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Development of public health in the context of new urbanization and high-quality economic development based on factor analysis

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Abstract: *Under the background of new urbanization and rapid economic development, all countries are facing the challenge of public health security and actively develop public health. At present, public health is faced with a variety of biological threats that threaten public health on a large scale, inefficient and chaotic health governance, and unreasonable political, economic and wealth order, which aggravate the health dilemma. In order to promote and improve the development of public health, this paper analyzes their contribution to the development of public health from the perspective of the new urbanization process and economic development, and analyzes the role of many sub-factors in the development of public health. This paper proposes a method of factor analysis to consider the contribution of urbanization and economic development, and analyzes the importance of each part of public health. The results showed that urbanization process and economic development were positively correlated with public health. Government intervention, the level of market process, population density and the degree of industrialization play a crucial role in the development of public health. The factor analysis shows that disease prevention and control play an important role in the evaluation of public health and is an effective method to consider the contribution of urbanization and economic development to public health.*

Keywords: *Public Health; Factor Analysis; Urbanization; Economic development; Machine learning*

1. Introduction

As an important carrier of national economic development, some scholars have made extensive studies on the relationship between urbanization and economy. The early studies mainly discussed the influence relationship between urbanization and economic growth theoretically [1-3]. Subsequent studies conducted empirical analysis on the basis of theoretical basis, and most of the research results believed that there was a positive correlation between the two. Moomaw and Shatter [4] believed that urban population was significantly and highly positively correlated with per capita GDP based on national data. Henderson [5] also came to a similar conclusion in his research on the relationship between urbanization development level and per capita GDP in different countries, showing a high correlation between them. Zhou [6] and Vernon [7] both found a positive correlation between urbanization and economic development indicators of several countries. Guo [8] and Zhou [9] believe that there is a cointegration relationship between urbanization and economic growth. Liu [10] took into account that the relationship between urbanization and economic growth was different due to time periods, and showed that urbanization and economic growth had a long-term mutually promoting relationship. However, urbanization and economic growth will also bring negative effects to each other [11-12], some scholars believe that urbanization has no obvious impact on economic growth. Lewis [13] believed that there was no significant correlation or negative correlation between urbanization level and economic growth. Bertionlli and Strobl [14] used panel data of 39 countries and regions for estimation, and believed that there was no systematic correlation between urbanization process and economic growth. Jin [15] used the panel data of various provinces in China to conduct research and held that there was no clear relationship between urbanization and economic growth, and the difference in the development level of provinces determined the degree of correlation between them. Huang Ting [16] showed through the study of VAR model that the mutual explanation between new urbanization and high-quality economic development was very low, that is, there was a weak correlation.

The rapid economic development of a region can become a strong safeguard of the government department supply basic public health service, which will exert a great influence on the supply strength

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of Chinese government departments, and then relate to the level of basic public service supply efficiency. With the improvement of the economic level, the corresponding health needs of the people have dynamic changes, with higher requirements, thus affecting the supply cost. However, regions with a high level of economic and social development do not necessarily have a high level of efficiency and technology in the provision of basic public health services. Therefore, the relationship between regional economic development level and the efficiency of basic public health service supply needs to be fully tested. The economic development level of each region is expressed as per capita GDP.

This paper introduces the process of urbanization and the situation of economic development. From the perspective of urbanization, the interaction mechanism between urbanization and public health development is explained. Correlation analysis was used to analyze the correlation between urbanization process, economic development and public health development. In this article, the dimension reduction method of factor analysis is used to pick out the parts that are crucial to the development of public health. In addition, factor analysis was used to analyze the importance of each component in public health.

