1} * S_{i-1});$$

Pearson correlation coefficient is used to measure two variables between the M and N, with a value between -1 and 1. The positive and negative signs indicate positive correlation and negative correlation, and the value 0.8–1.0 indicates strong correlation; 0.6–0.8 indicates strong correlation; 0.4–0.6 indicates moderate correlation; 0.2–0.4 indicates weak correlation; 0–0.2 indicates very weak correlation or no correlation [36].The formula of Pearson correlation coefficient (ρ) is:

$$\rho_{MN} = \frac{cov(M, N)}{\sigma M \sigma N}$$

4. Results and Discussion

4.1. Spatial Scale Distribution

We have collected the area, elderly population, pension institutions and number of beds in various districts of Shanghai, as shown in Table 3 and Figure 3. From the perspective of Shanghai as a whole: the overall occupancy rate of elderly care institutions in Shanghai is 66.24%. There are 71 intelligent nursing institutions with a total of 5855 beds in the city. There are 262 semi-intelligent nursing institutions with a total of 15,211 beds. There are 377 non-intelligent elderly care institutions with a total of 17,623 beds. Intelligent pension institutions accounted for 10%, while semi-intelligent pension institutions accounted for 53.1%. The above results indicate that the overall intelligent level of pension institutions in Shanghai is low, and the development of intelligent pension institutions has a large room for improvement.

Table 3. Scale distribution of pension institutions in Shanghai.

District	Area	Elderly Population	Number of Institutions Adoptions	Number of Beds in Pension Institutions			
				Total	Intelligent	Semi-Intelligent	Non-Intelligent
a	20.52	32.62	1921	2362	412	997	953
b	54.93	33.44	4043	5752	853	2314	2585
c	37.18	22.38	4291	5213	682	1388	3143
d	37	36.25	3315	4221	1306	1816	1727
e	55.53	36.6	5241	5612	428	2789	2106
f	23.48	29.49	4903	6953	1224	2193	3536
g	61.61	40.95	7305	8248	961	3714	3573
Urban	289	231.73	31,019	38,361	5866	15,211	17,623
h	372.56	37.76	8860	12,698	1634	7036	4028
i	365.3	37.98	7242	11,409	3283	3933	4193
j	463.16	23.44	4995	9623	411	5036	4176
k	1210	102.48	15,326	20,953	2822	10,473	7658
l	586.05	17.78	3155	5513	1144	1422	2947
m	606.64	20.04	4961	9556	3354	2802	3400
n	668.54	16.49	2040	6685	2389	2203	2093
o	773.38	18.66	2956	6019	1198	3243	1578
p	1413	26.07	3893	6674	590	3150	2934
Suburban	6050	300.70	53,428	89,130	16,825	39,298	33,007
Shanghai	6339	532.43	84,447	127,491	22,691	54,509	50,630

The elderly population refers to the number of elderly people over 60 years old (including 60 years old), and the data are from Shanghai Statistical Yearbook 2021. The data on the number of adoptions in pension institutions came from the Statistical Yearbook of Shanghai Districts in 2021.The number of beds in pension institutions is the number of beds in sample pension institutions.

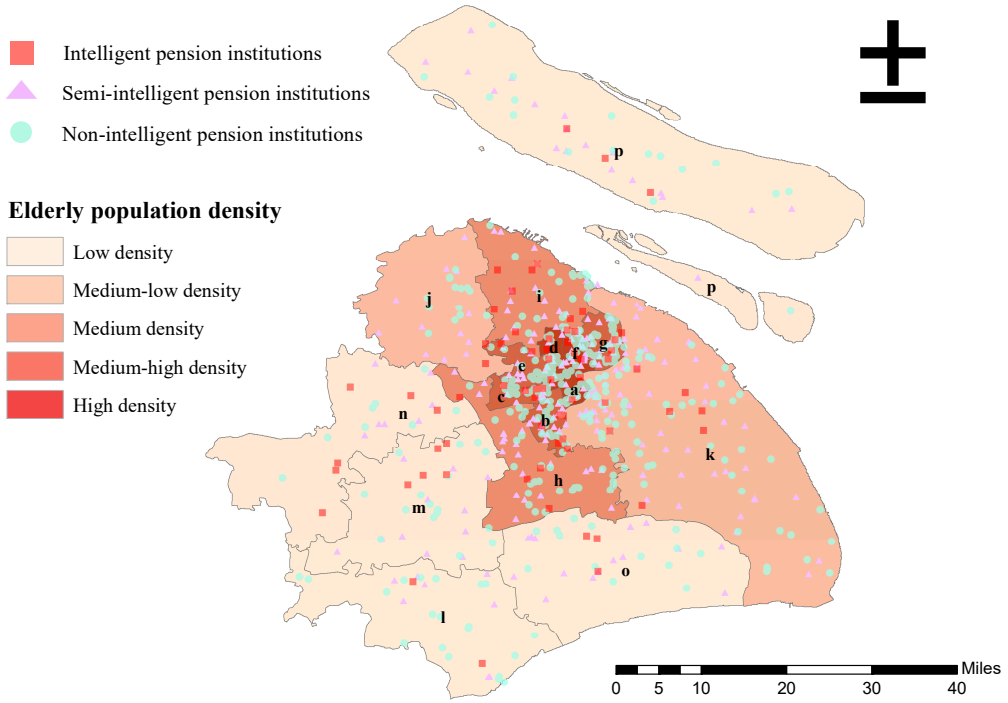

Figure 3. Overall distribution of pension institutions in Shanghai.

