Study on the Construction of Environmental Health Evaluation Index System of Built Environment in High-density Areas in China

Jing Li[1,*], Huaqi Shi[1], Xinning Liu[2]
[1]*North China University of Technology, Beijing 100144, China*
[2]*China Construction Design Group Co. LTD, Beijing 100000, China*
**Corresponding Author.*

Abstract: The healthy district evaluation system quantifies the impact of the built environment on residents' health on the spatial elements, providing an effective path for urban renewal to take into account public health. There are few studies on the systematic evaluation of healthy blocks at domestic and foreign, and the mechanism of spatial environment affecting public health is still unclear. Therefore, this paper, by sorting out the built environment evaluation indexes on the block scale proposed by domestic and foreign scholars, and based on policy documents, academic literature and news media materials, determines the weights of each index through the analytic hierarchy process and builds the evaluation index system of healthy blocks. Finally, using Dongba Area in Chaoyang District, Beijing as an empirical case, we explore the mechanism of spatial layout, transportation, public services and living environment in four dimensions of spatial elements on residents' health, and provide planning suggestions for the construction of healthy blocks.

Keywords: Healthy Block; Evaluation System; Dongba Area; Beijing; Empirical Study

1. Introduction

With the continuous improvement of urbanization rate, a large number of people are highly clustered in cities. Affected by unhealthy living environment and lifestyle, the health evaluation and optimization strategy of built environment have become the focus in related policies and research. Recently, with the development of public health research, more and more attention has been paid to the built environment on the block scale. In 2016, The Outline of "Healthy China 2030" has been issued. It proposed that the concept of health promotion should be incorporated into the formulation and implementation of public policies, so as to accelerate the formation of a new situation of coordinated urban health development. The health evaluation index system was released in 2018. In 2020, the Healthy Community Evaluation Standard was issued, becoming the first healthy community evaluation standard in China. It can be seen that the improvement of the public health level of the whole people and the improvement of the public health protection and construction of the whole society has been elevated to the developmental strategic level, and the improvement of the health level of the built environment in the future will become the key to promote the construction of a healthy China. Urban planning is closely related to public health. From the perspective of influence path, urban planning adjusts the urban built environment, and then influences residents' behavior and life style, and finally acts on individual internal factors at the micro level and produces individual health effects. This process is often the comprehensive effect produced by the combined action of multiple pathways. Therefore, urban planning research from the perspective of public health orientation focuses on how the built environment affects individual behavior and life [1]. The empirical study shows that the effects of urban planning on residents' health can be divided into two ways: reducing health risk exposure and promoting residents' physical activity [2]. In terms of reducing health risk exposure, scholars such as Chenjing Fan proposed that dispersed urban structure would bring greater traffic demand

and thus increase residents' exposure to traffic risk, air pollution and noise risk [3]; Yunlu Zhang and other scholars proposed that urban development boundary affects the scope and structure of ecological space, and a good ecological space structure is conducive to improving urban ventilation environment and reducing the probability of urban haze occurrence [4]; In addition, Yanyan Cui etc. found that different land types have different effects on health risk exposure. Land types such as green land, forest land and water area can bring positive health effects, while functional land such as industrial land and transportation land can bring negative health risk exposure [5]. In terms of promoting residents' physical activity, Xiongbin Lin etc. proposed that land plots with higher land use mix degree and public transport accessibility could improve residents' physical activity [6]; Chenwei Lin etc. found that different spatial forms of land plots can provide different physical activity environments for residents. Residential development density is positively correlated with residents' physical activity, but for children, the higher the building density, the lower the level of physical activity [7].

Defining and evaluating the health level of built environment is the basis for urban renewal activities and decision-making in the future. In recent years, many scholars at domestic and abroad have investigated and discussed the relationship between built environment and residents' health. Most of these studies focus on urban scale and community scale, and explore the mechanism of impact of built environment factors on residents' health at macro and micro spatial scales. In terms of city scale, Ruyin Long et al. summarized the indicators of healthy cities through literature analysis and bibliometrics, combined with frequency analysis and relevant research results to build an evaluation system containing four categories of indicators: healthy economy, environment, society and people [8]; Based on the urban health status theory, Yifu Ge et al. analyzed the mechanisms of urban planning on public health at macro, meso and micro scales and constructed an evaluation index system applicable to master plans and detailed plans [1]; In terms of community scale, there are fewer research elements in the health community assessment index system. By constructing a multi-level curve development model, Jiannan Ma et al. analyzed and found that there is an imbalance in the distribution of health service resources in China, and proposed that the number and effectiveness of medical institutions are the key elements affecting the health level of residents [9]; Yanwei Chai et al. built an "environment-behavior-health" analysis framework, took residents' self-rated health as the dependent variable, and used the analytic hierarchy model to explore the impact mechanism of block built environment and community integration on residents' physical and mental health. The research found that compared with the objective built environment around the community, residents' physical and mental health was more likely to be affected by community integration [10]. In general, research on built environment and health is still at the discovery stage, with few studies focusing on spatial assessment and optimization strategies for health at the block scale, which is located in the middle of urban and community scales. Basic scientific questions such as how to identify built environment elements that affect health and how these elements affect population health are still being explored. Nowadays, residents in China often choose to complete their daily walks, chats and interactions within walking distance, therefore, it is urgent to build a health space assessment system at the block scale.

