WEP Warwick Evans Publishing

International Journal of Social Sciences and Public Administration

ISSN: 3005-9836 (Print), ISSN: 3005-9585 (Online) | Volume 7, Number 1, Year 2025
DOI: https://doi.org/10.62051/ijsspa.v7n1.04
Journal homepage: https://ijsspa.org

Spatial-Temporal Evolution Characteristics of Population Aging and its Influencing Factors in Zhongyuan Urban Agglomeration

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ABSTRACT

Taking the aging population in the Zhongyuan urban agglomeration as the research subject, using the proportion of the elderly population aged 65 and above as the primary measurement index. Methods such as standard deviational ellipse,spatial autocorrelation analysis, and the optimal parameters-based geographical detector are employed to analyze the spatial-temporal evolution and influencing factors of aging at the county scale.The results indicate that:①From 2000 to 2020, population aging in the Zhongyuan urban agglomeration intensified from northwest to southeast. The region shifted from an adult-dominated to an elderly-dominated demographic. Among them, the districts and counties under the jurisdiction of Xinyang City,Henan Province, are the most obvious. ②Population aging in the Zhongyuan urban agglomeration exhibits a strong global spatial positive correlation, with distinct local spatial clustering. The high-high cluster and low-low cluster show a trend of increasing first and then decreasing, indicating that the spatial difference of population aging has narrowed.③Factors such as fertility levels, the 2010 aging ratio, birth rates, and migration rates are the primary determinants of population aging distribution. The impact of greening and healthcare levels follows, with the influence of population, natural, and economic factors diminishing progressively.④The interaction of fertility level∩2010 aging ratio and fertility level∩greening level has a strong impact on population aging, indicating that fertility level plays a major role in the process of population aging. The research can provide an important basis for the subsequent population structure adjustment.

KEYWORDS

Population Aging; Optimal Parameters-based Geographical Detector; The Zhongyuan Urban Agglomeration.

1. INTRODUCTION

The data of the seventh national census in 2020 showed that the proportion of elderly population over 65 years old in China has increased by 4.6% compared with the sixth census in 2010, and the problem of population aging is gradually aggravated[1]. In the face of the current situation of population aging, the State Council has issued the National Plan for Actively Responding to Population Aging and the Opinions on Strengthening the Work on Aging in the New Era, which explicitly put forward the comprehensive implementation of the National Strategy for Actively Responding to Population Aging. As an important city cluster connecting east and west and north and south in China, the strategic significance of the Zhongyuan urban agglomeration is becoming more and more prominent with the implementation of the "One Belt, One Road" initiative and the promotion of the strategy of

the rise of central China. With the characteristics of large population base, relatively serious aging and high mobility in the region, how to accurately ageing status and clarify its influencing factors is of great significance for actively coping with population aging, and it is also an important cornerstone for the promotion of the region's harmonious height.

The research of foreign scholars in the field of geography on population aging mainly focuses on spatial distribution, influencing factors, health, and migration of the elderly population[2-3]. Domestic scholars, on the other hand, have researched on aging with the current situation, spatial pattern, driving factors, forecasts and other issues[4]. For the spatial and temporal evolution characteristics and influencing factors of population aging have been studied in degrees.Taking an overview of the existing studies, most of them are carried out for a single administrative division, while city clusters play an increasingly important role in China's population agglomeration, economic growth and urbanization[5], and their aging problems are also becoming more and more prominent, and at present, there are relatively few studies on the problem of aging with city clusters as the unit. As an important economic and cultural region in China, the Zhongyuan urban agglomeration, with the acceleration of the socialization process, the proportion of the elderly population is gradually increasing, and the demographic changes are extremely important for the maintenance and its strategic position. In recent years, the Zhongyuan urban agglomeration has also faced the serious challenge of population aging. Therefore, exploring the aging problem and thinking about how to actively respond to it will be an important direction for a long time to come. This study takes the Zhongyuan urban agglomeration as the study area, and based on the three census data in 2000, 2010 and 2020, adopts the spatial and temporal characteristics of population aging in the region at the county scale, and then analyzes the factors affecting the spatial and temporal characteristics of population aging by using the optimal parameters-based geographical detector, with the aim of providing a reliable basis for the formulation of strategies to cope with the aging of the population in the Zhongyuan urban agglomeration.