From the perspective of urban and suburban areas of Shanghai: (1) The central urban area is relatively small, accounting for only 4.56%, and the proportion of the elderly population is 35.29%, which belongs to the high-density area and medium–high-density area of the elderly population distribution; The distribution of nursing institutions in the central city is relatively dense, and the number of beds accounts for 30.09%, and the occupancy rate of nursing institutions is as high as 80.86%. (2) The area of the suburbs is large and accounts for 95.44%, while the elderly population accounts for 64.71%. The suburbs near the central urban area belong to the middle–low density area of the elderly population distribution, but the suburbs far away from the central urban area belong to the low-density area of the elderly population distribution, that is, the distribution of the elderly institutions in the suburbs is sparse. In the suburbs, the occupancy rate of nursing institutions was 59.94%, and the number of beds accounted for 69.91%, among which the number of beds of intelligent nursing institutions accounted for 74.15%, in semi-intelligent nursing institutions accounted for 72.09%, in non-intelligent nursing institutions accounted for 65.19%. The above data show that the main distribution area of the elderly in Shanghai is the small central urban area; The proportion of beds in the central urban area is smaller than that of the elderly population, indicating that the area cannot meet the needs of the elderly. The suburban area is large and sparsely populated, and the proportion of beds is slightly larger than that of the elderly population, which indicates that the suburban area can meet the needs of the elderly and help relieve the pressure of beds in the central city.

From the perspective of each region in Shanghai: (1) Pudong New Area has the largest area, the largest number of elderly populations, the largest number of beds, and the largest number of beds of semi-intelligent and non-intelligent pension institutions in Shanghai, which belongs to the middle-low density area of the elderly population. (2) Huangpu District is the region with the smallest area, the least number of elderly populations, the least number of beds, and the highest proportion of non-intelligent nursing institutions, which should belong to the high density of the elderly population. (3) Hongkou district is the area with the largest density of the elderly population. (4) Chongming District is the area with the lowest density of the elderly population. (5) Songjiang District is the area with the largest number of beds and low density of the elderly population. (6) The beds of intelligent nursing institutions and intelligent nursing institutions in Qingpu District are 27.27% and 35.74%, respectively, and the occupancy rate of nursing institutions is only 49.11%, which belongs to the low-density area of the elderly population. To sum up, Songjiang District and Qingpu District are the best areas for the intelligent development of pension institutions; The intelligence level of elderly care institutions in Huangpu District is poor; and Pudong New Area is the most potential area for the intelligent development of elderly care institutions.

4.2. Spatial Clustering Distribution

4.2.1. Standard Deviation Ellipse and Kernel Density Estimation Analysis

The standard deviation ellipse and kernel density of various pension institutions in Shanghai are estimated and analyzed by ArcGIS10.8 software. The results are shown in Figure 4. On the whole, the center and high-density area of the standard deviation ellipse are in the central urban area of Shanghai, and the spatial density distribution pattern is mainly restricted by administrative planning and the distribution of the elderly population.

According to the results of the standard deviation ellipse analysis, the center of the spatial distribution of pension institutions is located in Xuhui District and shows a "north-south" direction as a whole. The specific situation is as follows: the centers of semi-intelligent and non-intelligent pension institutions are all in Xuhui District. Its spatial direction is consistent with the overall distribution direction of institutions, but the direction of semi-intelligent pension institutions is more significant. The center of intelligent pension institutions is located in Changning District and is distributed in the direction of "northeast-southwest".