Based on this, this paper constructs a healthy neighborhood evaluation index system by sorting out the health performance indicators at the neighborhood scale involved in the existing healthy block evaluation systems and guidelines at domestic and international level, then using the method of qualitative analysis, based on policy documents, academic literature and news media materials, and determining the weights of each index through hierarchical analysis. Finally, the Dongba Area in Chaoyang District of Beijing is used as an empirical case to study the mechanisms of spatial elements on residents' health in ten aspects: residential environment, green environment, road connectivity, street quality, slow traffic, public transportation, public service facilities, other facilities, land use, and open space. It will provide support for the future planning and construction decisions of healthy blocks in high-density cities in China.

2. Correlation Between Spatial Environment and Residents' Health in High-density Urban Blocks in China

In this study, we summarized the basic characteristics of the spatial environment of high-density urban blocks in China, and based on this, we analyzed the influence paths of different built environment features on residents' health, and constructed a correlation model between spatial planning dimensions and residents' health.

2.1 Spatial Environment Characteristics of High Density Urban Blocks in China

Compared with low-density urban blocks, the health of residents in high-density urban blocks is more likely to be affected by both the built environment and their own behaviors. High-density urban blocks generally have the following four characteristics: (1) Public services are diversified, multi-functional business forms are three-dimensional mixed, people and vehicles are highly dense, and congestion occurs from time to time; (2) The road system is dense, the block form is mostly small-scale, and public transportation is more developed; (3) The open space in the built environment is scattered, and the outdoor walking space is fragmented due to the division of the dense road network; (4) The layout of the building is relatively close, and the internal ventilation of the high-density space is not smooth. At the same time, the land use mix is diversified, the traffic flow on the ground is large, and the noise pollution is serious. Based on the above spatial characteristics of high-density urban blocks, the influence path of high-density urban space and residents' health behavior is explored.

2.2 Construction of Interactive Influence Model Between High-density Urban Space and Residents' Health in China

By collating the relevant literature, we found that the existing research has paid increasing attention to healthy and resilient blocks. Compared with resilient blocks, healthy blocks emphasize the built environment's mental health regulation of residents, mainly in two dimensions: emotional support and instrumental support [11]. Frequent social interaction between neighbors facilitates emotional support for individuals, which effectively reduces morbidity and mortality from non-communicable diseases [12]. Generally speaking, the built environment of a block can affect residents' health level by influencing the mediating variables of residents' physical activity and life satisfaction, while the characteristics of public service environment, transportation environment, living environment and spatial layout of high-density urban space will affect residents' travel intention, travel mode, travel duration and travel purpose, thus regulating residents' health level. Based on this, the relationship model between spatial planning dimension and residents' health is constructed as follows (Figure 1).