2. STUDY AREA, DATA SOURCES AND RESEARCH

2.1. Study Area

The Zhongyuan urban agglomeration is the study area, and the county is the study scale. The Zhongyuan urban agglomeration is located in the central-eastern part of China, covering the entire region of Henan Province as well as two cities in western Shandong, five cities in northern Anhui, two cities in southern Hebei, and three cities in southeastern Shanxi, with a total of 30 municipal-level administrative units and 269 county-level administrative units. By the end of 2020, the Zhongyuan urban agglomeration will have a total area of about 287000km^2 and a resident population of about 140 million.

2.2. Data Sources

According to the relevance and availability of data, the proportion of elderly people over 65 years old is selected as an important indicator of the degree of aging, i.e., the aging ratio.The population data from 2000 to 2020 are derived from the "China Census Sub-county Data" as well as those of the 30 cities and some districts and counties in the Zhongyuan urban agglomeration, etc., and the county-level administrative districts of 2000 and 2010 are unified in the 2020 administrative district system. The data used for the impact factors come from the China Population Census Sub-county Data, China County Statistical Yearbook, cities and counties, and so on.

2.3. Researches

2.3.1. Standard Deviational Ellipse

Standard deviational ellipse is a spatial statistics that can accurately reveal the multifaceted characteristics of the spatial distribution of elements, mainly composed of three elements, namely, the corner, the difference along the long axis and the difference along the short axis[6], which is used to determine the center of gravity of the distribution of the aging population, the direction of the distribution, and the trend of evolution.

2.3.2. Spatial Autocorrelation Analysis

1) Global Moran's *I*. Identify the spatial clustering characteristics of the distribution of population aging from the whole, the value range of Moran's *I* is [-1,1], When Moran's *I*>0, population aging has a clustered distribution; when Moran's *I*<0, aging is diffuse; and equal to 0 represents no correlation.

2) Local Moran's *I*. To make up for the insufficiency of global spatial autocorrelation analysis, it can specify the spatial location of the agglomeration, and is mainly used to identify the spatial high and low value agglomeration characteristics as well as the outliers in the local area.

2.3.3. Optimal Parameters-Based Geographical Detector

The geographic detector is a statistic that detects spatial heterogeneity and illustrates the degree of influence of the independent variable on the spatial and temporal distribution of the dependent variable. In this study, using the optimal parameters-based geographic detector, which is an improvement based on the geographic detector, to calculate the discretization of each independent variable and find the optimal grouping interval through the GD package of the R language, so as to maximize the q-value of the independent variable on the dependent variable. q-value reflects the explanatory power of the independent variable on the dependent variable, and the larger q-value is, the stronger the explanatory power is[7]. The optimal parameters-based geographic detector includes four detectors, divergence and factor detection, and interaction detection are used in the research process. Factor detection is used to detect the explanatory power of each independent variable X on the spatial dissimilarity of the dependent variable Y, while interaction detection is used to detect the explanatory power (or reduction) of the dependent variable when two different independent variables act together.

3. CHARACTERISTICS OF TEMPORAL AND SPATIAL EVOLUTION OF POPULATION AGING

3.1. Temporal Characteristics of Population Aging

Table 1. The classification types of population aging in Zhongyuan urban agglomeration

Percentage of elderly population	Type
<7.0%	Adult type
7.0%~10.0%	Old type early
10.0%~14.0%	Old type middle
>14.0%	Old type late

