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Construction and Measurement of Comprehensive Evaluation System of Life Quality of the Elderly in China

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Abstract. Population aging is one of the basic national conditions in China. The implementation of the strategy of actively coping with the aging of the population is of great significance to the construction of the working pattern of the aging which is compatible with the modernization of the Chinese style and the promotion of the modernization of the Chinese style population. Conducting a national survey on the quality of life of the elderly and constructing a comprehensive evaluation system to measure the quality of life of the elderly can understand the real situation of the life of the elderly in our country, and is conducive to improving people's livelihood and improving people's quality of life. However, at present, the comprehensive evaluation system of the quality of life of the elderly in China lacks a unified standard, and some indexes in the past research are no longer applicable under the background of Chinese-style modernization. Therefore, the evaluation of the quality of life of the elderly urgently needs a set of contemporary, scientific, and systematic system standards. Based on the data of the fourth sample survey on the living conditions of the elderly in urban and rural China, this paper first clarified the existing achievements and standardization status of the assessment of the quality of life of the elderly, then combined with the requirements of the working pattern of the elderly under the background of Chinese modernization, selected 26 secondary indicators, and used DHNN for data specification and objective empowerment. An evaluation index system composed of six first-level indicators, namely family life, health care, economic status, social participation, cultural life, and subjective feelings, was formed to obtain the score distribution of the life quality of the elderly in the country and the specific scores of the six first-level indicators. On this basis, reasonable development suggestions were given for the cause of active aging.

Keywords: active aging; the elderly; quality of life; comprehensive evaluation system; DHNN.

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1. Introduction

In 1956, the United Nations "Population Aging and Its Social and Economic Consequences" stipulated that the proportion of the population aged 65 or over exceeds 7% as an aging society. China officially entered the aging society in 2000. From 2010 to 2020, the aging rate (the proportion of people aged 65 and above in the total population) increased from 8.87% to 13.50%, with an average annual growth rate of 2.29%. China has become one of the countries with a high degree of population aging in the world, and the aging trend is becoming increasingly severe. In this context, the Party

Central Committee has always attached great importance to the problem of population aging. The report of the 18th National Congress of the Party proposed for the first time that "actively respond to population aging" and "Implement a national strategy to actively respond to population aging" was written into the report of the 20th National Congress of the Party.

Previous studies on the quality of life of the elderly were mostly limited to the influencing factors of the quality of life of the elderly in a certain region. Although they covered many fields such as physical and mental health and economic conditions, the research conclusions were not universal and extrapolated. On the basis of existing studies, this paper explores the key factors affecting the quality of life of the elderly in China under the background of Chinese-style modernization, extracts six main dimensions, not only measures the objective living standards of the elderly from multiple angles, but also obtains their subjective life feelings, and builds a comprehensive comprehensive evaluation system for the quality of life of the elderly. According to the evaluation results, the status quo of the life quality of the elderly in China and the situation of each dimension are understood, and the conclusions and suggestions corresponding to the strategy of actively coping with the aging population are drawn.

This study aims to combine Maslow's hierarchy of needs theory from macro and micro perspectives, and based on the data of the fourth sample survey of living conditions of the urban and rural elderly in China, comprehensively using the Principal Component Analysis (PCA). PCA, Discrete Hopfield Neural Networks (DHNN) and other methods were used to investigate the family life, health care, economic status, social participation, cultural life and subjective feelings of urban and rural elderly people. Measure and evaluate the living quality of the elderly in urban and rural areas. To supplement the comprehensive evaluation system of the quality of life of the elderly from a new perspective, to take into account the previously less considered factors such as family life, social participation and cultural life, to build a more comprehensive evaluation system and supplement and expand the existing research on the quality of life of the elderly. The evaluation results quantitatively reflect the overall quality of life and various dimensions of the elderly in urban and rural areas of China, provide guidance for improving the quality of life of the elderly, help meet the material and spiritual needs of the elderly, and better enjoy the fruits of Chinese-style modernization development.