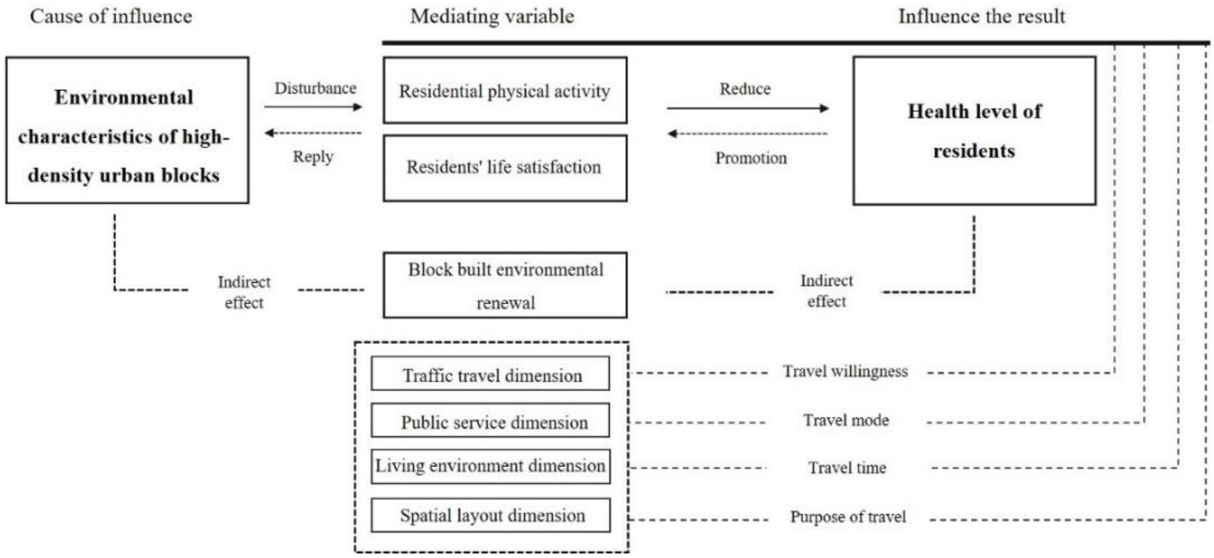

Figure 1. Relationship Model between Spatial Planning Dimension and Residents' Health

3. Construction of Spatial Environmental Health Evaluation Index System for High-density Urban Blocks in China

In this study, the healthy environment, healthy travel, healthy service and healthy layout of blocks are set as the criterion layer, and the living environment, green environment, road connectivity, access quality, slow traffic, public transport, public service facilities, land use and open space are set as the element layer, so as to establish the evaluation index system of China's high-density urban healthy blocks. Then the quantitative evaluation method of each index content is developed.

3.1 Selection of Evaluation Indicators

Through literature analysis and bibliometry, based on the built environment assessment indicators on the block scale proposed by Arnold R. Spokane [13], Ma Shwe Zin Nyunt [14], Jordan A. Carlson, etc. [15], this study summarized the coverage of index categories and influence paths (Table 1) [16-24].

Table 1. Studies Related to the Impact of Neighborhood Built Environment Elements on Residents' Health at Domestic and International Level

Built Environment Dimension	Author	Year	Specific built environment elements
Public service dimension	Jordan A. Carlson etc.	2015	Density of commercial facilities, density of recreational facilities, land use mix
	Javier Molina-García etc.	2017	Land Use Portfolio
	Jie Yang etc.	2019	Accessibility of living facilities
	Mengge Du etc.	2020	Accessibility of public service facilities
Traffic and travel dimension	Javier Molina-García etc.	2007	Walkability (street and sidewalk characteristics)
	Philippa J. Clarke etc.	2010	Street and sidewalk quality, traffic volumes, public transportation routes
	Ma Shwe Zin Nyunt etc.	2015	Transportation Safety
	Jordan A. Carlson etc.	2015	Crossing density
	Wonsik Choi etc.	2016	Street width, block length
	Jie Yang etc.	2019	Subway Station Accessibility
	Mengge Du etc.	2020	Road network density
	Siqin Wanga etc.	2021	Road coverage, traffic commuting, car-free households, distance to CBD
	Yong Chen etc.	2021	Dense and continuous pedestrian and bus networks, multiple public transportation options, and convenient station services
Living environment dimension	Arnold R. Spokane etc.	2007	Internal visibility (slope, windows, bay windows), external visibility (balconies, terraces, etc.), features (balcony decorations, etc.), density (number of dwelling units per parcel)
	Philippa J. Clarke etc.	2010	Social disorder index (street graffiti, etc.), residential security measures
	Ma Shwe Zin Nyunt etc.	2015	Residential density, aesthetics, freedom from crime, infrastructure, park density
	Jordan A. Carlson etc.	2015	Residential Density
	Wonsik Choi etc.	2016	Number of buildings in the block, average building height, floor area weighted height, building heterogeneity, ratio of building occupied area to total plot area
	Javier Molina-García etc.	2017	Residential Density
	Jie Yang etc.	2019	Population density, park accessibility

	Mengge Du etc.	2020	Street scale, park accessibility
	Siqin Wanga etc.	2021	Housing density, green space coverage, housing diversity
	Yongchen etc.	2021	The scale of public space and street space with water and greenery
Spatial layout dimension	Arnold R. Spokane etc.	2007	Adjacent diversity (degree of site mix)
	Ma Shwe Zin Nyunt etc.	2015	Land use diversity, ease of mixed land use
	Siqin Wanga etc.	2021	Land use diversity
	Yong Chen etc.	2021	Land use of functional services