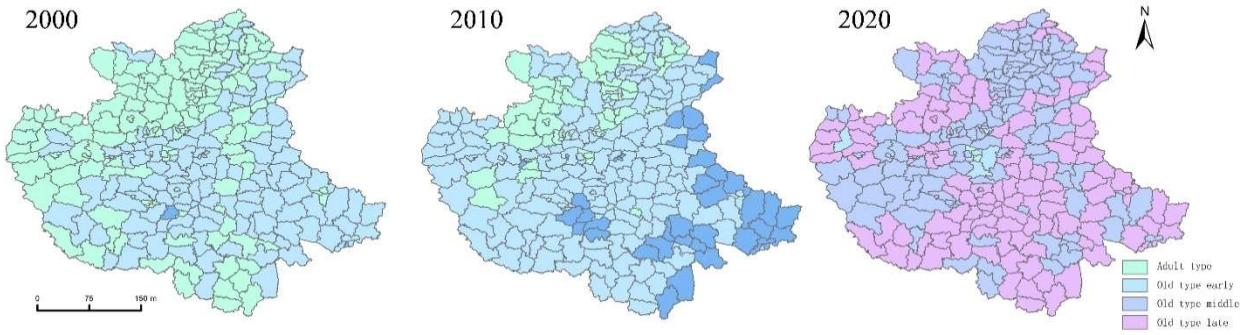

Figure 1. Spatial distribution and change of population aging in Zhongyuan urban agglomeration from 2000 to 2020

Taking the age ratio as an indicator to measure the difference of population aging, according to the age division and related research[8], and combining with the actual situation of the Zhongyuan urban agglomeration on the refinement of the division of aging, the population aging is divided into four types (Table 1). Drawing the distribution map of aging in the Zhongyuan urban agglomeration from 2000 to 2020 according to the above (Figure 1), the following characteristics are mainly presented:

1)The overall degree of aging is deepening. in 2000, population aging was dominated by the adult type and old type early, with the adult type concentrated in the northwestern region, while the old type early was concentrated in the central and eastern regions, and there were no old type late at that time. In 2010, the old type early was dominated by the adult type, with the adult type concentrated in the northern region, and the old type middle scattered in the Southeast region, such as Xiayi County and Dangshan County in Shangqiu, Henan Province belonging to the old type middle. As in 2000, there is still no old type late in 2010. By 2020, aging will be dominated by old type middle and old type late, a change that indicates that the type of population aging in the Zhongyuan urban agglomeration has completed the transition from adult type to old type, with old type middle concentrated in the western and northern regions, such as Luanchuan and Luoning counties in Luoyang, Henan Province, while old type late is concentrated in the southern regions. In 2000-2020, the population aging in the Zhongyuan urban agglomeration presents the characteristics of "low in the northwest and high in the southeast", and the degree of population aging gradually deepens from the northwest to the southeast.

2)The regional aging type changes significantly: from 2000 to 2020, the adult and old type early in the northern region gradually disappeared, while the other types showed an increasing trend. The same as the northern region, the southern region of the adult and old type early gradually disappeared, and other types showed a trend of growth, with the largest increase in the old type late. In the western region, the adult type gradually disappeared, all other types showed an increasing trend, and the largest increase was in the old type middle. In the eastern region, the old type early gradually disappears, all other types show an increasing trend, and the largest increase is in the old type late.There is little change in the central region in 2000-2010, with the old type early predominating, while the only areas that change from old type early to old type late in 2010-2020 are Jinshui District and Zhongmou County in Zhengzhou, Henan Province, Xinzheng City remain in the old type early.

3.2. Spatial Characteristics of Population Ageing

3.2.1. Evolution of the Spatial Skew of Population Ageing

In order to reveal the spatial evolution trend of population aging in the Zhongyuan urban agglomeration from 2000 to 2020, ArcGIS was used to generate the standard deviational ellipse map

of population aging for the three years (Figure 2), to obtain the parameters of the standard deviational ellipse (Table 2), and to select the one-level difference.

