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The EWM-Based Evaluation of Healthy City Construction Levels in East China under the Concept of "Making Improvements Is More Important Than Reaching Standards"

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Abstract: In order to effectively identify the shortcomings and potential health risks in the construction of healthy cities and achieve sustainable development, relevant improvement strategies have been formulated. According to the National Healthy City Evaluation Index System, with the concept of "Making improvements is more important than reaching standards", the healthy city construction levels of the first batch of 13 cities in East China were evaluated by combining entropy weight and linear coefficient weighting from the five dimensions of environment, population, society, service, and culture, based on the data of statistical yearbooks, bulletins, and government websites. The results show that Suzhou, Jiading, Wuxi, Hangzhou, Ningbo, Tongxiang, and Zhenjiang are in the first-grade group, Xiamen, Yantai, Jinan, and Weihai are in the second-grade group, and Yichun and Ma'anshan are in the third-grade group. There is also more significant heterogeneity in the healthy environment indicator among the 13 cities; at the same time, there are specific differences in the healthy culture indicator, and there are slight differences in the indicators of healthy population, society, and service. The study reveals the gaps and problems in the construction of healthy cities. It proposes constructive ideas for promoting follow-up improvement of "making up for shortcomings and strengthening the weaknesses".

Keywords: "making improvements is more important than reaching standards"; healthy city; construction level; weight; index evaluation

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1. Introduction

Socioeconomic growth and rapid urbanization have led to urban expansion and high-density urban space, and land use change has become an important and significant factor affecting people's health [1,2], while high population concentration [3] and industrialized pollution [4] have also brought environmental risks and health threats, and healthy cities have become a focus of social attention. The construction of healthy cities is a necessary global action to address health challenges in the process of urbanization and industrialization. In recent years, the outbreak and spread of the COVID-19 virus have exposed the sub-health problems of urban development [5], which has triggered in-depth thinking about issues of public health and healthy cities around the world. How to effectively identify the shortcomings of urban health development, actively respond to urban health risks [6], improve the environmental health of cities, and upgrade the overall health level of cities have become urgent issues affecting the sustainable development of cities.

Modern urban planning focuses on urban health issues and aims to improve urban health through planning [7]. The concept can be traced back to the 1842 report on labor hygiene by the British scholar Edwin Chadwick [8]. Subsequently, the enactment of the British Public Health Act in 1848 marked the beginning of integrating urban planning and health [8]. Nevertheless, the importance of health in urban planning was neglected until the 20th century, when the idea of healthy cities received renewed attention. In 1984, the World Health Organization (WHO) introduced the concept of "Healthy Cities" [8], and in 1987, the "European Healthy Cities Network" was established in the European region [9]. In 1994, the WHO officially defined a "Healthy City" as one that continuously improves its natural and social environments [10], and fosters the development of residents' vital functions and potential [6]. Since the 1990s, China has begun to adopt urban health planning and has set the goal of building healthy cities based on the "Healthy China 2030" planning outline. In 2010, the WHO Kobe Center published an "urban health equity assessment and response tool", providing guidelines for health equity and urban construction assessment [11]. In 2016, China announced the first list of pilot healthy cities. Currently, China is in the initial stage of a comprehensive development of sanitary cities and the construction of urban health planning [12], necessitating a coordinated mechanism led by the government, with departmental collaboration and societal participation, to advance the construction of healthy cities from multiple dimensions [12]. The publication of the "National Healthy City Evaluation Index System" in 2018 has provided a basis for evaluating healthy city construction. The theory of healthy cities has evolved from an early focus on environmental sanitation and disease treatment to incorporating health issues into all policies [13]. The rise of health sociology has expanded the study of health issues from the medical field to include various aspects such as society [14], economy, environment, and politics [15,16], emphasizing an extensive assessment of all factors affecting health. Therefore, a comprehensive evaluation of the development of healthy cities is crucial for understanding their philosophy and promoting health.

Although the connotations of a healthy city are different at home and abroad, the core requirements are hygiene, health, and sustainability. To evaluate healthy cities, "Making improvements is more important than reaching standards". There are currently no standard values for the assessment [11]. Recently, 290 cities in China were comprehensively evaluated by the China Research Society of Urban Development in the four dimensions of environment, culture, conditions, and society. Seven sub-provincial cities were evaluated using the entropy weight method (EWM) from five dimensions according to the outline [17]. Ten cities were evaluated adopting the weighted rank sum ratio method [18]. In addition, each city in Shandong Province was evaluated using the TOPSIS method for healthy city evaluation in 2018, and a healthy city index system was established according to the conceptual framework of "driver-response" [19]. In summary, scientific, systematic, and feasible are the keys to constructing the healthy city evaluation system [20].