3.2 Evaluation Index System Construction

Grounded theory is a qualitative method of arriving at a final theory through layers of summary based on information and literature, etc. In the process of constructing a theoretical framework of knowledge, the main focus is on summarizing and generalizing information. The sources of information for constructing the evaluation system in this study rely on policy texts, academic materials and news media materials, and the specific process is shown in the figure below (Figure 2). Since the spatial planning dimensions of the neighborhood built environment in the post-epidemic context have been summarized in the previous paper through the literature, they were used as the first level of evaluation indicators and the content of the main axis coding was determined by the reverse extrapolation method. In this study, Nvivo11 software was used to analyze the relevant literature, and some of the metrics established in this paper were taken directly from the relevant metrics in the literature.

The data of evaluation indexes in this study were obtained from policy texts, academic literature and news media. Considering that policy texts represent the future development direction to a certain extent, this study conducted a search on "government website" and "Beida Fabao legal database" under the title of "public health emergencies" and "health". 17 policy documents were selected, 15 of which were used for coding and 2 were used for saturation test (Table 2); The keywords "built environment", "health", "neighborhood" and "evaluation" were used to search core journals on Cnki and web of science, and 40 representative Chinese and 40 English papers were selected in order of relevance (Table 2), of which 74 were used for coding and 6 were used for saturation testing. Using the inverse induction method of grounded theory as the basic method for constructing healthy block evaluation indicators, the living environment (healthy environment), traffic and travel (healthy travel), public services (healthy services) and spatial layout (healthy layout) are taken as the first-level indicators, and the steps for constructing the indicator system are as follows: The core concepts were first extracted from the original data by open coding, and then the information in the open coding was integrated again by using spindle coding to obtain 24 spindle codes. Then the four dimensions of healthy environment, healthy travel, healthy service and healthy layout are selectively coded as the core categories to derive the corresponding 10 spindle concepts, and the evaluation system is constructed by selecting easily quantifiable and accessible evaluation indicators with the initial concepts as the benchmark. Finally, the saturation test was performed on the original data, excluding the data used for coding, and the literature left alone was coded again following the same steps, and no new concepts or categories were found during the coding process, so the index system established by the rooting theory in this study passed the saturation test. For the accuracy and reasonableness of the indicators, the initial list of indicators was sent to 6 experts and workers in related fields by mail questionnaire. The initial list of indicators was revised by combining the experts' opinions, and finally 4 primary indicators, 10 secondary indicators and 25 tertiary indicators were obtained.

There are mainly subjective assignment methods and objective assignment methods to determine the weight of evaluation indexes, and in view of the advantages and disadvantages of the two assignment methods, some scholars have proposed a comprehensive subjective and objective assignment method, but the current combined assignment method does not organically combine the process of finding the weight of the two methods [25]. Based on this, this paper mainly adopts the hierarchical analysis method to determine the index weights. Firstly, we construct a three-level hierarchy of "target-criteria-indicator". Secondly, the judgment matrix is constructed, the weights are calculated using yaahp and the consistency test is performed, and according to the calculation, all indicators are consistent with the consistency test results. Finally, the weights of the evaluation index system for the spatial environment of healthy blocks in the context of high-density urban built environment were determined, as shown in the following table: (Table 2).

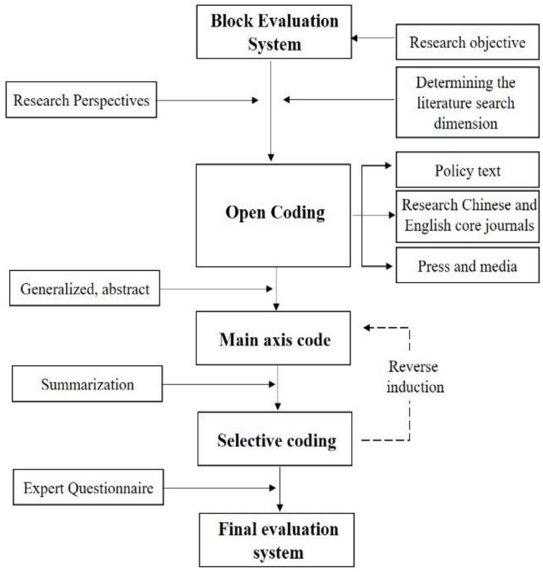

Figure 2. Construction Process of Evaluation Index System

Table 2. Spatial Environmental Evaluation Index Weights of Healthy Blocks in the Context of High-Density Urban Built Environment

