Research Paper

A study on the elderly-oriented evaluation of walking environment in northeast cold community under the background of healthy city

A case study of Haicheng Street Community in Harbin City

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Abstract

Under the dual background of healthy cities and population aging, the community, as the basic unit of Chinese cities, undertakes the heavy responsibility of old-age care. In Northeast China, due to natural factors such as climate and region, the comfort level of the community walking environment has declined significantly. At the same time, the quality of the existing space environment and other facilities in the community has deteriorated, making it difficult to meet the walking needs of the elderly. In this case, how to build an elderly-friendly community walking environment has become a key issue. Therefore, the study takes the Haicheng Street community in Harbin City as an example. First, the daily activities and walking needs of the elderly in the community are obtained through questionnaires, interviews, behavior observation, and path tracking. system, using IPA analysis and other methods to determine the contribution rate of each evaluation factor to the pedestrian environment and the priority of renovation. Secondly, this study proposes an aging-friendly renovation strategy for the pedestrian environment from the aspects of transportation, landscape, public space, service facilities, architectural design, and non-built environment. Finally, select typical streets and important nodes to propose a detailed planning and design scheme.

Keywords

Healthy city, Cold community, Walking environment, Ageing evaluation

1. Introduction

Since the beginning of the 21st century, the aging process of Chinese population has been accelerating day by day, according to the census data of the Seven Census, the proportion of China's population aged 60 and above has reached 18.7%, of which the proportion of the population aged 65 and over has reached 13.5%, and the aging of the population has shown a huge scale, a significant acceleration of the process, and a significant difference between urban and rural levels. It can be seen that China's aging problem cannot be delayed. In recent years, the problem of community walking environment discomfort

and aging has become more and more obvious, exposing the problems of public service facilities and infrastructure construction and the requirements of aging social development (Wang and Chen, 2020). Especially in cold areas, factors such as cold winter climate, monotonous landscape, difficulty in travel, and low utilization of outdoor activity space have adversely affected the construction of the walking environment in cold and old-age communities, and the aging transformation of community walking environment is imminent. In the context of the new crown epidemic, China's healthy city construction not only needs to meet the challenges of the pandemic, but also quickly respond to the rapidly growing demand for elderly care(Bai et al., 2022).

Therefore, scholars at home and abroad have carried out research on the aging transformation of the community walking environment in a healthy city. At the same time, ageing has attracted global attention. Ageing is increasing the cost of health(Harrison et al., 2021), which places a burden on society. Urban changes brought about by population ageing have become major issues in the field of public policy(Buffel and Phillipson, 2016; van Hoof et al., 2021). As one of the most important ways of travel, the importance of shaping the walking environment has been greatly overlooked(Chan and Li, 2022).

In terms of specific research content, different scholars have carried out research based on actual cases. (Joy, 2021) examined how the neoliberal techniques of benchmarking, governance, devolution and responsibilization operate through the AFCC program in Toronto. (Lee et al., 2021)studied the differences in pedestrian perception and understanding of pedestrian perception by the characteristics of the walking environment. (Ruza et al., 2015)developed a framework to systematically evaluate the age-friendliness of cities. (Santos et al., 2022)pointed out that providing a good pedestrian environment, appropriate pedestrian infrastructure, green space, and access to commercial, retail and transportation hubs is conducive to livable, healthy and sustainable cities. (Shi, Liu and Feng, 2023) explored the impact of AFCC on cognitive health in older adults at the community and city levels. (Steels, 2015) examined the current evidence of approaches and interventions used to create age-friendly cities and communities identified in recent research and practice. (Adams and Cavill, 2015) explored engaging communities in changing the environment to facilitate transit-related walking. (Yang et al., 2021) discussed the issues and challenges of implementing comprehensive transformation in ageing communities. (Krawchenko et al., 2016) explored how infrastructure and assets important to vulnerable seniors in rural communities may be affected by coastal climate change. (Ravi, Fields and Dabelko-Schoeny, 2021)created a rich description of older adults' experiences with outdoor spaces, buildings, and transportation as part of an age-friendly assessment. (Ruza et al., 2015)developed a framework to systematically evaluate the age-friendliness of cities. (Santos et al., 2022)measured public space quality and walking environment in Lisbon. (Wu, Fu and Yang, 2022)suggested that for European and developing countries, the construction of age-friendly housing should be achieved by raising the awareness of the elderly about the benefits of housing renovation and the appropriate time for renovation. (Zhang et al., 2021)proposed a multiscale spatial framework of housing and develops a multi-level assessment of housing age-friendliness. (Zhang, Yang and Wang, 2021)established an evolutionary game model of the local government, investors and residents and then explored the stable strategy set of the evolutionary game of stakeholders.

