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Evolution of Patterns in the Ratio of Gender at Birth in Henan province, China

Ewolucja rozkładu wskaźników urodzeń według płci w prowincji Henan w Chinach

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Abstract

The imbalance in the ratio of males to females at birth is one of the major challenges facing modern China. It is a problem that cannot be overlooked, especially in the context of the socioeconomic development being experienced in China. Based on data of the sex ratio at birth in 2000 and 2010, and using exploratory spatial data analysis and geographical detector methods, this paper systematically explores spatial patterns, evolutionary characteristics and the mechanisms for the analysis of this ratio in Henan province. The results show that: (1) the degree of imbalance between the sexes is exhibiting a downward trend, while significant differences in the levels exist in internal county units and these variations are increasingly expanding; (2) areas exhibiting extreme levels of imbalance are located in the north, east and south of Henan. The remaining areas had a mixed distribution and were widely spread in the central and western regions of the province; (3) according to the spatial correlation characteristics, there exists an obvious aggregation phenomenon in sex structure at birth which has moved northwest in the decade under review; and (4) there are many factors affecting the distribution of the ratio between the sexes at birth, including natural environmental conditions, levels of education, population stress, economic development and population migration. In addition to these factors, urbanization, living conditions, social development, traffic conditions, income level, reproductive potential and health factors have also influenced the proportion of males to females to different degrees.

Key words: sex ratio at birth, sex structure, country scale, space evolution pattern, Henan province

Streszczenie

Dysproporcje w liczbie urodzeń mężczyzn w stosunku do liczby urodzeń kobiet stanowią jedno z głównych wyzwań współczesnych Chin. Jest to problem, który nie może zostać pominięty, szczególnie w kontekście trwającego w Chinach rozwoju społeczno-gospodarczego. Niniejszy artykuł podejmuje metodyczną analizę wzorców przestrzennych, cech ewolucyjnych i mechanizmów analizy wskaźnika urodzeń według płci w prowincji Henan w oparciu o dane z lat 2000 i 2010 oraz z wykorzystaniem danych przestrzennych i metod detekcji geograficznej. Wyniki badań pokazują, że: (1) stopień dysproporcji pomiędzy liczbą urodzeń według płci wykazuje tendencję spadkową, a znaczne, coraz bardziej widoczne, różnice istnieją w wewnętrznych jednostkach powiatowych prowincji; (2) północne, wschodnie i południowe obszary prowincji Henan odznaczają się najwyższym stopniem tych dysproporcji. W pozostałych obszarach prowincji dysproporcje rozkładały się w sposób mieszany i były szeroko rozpowszechnione w regionach centralnych oraz zachodnich; (3) zgodnie ze specyfiką korelacji przestrzennej,

istnieje oczekiwane zjawisko agregacji w strukturze urodzeń według płci, które na przestrzeni dekady przemieściło się w rejon północnego-zachodu; (4) istnieje wiele czynników, które mają wpływ na rozkład proporcji płci podczas narodzin, należą do nich: warunki naturalne, poziom wykształcenia, poziom stresu ludności oraz rozwoju gospodarczego, migracja ludności. Oprócz powyższych czynników, wpływ na odsetek mężczyzn wśród kobiet miały w różnym stopniu: urbanizacja, panujące warunki mieszkaniowe, potencjał reprodukcyjny oraz czynniki zdrowotne.

Słowa kluczowe: wskaźnik urodzeń według płci, struktura płci, skala krajowa, wzorce ewolucji przestrzennej, prowincja Henan