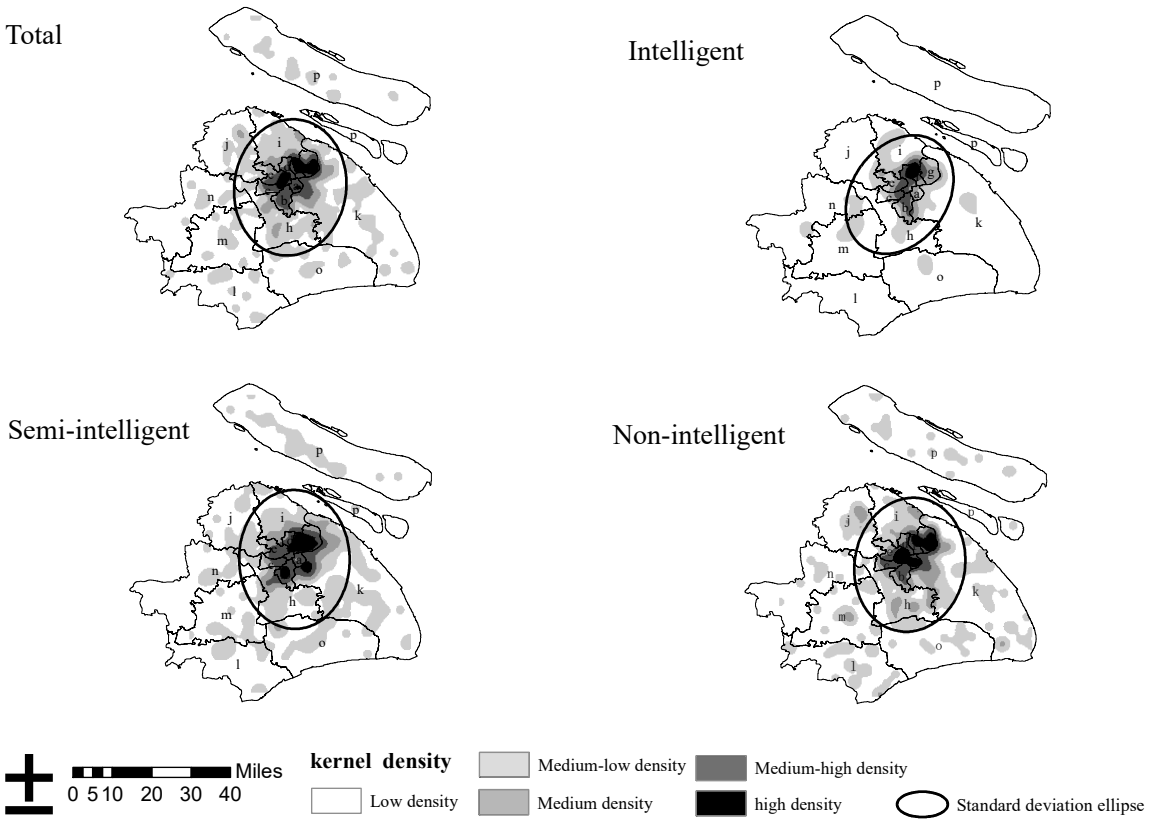

Figure 4. Standard deviation ellipse and kernel density map of the spatial distribution of various pension institutions in Shanghai.

From the results of kernel density analysis, the overall distribution of pension institutions is relatively scattered in space, mainly in middle-low density areas and low-density areas, which are concentrated in the central urban area; intelligent pension institutions are concentrated in low-density areas, while high-density areas are concentrated in Jing'an District and Hongkou District, while medium-density areas and medium–high-density areas are concentrated in the central urban area. The low and middle-density distribution of semi-intelligent and non-intelligent pension institutions is roughly the same as the overall distribution of pension institutions; the high-density areas of semi-intelligent pension institutions are concentrated in Xuhui District, Pudong New Area, Hongkou District, Yangpu District, and Jing'an District; the high-density areas of non-intelligent pension institutions are concentrated in the central urban area.

4.2.2. Spatial Correlation Analysis

Spatial correlation analysis can judge whether there is a significant aggregation distribution of beds in pension institutions. This part carries on the spatial correlation analysis of beds in Shanghai pension institutions based on Moran's I index, and the calculation results are shown in Table 4. The Moran's I index of pension institutions and semi-intelligent pension institutions is positive and passed the significance test, indicating that there is a significant spatial positive correlation; that is, the number of beds per capita of semi-intelligent pension institutions in adjacent units is similar, while the Moran's I index of intelligent and non-intelligent pension institutions is not significant, indicating that there is no significant spatial correlation in bed space, that is, spatial distribution equilibrium.

Table 4. Moran's I Index of Spatial Distribution of beds in Shanghai pension institutions.

Types of Pension Institutions	Moran's I	Z	P
Total	0.053	8.488	0.000
Intelligent	−0.007	0.177	0.859
Semi-intelligent	0.082	3.373	0.001
Non-intelligent	0.018	1.641	0.101

Spatial hotspot analysis can identify specific aggregation locations. The darker color of the hotspot map indicates that the number of beds of this type of pension institution in this region is more, and this type of pension institution is more concentrated. The study analyzes the spatial hot spots of beds in various pension institutions in Shanghai based on ArcGIS software. The result is shown in Figure 5. The "cold spot" distribution of the three types of pension institutions is located in the central urban area and Pudong New Area, indicating that the bed resources of the pension institutions in this area are relatively scarce. The "hot spots" of intelligent pension institutions are located in Qingpu District and Songjiang District, while the "hot spots" of semi-intelligent pension institutions are located in Qingpu District, Songjiang District, Jiading District and Minhang District, and the "hot spots" of non-intelligent pension institutions are located in Qingpu District, Jiading District and Baoshan District. The grey "○" indicates that the number of beds in this type of pension institutions shows a balanced distribution in space. The hot spot analysis results show that the spatial distribution of various types of pension institutions is basically consistent with the previous scale distribution analysis results.