First-order index	weight	Secondary index	weight	Three-level index	Final weight
Healthy environment	0.0789	Living environment	0.0131	Building density	0.003
				Population density	0.0078
				Architectural age	0.0007
				Number of community entrances and exits	0.0016
		Green environment	0.0657	Service coverage of park green space	0.0548
				Green coverage rate	0.011
Healthy travel	0.2009	Road connectivity	0.0801	Road intersection density	0.0466
				Road network density	0.0088
				Block connectivity	0.0248
		Street quality	0.0167	Street openness	0.0021
				greenness	0.0146
		Slow traffic	0.0718	Walkway density	0.0359
				Density of non-motorized lanes	0.0359
		Public transport	0.0323	Density of bus stops	0.0242
				Service coverage of subway station stores	0.0081
Health service	0.2009	Public service facilities	0.1674	Commercial facility density	0.0436
				Density of recreational facilities	0.0178
				Density of medical facilities	0.106
		Other facilities	0.0335	Number of logistics facilities	0.0279
				Coverage of public toilet service	0.0056
Healthy layout	0.5193	Land use	0.4328	Land use mixing degree	0.3607
				Block side length ratio	0.0721
		Open space	0.0866	Community entrance and exit open space	0.0137
				Number of emergency places	0.0567
				Block potential	0.0162

4 Spatial Environment Assessment of Healthy Block in Dongba District, Chaoyang District, Beijing

Based on the spatial environment evaluation system of China's high-density urban healthy blocks, this study selects Beijing, a typical high-density city, and takes Dongba Area of Chaoyang District as the research object. Based on relevant statistics and spatial data, the spatial environment evaluation of healthy blocks in the study area is carried out. Combined with the evaluation results, the environment of blocks with high and low scores is investigated and residents are interviewed. The interactive relationship between built environment space elements and residents' health level is analyzed, and the planning strategy is proposed.

4.1 Study Area Profile

Dongba Township is close to the Fifth Ring Road of Beijing, located in the northeast of Chaoyang District. The specific research scope of this paper covers Bahe in the north, the administrative boundary of Dongba in the south, the Fifth Ring Road in the west, and the second expressway of the airport in the east (Figure 3). At present, the research objects are mainly newly built communities, which have certain deficiencies in urban vitality and public service facilities allocation, etc. Therefore, taking them as empirical research objects has good reference significance for regions in the process of urbanization. In addition, since Dongba area as a whole is still in a state of development and the street hierarchy is not obvious, this paper divides the blocks based on the urban secondary roads of Dongba area planning documents (Figure 4), which are divided into 18 blocks, and obtains data on indicators of four dimensions, such as healthy environment and healthy travel etc.

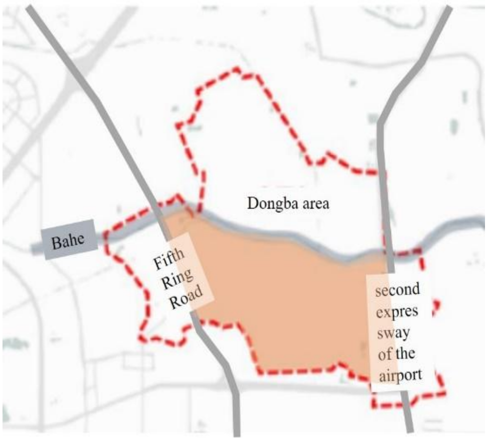

Figure 3. Research Scope of Dongba Area

Figure 4. Block Division of Dongba Area

4.2 Data Source

The data in this study mainly come from field investigation, statistical data and network capture data, which can be divided into four dimensions, such as healthy environment and healthy travel. Because the indicators have different scales, large differences in mean values, and some of them do not have relevant criteria for reference at present, it is impossible to provide specific quantitative scoring values for each indicator. Therefore, this study refers to the research method of Shen Jie et al. [26], and uses the natural discontinuous method of GIS software to divide each group of indicators into 5 categories from high to low, in which positive indicators are assigned scores of 1, 2, 3, 4 and 5 successively, while negative indicators are assigned scores of the other way around. The sources of health environment indicators are shown in Table 3.