The majority of related studies have been evaluated with the index system of "Healthy China 2030" planning outline and the Report on China's Urban Healthy Life (2016). Those have provided essential ideas for research [17–19]. With the publication of the "National Healthy City Evaluation Indicator System", the comprehensive evaluation from this indicator system is more realistic and provides significant guidance. However, there are fewer relevant studies based on this system at present. Because of this, under the concept of "Making improvements is more important than reaching standards", the index system is used to carry out the scientific and reasonable evaluation of healthy cities, summarize the advantages and identify the shortcomings of healthy cities, and provide ideas for promoting the level of healthy city construction in China.

2. Data Sources and Research Methods

2.1. Research Objects

In 2016, China announced the first batch of 38 pilot healthy cities. Among them, 13 urban areas from 6 provinces and 1 city in East China are listed, accounting for 34.21% of the national pilot healthy cities, showing a trend of relative concentration. A total of 13 pilot healthy cities in East China (Figure 1), including Jiading District in Shanghai, Suzhou, Wuxi, and Zhenjiang in Jiangsu Province, Hangzhou, Ningbo, and Tongxiang in Zhejiang Province, Ma'anshan in Anhui Province, Xiamen in Fujian Province, Yichun in

Jiangxi Province, and Jinan, Yantai, and Weihai in Shandong Province, were selected as research objects to evaluate the construction level of healthy cities.

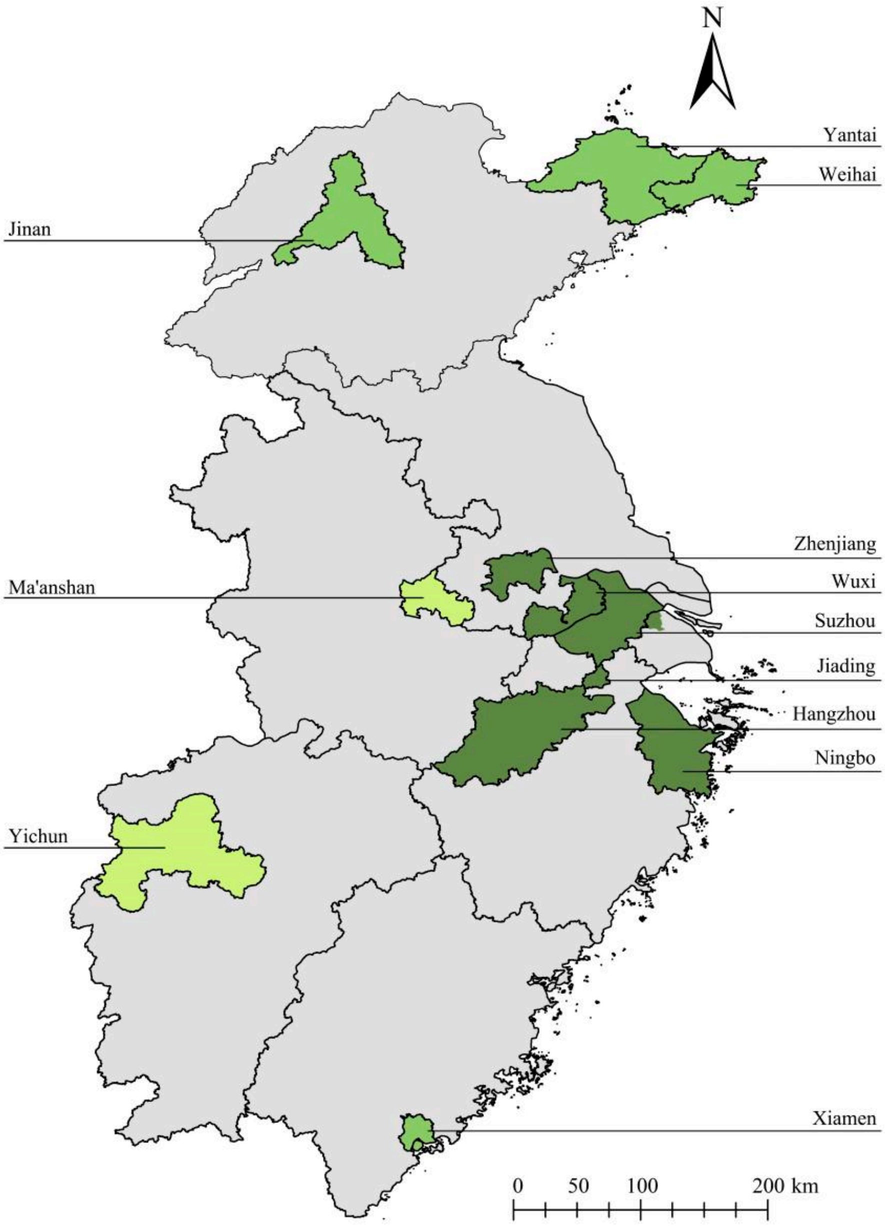

Figure 1. The geographic location of the first 13 pilot healthy cities in East China.