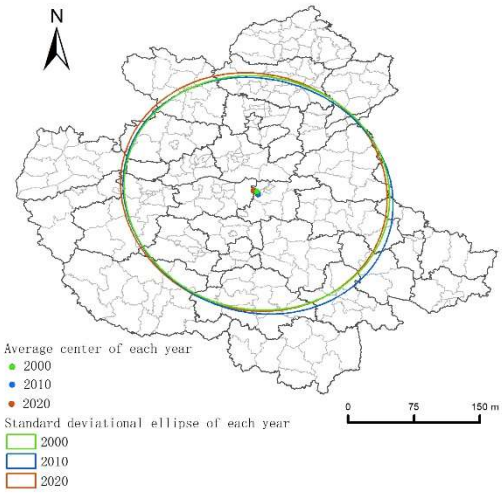

Figure 2. Standard deviational ellipse and center migration of population aging in Zhongyuan urban agglomeration from 2000 to 2020

Table 2. Standard deviational ellipse parameters of population aging in Zhongyuan urban agglomeration

parameters	2000	2010	2020
semimajor axis/km	241.80	242.32	242.25
semiminor axis/km	264.07	269.65	269.02
rotation angle/°	161.12	152.67	161.25
flattening/m	0.09	0.11	0.11
Center X	12713.56	12715.85	12708.07
Center Y	4103.43	4097.40	4105.64
ellipse area/km^2	200495.68	205172.59	204634.10

It can be derived from Figure 2 and Table 2:

1)Changes in spatial distribution. the ellipse area of population aging in the Zhongyuan urban agglomeration from 2000 to 2020 ranges from 200,495.68km^2 in 2000 to 205,172.59km^2 in 2010, and then decreases to 204,634.10km^2 in 2020, which indicates that the spatial distribution range of population aging from 2000 to This indicates that the spatial distribution range of population aging increased in 2010, while the distribution range of population aging narrowed in 2010-2020, showing a tendency of clustering.The flatness increased in 2000-2010, reflecting an increase in the spatial distribution range and direction of population aging, while the flatness in 2010-2020 was smooth, showing a tendency of clustering. The flat rate is stable in 2010-2020, indicating that the change in its spatial distribution is not obvious.

2)Changes in the angle of rotation: the angle of rotation of population aging in the Zhongyuan urban agglomeration from 2000 to 2020 decreases from 161.12° in 2000 to 152.67° in 2010, and then

rebounds to 161.25° in 2020, with a change of less than 10°. The population aging centers are all located in Kaifeng City, with Xiangfu District in 2010 and Longting District in both 2000 and 2020, and the two districts are closely adjacent to each other, which indicates that the direction of the center of population aging offset in the Zhongyuan urban agglomeration is relatively stable.

3)Change of center offset. The center of population aging in the Zhongyuan urban agglomeration fluctuates between Xiangfu District and Longting District in Kaifeng, Henan Province. 2000-2010, the center shifted to the southeast, as Luohe, Xuchang, and other cities adopted industrial investment policies, and made great efforts to promote food processing, equipment manufacturing, and other industries, which created job opportunities for young people, and some elderly people followed their children and migrated there, thus pushing aging to the southeast. While 2010-2020 center is moving to the northwest, Zhengzhou and other cities to accelerate economic transformation, rapid service industry, attracting a large number of talents and families, the elderly population with it, driving the center of aging to the northwest direction. This change reflects the spatial dynamic characteristics of the distribution of the elderly population in the zhongyuan urban aagglomeration, which is the result of multiple factors such as policy, economy, society and culture.

3.2.2. Spatial Correlation and Heterogeneity

The global Moran's *I* value and related indicators of population aging in the Zhongyuan urban agglomeration from 2000 to 2020 (Table 3) are calculated separately to determine the spatial evolution trend of population aging. The global Moran's I value was from 0.47 in 2000 to 0.57 in 2010, and then decreased to 0.38 in 2020.The global Moran's I values of the three years were all greater than 0 and passed the significance test, indicating that there was a strong global spatial positive correlation of population aging in the Zhongyuan urban agglomeration, and there was a tendency of clustering in the space. From the trend of change, the global Moran's *I* gradually increased during 2000-2010, and population aging showed a strong clustering characteristic. However, the agglomeration characteristics gradually weakened during the period 2010-2020, indicating that there are fluctuations in the agglomeration trend of population aging in the Zhongyuan urban agglomeration.

