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The Influence Mechanism of Built Street Environment on the Subjective Well-being of Elderly Residents around Streets: Based on the Subjective Perception Perspective

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Abstract: *The topic of living street is the core area of urban residents' daily life, and its subjective perception characteristics also have a significant impact on mental health. Based on the theory of mental health research model, this paper used multiple regression combined with structural equation to construct a mechanism model of the influence of life street perception characteristics on the subjective well-being of elderly residents. The results show that the characteristics of street environment have an impact on the subjective well-being of elderly residents. The physical environment of the street includes six components: the external characteristics of the building, the quality of the street environment, the characteristics of the street interface, the street furniture, the greening of the street and the spatial scale of the street. It is not only the characteristics of the street environment that have an impact on the subjective well-being of the elderly residents, but also the characteristics of the residents themselves. This study reveals the influence mechanism and degree of the characteristics of the living street environment on the subjective well-being of elderly residents, and provides specific suggestions for improvement in aging cities.*

Keywords: *Environmental characteristics of built streets, elderly residents, Subjective well-being, perceptual characteristics, Structural equation model*

1. Introduction

Research by scholars at home and abroad shows that the built environment has an important impact on the subjective well-being of elderly residents.Subjective well-being (SWB) is the overall evaluation of people's quality of life[1-2]. According to the 2018 Global Happiness Report, China ranks 86th in the happiness index of 156 countries and regions around the world. China is ushering in the development stage of the "new normal", and improving the public happiness index has become the focus of attention of the government and all sectors of society[10]. Improving the quality of the living environment has become an important embodiment of the high-quality development of urbanization. Therefore, it is of great practical significance to analyze the influencing factors of urban residents' well-being and seek effective strategies to improve well-being, so as to promote the construction of new urbanization. In recent years, some scholars at home and abroad have explored the influencing factors of the built environment on the happiness of elderly residents, and found that factors such as street environmental quality[3], external characteristics of streets[4], street furniture[5], street spatial scale[6], and street greening[7][12] have a significant impact on the happiness of elderly residents. On the basis of empirical data collected in specific cities such as Shanghai, Beijing, and Heilongjiang, some scholars have explored the positive effects of the construction environment and social environment of residential communities on the happiness of urban residents at the micro level. For example, Lin Jie's analysis[8] shows that the built environment of cities and communities has a significant impact on the subjective well-being of Chinese residents. There is a two-way relationship between community environment and well-being: on the one hand, community environment directly affects subjective well-being by influencing individual behavior and perception; On the other hand, subjective well-being and its determinants may also have a negative impact on the community environment. Ma et al [9] used multi-layer regression model and mediating effect analysis techniques to explore the driving role of community environment on life satisfaction of Beijing residents and the bridging role of community satisfaction in it. Lv Fei et al [7] said in their reflections on the environmental transformation of old urban settlements that environmental pollution will affect the physical and mental health of residents, and the lack of green space for recreation

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will lead to a decrease in leisure activities and affect spiritual recovery. Therefore, street greening is an important impact indicator.

In China, there has been an increasing amount of research on the relationship between community built environment and residents' sense of happiness. However, these studies are mostly based on administrative boundaries dividing communities rather than residents' daily activity areas. This approach may overlook the spatial heterogeneity of the impact of community environment on residents' sense of happiness, leading to inaccurate analysis results [10]. Liu Ye et al. found that traditional studies based on administrative regions have overlooked the impact mechanism of urban built environment on residents' happiness. In contrast, building environment indicators based on a 15 minute walking distance are more closely related to residents' happiness. [10]. Therefore, this article chooses residential streets near residential areas as the main research objects.

Secondly, existing research lacks attention to the impact mechanism of urban built environment on the specific population of elderly people. Therefore, to make up for the shortcomings of previous research, we specifically selected streets with a large elderly population as the main survey locations.

This article attempts to clarify the following questions: What are the built environment factors that affect the happiness of elderly residents, referred to as the environmental factors that have the greatest impact on the happiness of elderly residents, and how can these factors be improved to enhance the happiness of elderly residents? This article develops a theory to enhance elderly well-being and offers policy advice for creating happier cities to improve their living conditions.

2. Theoretical Basis and Research Framework

2.1 Construction of index system

The impact of street environment on individual mental health includes both material and social environments. Based on the relevant research results at home and abroad mentioned earlier [3-7][12] we integrated the characteristics of the street material environment that affect individual mental health, and classified them according to the characteristics of the street environment in China. Finally, we determined six categories:

Street environmental quality category: including the cleanliness of the ground, the degree of damage to the street surface, and the degree of vehicle aggregation.