2.2. Evaluation Index

Based on the National Healthy City Evaluation Index System (2018) released by the National Health Commission of China, this study followed the principles of reliability and validity, universal recognition and relevance, reproducibility, and availability [17–20], and used 17 second-level indicators and 32 third-level indicators under 5 first-level health indicators (environment, society, service, population, and culture) to comprehensively evaluate the construction levels of pilot healthy cities in East China [21] (Table 1).

Table 1. Comprehensive evaluation index system and the weights.

First-Level Indicator	Weight	Second-Level Indicator	Weight	Third-Level Indicator	Weight
U1 Healthy environment	0.2627	V1 Air quality	0.0360	X1 Proportion of days with good air quality	0.0196
				X2 Number of days with severe pollution and above	0.0164
		V2 Water quality	0.0001	X3 Safety rate of centralized drinking water sources	0.0001
		V3 Waste treatment	0.0002	X4 Harmless treatment rate of domestic waste	0.0002
		V4 Other environmental issues	0.2264	X5 Density of public toilets	0.0327
				X6 Coverage of non-hazardous sanitary toilets (countryside)	0.0577
				X7 The per capita area of green park space	0.0302
				X8 Proportion of sanitary counties (towns)	0.1058
U2 Healthy society	0.1646	V5 Social security	0.0221	X9 Reimbursement ratio of hospitalization expenses under basic medical insurance	0.0221
		V6 Fitness activities	0.0796	X10 Stadium area per capita in the city	0.0362
				X11 Proportion of the number of social sports instructors per 1000 people	0.0434
		V7 Food safety	0.0446	X12 Food sampling inspection batch per 1000 people	0.0446
		V8 Support for the old	0.0183	X13 Number of older people care beds per 1000 older people people	0.0183
U3 Healthy service	0.1794	V9 Mental health management	0.0132	X14 Standardized treatment rate of patients with severe mental disorders	0.0132
		V10 Maternal and child health services	0.0345	X15 Rate of child health management	0.0134
				X16 Rates of systematic maternal management	0.0211
		V11 Health resources	0.1317	X17 Number of general practitioners per 10,000 people	0.0253
				X18 Number of public health personnel per 10,000 people	0.0390
				X19 Number of beds in health care facilities per 1000 people	0.0250
				X20 Proportion of primary medical and health institutions providing Chinese medicine services	0.0003
				X21 Proportion of health expenditure in fiscal expenditure	0.0421
U4 Healthy population	0.2077	V12 Health level	0.1004	X22 Life expectancy	0.0164
				X23 Infant mortality rate	0.0146
				X24 Under-5 mortality rate	0.0125
				X25 Maternal mortality rate	0.0235
				X26 The proportion of urban and rural residents who have reached the "National Physical Fitness Measurement Standards" or above	0.0334
		V13 Infectious diseases	0.0393	X27 Incidence of Class A and B infectious diseases	0.0393
		V14 Chronic disease	0.0680	X28 Prevalence of hypertension in people aged 18–50 years	0.0680
U5 Healthy culture	0.1856	V15 Health literacy	0.0234	X29 The level of health literacy of residents	0.0234
		V16 Health behaviors	0.0897	X30 Smoking rate of people over 15 years of age	0.0603
				X31 Proportion of the population regularly participating in physical activity	0.0294
		V17 Health atmosphere	0.0725	X32 Proportion of registered volunteers	0.0725

Note: Standardized values of raw data are not presented due to constraints on space.

2.3. Data Sources

Because of the availability of data and the average construction level reflected in the data, the study was mainly based on the statistical data 2018, which was not affected by the epidemic. The relevant raw data for 13 cities were meticulously extracted and collected from the authoritative "China Statistical Yearbook", "China Environment Statistical Yearbook", and "China City Statistical Yearbook" provincial and municipal statistical yearbooks, the Statistical Communiqué of China on the National Economic and Social Development, the Statistical Communiqué of China on the development of health undertakings, and the websites of Municipal People's Government, Municipal Health Commission, and Municipal Sports Bureau of the 13 pilot cities.