Introduction

The sex ratio at birth of the populations of 18 countries and regions around the world is higher than the upper limit of what is considered to be the normal value. In China, the sex ratio at birth (SRB) has been in imbalance since the 1980's, and China has become the country facing the most serious issues as a result (Nhfpcprc, 2015). Although China's gender ratio imbalance at birth has declined for the seventh consecutive time since 2009 due to the continuous adjustment of population policy, the problem of the imbalance in births is still severe due to traditional concepts of fertility and an aging society. A series of social phenomena may arise as a result of this combination of factors, including *high price bride price*, the increase in *transnational brides*, *marriage refugee* and even sexually motivated crime. All of this could prove to be serious obstacles to continued economic growth, social stability and sustainable managed population development, and China is large enough that significant difference in environmental and socio-economic conditions are possible in various regions within the country. The deep-rooted traditional concepts of fertility not only leads to an imbalance in the spatial distribution of population in terms of age structure (Wang et al., 2016), but also causes significant spatial differences in the ratio between sexes at birth. The study of these ratios has gradually drawn the attention of more and more scholars, both at home and aboard, to the issue. Foreign scholars tend to focus on the studies related to theory and practice. Anantharan et al. (1989) analyzed the relationship between the sex ratio at birth and birth rates, and found that they showed an inverted U-shaped curve (Anantharam and Premi, 1989). Park et al. (1995) found that an imbalanced sex ratio at birth exacerbates marriage squeeze and changes the marriage model. Empirical evidence from the 2000 Census in China revealed that the number of *missing girls* in the relevant cohorts is approximately 12 million (Cai and Lavely, 2003). Li et al. studied gender preference in Hebei province, from 1979 to 1989, and argued that sex-selective abortion may be responsible for half of the high levels of imbalance in the ratio of male to female births in China in this period (Li and Cooney, 1993). Guilmoto used population projections based on the gender ratio at birth, and concluded that the population in China and India will reduce by 28 and 24 million, respectively, by 2050 (Guilmoto, 2012). In China, the research has been focused particularly on the measurement of the gender ratio at birth (Shen, 2014; Wang, 2008), trends in variations (Peng and Chen, 2015), space-time patterns (Liu and Li, 2014; Shi and Mi, 2015; Liu and Zhu, 2015), mechanisms (Liu et al.,2014), the consequences of imbalance (Liu and Li, 2010; Guo et al.,2016), and governance measures (Shi, 2009; Wei, 2011; Shi, 2016).

Previous literature on scale indicates that there are alternative geographic units that can be used for spatial analysis, such as blocks, tracts, cities and states (Qiu and Li, 2016). Scholars have completed extensive work on the pattern of gender birth in China at the city and state levels. However, research related to the county level is rare (Messner et al., 1999; Guo et al., 2013; Luo et al., 2016). As for research methods, the development of spatial analysis technology, statistical analysis, spatial statistics methods and geographic information technology has widened the researcher's available tools (Zhang, 2001; Liu, 2014; Li, 2015). From a disciplinary perspective, the research on gender imbalance focuses on demography, sociology, economics, psychology and criminology, but studies based on geographic factors are not currently available (Feng, 2012).

In this paper, spatial patterns and the evolution of the characteristics of gender balance at birth in Henan province, based on the county-wide data and using exploratory spatial data analysis methods, are analyzed in detail. The mechanisms for determining spatial patterns are analyzed by means of geographical detectors, which provide guidance for population policy adjustment, gender structure optimization and sustainable development of a population's health.

1. Material and methods

1.1. Study area

China had a population of 1.361 billion at the end of 2013, and the gender imbalance at birth had resulted in an average sex ratio of 117.60. Henan province has a large population matching many countries, with 106 million people in 2013. It is located in the eastern part of China, around the middle and lower reaches of the Yellow River, between 110 ° 21 '~ 116 ° 39'E and 31 ° 23 '~ 36 ° 22'N (Figure 1). The province is 550 km long from south to north and 580 km wide from east to west. The sex ratio at birth was imbalanced at 116.54. There are many similarities in the evolutionary trends, concepts of fertility, and the stage of development of sex structure at birth between China and Henan prov-

ince. In other words, Henan province can be seen as the epitome of China itself (Ding et al., 2015; Liu et al., 2016). Therefore, the choice of Henan province as the typical area in which to study issues of gender imbalance sex structure at birth was a logical and appropriate one.