2. Literature review

Since 1970s, foreign countries began to study the quality of life evaluation system, and mainly focused on the construction of the overall quality of life evaluation system of residents. In 1972, American scholar Forrest put forward a set of objective quality of life index model, which mainly measured the degree of environmental pollution, population density and living standard. The World Health Organization Quality of Life Scale (WHOQOL-100) measures residents' quality of life from 24 aspects, covering physiological, psychological, independence, social relations, environment and other fields. Sarvimaki et al. (2000) believes that quality of life is a multidimensional concept, including four aspects: psychological status, objective environment, expected quality of life, and behavioral ability [1]. In terms of the evaluation of the quality of life of the elderly, Foottit et al. (2012) took diet, smoking and drinking directly as indicators of the quality of life, which were juxtapoted with basic activities and healthy development [2]. The evaluation system of the quality of life of the elderly constructed by foreign researchers attached great importance to the measurement of the health status and habits of the elderly.

In recent years, our country has made some progress in the comprehensive evaluation system of quality of life for the elderly. Liu Yuyan et al. (2005) set subjective and objective indicators from the three levels of goal level, index level and criterion level, and obtained the comprehensive index of the quality of life of the elderly population by using the weighted average method [3]. Zhang Jiaojiao et al. (2010) argued that the index system of the quality of life of the elderly should include nine systems: economy and consumption, life and health, traffic conditions, living environment, social support, social security, public safety, social security, social security, culture and leisure [4]. Zheng

Zhidan (2017) measured the number of children and the average salary based on the CHARLS data of 2013, and obtained the impact of intergenerational family economic support on the quality of life of the elderly [5]. The Report on the Development of the Quality of Life of the Elderly in China (2019), compiled by China Scientific Research Center on Aging, pointed out that "the quality of life of the elderly refers to the sum of the objective living conditions, life behaviors and subjective feelings of the elderly." Starting from these three factors, a comprehensive evaluation system with five dimensions of health status, economic status, living environment, mental status and subjective feelings has been established, and the indicator setting is policy-oriented, providing practical suggestions for China's aging work. The comprehensive evaluation system of the quality of life of the elderly in China pays attention to the combination of subjective and objective factors.

Although there have been some achievements in the current research on the evaluation index system of the quality of life of the elderly, the research on the quality of life of the elderly often only considers the influence of a single factor, and does not include all aspects of the daily life of the elderly in the evaluation, which makes the research results lack of guiding significance at the global level. In addition, different scholars have proposed corresponding life quality evaluation index systems according to their own research fields, but there is a problem of fragmentation of research results, which can not comprehensively and systematically evaluate the quality of life of the elderly. In addition, the empowerment of the existing index system for the quality of life of the elderly relies too much on the results of expert evaluation, ignoring the subjective initiative of the elderly, that is, the self-evaluation of the quality of life of the elderly. Further exploration is needed in the selection of indicators and empowerment methods.

3. Third, the construction of comprehensive evaluation system for the quality of life of the elderly

3.1. Principles for the construction of the comprehensive evaluation system

The construction of the comprehensive evaluation system of the quality of life of the elderly follows the following five basic principles: First, policy-oriented, that is, combining the strategies and policies related to active aging to extract the evaluation indicators of the quality of life of the elderly; Second, systematic, that is, highlighting the comprehensiveness and complexity of the quality of life of the elderly, focusing on the formation of a comprehensive evaluation system with a clear structure and close connections; Third, scientific and reasonable, that is, the index can reflect the content and characteristics of the quality of life of the elderly, the number of indicators is reasonable; Fourth, operability, that is, the acquisition and calculation of indicators are technically and economically feasible and practical; Fifth, typicality, that is, taking the needs of the elderly as the orientation, considering the relevant indicators of the subjective evaluation of the elderly.