2.4. Research Methodology

Because of the variety of difference and importance of each of the 32 third-level indicators constructed above in the evaluation system, the key to the evaluation is to put reasonable weights on the indicators. Weighting at the later stage is the premise of scientific evaluation. The study adopted the Entropy Weight Method (EWM) to determine the weights of the indicators, in order to ensures the objectivity of the comprehensive evaluation and avoid the subjective drawbacks of the Analytic Hierarchy Process (AHP) [15]. Entropy is a measure of the degree of disorder in a system. According to the definition of information entropy, for a specific indicator, the smaller the information entropy value and the greater the dispersion of the indicator, the greater the weight of the indicator, and vice versa. Therefore, the EWM method can be used to put weights on indicators. The linear weighted summation method is a method that assigns weight coefficients according to the target weights and obtains the optimization or the solution of the linear combination. The above techniques have been proved in evaluating of healthy cities, smart cities, high-quality urban development, and innovation-driven capacity. The steps are as follows:

(1) Establish an evaluation matrix

Establish the evaluation matrix $X = (X_{ij})n * m$. X_{ij} is the data of the city i in terms of the indicator j. n represents the number of cities, and m represents the number of indicators. Here, the vector of evaluation indicator the city i is $X_i = [X_{i1}, X_{i2}, \ldots, X_{i32}]$, and the evaluation matrix is $X = [X_1, X_2, \ldots, X_{13}]^T$.

(2) Standardization of indicators

To address the excessive errors attributable to differing dimensions, inherent self-variation, and disparities within big data, we undertook a standardization process for the indicators, tailored to the specific characteristics and utilizing the data gleaned from our constructed index system. Evaluation indicators are categorized into two types: positive and negative. Positive indicators represent attributes where a larger value is preferable, whereas negative indicators denote aspects where a smaller value is deemed more favorable. For percentage indicators that have a maximum possible value of 100 percent, the actual raw values may be utilized directly as standard values. If an indicator is positive, the original data is calculated according to the following formula:

$$z_i = \frac{X_i - X^i_{\min}}{X^i_{\max} - X^i_{\min}} \tag{1}$$

If an indicator is negative, the original data is calculated according to the following formula:

$$z_i = \frac{X^i_{\max} - X_i}{X^i_{\max} - X^i_{\min}} \tag{2}$$

In Formulas (1) and (2), Z_i represents the standardized value of indicator X_i. X_i is the original data of the indicator. $X^i{}_{\min}$ and $X^i{}_{\max}$ are the minimum and maximum values, respectively.

(3) The weighted values of the indicators

The percentage of the indicator value of city i is calculated in terms of the indicator j, and the formula is as follows:

$$P_{ij} = Z_{ij} / \sum_{i=1}^{n} Z_{ij} \tag{3}$$

In this formula, Z_{ij} is the standard value of the indicator j of the city i.

The entropy of the indicator j is calculated with the following formula:

$$H_j = -k \sum_{i=1}^{n} \left(P_{ij} * \ln P_{ij} \right) \tag{4}$$

In this formula, $k > 0$, $H_j \geq 0$, $k = \frac{1}{\ln(n)}$, $0 \leq H_j \leq 1$.

The difference coefficient of the indicator j is calculated as $d_j = 1 - H_j$, and then the weights are acquired as follows:

$$W_j = d_j / \sum_{j=1}^{m} d_j \tag{5}$$

Then, the weighted values of the third-level indicators used for evaluation are obtained (Table 1).

(4) Calculation of composite index

As shown in Table 1, the composite index and the evaluation indices for each first-level indicator are calculated through a linear weighted sum of the index values across each dimension, with the relevant values detailed in Table 2.

$$F_i = \sum_{j=1}^{m} Z_{ij} * W_j \quad (6)$$

In this formula, F_i represents the composite index of city i.

Table 2. The first-level indicator and composite index of the pilot healthy cities.