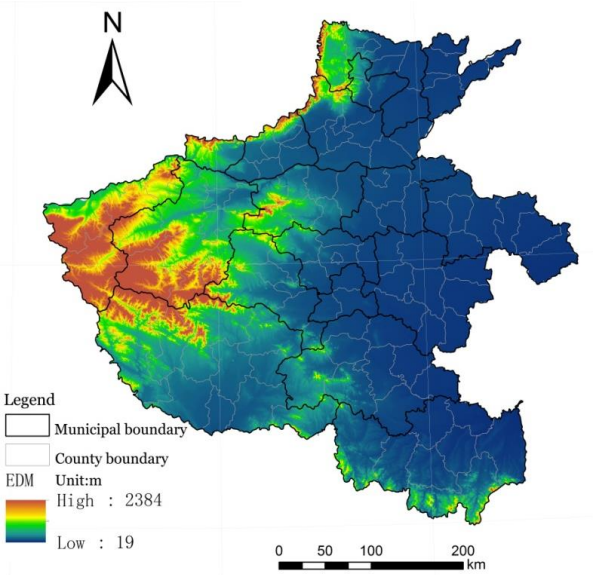

Figure 1. Location of study area

1.2. Exploratory spatial analysis method

The exploratory spatial analysis method was used to test whether the observations of a unit is related to the observations of the neighboring unit. Moran's I was used to estimate the global spatial autocorrelation as a whole, and the local indicators of spatial association (LISA) used as a measure for determining the local spatial autocorrelation. Using LISA to analyze the spatial pattern has consistently provided reliable and stable results, in part, because they can be standardized, so significance levels can be tested (Fu et al., 2016). The formula (Li et al., 2013) is:

$$\begin{cases} I = \dfrac{\sum_{i=1}^{K}\sum_{j=1}^{K}\left(X_i - \bar{x}\right)\left(X_j - \bar{x}\right)}{S^2\sum_{i=1}^{K}\sum_{j=1}^{K}W_{ij}} \\ I^* = \sum_{p\neq q}^{m} W_{pq}Z_pZ_q \end{cases} \quad (1)$$

Where X_i and X_j denotes the observed value at locations i, j, and W_{ij} is the spatial weights matrix for locations i and j, defined as 1 if the location i is contiguous to location j and 0 otherwise. Wpq is the standardized spatial weight matrix, Zp, Zq represent standardized values of p, q, respectively.

1.3. Geographic detector method

The geographic detector is often used to test the association between explained variable Y and factor X according to the consistency of their spatial distributions, to explore the determinant of factor x for variable y. The formula (Liu and Yang, 2012; Ding et al., 2014) is:

$$P_{D,G} = 1 - \frac{1}{\sigma_G^2}\sum_{i=1}^{m}(n_{D,i} \times \sigma_{D,i}^2) \quad (2)$$

Where $P_{D,G}$ is the detection force of the detection factor D, m is the number of sub-region, $\sigma_{D,i}^2$ stands for the discrete variance of the sex ratio of a population in sub-regions, and σ_G^2 indicates the discrete variance of the gender ratio in the whole region.

1.4. Data analysis with computer software

Moran's I and LISA values were measured using software ArcGIS (version 10.2). All maps were produced using GIS software ArcMap® (version 10.2).

1.5. Data sources

Based on 1: 4,000,000 databases for National Fundamental GIS and the base map of the administrative division of Henan province in 2010, 126 geographical units were obtained and used as the research object. As for the principle of comprehensiveness and comparability, data for sex ratio at birth at the county level in 2000 and 2010 was available and reliable, while data in other years was collected through a sample survey, though they were difficult to obtain and record. Therefore, the data used in this study was derived from the fifth and sixth national censuses conducted at a county level in 2000 and 2010, and the sex ratio at birth calculated, based on a population aged 0. In addition, the national economic and social data extracted from *Population Census of China* and *Henan Statistical Yearbook* was consulted. DEM data came from the National Basic Geographic Information Center and traffic network data was from *Henan and neighboring provinces highway traffic atlases*.

1.6. Classification standard of sex structure at birth

Sex ratio at birth (SRB) is defined as the number of boys born per 100 girls. In a large population, the average SRB ranges between 102 and 107 because the mortality rate of boys is usually higher than that of girls. Figures over 107 or less than 102 are considered to indicate an imbalance. In this study, sex structure at birth is divided into five types according to the characteristics of the gender of the population at birth in Henan province: a balanced SRB is one between 102 and 107, a mild imbalance has an SRB between 107 and 112, a moderate imbalance is an SRB between 112 and 117, a severe imbalance has an SRB between 117 and 122, and an extreme imbalance has an SRB above 122.

2. Results and discussion

2.1. Characteristics of spatial structure of relating to gender balance

2.1.1 Changes in spatial layout characteristics

Spatial distribution of the sex structure at birth in Henan province at the county level was shown in Figure 2.