2. The establishment of measurement and analysis methods

2.1 Establishment of indicators for urbanization and development of economic

In order to measure the impact of various factors on urbanization, different measurement indicators are selected to represent the urbanization process. EHQ was selected to represent high-quality economic development. LU represents the level of urbanization development. GOV is used to characterize the level of government intervention. The economic development of a region cannot be separated from government intervention. The government formulates and implements relevant policies according to regional development, supports regions to attach importance to industrial development, improves regional economic activity and regional comprehensive competitiveness, and provides a strong guarantee for economic development. MAR is used to characterize the marketization level. The active degree of market is an important characteristic of measuring regional economic development and an important reflection of regional comprehensive development level. The allocation and regulation of resources need to be carried out in the market. The improvement of market development level can drive the optimal allocation of resources, improve industrial production efficiency, and accelerate the pace of urban economic development. PEO is a measure of population density. The continuous increase of population density will promote the improvement of urban consumption and investment, resulting in economic agglomeration and other phenomena. Urban resources are limited, and population density exceeding a certain limit will also bring the corresponding burden to the city. INT is used to measure the level of informatization. During the economic development process, informationization exerts more and more important influence, and gradually becomes an important strategic task for our development. The level of informatization affects people's way of life and production and economic management mode, and it can have an impact on economic development through industry, industrial structure, service industry and other ways. IND is used to measure the level of industrialization. The status of industry in the economic development of our country has increased year by year, and the trend of industry has been towards industrialization. The development of industrialization provides more jobs for the urban population. According to the change of people's needs, the internal industry needs to be constantly adjusted and improved to meet the requirements of high-quality development. The level of industrialization is closely related to the high-quality development of the economy.

2.2 Establishment of indicators for public health

According to the meaning of basic public health service capacity and existing studies, the government needs to perform the functions of health education, health care, rehabilitation, family planning services and disease prevention and control, and the evaluation indicators are divided into three categories: health security, health security, disease prevention and control and public health. Among them, the evaluation indicators of health security reflect the conditions of health security and education provided by the government. Detailed public health evaluation indicators are listed in Table 1.

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Table 1: Related indicators in public health evaluation

Indicators	Variable	X
Health care	System management rate of pregnant women (%)	M1
	Health management rate for children (%)	M2
	Health examination rate (%)	M3
	Health education training number	M4
Sanition care	Health technicians per 1,000 population	M5
	Number of beds in medical institutions per 1,000 population	M6
	Number of medical institutions per 10,000 persons	M7
Disease control and Prevention and Public Health	Government expenditure on health	M8
	Specialized public health institutions	M9
	Centers for Disease Prevention health technician	M10
	Cities have public toilets for every 10,000 people	M11

2.3 Factor analysis

2.3.1 The basic principle

In order to eliminate the correlation overlap between measurement Factor variables representing different classes, this paper introduces the FA method commonly used in statistics, which uses the idea of dimensionality reduction to explain the original variables with a few unrelated variables on the premise of the least loss of information[17]. Suppose an observed random vector $X=[X_1, X_2, \bullet\bullet\bullet, X_p]$ with P components and a mean μ and covariance matrix Σ. The factor model requires that X be linearly dependent on several unobservable random variables $F=[F_1, F_2, \cdots, F_3]$ called common factors and P additional sources of variation called special factors $\varepsilon=[\varepsilon_1, \varepsilon_2, \cdots, \varepsilon_3]$. The FA model is as follows:

$$\begin{bmatrix} X_1 \\ X_2 \\ \cdots \\ X_p \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \cdots \\ \mu_{\mathrm{p}} \end{bmatrix} + \begin{bmatrix} l_{11} & l_{12} & \cdots & l_{1m} \\ l_{21} & l_{22} & \cdots & l_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ l_{p1} & l_{p2} & \cdots & l_{pm} \end{bmatrix} \begin{bmatrix} F_1 \\ F_2 \\ \cdots \\ F_m \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \cdots \\ \varepsilon_p \end{bmatrix}$$

Where: l_{ij} is the factor loading coefficient; l is factor loading matrix; F is the common factor; ε is a special factor. Since l_{ij}, F and ε are unobservable quantities in the model, this factor model cannot be directly confirmed from the observed values of X1, X2,⋯ and Xp. In order to obtain the factor submodel, additional assumptions should be made on the random vectors.

The purpose of retaining a few common factors is to reflect the information of the original sample as fully as possible with a few PF. The reservation of common factors usually adopts two criteria: (1) Cumulative variance contribution (CVC) criterion (CVC is greater than 85%); ② Eigenvalue criterion (eigenvalue greater than 1). The CVC expression is as follows:

$$a_m = \sum_{j=1}^{m} \lambda_j \Big/ \sum_{j=1}^{p} \lambda_j$$

The explanatory meaning of the common factor obtained by the above method may not be clear. In this paper, the maximum variance rotation method is used to carry out factor rotation. The purpose is to make one part of the load on each factor tend to 0 and the other part ±1.