Pilot Healthy City	First-Level Indicator					Composite Index	Overall Ranking
	Healthy Environment	Healthy Society	Healthy Service	Healthy Population	Healthy Culture		
Suzhou	0.2193	0.1216	0.0847	0.1038	0.0683	0.5977	1
Jiading	0.2196	0.0673	0.0716	0.1155	0.1151	0.5891	2
Wuxi	0.1804	0.0628	0.0884	0.1143	0.1290	0.5749	3
Hangzhou	0.1129	0.0494	0.1398	0.1111	0.1522	0.5655	4
Ningbo	0.1139	0.0737	0.1185	0.1000	0.1379	0.5441	5
Tongxiang	0.1848	0.0607	0.0948	0.0977	0.0650	0.5030	6
Zhenjiang	0.1216	0.0926	0.0655	0.1116	0.0808	0.4721	7
Xiamen	0.1371	0.0545	0.0773	0.0591	0.1219	0.4499	8
Yantai	0.0575	0.0785	0.0845	0.1512	0.0310	0.4027	9
Jinan	0.0195	0.0633	0.1300	0.1198	0.0474	0.3800	10
Weihai	0.0740	0.0804	0.0807	0.1188	0.0200	0.3739	11
Yichun	0.0587	0.0255	0.0759	0.0862	0.0213	0.2676	12
Ma'anshan	0.0512	0.0295	0.0660	0.0647	0.0151	0.2265	13

3. Results

3.1. Weighting Results

In this study, the assessment criteria have been meticulously constructed to include five first-level indicators, seventeen second-level indicators, and thirty-two third-level indicators. The average weight of the indicators was about 0.0312. The weights of thirteen third-level indicators exceeded the average weight, and these indicators belonged to the five first-level indicators, which were essential indicators for the construction of healthy cities. The weight of the healthy environment was the largest, and its weighted value was 0.2627, followed by the healthy population with the weighted value of 0.2077 (Table 1). Therefore, the healthy environment and the healthy population were the leading indicators affecting the evaluation of the construction level of the healthy city in East China. According to the weighting results in Table 1, and the calculation through weighted summation, the composite index of the 13 cities was in the range of 0.2265–0.5977, the mean was 0.4575 and the standard deviation was 0.1217. Among them, the composite index showed seven cities were significantly higher than the mean, while four cities were in the range of 0.3739–0.4499. The composite index indicated the remaining two cities were significantly lower than the mean and less than 0.3000, showing an apparent three-level distribution (Table 2 and Figure 2).

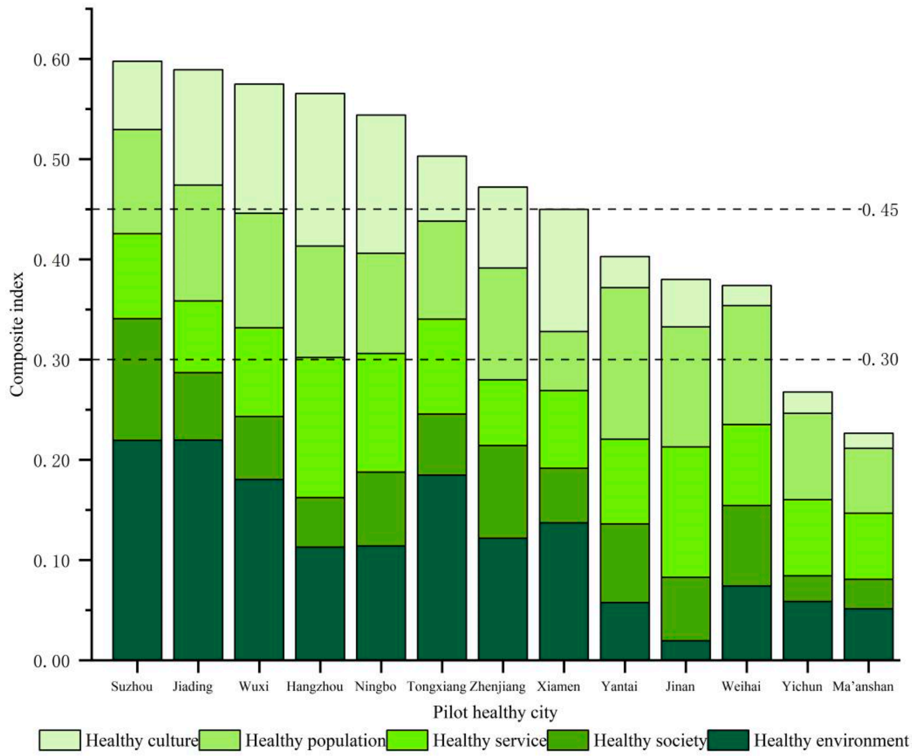

Figure 2. Composite index of 13 pilot healthy cities in East China.