External characteristics of buildings: including the transparency of the building facade, the continuity of the building, the number of housing unit doors open to the street, and the visibility of the front steps of the building.

Street facilities: including the number of rest facilities, the level of nighttime lighting, and the number of shelter facilities.

Street interface features: including the degree of interface personalization, the richness of interface colors, and the richness of interface functions.

Street spatial scale category: including the width of sidewalks, the scale of public activity spaces, and the aspect ratio of streets. These factors will affect the comfort and sense of security of street use.

Street greening category: including the degree of greening of the street. Greening can improve the street environment, enhance air quality, alleviate people's stress, and improve mental health.

2.2 Conceptual model construction

Based on the above indicator system, we have constructed a conceptual model (see Figure 1).

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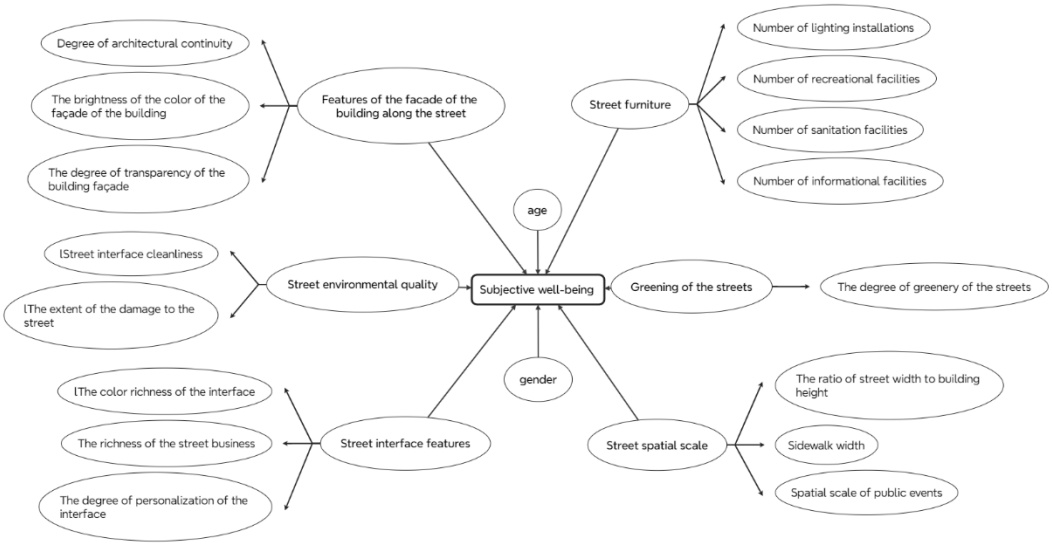

Fig.1 Conceptual model

3. Method and Data

3.1 Construction of Structural Equation Modeling

Using the confirmatory factor analysis of structural equation modeling, a hypothesis on the correlation between subjective well-being of elderly residents and street material environmental factors is proposed, and a structural equation model is constructed [11]. The correlation research hypothesis includes: H1 street material environmental elements (street facade features, street environmental quality, street interface features, street facilities, street greening, street spatial scale) are significantly positively correlated with the subjective well-being of the elderly; The subjective well-being of elderly people in H2 is significantly positively correlated with their own characteristics. Based on the theoretical foundation and path assumptions mentioned above, combined with the indicator system and data statistical analysis, a structural equation model is constructed and calculated in AMOS software.

3.2 Research Area and Data Collection

3.2.1 Study area

Figure 2 The length, starting point, and end point of the study street.

Select the densely populated residential blocks in Shuangyushu Street, Haidian District, Beijing as the study area (see Figure 2).

The selection criteria are:

1) The macro built environment characteristics of the district where the street is located are similar, but there are certain differences in the internal micro environment characteristics[12];

2) Streets rarely have other external psychological interference factors[11]. We will conduct segmented research on the South Road of the Academy of Sciences, dividing it into 4 sample blocks based on distance. The sample blocks belong to typical old blocks with 6-story red houses, and urban secondary roads or branch roads with a width of less than 17m.