In order to reflect the correlation of original variables and describe the characteristics of samples at the same time, it is necessary to use common factors to represent the original variation. The equation of common factors expressed as linear combination of original variables is called factor score equation:

$$F_{\mathrm{j}} = \beta_{j1} X_1 + \beta_{j2} X_2 + \cdots + \beta_{jp} X_p$$

Where, βjp is the factor score coefficient. By substituting the original variable value and factor score coefficient into Equation (9), the factor score can be obtained.

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2.3.2 Data pre-processing and calculation

Since the dimensions of random variables X1, X2, ⋯ and Xp are often different, 0-1 standardization should be performed on the original data to eliminate the influence brought by the dimensions. In addition, the factor loading matrix L, the common factor F, the special factor ε and the covariance matrix σ in the FA model are solved by reference. [17]. Figure 1 shows the flow chart of factor analysis.

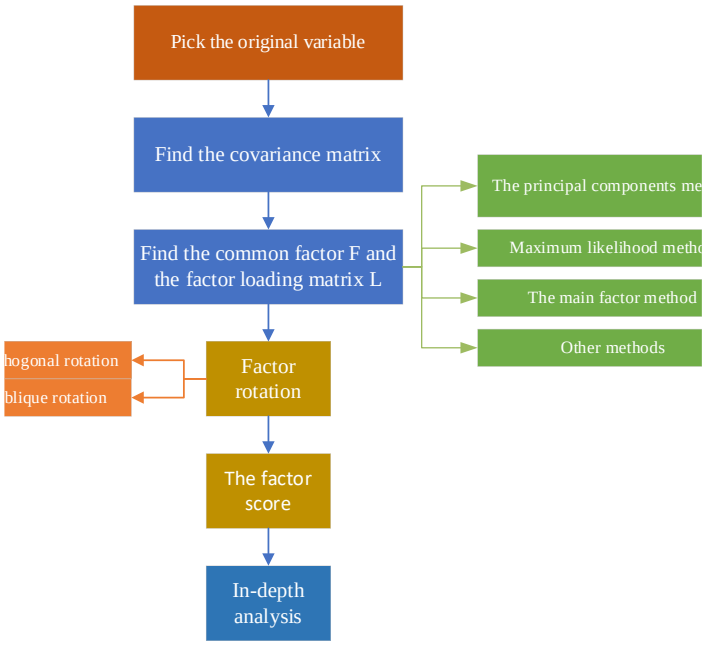

Figure 1: Flow chart of factor analysis

3. Results and Discussion

3.1 Analysis of correlation

Select Chinese urban development data for analysis. Figure 2 shows the correlation analysis of the relationship between urbanization level and public health level. LU represents the level of urbanization and PH represents the level of public health development. As can be seen from the Figure 3, there is a strong positive correlation between urbanization level and economic development level. With the improvement of urbanization level, the level of public health is constantly improved. Figure 3 illustrates the correlation between the level of economic development and the level of public health development. Similar to the development level of urbanization, with the improvement of economic development level, the development of public health level shows a trend of improvement.