3.2. Results of Composite Index

Figure 2 showed that among the seven cities that achieved the first grade in the composite index, the top four cities surpassed 0.5500, indicating a high level of healthy city construction. According to the evaluation and analysis of the first-level indicators shown in Table 2, Suzhou, Wuxi, and Ningbo were distributed between 1–8, 3–8, and 2–9, respectively, showing a high level of coordinated construction (Figure 3). Jiading District of Shanghai achieved rankings between 1st and 6th in all other indicators; however, the healthy service indicator ranked in the 11th place. Hangzhou achieved rankings between 1st and 8th in all other indicators with the exception of the healthy society indicator, which was ranked 11th. Zhenjiang achieved rankings between 2nd to 6th in all other indicators with the exception of the healthy service indicator, which was ranked 13th. The three urban areas showed differentiated high levels of healthy city construction in terms of the first-level indicators. Tongxiang achieved rankings between 3rd and 10th in terms of all five indicators, showing a balanced construction level (Figure 3). For Jiading District of Shanghai, the number of public health personnel per 10,000 population was 21.98, and the number of beds in medical and health institutions per 1000 population was 2.53. The data of the two indicators led to a lag in the healthy service indicator. For Hangzhou, the number of social sports instructors per 1000 people was 2.1, and the number of food sampling inspection batches per 1000 people was 4.45. The data of the two indicators led to a lag in the healthy society indicator. For Zhenjiang, the proportion of health expenditure accounted for 5.34% of fiscal expenditure, and the number of public health personnel per 10,000 population was 25.73. The data of the two indicators resulted in the worst ranking in the healthy service indicator. The shortcomings indicated by the above indicators urgently need to be improved in follow-up construction of healthy cities.

In the second grade of ranking, the composite index of Xiamen was close to the mean, and that of Yantai, Jinan, and Weihai was above 0.3000, showing a medium level of healthy city construction. Regarding the first-level indicators. Xiamen ranked in the top five in the indicators of healthy environment and healthy culture. However, its rankings for the indicators of healthy society and healthy population were below 10th. Yantai ranked in the top five in the indicators of healthy population and the healthy society. However, its rankings for the indicators of healthy culture and healthy environment were below 10th. Jinan ranked in the top two in the indicators of healthy service and healthy population. However, its ranking for the indicator of healthy environment was 13th. Weihai ranked in the top three in the indicators of healthy society and healthy population. However, its ranking for the indicator of healthy culture was 12th. Therefore, the four cities all showed a relatively uneven medium level of healthy city construction. For Jinan, the proportion of days with good ambient air quality was only 51.5% in 2018, the number of days with severe pollution or above reached 14 days, and the proportion of sanitary counties (towns) was low. The lag in the three indicators led to the bottom ranking of Jinan in the indicator of healthy environment. For Weihai, the proportion of registered volunteers was less than 10%, and the smoking rate of people over 15 years old was relatively high, which led to a poor ranking in the indicator of healthy culture. Therefore, the gaps in the above indicators need to be enhanced in follow-up construction.