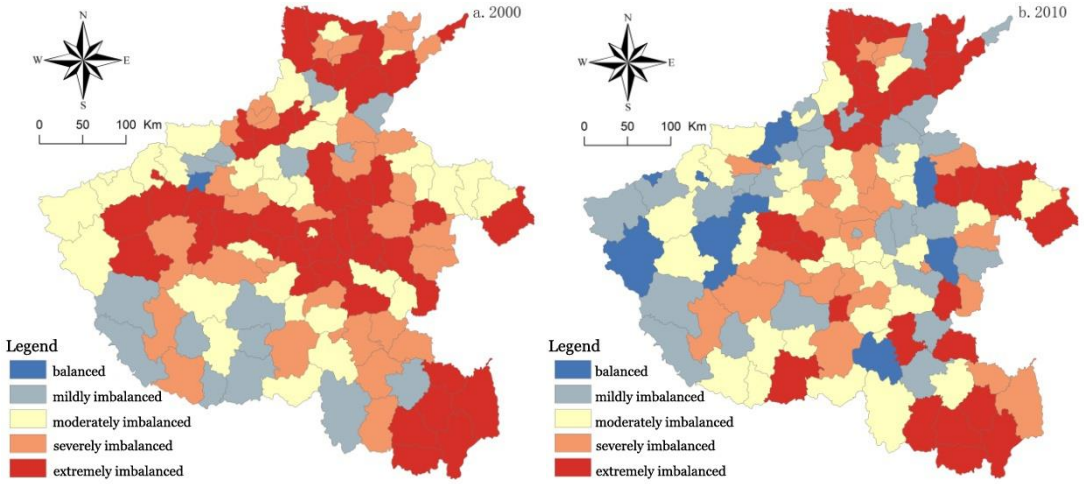

Figure 2. Spatial distribution of the sex ratio at birth in 2000 (a) and 2010 (b) in Henan province

In 2000, the number of county units in which the sex structure at birth was balanced, mildly imbalanced, moderately imbalanced, severely imbalanced and extremely imbalanced was 1, 15, 33, 31 and 46, respectively (Figure 2a). The results indicated that the gender balance was optimal in only one county unit in Henan, while the rest of the 125 county units were imbalanced to a greater or lesser extent. Among the 125 unbalanced county units, there are 77 (61.11%) with severe imbalances and above, indicating that the problem of the imbalanced sex ratio at birth in Henan province has been severe. Xinxian had the highest sex ratio at birth, at 136.03, while Luoyang had the lowest, at 105.96. The difference between them was 30.07. This significant difference was mirrored among the counties in Henan. In 2010, there were 11(8.73%), 28(22.22%), 32(25.40%), 22 (17.46%) and 33 (26.19%) county units, where the sex structure at birth was imbalanced, mildly imbalanced, moderately imbalanced, severely imbalanced and extremely imbalanced, respectively (Figure. 2b). The number of imbalanced county units account for 91.27% of the total. Compared to 2000, the number of county units that were in the severe and extreme imbalanced categories has reduced to 55, while those in the balanced and mildly imbalanced groups have increased to 39. The results illustrate that, although imbalances in sex ratio at birth has been alleviated to some extent, the imbalanced situation persists. Yongcheng had the highest SRB of 144.98 and Yima had the lowest at 102.03 in 2010. The difference between the two counties was 42.95, which was larger than that in 2000, indicating that the differences between counties in Henan increased.

In 2000, the severe and extreme imbalances in SRB in different parts of Henan tended to be most marked in Anyang, Hebi, Puyang (north Henan), Zhoukou, Kaifeng (east Henan), Xuchang, Luohe (Yuhong), Luoyang, Jiaozuo (west Henan) and Xinyang, Zhumadian (south Henan). Other areas of notable imbalance were scattered around them. In 2010, the mixed nature of the distribution in SRB was more obvious than that in 2000. Severely and extremely imbalanced areas were concentrated in Xinxiang、Anyang、Puyang (north Henan), Xinyang (south Henan), Shangqiu (east Henan) and Nanyang、Luoyang、Pingdingshan (west Henan). Moderate imbalances, mild imbalances and balanced figures were widely distributed in the central and western regions of Henan province and the spatial pattern was decidedly that of mixed distribution.

2.1.2. Changes in spatial correlation characteristics

2.1.2.1. Global spatial autocorrelation

Moran's I index of sex ratio at birth in 2000 and 2010 in Henan province was calculated (Table 1).

Table 1. Moran's I value of the sex ratio at birth in Henan province

Index	2000	2010
Moran's I	0.2685	0.2340
P value	0.0003	0.0004
Z value	4.7081	4.1352

Moran's I global value of sex ratio at birth in 2000 was 0.2685 with P value < 0.05. Positive spatial autocorrelation was observed for the sex ratio at birth, revealing that the spatial distribution of sex population at birth in 2000 in Henan province was clustered. Moran's I global value of SRB in 2010 was 0.2340 with P value < 0.05, which was also greater than 0. This result showed that the sex structure at birth in Henan province in 2010 demonstrated the characteristic of spatial clustering. It is worth noting that Moran's I values of SRB in 2010 was lower than those in 2000, which indicated that the SRB was still dominated by aggregated distribution in that decade, but there was potential spatial randomness in its spatial distribution.