Table 3. Healthy Environment-Residential Environment Index Measurement

First-order index	Secondary index	Three-level index	Data source	Index property
Healthy environment	Living environment	Building density	Baidu AOI data, research data	Negative index
		Population density	The seventh census data	Negative index
		Building age	Baidu POI, Anjuke, research data	Negative index
		Number of community entrances and exits	Survey data	Positive index
	Green environment	Park green space service area coverage rate	Baidu POI data, research data	Positive index
		Greenery coverage	NDVI data	Positive index
Healthy travel	Degree of road connectivity	Road intersection data	OSM data, research data	Positive index
		Road network density	OSM data, research data	Positive index
		Block connectivity	Survey data	Positive index
	Street quality	Street openness	Baidu Street View data	Positive index
		greenness	Baidu Street View data	Positive index
	Slow traffic	Walkway density	OSM data, research data	Positive index
		Density of non-motorized lanes	OSM data, research data	Positive index
	Public transport	Density of bus stops	Baidu POI data, research data	Positive index
		Coverage of subway station service range	Planning documents, research data	Positive index
Health service	Public service facilities	Commercial facility density	Baidu POI data, research data	Positive index
		Density of recreational facilities	Baidu POI data, research data	Positive index
		Density of medical facilities	Baidu POI data, research data	Positive index
	Other health facilities	Number of logistics facilities	Research data	Positive index
		Coverage of public toilet service area	Baidu POI data, research data	Positive index
Healthy layout	Land use	Land use mixing degree	Baidu POI data, research data	Positive index
		Block side length ratio	Baidu POI data, research data	Negative index
	Open space	Community entrance and exit open space	Research data	Positive index
		Coverage of emergency site services	Baidu POI data, research data	Positive index
		Block potential	Research data	Positive index

4.3 Evaluation Results and Discussion

The evaluation results of each block in Dongba Area were implemented into the space by GIS (Figure 5), and it can be seen that the health level of the block was high in the southwest and low in the northeast. Considering that variables should be controlled uniformly in comparative analysis, blocks with similar block size and block type were selected for comparative analysis with blocks 5 (good health degree) and 4 (poor health degree) to further explore the influence mechanism of built environment and public health.

Building density and green coverage were the indicators that had a large difference in the health environment impact score. By comparison, it is found that the reason for the high score of block 5 is that the block is evenly divided into four parts, and the walking path running through the north and south is designed. The walking path with a better green environment not only provides a good walking environment for the residents of the community, but also improves the green coverage rate of the block; Road network density and street connectivity were the indicators with significant difference in health travel scores. Through the field investigation, it is found that block 4 has access control in the south and north, and due to the lack of through roads, its score in street connectivity and road network density is low. Block 5 creates a good walking environment by laying bricks and planting trees, thus reducing the interference of motor vehicles and improving the willingness of residents to travel on foot; In terms of health services, the index that affected the score significantly was the density of commercial facilities. Through field investigation, it is found that block 5 has continuous shops on both sides of the pedestrian path, which provides convenience for residents, while block 4 is less exposed to commercial radiation due to the influence of high-grade roads around it, and has a lower score; In terms of health distribution, land use mixing and emergency site service coverage varied widely. Through field investigation, it is found that although both block 4 and block 5 are mainly residential land, many bottom shops are set around block 5 to provide vitality for the block. At the same time, block 5 is equipped with relevant emergency places. These factors have improved the health level of the block to some extent.

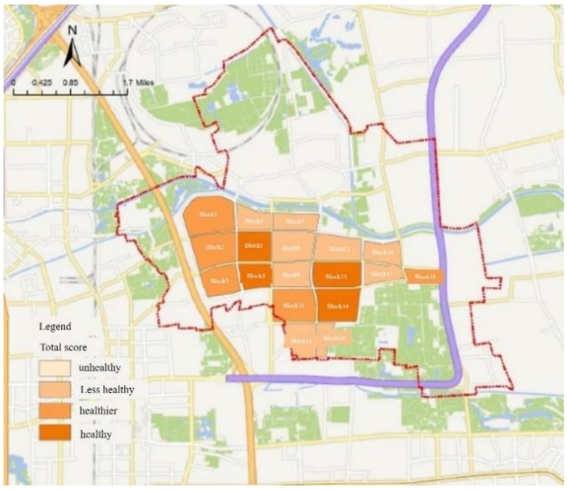

Figure 5. Overall Health Evaluation Results of Dongba Area

4.4 Dongba Block Space Environment Health Promotion Strategy

4.4.1 Healthy environment: connecting small and micro green spaces to build pedestrian green corridors

Green environment is an important factor that determines the length of travel time of residents in a block. Existing green space should be flexibly used in block units. In the block scale design, node green space within the community can be connected to build a block green network. Green path can be used as the boundary of the block, and soft green landscape can replace hard pavement, which not only improves residents' travel frequency and travel time, but also improves the environmental quality of the block. To ensure that even residents at home can enjoy the "green outside the window" landscape.