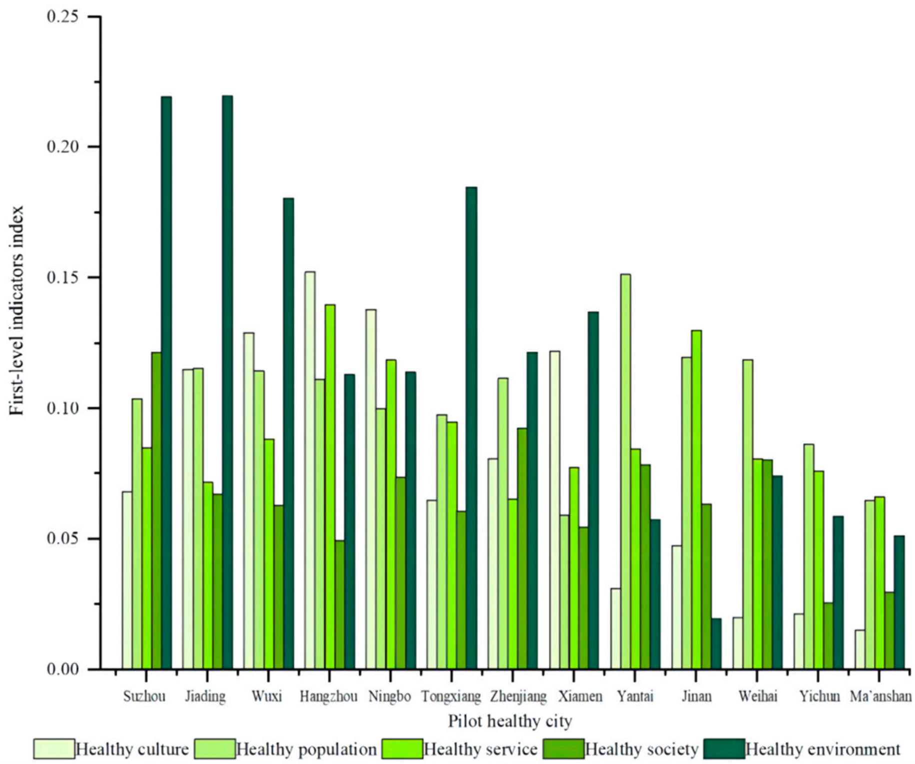

Figure 3. First-level indicators of 13 pilot healthy cities in East China.

In the third grade of ranking, Yichun and Ma'anshan showed a low level of healthy city construction. Regarding the first-level indicators, Yichun ranked below 10th in the five indicators, and Ma'anshan ranked below 12th in all indicators, showing a relatively low level of construction, comprehensively behind the other cities. For Yichun, the number of social sports instructors per 1000 was only 2, and the number of food sampling inspections was 4 batches per 1000. In addition, Yichun lagged in the indicators of degrees mental health management and maternal and child health services under the first-level indicator of healthy service, as well as in the indicator of health level under the first-level indicator of healthy population. Ma'anshan ranked behind in the indicators of food safety, maternal and child health services, infectious diseases, health behaviors, and other relevant environmental indicators. Therefore, the two cities should accelerate their efforts and make comprehensive improvements.

4. Conclusions

Based on the framework of the National Healthy City Evaluation Index System (2018), the construction level of 13 pilot healthy cities in East China was evaluated in this paper.

Due to the limitations of data availability, timeliness, and relevance, after excluding three second-level indicators (occupational safety, culture and education, and healthy cells) and their corresponding nine third-level indicators, seventeen second-level indicators and their corresponding thirty-two third-level indicators were selected to conduct a comprehensive evaluation. Compared with the existing research on the assessment of healthy cities, the results of this paper are more extensive and closer to the results of a whole-index-system evaluation. According to the evaluation results, the conclusions are following:

(1) The weighting results proved that significant differences existed among the indicators.

Regarding weighted indicators, the first-level indicator with the most significant weight was the indicator of healthy environment (26.27%), followed by the indicator of healthy population (20.77%), indicating that the data of the two indicators were quite different in the construction of healthy cities. The second-level indicators with the most weights were the indicators of other environmental issues and the health resource, indicating that sanitary cities and health resources were the top priorities in the constructing of healthy cities. The top three third-level indicators with the largest weights were the proportion of domestic health counties (towns), the proportion of registered volunteers, and the prevalence of hypertension among people aged 18–50, among which the weight of the proportion national health counties (towns) was the highest, namely 0.1058. The indicators with the lowest weights were the safety rate of centralized drinking water sources and the harmless treatment rate of domestic waste, both with weights below 0.0002.

(2) The composite index evaluations showed that the construction of healthy cities was at differentiated levels.

Regarding the composite index, Suzhou, Wuxi, and Ningbo reached a high level of overall coordinated construction of the five indicators. Jiading District of Shanghai, Hangzhou, and Zhenjiang were at differentiated high levels of construction. Tongxiang showed a balanced high level of construction. Yantai, Jinan, and Weihai showed an unbalanced medium level of construction. Yichun and Ma'anshan were at a backward level of construction in many aspects. The differences mentioned indicate that there are significant differences in the construction of healthy cities, reflecting disparities that are both inter-provincial and inter-city.

5. Policy Suggestions

In summary, according to the requirements of the "Healthy China 2030" planning outline and in view of the evaluation conclusions, this paper proposes the following suggestions for macro strategy and micro-measures.

Macro strategy: (1) Because of the problem of inter-provincial differences, it is suggested that publicity and regulation efforts at the national level should be strengthened. The National Health Commission of China should play a role in coordinating and guiding provinces and municipalities, improving the ability of regional coordinative construction, and achieving the simultaneous improvement of the overall level of the regional construction [17]. At the same time, because of the inter-city differences within the province, a guiding coordination mechanism should be established for providing directions in hierarchical sequence from provinces and municipal cities to county-level cities to townships, so as to achieve undifferentiated improvement within the province [11]. (2) In view of the problem of differentiated construction levels indicated by the five first-level indicators in some cities, it is suggested to strengthen the advantages and make up for shortcomings, improving the overall level of healthy city through all-round and all-index coordination construction.