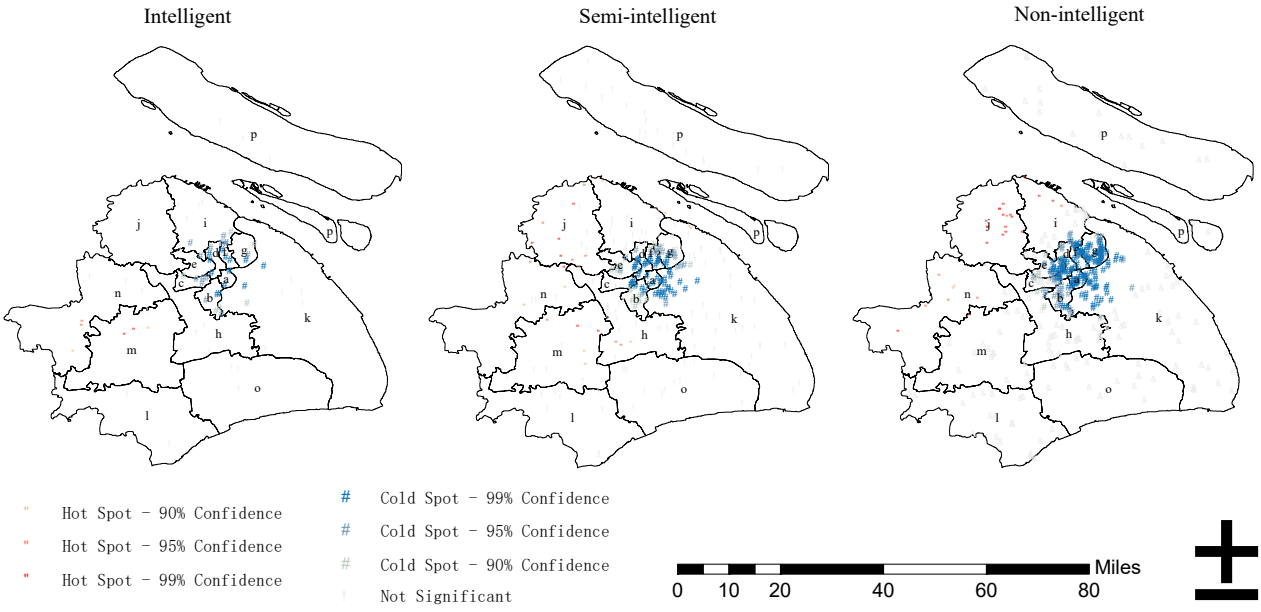

Figure 5. Spatial hot spot distribution map of the number of beds in Shanghai pension institutions.

4.3. Spatial Fairness Distribution

4.3.1. Gini Coefficient

The Gini coefficient and Python software are used to calculate the wisdom coefficient, the number of beds, and the Gini coefficient of wisdom beds of pension institutions. The results are shown in Table 5.

Table 5. Gini coefficient of pension institutions in each region of Shanghai.

District	G_1	G_2	G_3	District	G_1	G_2	G_3
a	0.486	0.529	0.646	h	0.406	0.500	0.471
b	0.412	0.476	0.407	i	0.347	0.481	0.516
c	0.452	0.537	0.503	j	0.418	0.435	0.491
d	0.426	0.531	0.512	k	0.318	0.421	0.449
e	0.454	0.455	0.461	l	0.323	0.367	0.526
f	0.346	0.515	0.480	m	0.350	0.521	0.534
g	0.461	0.515	0.472	n	0.324	0.454	0.409
Urban	0.440	0.518	0.500	o	0.345	0.398	0.474
				p	0.259	0.341	0.391
Shanghai	0.387	0.495	0.513	Suburban	0.350	0.466	0.509

Furthermore, the gap in the intelligence level of Shanghai pension institutions belongs to the normal range, but the gap in the number of beds resources is large, and the distribution of smart beds resources is extremely unbalanced. G_3 is greater than G_1 and G_2, indicating that the number of beds in pension institutions with a higher degree of intelligence is also more; namely, the resource allocation distribution of pension institutions in Shanghai is extremely uneven.

From the perspective of the central urban area and the suburbs, there is a large gap in the intelligence level of pension institutions in the central urban area, and the distribution of bed resources and wisdom bed resources is extremely unbalanced. The resource distribution of pension institutions in the suburbs is close to that of Shanghai as a whole, and the intelligence level of pension institutions and the distribution of bed resources are more reasonable than those in the central urban area.

From the perspective of each district, Chongming District reached the best state of intelligent level distribution of pension institutions. Huangpu district has the largest gap in the distribution of intelligence level. The intelligent level of pension institutions in half of the regions is reasonably distributed. The number of beds is distributed reasonably in Chongming District, Jinshan District, and Fengxian District. The distribution of bed number resources in Changning district was the most unreasonable. The number of beds in nearly half of the regional nursing institutions is extremely unbalanced. In addition, the distribution of smart beds in Chongming District is reasonable. The distribution of smart beds in Huangpu District is completely unbalanced, and the allocation of resources is dangerous, which requires timely adjustment. The distribution of smart beds in one-third of regional pension institutions is extremely unbalanced.

4.3.2. Correlation Coefficient

In order to further analyze the causes of the unbalanced distribution of the wisdom coefficient, number of beds, and smart beds in Shanghai, we analyze the correlation between the Gini coefficient and Shanghai's economy and population, income sources of the elderly, living conditions, and health status. The results are shown in Table 6.

First, there is a strong positive correlation between the wisdom Gini coefficient and "per capita disposable income" and "elderly population density", indicating that the higher the per capita disposable income or, the higher the density of the elderly population, the greater the difference in the wisdom level of the pension institutions in Shanghai. The correlation coefficient of the "Proportion living with spouse" is -0.646, indicating a strong negative correlation, indicating that the higher the proportion of the elderly living with their spouse in each district of Shanghai, the smaller the difference in the wisdom level of pension institutions. Second, bed Gini coefficient is strongly positively correlated with "per capita disposable income", strongly positively correlated with "elderly population density", "proportion of living with spouse and children" and "proportion of living alone (with nanny)", but strongly negatively correlated with "proportion of living with spouse". Finally, the Gini coefficient of smart beds has no strong correlation with the economy,

income, residence, and health status but has a moderate positive correlation with "total service assets" and a moderate negative correlation with "proportion of living with spouse".

Table 6. Correlation of the Gini coefficient with the economy, income, living conditions, and health status.