It can be found that the existing research on the aging transformation of the walking environment in coldland communities is not sufficient, and the methods and means of specific transformation still need to be supplemented. Therefore, this paper attempts to take a typical coldland community in Northeast China as an example to study the aging transformation of the community's walking environment through solid survey data. The purpose of this study is to establish a community evaluation system for the pedestrian environment in typical cold regions, to determine the focus of the aging-friendly renovation of the community's pedestrian environment, and to propose specific renovation strategies from the perspective of spatial planning.

2. Research objects and methodology

2.1. Research objects

The study selects the typical cold land community Haicheng Street community as an example, Haicheng Street community is located in the central area of Harbin City, under the Nangang District of Harbin Garden Street, east from Haicheng Street, west to Yaojing Street, south of Majiagou River, north to Xidazhi Street (Figure 1), covers an area of 14.04 hectares, with a total of 8 streets, 30 courtyards, 40 buildings, and 140 units. The protected buildings are 64 Lianfa Street and 26 "Yellow House" protected neighborhoods. In the community, there are harbin railway public security bureau, Harbin railway public security office, Harbin railway military representative office, Harbin railway real estate section of the sixth industrial district, nine industrial district, university of technology museum, university of technology school of architecture, Haicheng primary school, garden community health service center and other major units .

Figure 1. Haicheng Street community location map. Source: self-drawn.

2.2. Research methodology

This study mainly uses the Likert scale method and the IPA analysis method. The Likert scale is one of the most commonly used scales of scoring plus total, and these items belonging to the same concept are scored in the summation method, and it is meaningless to score individually or individually. It was improved by the American social psychologist Rickett in 1932 on the basis of the original total plus scale. The scale consists of a set of statements, each of which has five responses, "very agreed", "agreed", "not necessarily", "disagreed", and "very disagreed", which are recorded as 5, 4, 3, 2, and 1, respectively, and the total score of each respondent's attitude is the sum of the points he obtained from his answers to each question, which can indicate the strength of his attitude or his different states on this scale.

The IPA analysis method is the importance and its performance analysis method, which is widely used to identify important influencing factors in surveys such as customer satisfaction and tourism satisfaction. According to the average score of satisfaction and importance obtained in the survey, it falls into the four quadrants of IPA grid division for analysis. As shown in the figure below, the I quadrant is a high/high area, which can be interpreted as a prominent focus. The corresponding countermeasure is to continue to work hard; the II quadrant is a low/high area, which can be interpreted as a low importance, but a significant effect. Corresponding It is recommended not to deliberately pursue it, but to let nature take its course; the third quadrant is a low/low area, which can be interpreted as poor performance, but the importance is low and it is recommended to be listed as a low priority. Quadrant IV is a high/low area, which can be interpreted as high importance but poor performance. The countermeasures and suggestions are to focus on this area and focus on improvement in the next step (Figure 2).

