The Practice of Urban Design in An Aging Society in China

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Abstract: The current demographic issue in China is facing the dual challenges of negative natural growth rate and accelerated deepening of the aging society. This paper reviews China's experience in the field of urban design in response to the challenges of aging, with the theme of population aging, and presents a literature review at three levels: macro design principles, meso design ideas, and micro design specifications. Based on the CNKI database, by reviewing and summarizing China's empirical measures in the field of urban design under aging since 2011, this paper aims to provide a reference for future scholars to study the issue. The study found that the academic community mainly used qualitative research methods, with more recommendations for the renovation of streets, squares, parks and neighborhoods in public spaces.

1. Introduction

Since China entered an aging society in the 21st century, the trend of population aging has been accelerating. The China Statistical Yearbook - 2021 shows that China currently has 264 million people aged 60 or above, accounting for 18.7% of the total population [1]. Despite the full implementation of China's two-child policy since 2011 to alleviate the country's rising aging figures, the natural population growth rate in 2021 is only 1.45%, a record low since 1978. China's population problem is facing the twin challenges of negative population growth and accelerating aging. Population aging is not only a current social issue in China, but is also closely related to the field of urban design. Based on the CNKI database, this paper reviews the domestic experience of the urban design discipline in dealing with population aging in previous studies. Previous research suggests that responses and experiences in the field of urban design have focused on improving the quality of life of older people by transforming their living environment. Some research findings are based on analysing the realities of specific urban or neighbourhood sites and providing targeted solutions. There are also ideas based on relevant theories of aging. However, few of these research findings contain a clear overview of the various coping strategies and measures, and many are discussed in categories based on specific planning objectives. Therefore, in order to gain a clearer understanding of the empirical measures proposed by different scholars on this issue, this paper divides the relevant measures into three levels: theoretical design principles, design ideas based on design principles and issues, and specific urban design practices. Using the themes of 'aging' and 'older people', this paper retrieved journal literature related to the field of urban design since 2011 which is an important year in the field of Chinese population policy. After manual reading and classification, invalid literature (non-academic articles such as reports, press releases, conference announcements, statements, etc.) and literature with low relevance to coping strategies were eliminated, and a total of 25 articles related to the field of urban design were eventually found.

2. Analysis of Aging-Friendly Measures in Urban Design

In an aging society, there are two real challenges: the physical and mental decline of the elderly and the deterioration of the quality of life in society, which also places new demands on urban design. Urban designers have conducted in-depth research based on this issue and have produced a large number of theoretical results and practical experiences. In general, these practical experiences can be

divided into design principles, design ideas and design specifications, ranging from macro theories to specific operational strategies. The classification of specific articles can be found in Table.1.

Table.1. Classification of literature on age-friendly urban design

Type of Measures	References	Number of Papers
Design Principles	[3][5][6][7][8][9][10][11][12][13][14]	11
Design Ideas	[3][5][6][8][9][10][12][13][15][16][17][18] [19][20][21][22][23][24][25][26][27][28]	22
Design Specifications	[7][9][10][11][12][13][15][17][20][24][26]	11

2.1 Analysis of Design Principles for Aging Appropriateness

In responding to aging, many researchers have proposed age-friendly urban design principles as a guide and framework. In general, the principles of age-friendly urban design can be divided into two broad categories: those that are highly general and programmatic in the policy documents issued by the United Nations General Assembly, the World Health Organization and the health services of national governments. The other is guiding principles that have been developed by researchers applying interdisciplinary theory to the analysis of practical issues for older people.