3.2. Comprehensive evaluation system for the quality of life of the elderly

Based on the above research, a first-level index is constructed from six dimensions by theoretical analysis, conceptual analysis and extraction. Each dimension covers the five types of needs in Maslow's hierarchy of needs theory, namely, physiological needs, safety needs, social needs, respect needs and self-actualization needs, and is represented by 26 second-level indicators under the first-level index. To construct a comprehensive evaluation system for the quality of life of the elderly, as shown in Table 1. Among them, the positive indicator indicates that the larger the value of the indicator, the better; the reverse indicator indicates that the smaller the value of the indicator, the better; and the moderate indicator indicates that the value of the indicator should be a moderate value or within a moderate range. [6]

3.2.1. Family life dimension.

Family support is a traditional way of supporting the elderly, and the quality of life of the elderly is closely related to their family life. As an important attribute of a family, family size has an impact on

the intergenerational relationship, the way of care and the mode of providing for the aged. Offspring's intergenerational support for the elderly has an important impact on the elderly in both material and emotional aspects [7]. As a family member, the elderly care for other elderly people in the family will also cause a certain burden on their life, which has a non-negligible effect on the quality of life.

3.2.2. Health and medical dimension.

The health and medical problems of the elderly are accompanied by the aging of the population, and the disease burden of the elderly has become the primary challenge facing the healthy aging. It is of great significance to include the current situation and trend of the health and disease burden of the elderly and the medical situation in the evaluation system. Among them, the basic health situation can directly reflect the health status of the elderly, the development of health can be used to understand the elderly's attention to the future health and the degree of protection, medical treatment, medical security and medical expenditure can evaluate the elderly's demand for health services and utilization.

3.2.3. Economic status dimension.

The quality of life of the elderly is the comprehensive feeling and evaluation of the elderly on themselves and their various environments, which is based on material conditions. In addition, under the background of population aging, the elderly have become an important consumer group. Clarifying the consumption behavior of the elderly is of great practical significance for making full use of the aging population to expand domestic demand, promote the development of related industries, and even promote the overall economic growth. In this dimension, the inclusion of indicators of income, consumption and assets of the elderly is conducive to improving the cognition of the quality of life of the elderly, and providing references for the introduction of policies and systems.

3.2.4. Social participation dimension.

The core of active aging is employment and social participation.[8] In the process of social participation, the elderly can give full play to their surplus heat, and material feedback to a certain extent can create better living conditions and more opportunities for them. Proper participation in social production and social development can enhance the self-confidence of the elderly, satisfy their sense of gain and achievement, and realize their self-worth. The connection built with others in social participation can also enhance the communication between the elderly and others, and reduce their sense of loneliness to a certain extent. Therefore, the influence of social participation on the quality of life of the elderly cannot be ignored.

3.2.5. Cultural life dimension.

The report of the 20th National Congress of the Communist Party of China proposed that "Chinese-style modernization is a modernization in which material civilization and spiritual civilization are in harmony". The elderly have both material and spiritual needs, and whether their cultural life is rich, healthy and beneficial is of great significance to the quality of life of the elderly [9]. Evaluating the current situation of the cultural life of the elderly is conducive to a more comprehensive understanding of the quality of life of the elderly and to meeting the diversified spiritual and cultural needs of the elderly.

3.2.6. Subjective perception dimension.

Subjective quality of life mainly focuses on individuals' evaluation of their own happiness and satisfaction with life, which can more directly reflect people's real intentions and touch some subjective factors and influences that cannot be measured by objective indicators. The report of the 20th National Congress of the Communist Party of China clearly points out that people's quality of life has both objectivity and subjectivity. Subjective quality of life refers to the elderly's sense of gain and happiness in their own lives. To effectively improve the sense of gain and happiness of the elderly, it is necessary to pay attention to the elderly's subjective feelings about their own life quality, and

understand the real thoughts and specific needs of the elderly. Therefore, the subjective feelings are listed as an important first-level indicator in this study.