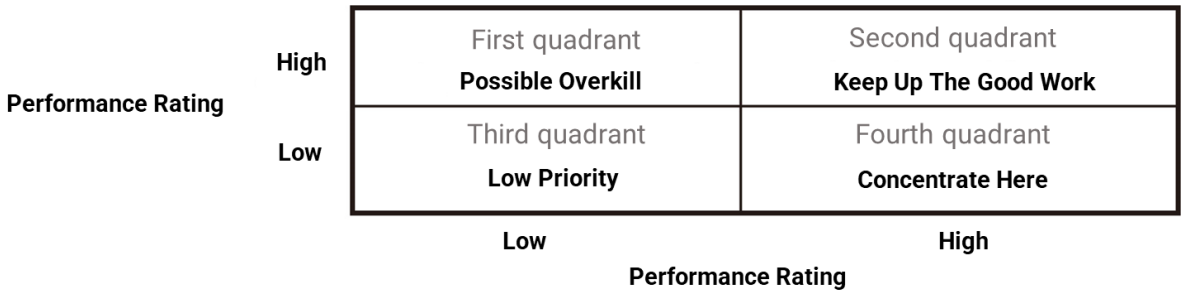

Figure 2. IPA quadrant analysis plot. Source: self-drawn.

Also, the research was conducted in the form of questionnaire surveys, interviews and field visits, which mainly included the current situation of the main pedestrian streets in the community, the safety hazards of pedestrian space and the walking behavior of the elderly. The distribution sites of the questionnaire cover the walking path space and the stay node space with more elderly people, mainly including the public space nodes within each community of Haicheng Street community, each street and Majiagou Park (Figure 3). A total of 116 questionnaires were distributed in this questionnaire survey, and 116 questionnaires were effectively recovered. The respondents accounted for the largest proportion in Area B of Yaojing Community.

Among them, the proportion of elderly people in all ages is: 9% of 50-59 years old, 35% of 60-69 years old, 27% of 70-79 years old, 23% of 80-89 years old, and 6% of 90 years old and above(Figure 4). The age of the respondents was concentrated in the range of 60 to 79 years. The reason for this phenomenon is that the elderly of this age have good physical function, the ability to travel independently and the time of activity, and their range of activities is also more flexible.

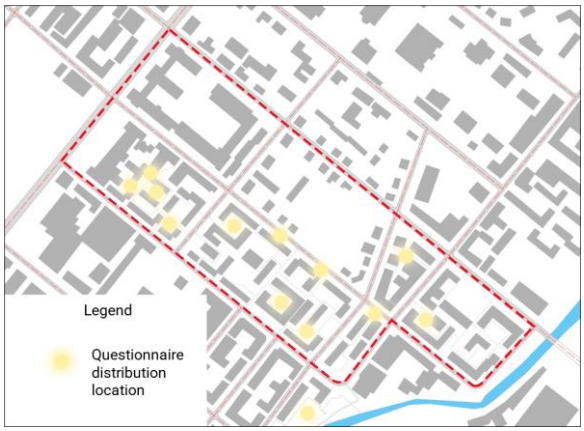

Figure 3. Questionnaire distribution map. Source: self-drawn.

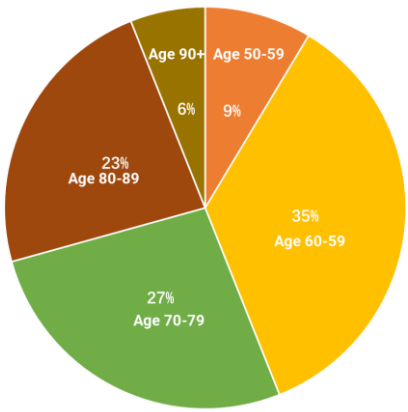

Figure 4. Age composition. Source: self-drawn.

3. Evaluation of ageing of walking environment in coldland communities

3.1. Pedestrian space safety hazards and bad walking experience

Due to the lack of regular maintenance and repairs, there are many unsafe factors in the current walking space of Haicheng Street community, such as aging facilities and lack of maintenance, parking encroaching on public space, accumulation of debris, lack of cross-street safety facilities and traffic signs, free entry and exit of outsiders, road damage, unreasonable height difference and so on(Figure 5).

At the same time, the quality of walking can directly affect the travel experience of the elderly. The accessibility, convenience, fun and flexibility of the walking environment can improve the satisfaction of the elderly's travel experience, on the contrary, the crowded, monotonous and walkable walkable walking environment will bring inconvenience and safety hazards to the travel of the elderly. We also investigated the unfavorable factors that affect the walking feeling of the elderly through questionnaires, so as to make the research more authentic(Figure 6). Among them, in view of the research focus of the walking environment, this study divides the influencing factors of walking sensation into two aspects: favorable factors and unfavorable factors (Figure 7).