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3.2.2 Questionnaire design and distribution

Table 1 Description of questionnaire indicator items (quantitative method table)

Item descriptions of the questionnaire indicators	
feature	Scale itemized description
The physical environment of the streets	
Building facade street features	Street buildings often have windows on their façades, creating a sense of interruption between them. The façades are usually vibrant in color.
Street environmental quality	Feel that the street interface is neat; The extent of street deterioration.
Street interface features	It feels like the streets are colorful; I feel that the street format is rich in functions and meets the needs; It feels like the street has character.
Street furniture	Night lighting, sanitation, rest facilities ample; clear street signs, easy access to information.
Greening of the streets	There is enough greenery
Street spatial scale	The public space is ample with appropriately wide sidewalks, avoiding a narrow and oppressive street-side feel.
individuality	gender; age
Subjective well-being	
Life Satisfaction, Happiness Index, Affective Index	This passage assesses your current emotions, life satisfaction, enthusiasm, motivation, sense of success, living conditions, achievements, and contentment with your life.

Perceived environment is people's daily cognition of the objective environment. Research has shown that studying the perceived environment is more helpful in explaining health benefits. The questionnaire (see Table1) design revolves around the characteristics of the street's material environment and residents' sense of happiness, including six aspects: architecture, environment, interface, facilities, greenery, and spatial scale, with a total of 16 sub items. The subjective well-being scale for residents consists of a happiness index scale, an emotion scale, and a life satisfaction scale, with a total of 15 sub items. The questionnaire collects data through offline interviews and online surveys. The invitation conditions are:

1) Age between 60 and 90 years old;

2) Residence for 1 year or more;

3) Has not suffered any significant mental trauma or major illness in the past year;

4) There is enough time to complete the questionnaire.

Offline semi-structured interviews were conducted with 30 elderly residents, and a total of 50 valid data were collected from online questionnaires. The distribution of individual attributes in the samples was relatively reasonable, and the data had good representativeness.

3.3 Impact path verification

Construct a structural equation model using AMOS based on assumptions H1 and H2. Use maximum likelihood estimation method to estimate model parameters and obtain standardized path coefficients.

The fitting indicators CMIN/DF and GFI values meet reasonable standards, and the model fitting degree is acceptable. After multiple revisions, the final model was obtained, and the standardized path coefficients showed the relationship and degree of influence between the variables. From the results of the path coefficient test, it can be seen that hypotheses H1 and H2 hold true

4. Experimental results and analysis

In the calculation of standardized regression weights, the influence effects, from large to small, are as follows: building facade features along the street, street interface features, street facilities, street scale, street environmental quality, and street greening(see Table 2).

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Table 2 Analysis Table of Impact Effects.

	H1	H2	Total effect value	Sub item of influencing factors	Direct effect value	present situation	suggestion
SUBJECTIVE WELL-BEING	AGE	Exterior Facade Features of Buildings Along the Street	0.620	*Building continuity*	0.680	The weak continuous interface and inconsistency on both sides of the building make the entire block appear cluttered and lack overall coherence.	Develop a unified plan and clarify the architectural style. Integrate existing buildings and demolish some unnecessary ones.
				Brightness level of facade color	0.350	Adopting a combination of bright colors such as orange, red, yellow, and gray.	Add facade decorative elements, set LED light strips reasonably, and renovate exterior walls with warm toned coatings
				Transparency degree of building facade	0.410	Windows and transparent buildings bring a bright and ventilated feeling to the streets, enhancing the living experience of elderly residents.	Innovate the concept of facade design and enrich the vegetation on the façade,
		Street environmental quality	0.050	*Cleanliness of street interface*	0.444	Except for the oil stains at the entrance of the store, overall it is relatively clean.	Regularly clean the road surface to keep it clean. Establish standards for the business activities of operators and conduct reviews of hygiene conditions.
				The degree of damage to the street surface	0.804	Due to uneven road surfaces, it is easy for pedestrians to stumble, and the problem of damage to pedestrian slopes is prominent.	Repair damaged ground and sidewalk slopes to ensure unobstructed walking.
		Street interface features	0.120	*The richness of street business formats*	1.000	Among the elderly population, positive reactions to warm colors are predominant, and bright colors have a positive effect on improving the mood of the elderly.	While standardizing the style of street signs, reducing control over sign colors, store signs can be developed with distinctive features to enrich the interface.
				The richness of street business formats	0.570	he structure of commercial products has changed, and the number of small commodity types has decreased. Elderly people face inconvenience in purchasing daily necessities due to their inability to adapt to online shopping.	Set up small commodity and elderly product stores, morning market vegetable stalls, and a service center for housekeeping and medical facilities to support the elderly.
				Personalization level of interface	0.245	Most elderly people think it's not very important and don't pay attention to these things.	Explore and inherit local folk culture, such as folk art, traditional handicrafts, etc., and set up exhibition areas in the streets.
	GENDER	Street scale	0.060	*Street aspect ratio*	0.650	Elderly residents are discontent with the narrow, confined street planning, which negatively impacts their living conditions and mental well-being.	By removing some buildings facing the street, the aim is to reduce building congestion and provide necessary conditions for street expansion.
				Width of sidewalk	0.730	The overall scale is suitable, but vehicles occupy the pedestrian walkway, squeezing the space for the elderly to pass through.	Construct underground parking spaces or three-dimensional parking facilities to achieve separation of people and vehicles.
				Scale of public space activities	0.150	The scale of public activity spaces on both sides of the street is appropriate.	Optimize street layout, plan elderly activity areas reasonably, and equip corresponding fitness facilities, aiming to fully meet the fitness needs of the elderly population.