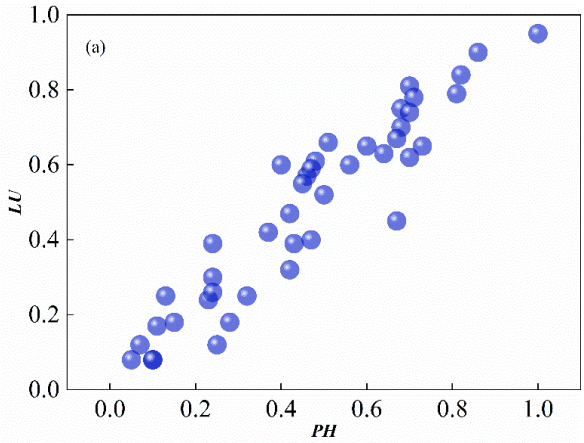

Figure 2: Correlation between public health and urbanization

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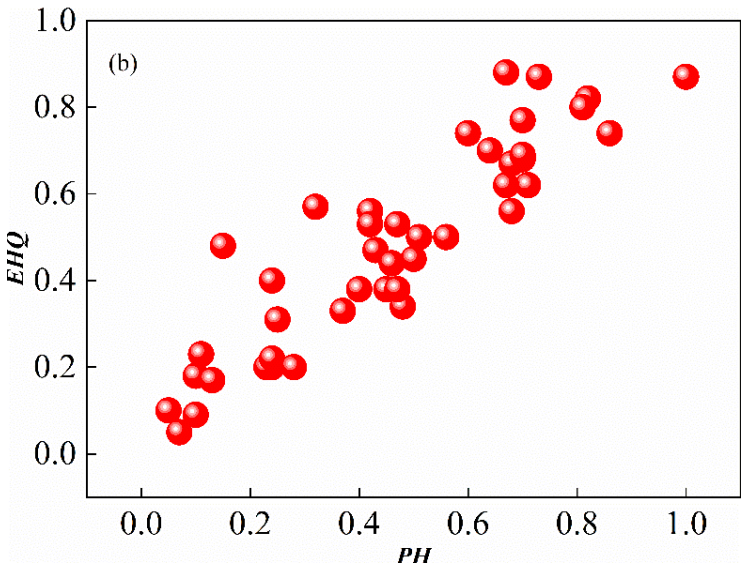

Figure 3: Correlation between public health and level of economic development

3.2 Discussion of Factor analysis results

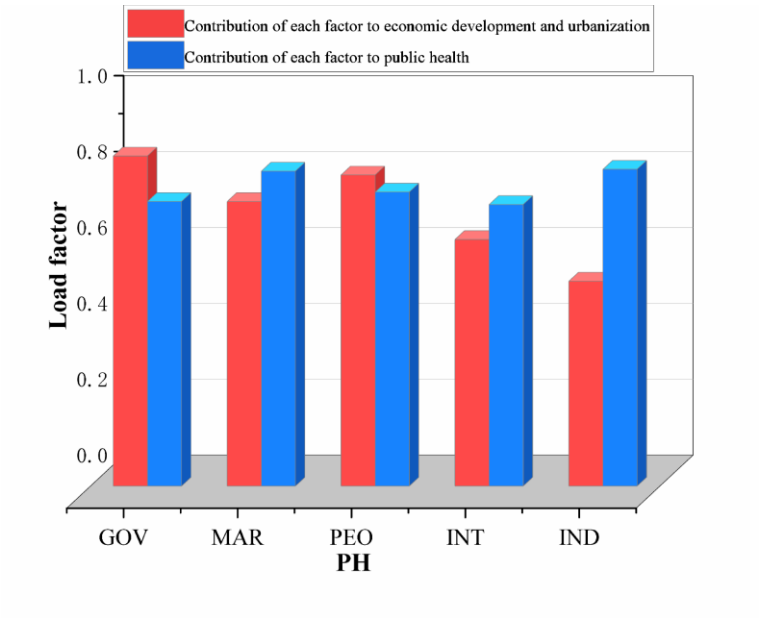

Figure 4: Load coefficients in factor construction

In order to make the factor analysis better interpretable, it is necessary to rotate the factor model. In this paper, the maximum variance rotation method in the orthogonal rotation method is used to rotate the Factor model, and the Factor loading (FL) after rotation is calculated. FL reflects the dependence degree of the original variable on PF, and the greater FL means the greater correlation coefficient between the original variable and PF. The red column in Figure 4 shows the FL corresponding to FA in the process of economic development and urbanization. The blue column in Figure 4 shows the FL corresponding to FA in the process of public health development. It can be seen from the Figure 4 that the loading coefficient of GOV on factors related to urbanization and economic development exceeds 0.8, while the loading coefficient of MAR, PEO and INT on factors related to urbanization and economic development exceeds 0.7. This shows that the factors related to economic development and urbanization are mainly determined by GOV, MAR, PEO and INT, and the other factors have relatively little contribution to urbanization and economic development. As can be seen from Figure.4, the loading coefficient of each factor for public health is more than 0.7, indicating that each factor is very important for the construction of factors related to public health. Among them, IND and MAR contributed more to public health development factors than other factors, which was consistent with the

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results of previous correlation analysis. Therefore, it can be seen that government intervention and population density are crucial to the urbanization process and economic development. At the same time, government intervention, marketization and industrialization are very important for public health evaluation.