2.1.1 Analysis of Policy Principles

Firstly, there are the relevant principles of age-friendly urban design based on policy documents. In 1991, the United Nations Principles for Older Persons set out five principles of independence, inclusion, protection, self-enrichment and equal respect, as well as eighteen related explanatory notes, with the aim of safeguarding the basic human rights, human dignity and value of older persons, and encouraging governments to incorporate these five principles into national development plans [2]. Based on these five basic principles, Yao's 2012 Vertical City Asia international competition proposed four new principles of urban design for aging in the Yongsan area of Seoul, South Korea, with a distinctive Asian response to aging [3]. In 2002, the concept of "active aging" and its policy framework, developed by the World Health Organisation (WHO), had a wide impact worldwide. The concept emphasises health, participation and security as the pillars of the response to population aging and the full improvement of the quality of life of older people [4].Forsyth et al. combine the theoretical system of active aging with the Ecological Theory of Aging, arguing that the elderly population is significantly differentiated, with both the able-bodied and the disabled, and emphasising the principle of inclusivity in urban design, whereby spatial environments should meet the needs of people of different age groups and different physical abilities [5]. To highlight active aging, Chong proposes to link aging with creativity and to channel social creativity through collective wisdom [6]. Similarly, Li and Yuan also emphasise the need for careful and innovative design of urban age-friendly spaces in the practice of an active aging policy framework [7]. Zhou, on the other hand, uses the Guidelines for Building Age-Friendly Cities issued by the China Office for the Aging as a basis for building a scientific age-friendly city as a strategic goal for integrated development [8]. Barrier-free urban design is closely related to the mobility activities of older people. After 30 years of accessibility in China and the historical opportunity of Beijing as the city of the double Olympics, Beijing has issued more than 20 accessibility standards, guidelines and other kinds of guiding documents. Based on this, the principles of accessible city design include the following aspects: to take the development of an international first-class liveable city as the goal; the applicable population includes all people with physical disabilities and all age groups; accessible facilities should be universal, inclusive and accessible to the people who benefit from them; the design should be systematic, humane, refined and intelligent [9].

2.1.2 The Principle of Interdisciplinary Inductivity

Secondly, the principles of urban design for aging are summarised in an interdisciplinary body of theory and qualitative analysis by researchers. Based on the theory of spatial syntax, Deng and Hu have proposed six principles of safety, accessibility, diversity, fault tolerance and comfort in the

process of improving the aging-appropriateness of urban public spaces, and have constructed a planning and design framework for the aging-appropriateness of urban public spaces [10].Based on the concept of environmental design for behavioural choice, Xu et al. use the design guidelines proposed by cities in developed western countries as a basis, and consider the characteristics of Chongqing's mountainous cities and the reality of the elderly's declining physical functions, and propose that the design of mountainous urban stairways should take into account the elderly's sense of access, legibility, safety, comfort and fun [11]. In addition to the above five points, Yang et al. add specificity requirements in urban design based on the book Inclusive Urban Design [12]. In their study exploring age-friendly urban public spaces, Quan and Jin propose three requirements: accessibility, comfort and iconicity [13]. Zhang and Wei summarized similar spatial characteristics of elderly-friendly streets based on Maslow's hierarchy of needs theory in their study on the evaluation of the elderly-friendliness of urban streets in the Daping area of Chongqing city [14].

2.2 Analysis of Design Ideas for Aging

Based on the basic principles of responding to aging issues, scholars have proposed many meaningful urban design ideas from different perspectives. In summary, urban design ideas are urban design opinions and retrofitting measures proposed by various scholars in the face of practical problems. Urban design ideas are a further implementation of the theoretical basic principles, and also guide the development of design specifications and rules in practice, serving as a bridge between the upper and lower levels. According to the division of urban design ideas for the transformation of different places, this paper will sort out and summarize the urban design ideas for streets, communities, squares and parks in public space, etc.

2.2.1 Summary of Urban Design Ideas for Age-Friendly Streets

Streets are an important place for elderly people's activities and a complex system composed of different elements. With the rapid development of urbanization, the activities of the elderly are greatly challenged by the large-scale renewal of urban living spaces, the weakening of the perception of the spatial environment by the elderly, and the safety hazards of motor vehicles on the activities of the elderly [10][12][13]. Scholars have made many recommendations for the age-appropriateness of urban street design, mainly in terms of enhancing the subjective experience of the elderly and modifying the street design.