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		Street greening	0.010	*Degree of street greening*	0.010	The greening rate of each type is about 87.6%, and the number of greening types is about 60. However, there are some problems such as disorderly greening, which affect the mood.	It is necessary to screen out green plants that are both safe and easy to manage, including varieties with non-toxic and thorn free characteristics, while ensuring periodic pruning of these vegetation.
		Street furniture	0.070	*Quantity of lighting facilities*	0.436	An analysis of 33 lighting devices revealed their effectiveness in enhancing nighttime visibility for the elderly, reducing fall risks.	Add various lighting facilities, such as LED lights, etc.
				Number of recreational facilities	0.831	There are 25 rest areas in this area, but their distribution is sparse and uneven. The seats are mostly in the lawn, with low usage and long-term disrepair, which affects the user experience.	Increase recreational facilities with standardized quality, using comfortable, durable seats at moderate heights for the elderly, and ensuring accessibility without obstacles.
				Number of environmental sanitation facilities	0.927	There are 17 sanitation facilities, with a moderate quantity, which can meet the living needs of the elderly.	Reasonably plan the layout of facilities based on the travel routes of the elderly, so that they can use them conveniently during their travels.
				Number of information facilities	0.917	There are few bulletin boards and a lack of facilities, which affects elderly people's access to the latest news.	Upgrade navigation with clear signs for seniors; build multifunctional centers to enhance their cultural and social activities.

The appearance, color, style, and other elements of buildings have the largest proportion in the visual aspect of streets, and therefore have the most direct impact on the psychological feelings of elderly residents. The unique and fully functional interface design makes the main street space outstanding in stimulating positive emotions, meeting the psychological needs of residents, and showing significant effects in increasing subjective well-being. Street facilities are ranked third and have a moderate impact on psychological depression. Perhaps due to the well-equipped facilities, streets mainly play a role in stimulating positive emotions, and their sufficient facilities can meet the happiness needs of some residents. The scale of the street is relatively appropriate, but due to the long-term presence of vehicles on both sides of the street, it occupies the walking and activity space of elderly reits effect on improving the happiness of the elderly is moderate. Due to the many small shops on both sides of the street, there are many stains in front of the shops. The uneven road makes it easy to trip while walking, and the sidewalk slopes are severely damaged, so it has little impact on the subjective well-being of elderly residents. Due to issues such as disorganized greenery or being isolated by roadside curbs, it has not effectively improved the sense of happiness among elderly residents and ranks sixth.

5. Conclusion

Our research developed a model linking lifestyle street characteristics to elderly mental health in Beijing's Haidian District. Findings reveal that street environment factors impact elderly psychology, with the social environment acting as a key mediator.

We have come to the following conclusion:

(1) The street environment's perceptual features independently influence elderly residents' mental health, highlighting the micro-environment's direct impact on their psychological well-being.

(2) The differential impact of street material environment: Multiple elements of street material environment have differential effects on the positive psychology and psychological distress of elderly residents, suggesting that comprehensive consideration of these aspects should be given when improving the quality of street environment.

(3) When exploring the impact of material environment on the mental health of the elderly, the mediating function of street social environment is particularly important, as it directly relates to the social connections and support among community members.

(4) The built environment impacts elderly psychological health, ranking from most to least influential: building facade, street interface, facilities, scale, environmental quality, and greening.

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This study explores how the environment impacts residents' happiness and offers targeted urbanization policy recommendations. The report's third part details improvements to the built environment. However, the study's limited sample size may affect data universality. Future research should expand samples and compare cities to strengthen findings.

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