3.3 Public health weighting factor

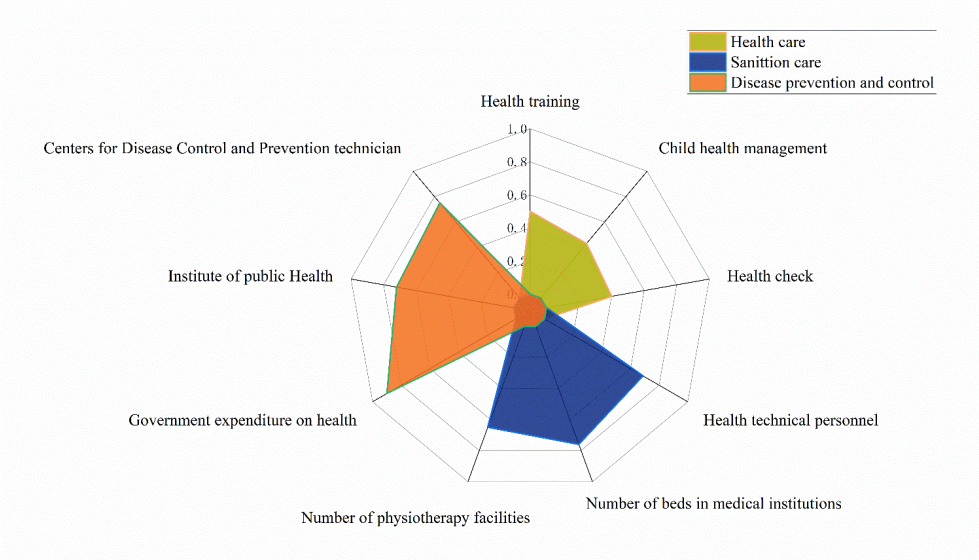

Figure 5: Factor load coefficient of each component in public health

Figure 5 contribution of factors in each part of the three evaluation indicators of public health development to public health development. Through factor analysis, dimensionality reduction of the influencing factors was carried out, among which the factors with great impact on public health are shown in the Figure 5. Among the three corresponding parts, disease prevention takes a large part in the development of public health. For the health care component, health training, child care management and health training are more important for the health care component. Its corresponding contribution is about 0.5. Secondly, for health care, the number of health technicians, the number of beds in medical institutions and the number of medical institutions are more important for health care. Among them, the contribution of the number of beds to health security reached 0.78. For disease prevention and control, government intervention, technical personnel of CDC and public health institutions are more important for disease prevention. Government spending is crucial for disease control and prevention. Therefore, for the development of public health, attention to the development of public health, we should consider increasing government expenditure to improve the development of public health, and improve the ability to deal with diseases to enhance health security.

4. Conclusion

This paper analyzes the development of public health under the background of urbanization process and economic development based on factor analysis method in statistics. First, the correlation analysis shows that urbanization, economic development and public health are closely related. By extracting features and constructing multivariate intensity factors, the contribution degree of each factor to public development in the process of urbanization and economic development is analyzed. In the construction of multiple influencing factors, the load coefficients of government intervention, marketization, population density and industrial informatization are all above 0.7, indicating that the construction of intensity factors using these factors to characterize urbanization and economic development can well represent their promoting effects on public health development. In addition, through the analysis shows that the disease prevention and control have a vital role in the development of public health, government intervention, set up public health agencies and the development of disease control and prevention technology can to improve the overall level of disease prevention and control, having the effect that cannot ignore its corresponding factor loading coefficient reached 0.9, 0.75, 0.72 respectively. Factor analysis is an effective way to consider the contribution of urbanization and economic development to public health.

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