4. Fourth, the quality-of-life measurement of the elderly based on DHNN and PCA

4.1. Data introduction

The data used in this paper are the data of the fourth sample survey of the living conditions of urban and rural elderly in China. The subjects of the survey are Chinese citizens aged 60 or above (i.e. born in 1955 or before) living in China, including 31 provinces, autonomous regions and municipalities directly under the Central Government (excluding Hong Kong, Macao and Taiwan) and Xinjiang Production and Construction Corps, with a total sample involving 7,456 village (residential) committees from 1,864 towns and townships (subdistricts) in 466 counties (cities and districts). The survey distributed 223,680 samples, with a sampling ratio of about 1.0‰. The survey actually collected 227,700 samples, and the valid samples were 220,017 samples, with a sample validity ratio of 98.8%. The survey covers nine aspects, including the basic situation of the elderly, family conditions, health care, nursing services, economic status, livable environment, social participation, rights protection, spiritual and cultural life.

4.2. Data preprocessing

4.2.1. Missing value filling.

Due to the missing data of a number of indicators, we carried out missing value processing. For numerical data, the average value is used to fill in; For non-numerical data, use the values that occur most frequently, according to the mode principle in statistics.

4.2.2. Normalize the data.

Due to the large number of selected indicators, in order to facilitate DHNN to dualize the input, this paper normalizes the input according to different strategies according to the data type, so that all indicators are in the same order of magnitude, which is convenient for subsequent analysis.

For very small variables, according to the operation, where $\bar{x} = \frac{M - x}{M} M$ is the maximum value of variable x. For a polar large variable, according to the operation, where is the norm of the variable $\bar{x} = \frac{x}{\|x\|} \|x\| x$. For intermediate-type variables, according to the and operation, where $\bar{x} = 1 - \frac{|x - m|}{K}$ $K = \max\{|x - m|\} m$ is the average of the variable x.

4.3. The comprehensive evaluation system measurement of the quality of life of the elderly

4.3.1. Establishment of data sets.

In order to construct an indicator system with universal significance, this paper constructs a data set based on the fourth sample survey of the living conditions of urban and rural elderly people in China. After data cleaning, there are 2683 samples in the experimental data set, and each sample has 532 categories of indicators. In the data set, the happiness of the elderly was 17.33% with self-evaluation of 1, 48.52% with self-evaluation of 2, 30.56% with self-evaluation of 3, 2.97% with self-evaluation of 4 and 0.62% with self-evaluation of 5.

4.3.2. Data preprocessing.

According to the index system established in the third chapter of this paper, we selected 60 types of indicators from the data set for processing, formed the 44 evaluation indicators mentioned above, and classified and judged each type of indicator. Then, for the experimental data set composed of the

selected data, we apply the data normalization processing standard mentioned above to process 44 indicators and form the experimental data.

4.3.3. Principal component analysis.

Due to the large number of data indicators in the fourth sample survey of the living conditions of urban and rural elderly in China, PCA was first used to reduce the dimensionality of the data. The PCA model can be expressed by the following mathematical formula:

Given the p n dimensional data matrix X of a set of sample points, let the covariance matrix of the dimensional data be n:

$$C = X^T X \tag{1}$$

Where the transposed matrix is represented. X^T X

The main idea of PCA C is to determine the principal component orientation of the data set by the eigenvectors found. For a covariance matrix, its C eigenvectors satisfy the following equations $\mathbf{u}$:

$$C\mathbf{u} = \lambda\mathbf{u} \tag{2}$$

Where is the eigenvalue, λ $\mathbf{u}$ is the eigenvector.