Table 3. The global Moran 's *I* value of the aging of the Zhongyuan urban agglomeration from 2000 to 2020

particular year	Moran's *I*	E(I)	Z(I)	p
2000	0.47	-0.003731	12.43	<0.001
2010	0.57	-0.003731	15.15	<0.001
2020	0.38	-0.003731	9.96	<0.001

The local spatial clustering characteristics of population aging in the Zhongyuan urban agglomeration are very obvious(Figure 3). The whole is dominated by the high-high cluster (H-H) and low-low cluster (L-L) agglomeration types, and the scope of H-H agglomeration shifts from the eastern and central regions to the southern region from 2000 to 2020, while the scope of L-L agglomeration is successive in the northern region.

Specifically, in 2000, H-H were clustered in the central region, with 22 counties centered on Henan Luohe's Place and 17 counties scattered in the east; in 2010, H-H were mainly concentrated in the southeast, with 53 counties centered on Lixin County in Huizhou, Anhui, an increase of 14 counties from 2000; in 2020, there is a clear spatial evolution, except for some still distributed in Dangshan County in Anhui, Guangshan County in Henan, Shangcai County, Xin County, Ye County and 15 other counties. In 2020, there is a clear spatial evolution, except for some of them still distributed in Dangshan County of Anhui, Guangshan County of Henan, Shangcai County, Xin County, Ye County

and other 15 counties, the other 38 counties become insignificant areas, and there are 9 new counties such as Taikang County of Henan, Qinyang County, Runan County and Zhengyang County, etc., which are clustered for H-H. 2000 L-L is mainly distributed in the northern part of the country. In 2000, the L-L was mainly distributed in the northern region, with 34 counties centered on Linzhou City in Henan Province and 38 counties scattered in Mianchi, Xin'an, and Yiyang counties in Henan Province and Wanrong County in Shanxi Province; in 2010, the L-L was still mainly distributed in the northern region, with 57 counties centered on Linzhou City in Henan Province; and in 2020, the low-low zone was mainly distributed in the northern region, with 57 counties centered on Guancheng District in Zhengzhou City in Henan Province. in 11 counties centered on Guancheng District in Zhengzhou, Henan, and 21 counties centered on Congtai District in Handan, Hebei. From 2000 to 2020, there are different degrees of counties with H-H and L-L, indicating that the spatial differences in population aging in the Zhongyuan urban agglomeration have narrowed.

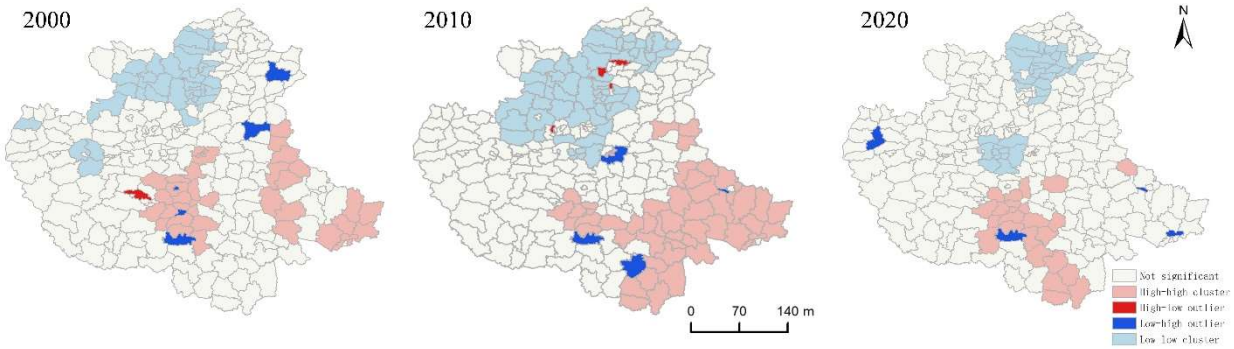

Figure 3. The LISA distribution map of population aging in Zhongyuan urban agglomeration from 2000 to 2020

4. INFLUENCING FACTORS OF THE SPATIAL AND TEMPORAL EVOLUTION OF POPULATION AGING

4.1. Selection of Influencing Factors

Combining previous studies and data accessibility[4-5], this study explores the factors affecting the spatial and temporal evolution of population aging in the Zhongyuan urban agglomeration at three levels: demographic, economic, and natural, based on the data from the Seventh National Population Census in 2020.