2.1.2.2. Local spatial autocorrelation

The results of a LISA analysis were illustrated in Figure 3.

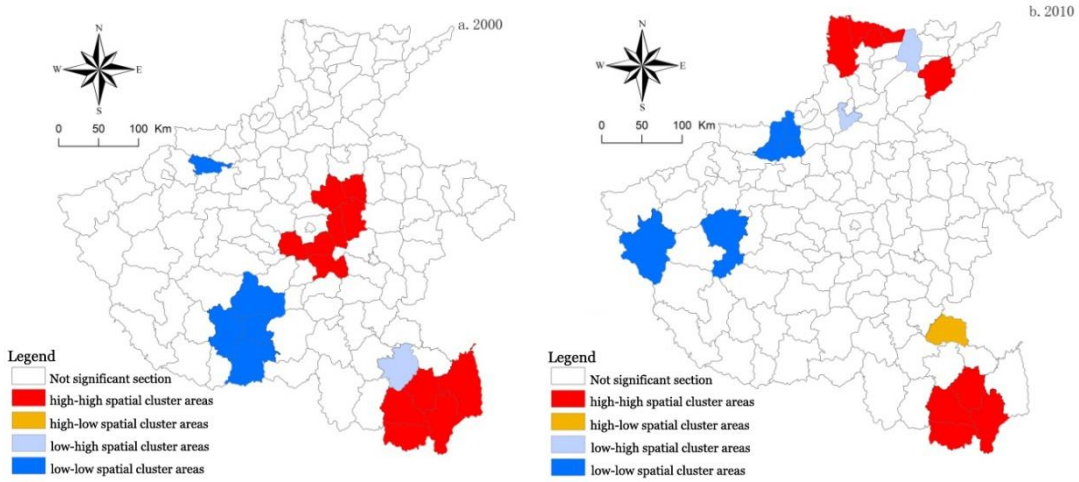

Figure 3. Spatial autocorrelation: the birth sex ratio in Henan province in 2000 (a) and 2010 (b)

Large high-high spatial cluster areas of sex ratio at birth in 2000 were observed in the south-eastern and middle part of Henan province, mainly in Weishi, Tongkou, Yanling, Fugou, Linying, Xiangcheng, Luohe, Luoshan, Guangshan, Xinxian, Huangchuan, Shangcheng and Gushi. Relatively small low - high spatial cluster areas were mainly located in Zhengyang. The low-low spatial clusters were distributed in the western part of the province, such as Fangcheng, Sheqi, Tanghe and Nanyang (Figure 2a). In 2010, the high-high spatial clusters were found in the southeast and north, in Linzhou, Anyang, Anyang city districts, Puyang, Guangshan, Xinxian, Huangchuan and Shangcheng. The high-low spatial cluster areas were to be found in Xin Cai. The low-high spatial cluster areas were mainly located in Neihuang and Xinxiang, and low-low spatial clusters were to be found in Qinyang, Mengzhou, Wenxian, Boai, Lushi and Ruyang (Figure 2b). The number of high-high spatial cluster areas reduced by five, while the number of high-low, low-high and low-low spatial cluster areas increased by 1, 1, and 2, respectively. The spatial distribution of SRB in high-high and low-low spatial clusters has not changed fundamentally in the past ten years. The data also showed that the local spatial autocorrelation of SRB in Henan province was positive, but the clustering distribution revealed a weakening of that tendency.