Economy, Population, Income, Housing, and Health Status		Value	Correlation Coefficient		
			G_1	G_2	G_3
Economy and population of Shanghai	GDP per capita	199,543.2	0.460	0.422	0.348
	Per capita disposable income	76,066.19	0.766	0.806	0.323
	Total service assets	6885.52	0.555	0.570	0.461
	Elderly population density	357.29	0.607	0.639	0.282
The elderly are the main source of income	Labor income ratio	3.19%	−0.546	−0.582	−0.179
	Pension ratio	94.07%	0.578	0.497	0.141
	The proportion of the rest of the family	2.09%	−0.427	−0.184	−0.055
	Subsistence allowance ratio	0.36%	−0.321	−0.353	0.091
	Proportion of property income	0.06%	0.165	0.076	−0.003
Living conditions of the elderly	Proportion living with spouse and children	27.41%	0.556	0.739	0.331
	Proportion living with a spouse	44.41%	−0.646	−0.813	−0.434
	Proportion living with children	12.67%	0.376	0.525	0.395
	Proportion living alone (with a nanny)	0.32%	0.559	0.601	0.132
	Proportion living alone (without nanny)	9.78%	−0.348	0.525	−0.231
	Proportion of pension institutions	1.96%	0.084	0.192	0.012
Health status of the elderly	Healthy ratio	61.80%	−0.252	−0.173	0.171
	Basic health ratio	28.54%	0.290	0.216	−0.149
	Unhealthy but self-care	6.48%	0.106	0.013	−0.248
	Unhealthy and non-self-care	3.17%	0.302	0.245	−0.080

The GDP and per capita disposable income data came from the Shanghai District Bureau of Statistics in 2021. Data source of total assets of the Service industry and 2021 Shanghai Statistical Yearbook. Data on income sources, living conditions, and health status of the elderly came from the 2020 Shanghai Census Yearbook.

4.3.3. Resource Allocation Analysis

We analyze the resource allocation of elderly care institutions in various districts of Shanghai from three aspects. First, the analysis of the elderly population density and the number of beds in nursing home institutions yields four types of regions with local heterogeneity. "High-High" indicates that the elderly population density and number of beds in nursing home institutions are both high and "Low-Low" indicates that the elderly population density and number of beds in nursing home institutions are low. These two can be identified as the basic reasonable matching space area. "Low-High" refers to areas with a low density of elderly population but a high number of beds in pension institutions, indicating that the bed allocation planning is advanced. "High-Low" refers to the area where there are more elderly people living in pension institutions but fewer beds, which is also the key area where the allocation of bed resources of pension institutions needs to be adjusted and supplemented. Second, analysis of resource allocation of the per capita disposable income and the wisdom coefficient of pension institutions. "High-low" refers to areas with High per capita disposable income but low wisdom coefficient of pension institutions. Finally, since pension institutions belong to the service industry, this paper analyzes of resource allocation of the total assets of the service industry and the number of smart beds of pension institutions. "Low-High" refers to areas with low total service assets but high number of smart beds of pension institutions, and "High-Low" refers to areas with high total service assets but low number of smart beds of pension institutions. The results obtained from the above analysis are shown in Figure 6.

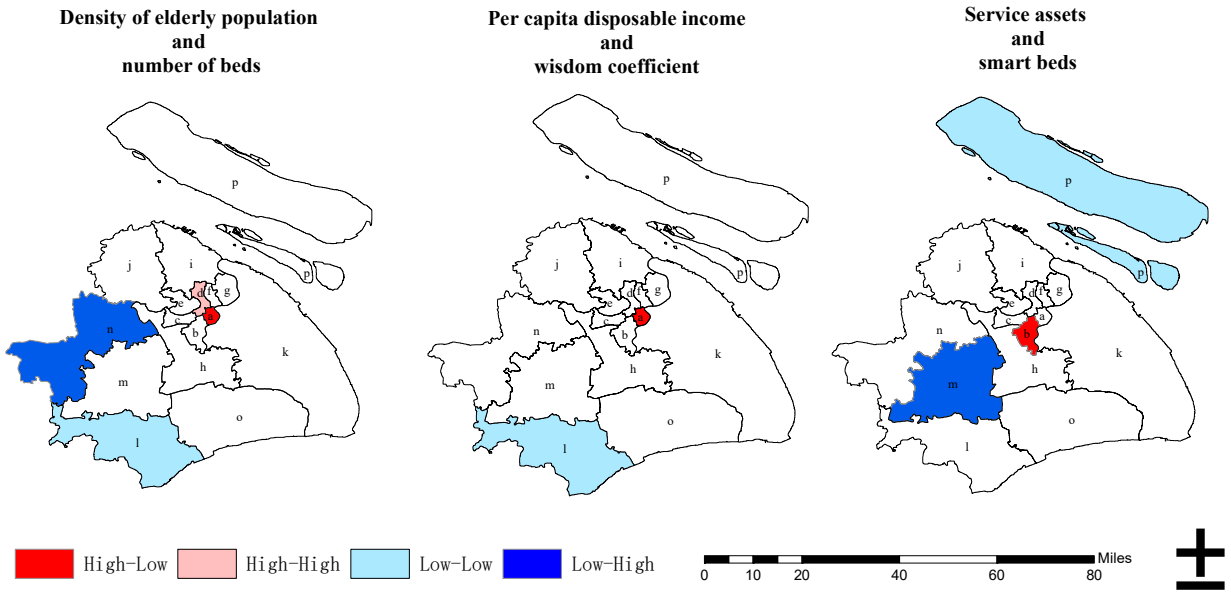

Figure 6. Resource allocation map of various districts in Shanghai.

Qingpu District is a low-demand-high-allocation area, and Songjiang District is a low-input-high-yield area; both of these two areas are regions with advanced allocation planning. Huangpu District is a region with high per capita disposable income but low wisdom coefficient of pension institutions and a high density of elderly population but few beds of pension institutions. The level of intelligent facilities and management services of pension institutions does not meet people's consumption level, and bed resources do not meet the needs of the elderly, indicating that this region needs to supplement and adjust the allocation of resources of pension institutions. Xuhui District is an area with high total service assets but low number of smart beds in pension institutions. The proportion of pension institutions in service assets is too low, resulting in low allocation of smart beds in pension institutions. Therefore, structural adjustment of the service industry is needed in this area.