Micro-measures: (1) Build a healthy environment from multiple perspectives. The relevant government departments should speed up the upgrading of heating systems and promote clean energy to improve air quality. Guarantee people a healthy living environment, ensure the safety of domestic water and the harmless treatment of domestic waste, increase the construction of sanitary counties and towns, and improve the level of public health. Increase the green coverage rate and per capita area of green space to create a beautiful ecological environment. (2) Maintain a healthy society in all aspects. Improve the medical security and insurance system and increase the reimbursement ratio. Pay attention to the problem of aging, and increase the number of beds for the older people following the requirements of "social support for the older people" to enhance the ability of society to provide for older people. Enlarge the per capita area of sports venues and promote the degree of openness of stadiums to the public, increase the number of social sports instructors, and form a fitness system with the participation of the people under professional guidance [22]. Improve food safety and diet, and increase accessibility to facilities such as food courts and fresh food supermarkets, as these are of great value in improving the overall health of the population [23].

(3) Provide healthy services in multiple ways. The government should increase fiscal expenditure in health, and improve the construction level of health industries and health resources [17]. Improve the quality and ability of the medical team, implement a medical grading system, increase the signing rate of family-doctor contracts, and provide free consultations and roving medical services to achieve full coverage of medical services. Encourage social sources to provide medical services, and support the integrated development of traditional Chinese and Western medicine to meet the needs of various types of medical treatment. In addition, strengthen the support for vulnerable groups in society such as persons with mental disorders, children, and pregnant women, provide accurate health services, and improve the health level of the people. (4) Build a healthy culture based on different forms. Strengthen health guidance and health publicity online and offline, and improve the health awareness of the public and their knowledge of health. By hosting activities such as "National Fitness Day" and "City Marathon", encourage the people to participate in physical exercises and create a culture of national fitness [21]. Build a multi-party platform integrating medical and healthcare services and sports and fitness resources to provide professional support for health guidance [24]. Finally, create a control system based on information technologies such as the Internet, big data, and machine learning, and with the help of network technology, identify the potential dangers and uncertainties affecting the construction of healthy cities to facilitate the intelligent and standard development of healthy cities.

In short, the construction of healthy cities is a dynamic process, and its evaluation should have a dynamic adjustment space [18,19]. Therefore, the construction of healthy cities should follow the concept of "Making improvements is more important than achieving standards" [16], which should not only emphasize the macro coordination and strategic guidance of public policies, but also rely on specific measures to strengthen the advantages and make up for the shortcomings, so as to continuously improve the construction level.

6. Research Limitations and Perspectives

This study evaluated the construction level of 13 pilot healthy cities in East China using the EWM under the concept "Making improvements is more important than reaching standards". The study provided practical guidance for realizing the idea of "evaluation for construction". However, there are some limitations and shortcomings in this study.

Research data: This study utilized statistical data from 2018, prior to the onset of COVID-19, and thus the conclusions drawn may have some possible limitations. As a global public health emergency, COVID-19 has affected China from 2019 to 2022, with its extensive reach and severity making its impact challenging to quantify. Consequently, the indicators across various sectors during this period may not accurately represent the level of normalized healthy city construction. As the impact of COVID-19 begins to subside, future studies could leverage data from both 2018 and 2023 to assess the differences in healthy city construction before and after the pandemic. Such a comparison could expose the vulnerabilities in the construction of healthy cities during public health crises and offer insights to enhance preparedness and response mechanisms in subsequent urban development.

Research methodology: Although the EWM can avoid the subjective drawbacks associated with the AHP, it provides a more objective assessment by determining actual response weights and indices. Recognizing that healthy city construction is a gradual and cumulative development process, it is clear that its complexity and dynamism necessitate research methods capable of adapting to changes over time. Consequently, subsequent studies may benefit from employing more sophisticated research methods, such as time series analysis, to uncover cyclical patterns and long-term trends in healthy city construction. This approach can offer a more precise and scientific basis for the formulation of relevant policies.

Research indicators: In comparison with other studies, this study utilizes the National Healthy City Evaluation Indicator System to assess the construction level. Though the system is recognized for being scientific, systematic, and feasible, it may encounter issues related to indicator settings and framework limitations. Notably, the adaptability and foresight of current indicator systems, especially in the context of the COVID-19 pandemic, have faced scrutiny. Future research could further refine and enhance the indicator system, particularly by integrating capabilities for responding to public health emergencies, thereby bolstering the urban response mechanism.

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