Figure 5. Safety hazards . Source: self-drawn.

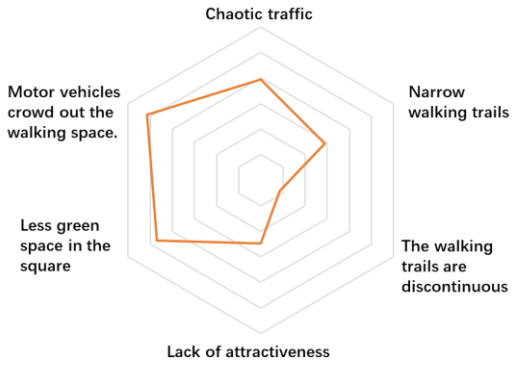

Figure 6. Unfavorable factors. Source: self-drawn.

types	Transportation facilities	Commercial facilities	Environmental aspects
Favorable factors	The management of traffic lights reduces the threat of rapid motorization	Prosperous ground floor commercial, bus stops	Wide walking trails, interesting street space
Headwinds	Sidewalk parking, unclear crossing facilities	Contradictions arising from free development (mobile vendors, night markets)	Ramps with no safety measures, rudimentary safety facilities, hidden obstacles to walking trails

Figure 7. Factors influencing walking sensation. Source: self-drawn.

3.2. Principles and elements for the construction of evaluation index system

The construction of the pedestrian environment evaluation index system of Haicheng community based on the daily behavior of the elderly follows the following principles: systematic principle, the principle of typicality, the principle of dynamics, people-oriented principle.Construct an evaluation index system for the ageing of walking environment in cold communities, and the criterion layer is summarized into four performance indicators of safety, health, convenience and comfort, and the sub-criterion layer is 11

elements such as site safety and street safety, and is further subdivided into 32 individual elements (Figure 8). Among them, safety refers to the degree of psychological protection of pedestrians, involving site safety, street safety, social supervision and other aspects; Health refers to both environmental health and mental health, convenience not only includes the accessibility of commercial facilities and service facilities for the elderly, but also involves the convenience of travel and transportation, such as the community street sign guidance system, appropriate traffic light waiting time, complete waiting seats, etc.; Comfort refers to the degree of humanized convenience and aesthetic pleasure felt during walking, including reasonable site space with functional partitions, perfect living service facilities along the street, shading facilities for bad climate, good environmental quality (air, greenery and noise), comfortable trail width, straight and smooth and clean sidewalks and pleasant street visual landscapes.

Target layer	Guideline layer	Sub-criterion layer	Indicator layer
Evaluation of the ageability of the walking environment in the cold community	Security	Venue security	Terrain with a suitable slope
			Barrier-free facilities
		Street safety	Leveled roads
			Pedestrians have priority in the right of way, and motor vehicles give way
			The walking path is of good width
			The road junctions are in good order
			The barrier-free system is perfect
		Social surveillance	Well-ordered neighborhood
			High degree of recognition
	Health	Environmental quality	No effect of pungent odor
			Quiet environment without car noise
			Have a certain amount of fitness equipment
			Facilities are available to protect guests from the wind and rain
			The green space inside the community is perfect
			The streets are continuously greened
		mental health	Cultural activities in the community are diverse
			The activity center provides a place for exchanges and exchanges
	Convenience	Commercial facilities	A variety of commercial and service facilities and temporary booths are arranged
		Service facilities	Fixed and removable tables and chairs are provided
			Public toilets are available on request
			The layout of the elderly activity center in the community is reasonable
		Transportation	The community street sign guidance system is perfect
			Continuous walking, traffic lights waiting time is appropriate
			Bus stop waiting for seats to be fully seated
	Comfort	Venue space	The functional partition is reasonable to meet the different activity needs of the elderly
			Lounge area and activity area are separated
		Small amenities	There are ample, comfortable resting places, taking into account the needs of caring for children
			Plenty of bins and reasonable location
			Seats, railings, and steps meet the needs of the elderly
		Green facilities	The microclimate is comfortable and meets the needs of outdoor activities in summer and winter
			The plant configuration is rich and the seasons are distinct
			The plants are beautifully shaped and unobstructed

Figure 8. Indicator system for the assessment of age-appropriate environment in cold communities

3.3. Results

According to the statistical results of the questionnaire, the quadrant map is drawn, and the origin points of different colors are used to represent the different factors affecting the community environment, and the priority of their transformation can be judged by the location of the factors (Figure 9).