5. Conclusions, Recommendations, and Limitations of Study

5.1. Conclusions

This study establishes the evaluation system of the intelligent level of pension institutions. Based on the data provided by the websites of major pension institutions in Shanghai, the pension institutions are divided into intelligent, semi-intelligent, and non-intelligent three levels. The methods of standard deviation ellipse, kernel density analysis, spatial autocorrelation analysis, spatial hot spot analysis, Gini coefficient, and LISA analysis were used to analyze the spatial distribution of pension institutions in Shanghai. The main conclusions obtained include:

Elderly care institutions in Shanghai are concentrated in the central urban area. The density of pension institutions in the central city is 9.8 times that in the suburbs, indicating that the distribution of pension institutions in the central city is more intensive. The occupancy rate of nursing homes in the central city is higher than that in the suburbs. The spatial distribution centers of the three types of pension institutions and the high-density and medium–high-density areas of the spatial distribution are concentrated in the central urban area.

The intelligent development of elderly care institutions in the suburbs of Shanghai is better than that in the urban area. First, the number of beds per capita in the suburbs of Shanghai is higher than that in the downtown area. The bed resources in the downtown area of Shanghai are scarce and unbalanced. The elderly population is mainly distributed in the small urban area, but the proportion of beds in the urban area is smaller than that of the

elderly population. Thus, it cannot meet the needs of the elderly in this area. The suburban area is large and sparsely populated, but the proportion of beds is slightly larger than the proportion of the population. Hence, the bed resources are relatively rich, which can meet the needs of the elderly in the suburbs and relieve the lack of pressure of beds in the central city. This conclusion is consistent with the research results of Yin and Sima [6,37], but the conclusions on bed number distribution in this paper are different from those of Chen [38]. The reason is that the data sources of the elderly population are different: the latter is based on the data of the Sixth National Population Census (2010) and the number of beds in nursing home institutions from the cross-section data of March 2017. Additionally, the elderly population data and the number of beds in nursing home institutions in this paper are the data for the end of 2020. Second, the distribution of intelligent resources of pension institutions in the suburbs of Shanghai is more reasonable. The gap in intelligent level of pension institutions in the suburbs is within the normal range, and the number of beds of intelligent pension institutions in the suburbs is three times that of the central urban area.

The development of various regional pension institutions in Shanghai is unbalanced. First, Songjiang District and Qingpu District are the areas with the best development of pension institutions. The elderly population density in this region is low, and the bed resources of intelligent nursing institutions are abundant. Qingpu District has a low-density of elderly population but a high number of beds. The total assets of the service industry in Songjiang District are low, but the number of beds of pension institutions is high. Both of them are advanced planning areas for endowment institutions. Second, the allocation of elderly care institutions in Huangpu District is poor. Its nursing home has the fewest beds. Non-intelligent nursing institutions accounted for the highest proportion. The per capita disposable income is high, but the wisdom coefficient of pension institutions is low. The density of the elderly population is high, but the number of beds in pension institutions is small. Finally, Pudong New Area and Chongming District are the most potential areas for the development of pension institutions. In Pudong New Area, the elderly population density is low, the number of beds is the largest, and the number of beds is the largest in semi-intelligent and non-intelligent pension institutions. Therefore, the intelligent-level distribution of pension institutions in this region is reasonable. Chongming District has the smallest elderly population density. The distribution of intelligent level of pension institutions reaches the best state, and the number of beds and intelligent bed resources of the pension institutions are reasonable.

5.2. Recommendations

The reasonable spatial distribution of pension institutions is of great significance to the development of pension services and intelligent pensions in Shanghai. Based on the research results, this paper puts forward the following recommendations:

We will optimize the allocation of bed resources in elderly care institutions and strive to build a more adequate, balanced, high-quality, and accurate service system for pension institutions. The contradiction of unbalanced development between urban and rural areas is more prominent. The phenomenon of "one bed is difficult to find" in the urban area and some vacant in the outer suburbs coexist. The urban areas should actively build pension institutions and increase the number of beds in pension institutions. Additionally, urban areas should encourage the urban elderly to choose low-demand areas to live in pension institutions, which can effectively alleviate the pressure of the elderly population and high demand for pensions.

We will consolidate social wealth reserves and strive to build more equitable and reasonably structured intelligent pension institutions. The planning standards for the construction of pension institutions are lagging behind, which is inconsistent with the continuous improvement of the degree of aging and the elderly's demand for intelligent services. Therefore, we should actively improve the allocation of intelligent pension institutions in high-income urban areas and the pension institutions in the region to build and complete intelligent facilities or expand the scale of intelligent pension institutions.

We will promote the high-quality development of undertakings and industries for the elderly, serve the high-quality life of the elderly, and promote the high-quality, rationalization, and innovative development of pension institutions. Currently, the contradiction between the quality, distribution, and efficiency of the service supply of pension institutions and the increasingly diversified demand is prominent. It is necessary to encourage the improvement of the management ability and service quality of the existing pension institutions, improve the construction of a livable environment for the elderly, and guide the location selection of new pension institutions and the rational layout of intelligent supporting facilities.

5.3. Limitation of Study

First, the evaluation system of the intelligent level of pension institutions only includes 11 s-level indicators and is not detailed and accurate enough. Second, the data collected in this paper only covers 86.06% of pension institutions in Shanghai, which may lead to slight errors in the analysis results. Finally, the allocation data of pension institutions, economy and population, income sources, living conditions, and health status of the elderly in Shanghai are all cross-sectional data. The horizontal research is limited to the discussion of the fair distribution of pension institutions and the lack of longitudinal in-depth analysis. In short, future research on the wisdom of pension institutions in Shanghai can further analyze the causes and mechanisms of the inequity layout of the facility by further optimizing the accuracy and integrity of the data and the measurement method of fairness.