4.4.2 Healthy travel: weaving the road system to create a bus cycle

Road traffic is an important aspect that affects the travel choices of block's residents, and the roads in a block can be divided into internal roads and peripheral roads. In the design of roads within blocks, namely "streets", the main purpose is to meet the activity needs of residents and improve their walking behavior. Therefore, it is necessary to pay attention to the perfection and coherence of the slow driving system, reduce the influence of motor vehicles on the traffic organization within blocks, and create a walkable road network system. The design of the external road and "road" of the block is mainly aimed at promoting traffic efficiency and meeting the traffic demand of the block. Therefore, both the scale of the block and the distance between the road network are relatively large, and the coherence and integrity of the buildings on both sides of the road and the interface along the street are emphasized. In addition, a three to four-block bus cycle system could also be considered, which would provide convenience for vulnerable groups and reduce the noise and air pollution and other health risks associated with large amounts of private traffic.

4.4.3 Health services: supplement public service facilities and improve the quality of life

Public service facilities are an important factor affecting residents' willingness to travel. In the design of blocks, on the one hand, the construction of public service facilities can be combined with the block environment, such as adding running lanes and mini fitness centers in the community, and installing sports facilities in the block through "cut-in-between" ways to improve the utilization efficiency of public space. On the other hand, on the basis of existing space resources in the block, function conversion can be carried out for some infrequently used places, inject new functions into the place, revitalize the negative public space, encourage the mixing of various business forms in the ground floor of the building and the interface along the street, and integrate commercial, recreational and other functions together, so that residents can achieve multiple goals in the same walking route.

4.4.4 Healthy layout: improve land mix and reserve enough emergency land

Land use layout is the key to influencing the travel purpose of residents in a block. To improve the land use mixing degree in a block, it is necessary not only to increase land use mixing in the plane dimension, but also to enrich different functions in the vertical dimension. Land use mixing in a block can effectively alleviate the frequency of residents using private transportation, and to some extent increase the frequency of residents' walking physical activity. Effectively improve people's health. In addition, the existing green space should be flexibly used in the block safety unit. In the planning and construction, attention should be paid to the combination design of open space construction and emergency land within the block.

5 Conclusion and Prospect

Taking into account the guiding direction of current national policies for spatial environment transformation, residents' demands for the built environment and the existing studies of experts and scholars on the relationship between the built environment and residents' health, this study applies the grounded theory and gradually analyzes policy documents, news media materials and academic literature. An evaluation index system of built environment of healthy blocks was established, which includes 4 first-level indicators, 10 second-level indicators and 25 third-level indicators, including healthy environment, healthy travel, healthy service and healthy layout. In addition, through the empirical study, this paper found that the built environment index that caused the big difference in the health level of blocks mainly lies in the spatial layout dimension of blocks, namely, the land use mixing degree, the block side length ratio, the open space at the entrance and exit of the community, the coverage of emergency place service scope and the block potential. Judging from the status quo of the scores of each block in Dongba, the development of each block is in a state of low degree and unbalanced development, and there is still a long way to go to improve the development level of healthy blocks. The mechanism of urban planning affecting public health is complex. The environmental assessment system of healthy blocks established in this study is based on part of health evidence, and the logic and mechanism are relatively simple to establish, which is far from a comprehensive system. Subsequent research can be more closely related to the planning content of control detailed planning, and establish a more complete theoretical framework according to the updating of planning content and planning technique methods, so as to provide reference for urban built environment renewal in our country.