There are two obvious characteristics of the high-high spatial clusters in Henan province: (1) the distribution range of the southern region has decreased; (2) the regions have gradually moved from the middle in a northerly direction throughout the province. In 2010, the high-low spatial cluster areas were mainly distributed in the southern region, which had no distribution in 2000. The low-high spatial cluster areas have moved from the southern region to the northern region. The low-low spatial clusters were mainly found in the southwest in 2000, while in the west and northwest region in 2010 there were different factors in play that resulted in different low-low spatial distributions. The low-low spatial clusters in 2000 were located in the Nanyang Basin, because economic development there was particularly fast, external traffic was relatively convenient, and people's concept of fertility was more aligned to scientific and rational ideas. Many mountainous counties were located in the western region of Henan province and external travel was problematic. In addition, the west region was being drained of young adults due to the lower proportion of secondary and tertiary industries and decreasing employment, which not only reduced the number of those of marriageable age within the population, but also caused increases in *bride price*, putting a large number of unmarried young men into a group for whom marriage was virtually impossible. These reasons were responsible for the low-low spatial clusters in 2010 in the west region of Henan province. In the northwest of Henan, industrial development started relatively early and accounted for a large proportion of the population who were employed in the industrial sector. However, with the parallel transformation in energy conservation and emission reduction policies in recent years, this region's economic growth has lagged behind other regions so that the area has gradually transformed from one experiencing a population net inflow into one where there is population net outflow.

2.2. The formation mechanism of spatial structure of sex structure at birth

The spatial distribution of the sex structure at birth is potentially influenced by a number of factors. This study has concentrated on the state of the natural environment, traffic conditions, population mobility, fertility potential, economic development, living conditions, educational levels, urban development, population stress, medical conditions, resident income and social development as the major contributors (Table 2), using the sex ratio at birth in 2010 at the county level in Henan Province as a detected fac-

Table 2. Indictors of potential determinants for sex ratio at birth

Detection factor	Potential determinants	Indictors	Data Sources
X_1	Natural condition	Average altitude (m)	Henan Province 90m resolution SRTM DEM data
X_2	traffic condition	Road network density (km / square kilometers)	2010 Henan and neighboring provinces highway traffic map book
X_3	Migration	The number of floating population (person)	2010 census data
X_4	Fertility potential	Number of women aged 15 to 49 ears (person)	2010 census data
X_5	economic development	GDP (Million)	2011 Statistical Yearbook of Henan Province
X_6	Education level	Average years of schooling (year)	2010 census data
X_7	living condition	Per capital housing area (m^2)	2010 census data
X_8	Town development	Population urbanization rate (%)	2011 Statistical Yearbook of Henan Province
X_9	Population stress	The proportion of the population over 65 years (%)	2010 census data
X_{10}	Medical condition	The number of beds per thousand people (piece)	2011 Statistical Yearbook of Henan Province
X_{11}	residence income	Per capita Savings Balance (RMB)	2011 Statistical Yearbook of Henan Province
X_{12}	Social development	Survival rate of child-bearing children (%)	2010 census data

Note: (1) Highways in Henan province occupy a dominant position in traffic systems.

tor. From there, then, the formation mechanism of the spatial pattern of sex ratio at birth in Henan province was analyzed.

The text refers to the road network density as only high-speed, national highway, provincial highway and county road grade 4 road network density. (2) The number of floating population by the resident population minus the number of registered population. (3) In general, the number of women aged 15-49 years of age, that is, childbearing age, is higher, indicating a greater risk to newborns in the region. Therefore, the number of women of childbearing age, 15 to 49, is used to express fertility potential. (4) Different social stages have different levels of development of productive forces. The history of human society shows that the survival rate of children is, to some extent, linked with the development of productive forces. Any improvements in infant mortality rates will have an impact on the birth gender ratio and could result in a change from a balance to a situation of imbalance. Infant survival rates can be seen as a reflection of the comprehensive development of social indicators.

The spatial distribution of classified potential determinants was plotted using ArcGIS10.2 software (Figure 4). The $P_{D,G}$ values ($p< 0.05$) were calculated to analyze the ability of each detection factor to determine the spatial distribution of sex ratio at birth in Henan province. The geographic detector disclosed the influence of detection factors on the sex ratio at birth which was ranked by $P_{D,G}$ value as follows: natural condition (0.860) > population flow (0.365) > urban development (0.271) > living conditions (0.234) > social development (0.231) > traffic conditions (0.182) > household income (0.176) > education level (0.744) > population stress (0.705) > economic development (0.600) > fertility potential (0.086) > medical conditions (0.051).