It can be seen from the sensitivity of the four-point quadrant that the satisfaction and attention of the elderly in the Haicheng community in Area A are high, and the results are remarkable, and this part of the content continues to improve; Area B has a low weight and high satisfaction, which can be pursued without deliberate pursuit and does not need urgent transformation for the time being. The satisfaction of the C interval is low and the weight is also low, and it should be added to the ranks of promotion; Area D has high weight and low satisfaction, so it should be focused on this, focusing on improvement, and it can be seen that the transformation content includes: the green space system inside the community, reasonable functional partitioning, plant pruning, reasonable layout of the community elderly activity center, sufficient rest positions, the need to care for children, the setting of fixed and movable tables and chairs, and the good order of road intersections. Accessibility systems and much more.

On the basis of the questionnaire analysis, combined with the preliminary on-site research and interviews, it can be determined that the content of Area D is a problem to be solved in the planning and design of the pedestrian environment of the elderly in Haicheng Community in the near future.

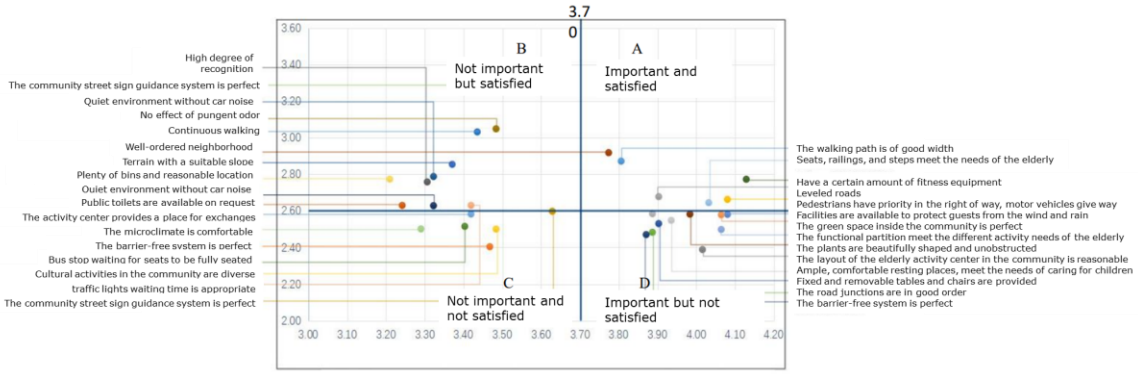

Figure 9. Four-quadrant matrix scatter plot. Source: self-drawn.

4. Design strategies for community pedestrian environment renewal

4.1. Pedestrian system design

According to the evaluation results of the survey and the strategies proposed in the plan, the places where the elderly often move in the Haicheng Street community are selected for detailed node design, and the internal pedestrian system of the community is planned and laid out in combination with the current pedestrian road, and the overall pedestrian system of the community is connected to form a pedestrian system suitable for the activities of the elderly covering the whole Haicheng Street community (Figure 10).

The optimized walking system in this study fully considers the various walking needs of the elderly, combines the characteristics of cold regions, creates multiple indoor and outdoor activity spaces, plants rich greenery, and supplements barrier-free facilities for spaces such as steps and ramps to realize human nature. It is designed to promote the healthy communication of the elderly and help shape a healthy city in cold regions.