Author Contributions: Conceptualization, Qinrui Tian and Qiaoxing Li; methodology, software, and formal analysis, Qinrui Tian; paper structure, Qiaoxing Li; funding acquisition, Qiaoxing Li. All authors have read and agreed to the published version of the manuscript.

Funding: The Research Project for Humanities and Social Sciences of College by Education Department of Guizhou Province in 2023 "Research on High Quality Development of Social Security and Relief System in Guizhou Province" [2023GZGXRW152].

Data Availability Statement: gscloud.cn (accessed on 22 December 2022) for Shanghai digital elevation data; zwfw.mca.gov.cn (accessed on 31 December 2022) for the data of pension institution (containing location coordinate, number of beds, and other information); yanglao.com.cn and anyang100.com (accessed on 3 January 2023) for the data of specific information of pension institution (containing infrastructure, medical and health care, elderly care services, management capacity, and other information); and stats.gov.cn (accessed on 11 January 2023) for the statistical data.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Zhou, Y.; Zhao, K.; Han, J.; Zhao, S.; Cao, J. Geographical Pattern Evolution of Health Resources in China: Spatio-Temporal Dynamics and Spatial Mismatch. *Trop. Med. Infect. Dis.* **2022**, *7*, 292. [CrossRef] [PubMed]
2. Yang, X.; Chen, L.; Pu, J.; Liu, Z.; Wang, Y.; Xiong, L. Current situation investigation of the internal medical institutions and the providing of health services in the elderly care institutions in a community in Shanghai. *Chin. Health Resour.* **2018**, *21*, 323–328. (In Chinese)
3. Jiang, Q.; Li, Y. Analysis on optimal allocation strategy of intelligent medical space for community home care. *Acad. Bimest.* **2020**, *03*, 63–65. (In Chinese)
4. Zhao, Y.; Tan, J.; Chen, Y. Research on Demand Forecast of Social Pension Facilities: A Case Study of Chongqing. In Proceedings of the 23rd International Symposium on Advancement of Construction Management and Real Estate, Guiyang, China, 24–27 August 2018; Springer: Singapore, 2021; pp. 457–475.
5. Huang, X.; Gong, P.; White, M. Study on Spatial Distribution Equilibrium of Elderly Care Facilities in Downtown Shanghai. *Int. J. Environ. Res. Public Health* **2022**, *19*, 7929. [CrossRef] [PubMed]
6. Yin, W.; Liu, S. Study on Spatial Distribution and Accessibility of Elderly Care Institutions in Shanghai. *Mod. Urban Res.* **2021**, *6*, 17–23. (In Chinese)
7. Yang, Q.; Yao, H.; Li, C.; Zhang, C. Study on the Spatial Distribution Characteristics and Influencing Factors of Pension Service Institutions in Shijiazhuang City of China. *Curr. J. Appl. Sci. Technol.* **2022**, *41*, 16–26.