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References

[1] Ge Yifu, He Zhongyu. Study on the evaluation mechanism and methods of urban planning health impact. Journal of Western Human Settlement Environment, 2022, 37 (4): 76-83.
[2] Li Yu. Theory of urban disease-prone space. China Architecture and Building Press, 2016.
[3] Fan Chenjing, Tian Li, Li Jingwei. Research progress on the influence of urban form on air quality. Urban Development Research, 2017, 24 (12): 92-10.
[4] Zhang Yunlu, Li Xiong. Planning Exploration of urban ventilation corridor based on spatial layout optimization of urban green space system: A case study of Jinzhong City. Urban Development Research, 2017, 24 (5): 35-41.
[5] Cui Y Y. Study on the impact of urban Land use change on air environment quality. Jinan: Shandong Jianzhu University, 2013.
[6] Lin Xiongbin, Yang Jiawen. A review of the relationship between built environment and public health in North American metropolitan areas and its implications. Planners, 2015, 31 (6): 12-19.
[7] Lin Chenwei, Han Xili, Fan Jing. Effects of land development intensity on Children's outdoor Physical Activity: A Case study of Shenzhen City. Urban Planning Review, 2018, 42 (11): 97-102.
[8] Long Ruyin, Fang Wenqian. Design and empirical study on evaluation system of healthy city. Ecological Economy, 2019, 35 (06): 84-90.
[9] Ma Jianlui, Wang Dewen. The cross-impact of community environment and individual factors on residents' health. Southeast Academic Journal, 2022 (03): 104-115.
[10] Yang Jie, Tao Yinhua, Chai Yanwei. The Effects of Neighborhood Built Environment and Community Integration on the Physical and Mental Health of Residents: The regulating Effect of traffic physical activity. Urban Development Research, 2019, 26 (09): 17-25.
[11] Fitnesssports P C O P, Washington, Atlanta. Physical Activity and Health. A Report of the Surgeon General. Clinical Nutrition Insight, 1996, 23 (8): 294.
[12] Saelens B E, Handy S L. Built environment correlates of walking: a review. Medicine & Science in Sports & Exercise, 2008, 40 (7 Suppl): S550－66.
[13] Spokane A R, Lom Ba Rd J L, Martinez F, et al. Identifying Streetscape Features Significant to Well-Being. Architectural Science Review, 2007, 50 (3): 234-245.
[14] Nyunt M S Z, Shuvo F K, Eng J Y, et al. Objective and subjective measures of neighborhood environment (NE): relationships with transportation physical activity among older persons. International journal of behavioral nutrition and physical activity, 2015, 12 (1): 1-10.
[15] Carlson J A, Saelens B E, Kerr J, et al. Association between neighborhood walkability and GPS-measured walking, bicycling and vehicle time in adolescents. Health & place, 2015, 32: 1-7.
[16] Spokane A R, Lom Ba Rd J L, Martinez F, et al. Identifying Streetscape Features Significant to Well-Being. Architectural Science Review, 2007, 50 (3): 234-245.
[17] Molina-García J, Queralt A, Adams M A, et al. Neighborhood built environment and socio-economic status in relation to multiple health outcomes in adolescents. Preventive medicine, 2017, 105: 88-94.
[18] Du Meng Ge, Zhang Qiang, Yuan Dachichang. The effect of built environment on the health status of the elderly: A case study of the East District of Changhong Park in Tianjin. Journal of Tianjin University (Social Sciences Edition), 201, 23 (01): 71-75.
[19] Clarke P J, Ailshire J A, Nieuwenhuijsen E R, et al. Participation among adults with

disability: The role of the urban environment. Social science & medicine, 2011, 72 (10): 1674-1684.
[20] Choi W, Ranasinghe D, Bunavage K, et al. The effects of the built environment, traffic patterns, and micrometeorology on street level ultrafine particle concentrations at a block scale: Results from multiple urban sites. Science of the Total Environment, 2016, 553: 474-485.
[21] Spokane A R, Lom Ba Rd J L, Martinez F, et al. Identifying Streetscape Features Significant to Well-Being. Architectural Science Review, 2007, 50 (3): 234-245.
[22] Nyunt M S Z, Shuvo F K, Eng J Y, et al. Objective and subjective measures of neighborhood environment (NE): relationships with transportation physical activity among older persons. International journal of behavioral nutrition and physical activity, 2015, 12 (1): 1-10.
[23] Wang S, Liu Y, Lam J, et al. The effects of the built environment on the general health, physical activity and obesity of adults in Queensland, Australia. Spatial and Spatio-temporal Epidemiology, 2021, 39: 100456.
[24] Chen Y, Hu X W. Pedestrian-friendly lifestyle block form and urban design strategy: A case study of three waterfront residential areas in Sweden. Architectural Skills, 201, 27 (05):110-113.
[25] Du Q Z. Study on built environment evaluation and design improvement strategy of Xi'an Cultural tourism characteristic Town. Xi'an University of Architecture and Technology, 2020.
[26] Shen Jie, Huang Jiaxin, Zhou Jie, Niu Qiang, Wei Wei, Peng Yang. Construction and application of Walkability evaluation system of urban residential Area Based on Multi-dimension theory: A case study of Wuhan City. Modern Urban Research, 2021 (10): 51-57.