The geographic detector method utilized is novel in that it identifies the interrelationships between gender ratio at birth in Henan province and a number of factors based on the correspondence of their spatial distribution. Results were obtained according to $P_{D,G}$ values as follows: (1) environmental condition was the primary factor that affected the spatial distribution of the gender structure in the province. In general, economic development lags behind other areas, external relations were consequently underdeveloped, as were social security systems. The belief in the necessity of raising sons in order to provide for parents in old age was deep rooted, and a large number of local young men could not find women of marriageable, childbearing age, to marry. Consequently, *marital squeeze* was greatly exacerbated in these areas, resulting in the gender ratio being imbalanced due to the decreasing numbers of newborns. (2) Educational level was the secondary determinant of differences between areas in the gender ratios. With the development of education, ideas such as *boys and girls are the same*, *a daughter is also a descendant*, and *a daughter can hold up half the sky* have gradually become more and more accepted and in some areas created a social consensus. This

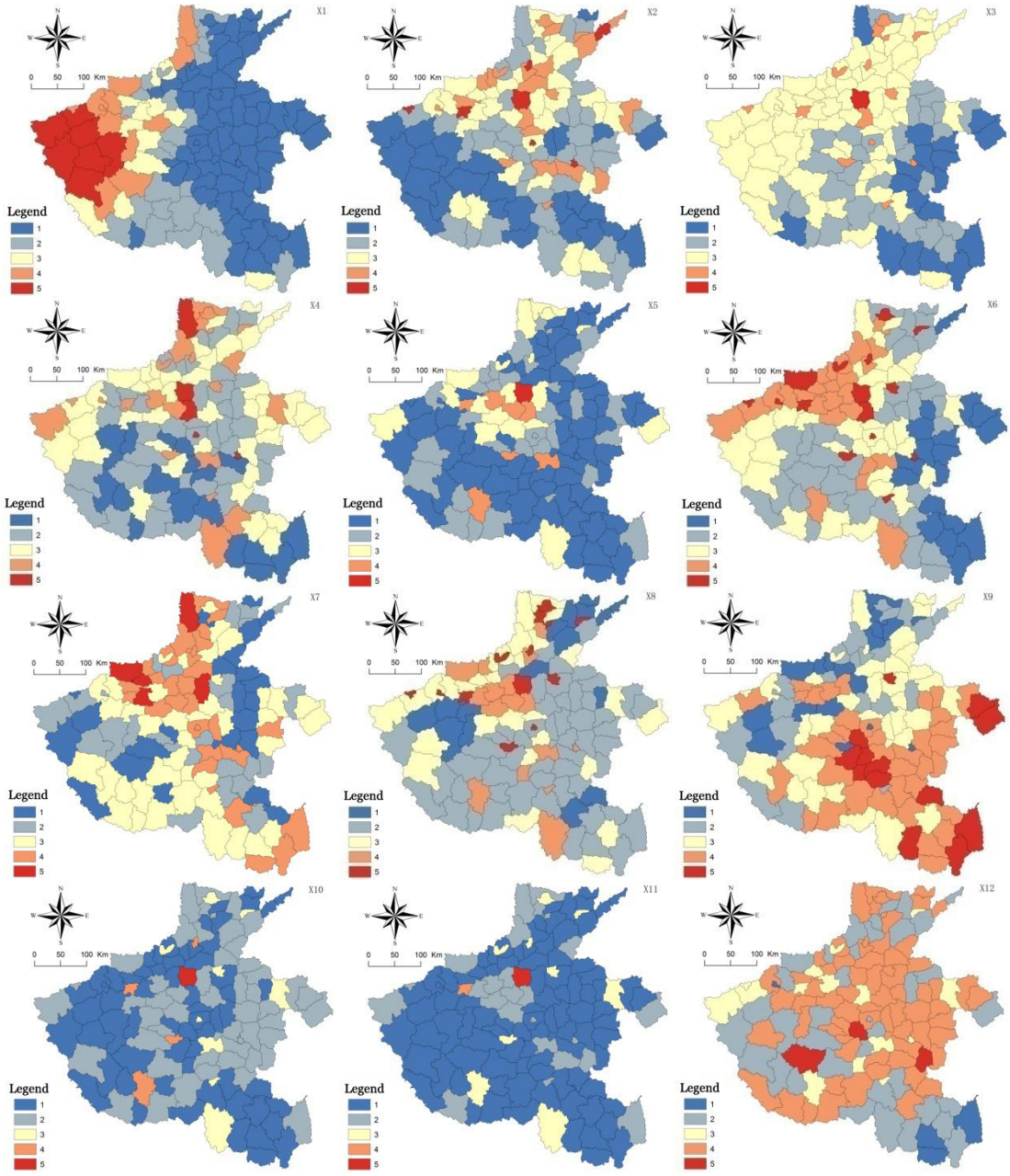

Figure 4. Spatial distribution of classified potential determinants

change in attitudes could account for changes in gender preference and might be responsible for the spatial distribution of the sex ratio at birth. (3) Population stress was the third most important factor as the more serious the level of the aging of a population, the weaker the fertility of that population. Traditional concepts of family planning, mixed with traditional ideas of procreation, also impact on the ratio. (4) Economic development and population flow both had an overwhelming effect on how the gender ratio was distributed in the province. Economic development attracted mass migration movements, especially of young people. On the one hand, this resulted in an increasing number of the elderly being left behind, along with women and children in those areas which experienced net outflows of population. On the other hand, the economic condition of those who moved for economic reasons was improved, ideas were changed and immigrants to the regions that experienced an inflow of population created situations that changed spatial patterns of gender balance at birth. (5) Urban development, living conditions, social developments, traffic conditions, income, fertility potential and health care also contributed to the pattern of distribution of gender at birth. Among these, urban development, living conditions, social developments, traffic conditions, household income and health care represented comprehensive development levels in the counties, and fertility potential had an effect on the distribution of the ratio at birth through affecting the population structure.

3. Conclusion and countermeasures

3.1. Conclusion

Based on census data from 2000 and 2010, we analyzed the sex at birth of children born in Henan province, the specific locations of those births, and the changes in proportion of males and females within those areas. The determinants for the spatial distribution of SRB in Henan province were obtained and the following conclusions were reached. Firstly, although the balance between males and females at birth in Henan province from 2000 to 2010 showed fluctuations and exhibited a degree of imbalance, the extent of that imbalance had decreased. Secondly, the distribution of sex at birth evolved from what might be termed concentrated distribution to one more akin to a mixed distribution. The areas where a severe imbalance occurred, SRB reduced, and those remaining at the severe level were in northern, eastern and southern Henan. Thirdly, the spatial autocorrelation of sex at birth was, for the most part, clustered. The spatial cluster areas in 2000 were in the middle, the southwest and southern regions of Henan province. In 2010, they were located in the southern, western, northern and northwest region of the province. Finally, natural conditions, education levels, population stress, economic development and population flow were important factors that contributed significantly to the sex ratio at birth of the population in Henan province.