8. Wang, Y.; Feng, Y.; Yang, Y. Research on Spatial Pattern of Henan Pension Institutions Based on Accessibility. *Int. J. Educ. Humanit.* **2023**, *8*, 230–236. [CrossRef]
9. Han, J.; Jiang, W.; Shi, J.; Xin, S.; Peng, J.; Liu, H. A Method for Assessing the Fairness of Health Resource Allocation Based on Geographical Grid. *Comput. Mater. Contin.* **2020**, *64*, 1171–1184. [CrossRef]
10. Ji, F.; Zhang, H. Study on the spatial equilibrium in pension combined with medicalcare resources allocation in Beijing. *Chin. J. Health Policy* **2020**, *13*, 7–13. (In Chinese)
11. Qin, L.; Zhou, Y. Research on the Configuration of Healthcare Space in Elderly Care Facilities under the Background of Medical-Nursing Combination. *Archit. J.* **2021**, *S1*, 74–79. (In Chinese)
12. Yu, Y.; Zhou, R.; Qian, L.; Yang, X.; Dong, L.; Zhang, G. Supply-demand balance and spatial distribution optimization of primary care facilities in highland cities from a resilience perspective: A study of Lhasa, China. *Front. Public Health* **2023**, *11*, 553. [CrossRef] [PubMed]
13. Wang, L.; Zhou, K.; Wang, Z. Spatial distribution of community pension facilities from the perspective concept of health equity: A case study of the central city of Shanghai. *Hum. Geogr.* **2021**, *36*, 48–55. (In Chinese)
14. Cai, X.; Zhang, Q.; Wang, X.; Zhang, X.; Zhang, J.; Wang, K. Analysis of fairness and trends in the allocation of medical and health resources in Shanghai from 1995 to 2018. *Chin. J. Evid.-Based Med.* **2021**, *21*, 1016–1023. (In Chinese)
15. Hu, S.; Song, W.; Li, C.; Lu, J. The Spatial Equity of Nursing Homes in Changchun: A Multi-Trip Modes Analysis. *ISPRS Int. J. Geo-Inf.* **2019**, *8*, 223. [CrossRef]
16. Ding, L.; Wang, J.; Hu, N. Equity Performance Evaluation for Resource Allocation in Urban Senior Care Organization from the Perspective of Health Equity: A Case Study of Wuhan. *Mod. Urban Res.* **2022**, *08*, 1–7. (In Chinese)
17. Kang, R.; Wang, Z.; Lv, X. Does Private Sector Participation Enhance the Fairness of Elderly Care Service Supply—Based on Beijing. *Soc. Secur. Stud.* **2022**, *03*, 29–45. (In Chinese)
18. Hu, P.; Liu, Z.; Lan, J. Equity and efficiency in spatial distribution of basic public health facilities: A case study from Nanjing metropolitan area. *Urban Policy Res.* **2018**, *37*, 243–266. [CrossRef]
19. Cheng, T.; Liu, C.; Yang, H.; Wang, N.; Liu, Y. From service capacity to spatial equity: Exploring a multi-stage decision-making approach for optimizing elderly-care facility distribution in the city centre of Tianjin, China. *Sustain. Cities Soc.* **2022**, *85*, 104076. [CrossRef]
20. Sui, D.; Peng, Q. Constructing basic analysis about the "Internet + Community Home-Based Care" service model in China's city. *Soc. Secur. Stud.* **2017**, *39*, 18–26. (In Chinese)
21. Zheng, S. Internet of Things and Smart Elderly Care. *Video Eng.* **2014**, *38*, 24–27. (In Chinese)
22. Sui, D.; Peng, Q. "Internet + Home-based care for Senior Citizens": Research in Service Model of Intellectual Home-based Care for Senior Citizens. *J. Xinjiang Norm. Univ. (Ed. Philos. Soc. Sci.)* **2016**, *37*, 128–135. (In Chinese)
23. Pires, P.; Mendes, L.; Mendes, J.; Rodrigues, R.; Pereira, A. Integrated e-Healthcare System for Elderly Support. *Cogn. Comput.* **2016**, *8*, 368–384. [CrossRef]
24. Majumder, S.; Aghayi, E.; Noferesti, M.; Memarzadeh-Tehran, H.; Mondal, T.; Pang, Z.; Deen, M. Smart Homes for Elderly Healthcare—Recent Advances and Research Challenges. *Sensors* **2017**, *17*, 2483–2496. [CrossRef] [PubMed]
25. Zhang, Q.; Li, M.; Wu, Y. Smart home for elderly care: Development and challenges in China. *BMC Geriatr.* **2020**, *20*, 318–325. [CrossRef] [PubMed]
26. Zhao, G.; Zhao, M. Spatial difference of intelligent pension service in China. *J. North Minzu Univ. (Philos. Soc. Sci.)* **2022**, *05*, 117–123. (In Chinese)
27. Meng, L.; Zhang, Y.; Tian, Y.; Wu, L.; Liu, L.; Zhao, T. Research progress of smart elderly care system in nursing home. *Chin. Nurs. Res.* **2023**, *37*, 1011–1014. (In Chinese)
28. Tong, F. Construction and Application Strategies of Multi-system Interactive Elderly Care System. *J. Nantong Univ. (Soc. Sci. Ed.)* **2021**, *37*, 89–96. (In Chinese)
29. Zhao, G.; Zhao, M. Research on the Evaluation Index System of Smart Elderly Care. *J. Northeast. Univ. (Soc. Sci.)* **2022**, *24*, 88–94. (In Chinese)
30. Zhu, L.; Hu, J.; Xu, J.; Li, Y.; Liang, M. Spatial Distribution Characteristics and Influencing Factors of Pro-Poor Tourism Villages in China. *Sustainability* **2022**, *14*, 632–644. [CrossRef]
31. Li, M.; Ouyang, W.; Zhang, D. Spatial Distribution Characteristics and Influencing Factors of Traditional Villages in Guangxi Zhuang Autonomous Region. *Sustainability* **2022**, *15*, 15953. [CrossRef]
32. De Jong, P.; Sprenger, C.; van Veen, F. On Extreme Values of Moran's I and Geary's c. *Geogr. Anal.* **1984**, *16*, 17–24. [CrossRef]
33. Rabbani, F.; Zech, W.C.; Nazari, R.; Karimi, M.; Bacchus, A. Developing a Geospatial Framework for Severe Occupational Injuries Using Moran's I and Getis-Ord Gi* Statistics for Southeastern United States. *Nat. Hazards Rev.* **2022**, *23*, 1527. [CrossRef]
34. Huang, X.; Gong, P.; White, M.; Zhang, B. Research on Spatial Distribution Characteristics and Influencing Factors of Pension Resources in Shanghai Community-Life Circle. *ISPRS Int. J. Geo-Inf.* **2022**, *11*, 518. [CrossRef]
35. Dai, G.; Li, R.; Ma, S. Research on the equity of health resource allocation in TCM hospitals in China based on the Gini coefficient and agglomeration degree: 2009–2018. *Int. J. Equity Health* **2022**, *21*, 145–152. [CrossRef]

36. Mei, K.; Tan, M.; Yang, Z.; Shi, S. Modeling of Feature Selection Based on Random Forest Algorithm and Pearson Correlation Coefficient. *J. Phys. Conf. Ser.* **2022**, *2219*, 012046. [CrossRef]
37. Sima, L. A Study on the Characteristics of Spatial Distribution of Care Facilities and Capacities for the Elderly in Shanghai. *Archit. J.* **2018**, *02*, 90–94. (In Chinese)
38. Chen, J.; Yao, S.; Wu, J.; Huang, L.; Ren, Z. Study on spatial Distribution of residential care facilities in Shanghai. *J. East China Norm. Univ. (Nat. Sci.)* **2018**, *05*, 157–169. (In Chinese)