By solving for the eigenvalues and eigenvectors, you can get the directions and weights of all the principal components. In PCA, the first principal component is the direction in which the variance of the data is greatest, and the following principal components must be orthogonal to the preceding principal components, i.e. perpendicular to each other. The weight of each principal component can be calculated using the dot product of the eigenvector and the original data matrix. Finally, by intercepting the principal component, the data can be reduced to a lower dimension. Typically, the data after dimensionality reduction retains 95% of the variance of the original data to reasonably preserve the data information. Therefore, principal component analysis plays an important role in the design of multi-input index system.

After obtaining the experimental data set, the covariance matrix is calculated, and the covariance matrix is decomposed by eigenvalue. After the eigenvalues and their corresponding eigenvectors are obtained, they are sorted according to the eigenvalue size, and the principal component score is calculated, and the dimension of 44 indicators is reduced to 14.

4.3.4. Enter the code.

Due to the normalization of the data, we normalized all the index types to extremely large size, and encoded 2683 samples according to the coding rules mentioned above, and obtained the input coding matrix that conforms to the DHNN input. The coding matrix of four samples is shown in Figure 1.

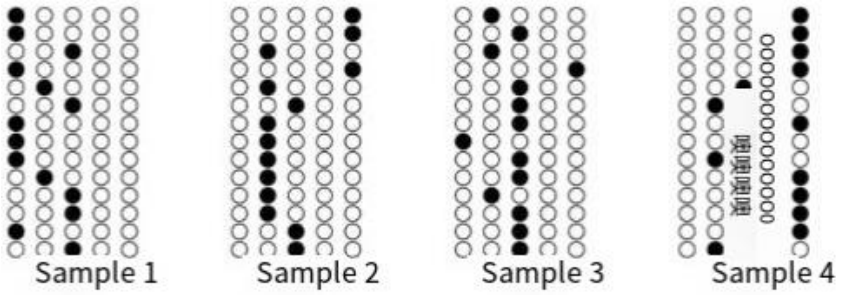

Figure 1. Sample coding matrix

In Figure 1, the coding matrix is coded according to the position of its index value in the corresponding indicator population. At the same time, according to the self-rated happiness values of each sample, we set the stationary coding matrix for all samples.

4.3.5. Model training.

DHNN was proposed by Hopfield. Etc in 1982. In practical applications, DHNN is usually used to deal with some discrete data and classification problems. The core component of DHNN is an single layer neural network composed of discrete neurons, the input of each neuron is dualized by a symbolic function. The connection weight between neurons is determined by the similarity between the two neurons, and the higher the similarity, the greater the connection weight between the neurons. The goal of neural network is to realize the information transfer between neurons through these connection weights and get the final output result. Relying on Matlab platform to build DHNN, the stationary matrix and coding matrix are input into the neural network for fitting analysis, the comprehensive evaluation system of the quality of life of the elderly is established, and the weights of different indicators are obtained.

4.4. Results of comprehensive evaluation of the quality of life of the elderly

The neural network output matrix of the four samples shown in Figure 2 is shown in Figure 2.

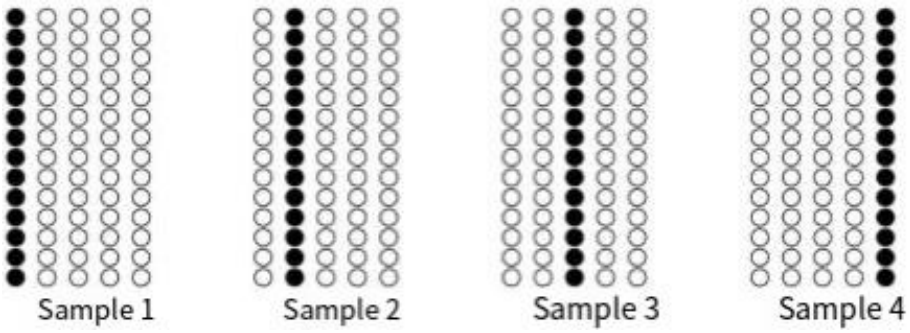

Figure 2. Model output results

By comparing FIG. 1 and FIG. 2, it can be found that the neural network selected in this paper achieves a better classification effect for the samples. Take sample 3 as an example: Among the 14 inputs of this sample, there is 1 at the first level; Level 2 has 3, Level 3 has 9, no parameters in level 4, and level 5 has one. DHNN has successfully classified it into the second class based on the distribution of its input indicators, achieving a smooth regression to the input.