3.2. Policy implications

The government plays a leading role in alleviating or reversing gender imbalance in the birth population, and this paper has outlined some suggestions that appropriate authorities might take into consideration in planning their strategies. The first of these is to promote sustained and rapid economic growth since winning the fight against poverty is fundamental to any attempt to manage population growth effectively. Economic development is the prerequisite and guarantee for the development of social factors, such as residents' income, progress in educational terms, improvements in medical care, the social security system, and the construction of an infrastructure that meets the needs of a modern society. Under normal circumstances, the higher the level of economic development in a given area, the less likely it is that young men of marriageable age will suffer from *marriage squeeze*. The willingness of people to procreate, and their ability to raise their children relative to higher levels than they themselves achieved, is enhanced. Poverty and misinformation leads to personal and societal gender preferences; consequently, the government should implement a strategy of balanced regional economic growth, adjusting industrial structures, increasing investment in science and technology and improving the infrastructure, all aimed at promoting sustained economic growth. Secondly, it is crucial to strengthen publicity and guidance and improve the general social security system. The gender imbalance in births is often the result of a totally unscientific concept of fertility, especially in rural, poor areas and remote areas. Social security coverage in these areas is relatively limited while *support* and *family*, along with the concept of *son preference*, are deeply rooted. The government should expand pension, medical, unemployment and other social insurance schemes in the region, while at the same time address the issues created by poor educational levels. Concepts of innovation and change have to be promoted and appropriate adjustments made to supporting policies, such as increasing one-child families in rural areas and the promotion of family planning. Finally, it is important to combat fetal gender identification and selective pregnancy termination. Due to a long tradition of acceptance of the *son preference* in China there are many fetal sex determination and sex-selective termination practices that are illegal and carried out only for profit. Some institutions involved in such practices cover their activities with a veneer, attempting to provide legitimacy under the cloak of medical considerations. This, in itself, makes it difficult to assess the true, natural, levels of sex imbalance in different areas. The government has to be much more proactive in legislating, implementing and enforcing policies that reduce illegal behavior. A multi-disciplinary approach to the enforcement of regulations, utilizing the resources of all involved, and relevant agencies, has to be adopted and effective sanctions imposed on those institutions and individuals who behave inappropriately. At the same time, incentives to encourage the population to act responsibly, including informing on those not adhering to guidance should be introduced.

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