1) Demographic factors: old age ratio, birth rate, death rate, fertility level and migration rate are selected. Among them, due to the existence of the base effect, the ageing ratio of the sixth national census in 2010 will have an impact on the aging of the seventh census in 2020; the birth rate and mortality rate directly affect the change of the age structure of the population; fertility can affect the aging process through the direct effect on the number of the population, measured by the number of women of childbearing age between 15-49 years old, and the number of childbearing age women The number of women of childbearing age affects the birth rate, which in turn affects the degree of aging; the migrating population is limited by the availability of data, and the rate of change of the resident population at the end of the year with the natural change of the population removed, i.e., the net migration rate represents the rate of migration, which has a certain impact on the degree of aging.

2) Economic factors: economic level, education level and medical level are selected. Economic growth is a measure of the total economic activity of a region, and the economic level can directly affect the speed and degree of population aging, measured by the per capita GDP of the corresponding

year; the medical technology and the soundness of the medical insurance system enable the elderly to receive better medical care, which helps to improve the life expectancy and life of the elderly, however, the defects of the medical insurance system may lead to the high medical costs of the elderly, and become a financial burden for the family. However, shortcomings in the medical security system may lead to high medical costs for the elderly, which may become a financial burden for families, thus affecting the fertility rate and increasing the pressure of population aging, and the level of medical care is measured in terms of the number of beds per 10,000 people in medical and health care institutions; modern education pays more attention to the individual, and this change of concept may lead to a greater tendency to marry later and have children later or to have fewer children, which will exacerbate the ageing of the population, and the average number of years of schooling was selected as a measure of the level of education.

3) Natural factors: Transportation level, greening level and meteorological conditions are selected. The level of transportation is measured by the per capita road area, the road is related to the safety and convenience of the daily travel of the elderly, the gradual decline in the physical function of the elderly, the ability to walk and vision weakening, the number of roads will also affect the degree of aging; similarly, the level of greening is measured by the per capita area of green space as an indicator, the green space can be purified, high-quality housing for the elderly population has an attraction to the population, which affects the degree of aging; Meteorological Conditions Meteorological conditions are measured by the average annual temperature, which is too high or too low and can aggravate population ageing by increasing the risk of health and death among the elderly.

4.2. Results

4.2.1. Dominant Factors of Spatial Differentiation

Organize 11 influencing factors as independent variables, and the aging ratio of the Zhongyuan urban agglomeration as the dependent variable. By optimal parameters-based geographic detector, each influence factor is hierarchically clustered in 2020, and the number of intervals is determined. And using factor detection, the explanatory power q value and its significance level of each influence factor on the change of the degree of population aging are derived (Table 4). the larger the q value is, the stronger the explanatory power of the independent variable on the spatial differentiation of population aging is; the significance is measured by the *p* value, and the *p* value is less than 0.05 for the explanatory power of significant factors.

Table 4. Impact factor detection results in Zhongyuan urban agglomeration

classification	variable	class method	space-number	*q*	*p*
Demographic factors	old age ratio X_1	natural discontinuity	18	0.473	0.000
	birth rate X_2	quantile discontinuity	19	0.371	0.000
	mortality rate X_3	Quantile discontinuity	16	0.234	0.004
	fertility level X_4	natural discontinuity	19	0.556	0.000
	migration rateX_5	quantile discontinuity	19	0.364	0.000
Economic factor	economic levelX_6	quantile discontinuity	17	0.295	0.017
	education levelX_7	quantile discontinuity	17	0.283	0.000
	medical water levelX_8	quantile discontinuity	19	0.341	0.000
natural actors	transportation levelX_9	quantile discontinuity	18	0.345	0.000
	greening levelX_{10}	quantile discontinuity	19	0.360	0.000
	meteorological conditionsX_{11}	quantile discontinuity method	18	0.359	0.000