According to the weights assigned by DHNN to each index, the top three contributors to the quality of life of the elderly are family life, health care and subjective feelings. The weight of family life was 0.82, which made the greatest contribution to the quality of life of the elderly. In family life, the number of cohabiting persons has the most prominent influence on the quality of life of the elderly. The elderly have a more traditional and conservative concept of family and attach importance to the connection of the family. They believe that children not only have the ability to live independently, but also can take care of and accompany themselves. The support of the family can positively affect the quality of life of the elderly in both material and emotional aspects. If there are other elderly people in need of care and nursing at home, it will have a negative impact on the quality of life of the elderly to a certain extent.

By combining the index weight and the original index score, the scores of the six primary indicators were obtained, which were added and mapped to the range of 1-10 to obtain the comprehensive evaluation results of the quality of life of the elderly. On the whole, the quality of life of the elderly in our country has greater room for improvement. The overall score distribution is unbalanced, showing a "bimodal distribution" situation. Most elderly people's quality of life scores are concentrated in 6-7 scores and 8-9 scores, indicating that there are obvious differences in the quality

of life among different groups, and it is necessary to improve the overall quality through the implementation of policies to narrow the internal gap.

The contribution of economic status to the quality of life of the elderly was low, but the overall score was high as China's economy continued to grow and entered a stage of high-quality growth. Cultural life showed a trend of low score and low weight. Overall, all aspects of social development need to be allocated resources so that they are commensurate with the weight.

Compared with material development, the scores of the elderly in spiritual and cultural life are generally lower in China. The existing cultural activities can not fully meet the multi-level and diversified spiritual and cultural needs of the elderly, and the participation of the elderly is low; In addition, the use of the Internet by the elderly is not ideal, there are problems of digital divide, and the development of the Internet cannot support the improvement of the quality of life of the elderly is weak; In recent years, although the construction of institutions for the self-improvement of the elderly such as universities for the elderly has made progress, the participation rate still shows a low trend.

5. Conclusions and Suggestions

According to the characteristics that the overall quality of life of the elderly in our country can be improved by large space and internal differences, we should first fully implement the strategy of actively coping with population aging. According to the development trend of the quality of life of the elderly in various dimensions, resources should be fully and reasonably allocated, and an age-related system covering all aspects of the life of the elderly should be established from the top-level deployment. The promotion and improvement of aging work in the new era cannot be separated from the participation and cooperation of multiple subjects. All subjects in society should recognize their main roles and responsibilities, take positive governance as the orientation, coordinate to promote the top-level deployment of healthy aging, and build a "large" aging work pattern.

Under the trend of stable and good economic development of China's economy, the economic condition of the elderly in China is also generally good. However, simply improving economic ability cannot meet the actual needs of the elderly to improve their quality of life. In the consideration of the quality of life of the elderly, the contribution of family life, health care and subjective feelings is large, and it is necessary to seek breakthroughs on the existing basis, and focus on promoting progress in key areas while achieving development in all aspects.

Among the scores in various fields, the cultural life of the elderly in China has the lowest score, indicating that the existing system and measures for the construction of cultural life in China can not fully meet the spiritual and cultural needs of the elderly. China needs to actively explore new forms of the cultural life of the elderly, improve the appeal of various cultural activities to the elderly, and enrich their spiritual world; Provide convenient conditions for the elderly to enjoy smart technology on an equal basis, bridge the digital divide and eliminate digital poverty; We will intensify efforts to build community universities and colleges for the elderly to provide broader platforms for the elderly to pursue self-improvement.

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