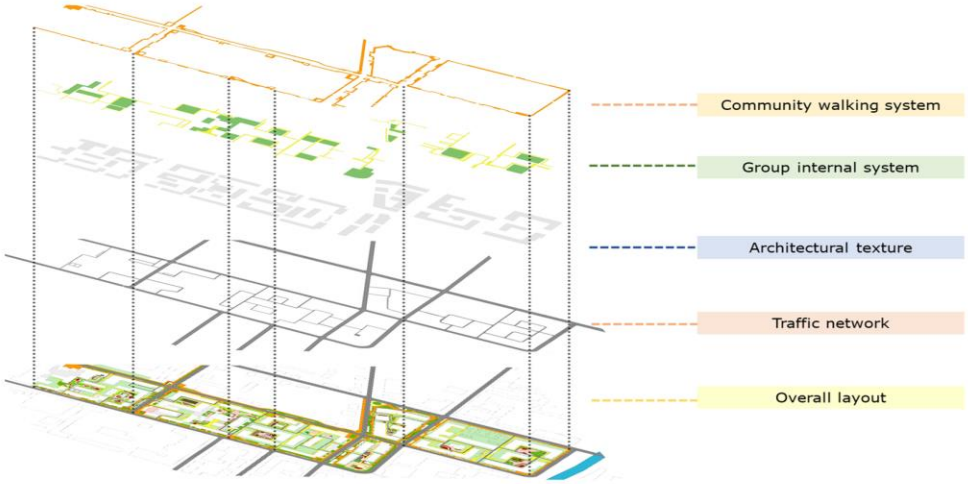

Figure 10. Construction of age-appropriate pedestrian environment system. Source: self-drawn.

4.2. Select typical street design: Company street optimization and transformation

Company Street Night Market Street is a street with both living and commercial features, so it is of great significance to transform it. We used a series of planning tools to carry out a series of renovations in the context of encouraging public participation. The transformed street effectively organizes the flow of people and vehicles, and provides a more friendly, convenient and interesting street space for the elderly and people of all ages.

In terms of traffic organization: living streets pay attention to the pedestrian walking experience, so first sort out the street traffic, delineate the roadside parking spaces, standardize the roadside parking behavior, and ensure the integrity and consistency of the pedestrian route of the sidewalk; Limit the speed of driving by setting up speed limit signs, speed bumps and other facilities to ensure the safety of pedestrians crossing the road. Secondly, delineate the placement of stalls to ensure that the width of the walking space is appropriate and improve the pedestrian walking experience. Local enlargement is carried out at the location where the pedestrian street is connected to the entrance and exit of the community to ensure the smoothness of the pedestrian space at the intersection of people.

In terms of pavement design, the street space is divided through the street paving design to ensure the continuity of the pedestrian space; Use warm yellow in terms of paving color to create a warm and comfortable space feeling; By improving the barrier-free facilities on the streets and using non-slip materials, the elderly can be safe to walk.

In terms of site construction, fully combine the needs of residents' activities, rationally plan the street space, and create a vibrant commercial street space. Considering the decline in physical function of the elderly and the short walking distance of one-time, improve the street recreation facilities, so that the elderly can rest and communicate on the street after visiting shopping, and at the same time increase the stay space on the street side is conducive to the interaction and exchange of the crowd here, adding vitality to the street. Considering the lack of existing street greening facilities, we will improve road greening, build tree ponds at existing ancient trees for people to rest and stay, add facilities such as landscape flower ponds, and improve the quality of the street environment through rational configuration and pruning of plants. The final optimized pedestrian environment of Company Street is as follows (Figure 9).

Figure 9. Street pedestrian environment adaptation to aging transformation map . Source: self-drawn.

5. Conclusion and future work

On the basis of collating and analyzing the survey data, the study analyzes the impact of the four factors of safety, health, convenience and comfort of the pedestrian environment of the Haicheng Street community on the walking environment of the Elderly through the IPA evaluation method, and analyzes the evaluation results to find the shortcomings in the current pedestrian environment, laying a solid foundation for discussing the aging transformation of the community walking environment. In the future, this study will further strengthen the quantitative research on the evaluation of walking environment adaptability to aging, and try to establish an intelligent walking environment system through the GIS platform to meet the various walking activities and needs of the elderly in a timely manner, so as to achieve the purpose of caring and helping the elderly, to create smarter walking environment systems (Colnar, Dimovski and Bogataj, 2021).

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