From the detection results, fertility level (X_4) > 2010 old age ratio (X_1) > birth rate (X_2) > migration rate (X_5) > greening level (X_{10}) > meteorological conditions (X_{11}) > transportation level (X_9) > medical water level (X_8) > economic level (X_6) > education level (X_7) > mortality rate (X_3). The dominant factors mainly include fertility level, 2010 old age ratio, birth rate and migration rate, all of which are demographic factors, followed by greening level in natural factors and medical water in economic factors. It can be seen that: demographic factors have a significant influence on population aging in the Zhongyuan urban agglomeration, while natural factors and economic factors have the second largest influence.

The primary influence factor of population aging in the Zhongyuan urban agglomeration is the fertility level, with an explanation degree of 55.6%. In recent years, with the improvement of women's status, education level and social competition pressure, some women choose to delay childbearing or the number of births, such fertility will lead to the number of births, which will accelerate the process of population aging. The second major influencing factor is the ageing ratio in 2010, with an explanatory degree of 47.3%; the ageing degree in 2010 indicates that the elderly population has already occupied a relatively high proportion, and due to the inertia of demographic change, the ageing degree in 2020 is likely to continue to be maintained or further increase, thus exacerbating the degree of population ageing. The third most influential factor is the birth rate, with an explanatory degree of 37.1%. The economy, accelerated urbanization, and policy shifts have combined to cause the birth rate in the Zhongyuan urban agglomeration to decline in recent years, which is consistent with the nationwide trend in fertility levels.

4.2.2. Factor Interaction

Population aging is not only affected by a single factor, but also by factor interactions. Therefore, the interaction detection of the optimal parameters-based geographic detector is used to deepen the influence of factor interactions on population aging in the Zhongyuan urban agglomeration.

From the results of the interaction probe (Figure 4), the degree of explanation of population aging in the Zhongyuan urban agglomeration by two-by-two interactions shows two-factor enhancement and nonlinear enhancement, which indicates that the explanatory power of factor interactions is higher than that of single factors, and that the factors work together to significantly enhance the explanatory power for the spatial and temporal evolution of aging. First of all, the 2010 ageing ratio∩fertility level has the most significant effect on population ageing, with an explanatory degree as high as 84.9%. Fertility level can directly affect the degree of population aging, and the demographic change has inertia, the significant increase of the 2010 ageing ratio has an impact on the aging in 2020, so the 2010 ageing ratio and the fertility level are important factors affecting the spatial and temporal evolution of aging. Second, greening level∩fertility level has the second highest degree of explanation. Greening level affects residents' life and air, and good housing tends to correlate with higher fertility intentions, making the interaction of the two more explanatory of aging. In addition, the birth rate∩ ertility level should not be ignored, as the birth rate determines the growth rate of the young population.

Taken together, the interaction between fertility level and other factors has a very strong explanatory power, indicating that fertility level significantly affects the spatio-temporal evolution of population aging. At present, China has implemented a number of policies to promote fertility, and various localities have more targeted measures aimed at slowing down the process of population aging, raising the fertility rate and further optimizing the population structure through the burden of family childcare. Examples include the full liberalization of the three-child policy, the introduction of preferential interest rates for home purchase loans in Zhengzhou City, and the granting of maternity allowances in Xinxiang City.

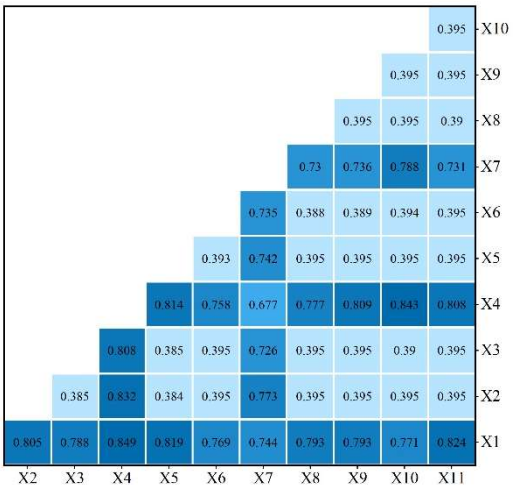

Figure 4. Impact factor interaction detection results

5. CONCLUSION

This study takes the county as the research scale, based on the population census data, takes 2000, 2010 and 2020 as the entry point to characterize the evolution of spatio-temporal pattern of population aging in the Zhongyuan urban agglomeration, and applies the optimal parameters-based geographic detector to investigate the factors affecting population aging. The main conclusions are:

1)In terms of temporal evolution, population aging in the Zhongyuan urban agglomeration from 2000 to 2020 shows the characteristics of "low in the northwest and high in the southeast", and the degree of aging is deepening from the northwest to the southeast, which has completed the transition from adult type to old type. Most counties show an accelerating trend of population aging, which is highly consistent with the nationwide population aging process.

2)In terms of spatial evolution, there is a strong global spatial positive correlation of population aging in the Zhongyuan urban agglomeration, while the local spatial agglomeration is obvious. The high-high cluster from 39 counties in 2000 to 53 counties in 2010, to 24 counties in 2020, while the low-low cluster from 38 counties in 2000 to 57 counties in 2010, but in 2020 to 32 counties, both types of agglomeration show the trend of increasing and then decreasing, indicating that the Zhongyuan urban agglomeration spatial differences in population aging have been reduced.

3)In terms of influencing factors, fertility level, 2010 old age ratio, birth rate and mortality rate are the main factors affecting the spatial and temporal evolution of population aging in the Zhongyuan urban agglomeration, all of them are demographic factors, and the explanatory power of the other factors is relatively weaker, but the natural factors and economic factors also have a certain influence. Compared with the results of single-factor influence, the influence of two-by-two factor interaction is stronger, and the interaction between fertility level and 2010 old age ratio, birth rate and greening level is more significant.

REFERENCES

[1] Zhao Dongxia, Han Zenglin, Wang Li.The spatial pattern of aging population distribution andits generating mechanism in China[J].Acta Geographica Sinica,2017,72(10):1762-1775.

[2] Watkins J F, Ulack R.Migration and regional population aging in the Philippines[J].Journal of Cross-Cult Gerontol,1991,6(4):383-411.

[3] Chomik R, McDonald P, Piggott J.Population ageing in Asia and the Pacific:Dependency metrics for policy[J]. Journal of the Economics of Ageing,2016,8:5-18.

[4] WANG Li, LIU Wanbo, ZHAO Dongxia, Han Zengli, Huang Xinhui.Spatial Differentiation Characteristics of Advanced Age Population in Northeastern China and Its Driving Factors.Scientia Geographica Sinica,2019,39(02): 267-276.

[5] Wang Chenggang, Ning Xiaogang, Wang Hao, Liu Xiaojiang.Spatial pattern change of China urbanagglomerations using nighttime light data[J].Science of Surveying and Mapping,2019,44(6):176-186.

[6] Hu Yuna, Mei Lin, Chen Yan.Quality Assessment andSpatial Feature of Portal Websites in China's 5A Rated Tourism Attraction[J].Scientia Geographica Sinica,2016,36(4):548-554

[7] Song Yongdong, Wang Jinfeng, Ge Yong, Xu Chengdong.An optimal parameters-based geographical detector model enhances geographic characteristics of explanatory variables for spatial heterogeneity analysis: cases with different types of spatial data[J].GIScience & Remote Sensing,2020,57(5):593-610.

[8] Wang Lucang, Wu Rongwei, Liu Haimeng, Zhou Peng, Kang Jiangjiang.Spatial patterns and regional differences of population ageing in China based on the county scale[J].Progress in Geography,2016,35(8):921-931.