In terms of preserving the familiarity of the street, in general, firstly, any renewal of buildings and public spaces should be small-scale and incremental; secondly, the form of new development should ideally be compatible with the original architectural style [12]. Yao et al. adopted an innovative development model that shapes neighborhoods through public space nodes such as train stations, markets, schools, churches, and other memory centers. In addition, a three-dimensional urban grid scale of different scales is constructed to preserve and develop urban memory according to the current status of roads and the limits of development functions [3]. And among them, a convenient and efficient street network system can be considered from the following two aspects: firstly, increasing the density of street network in the pedestrian area to provide more travel options for the elderly, while limiting the speed to guarantee safety; secondly, rational layout of buildings and greenery to ensure the continuity of the street landscape, and guiding the elderly to travel through the generated sense of centripetal and defiance [15][16]. On the other hand, it is important to give full play to the role of "street eyes" by building small-scale neighborhoods and installing store facades with mainly glass windows to increase neighborhood vitality, make pedestrians become each other's "spotters", ensure street safety, and provide a sense of familiarity and security for the elderly [15]. Outdoor signage system has guidance and wayfinding functions, so it should be designed with both visual and auditory stimulation, and at the same time, the personalized design of the signage system enhances the sense of orientation of the elderly by improving their sensory experience [17].

In terms of enhancing street comfort, Quan and Jin suggest to start with the ecology of the landscape, based on ecological principles, to regulate the range of sunlight, surface temperature, air humidity, and noise and dust reduction through the selection and combination of plants and local

climate characteristics [13][15]. Considering the climate, topography and economic conditions of Chongqing area, Lu and Kang concluded that: firstly, porches and eaves are suitable spatial forms for Chongqing to provide sufficient natural breeze and sunlight in summer and winter, respectively; secondly, for the elevation change of the special mountainous city, the platform space formed at high places provides sufficient view and light for the activities of the elderly and guides them to contact with nature; finally, the construction of public space should consider its economy and minimize the cost of input and use so that it can be integrated into the daily life of the elderly [16]. In a study of urban outdoor space planning layout for the elderly based on behavioral activity perspective, Xie et al. concluded that street-level outdoor spaces, which belong to the daily activities of the elderly, should avoid the streamlined spatial form of the lower field and build semi-enclosed spaces with complete activity facilities, as well as small-scale enclosed spaces for the elderly to carry out individual activities [18]. Furthermore, Yu et al. suggest introducing the concept of home into the streetscape design to create a warm and comfortable family atmosphere and attract more elderly people to enter the street for rest [15]. Enhancing the comfort design of the street system will not only increase the communication of the neighborhood system, but also enhance the neighborhood vitality.

In terms of enhancing street accessibility, the academic community has mainly focused on accessible design and pedestrian accessibility. Beijing has been at the forefront of barrier-free construction of urban roads. Therefore, based on the city's good infrastructure and other hardware conditions, ling and Xue believe that it is important to focus on the standardization, applicability, and systematization of urban road accessibility. Relevant departments should comprehensively investigate the installation status and specification of infrastructure, and strengthen the road accessibility design from the government maintenance and supervision level [9]. In addition, since walking trips are the main mode of travel for the elderly, it is important to respect the spatial scale of pedestrians and consider various elements such as walking environment, type and layout of walking destinations, walking distance, and social culture [16]. Zhao et al. focus on the design of pedestrian living circles at different time scales based on the summary of the current structure of streets, starting from the walking time and the physical distribution pattern of streets [19].

2.2.2 Summary of Urban Design Ideas for Age-Friendly Communities

Community-based aging is the dominant model of aging in the West. One of the important aspects is to enhance the participation of the elderly groups themselves and to take their initiative to build the retirement community. At the same time, it may be difficult to achieve the desired effect by unilaterally asking the public to join the participatory design, and an experienced planner is needed to design and coordinate, and to manage and follow up the whole participatory design process in order to explore the unique resources in the community and meet the needs of the residents [6]. In addition, the quality of life for seniors is improved through a combination of low-tech means (e.g., location of senior living communities in city centers to shorten travel distances) and high-tech means (e.g., online shopping, car sharing, etc.) [5]. In terms of high-tech tools, Chen and Jiang analyzed the cognitive characteristics of the elderly and the information content problems of existing smart travel services, and proposed to build an age-appropriate and smart travel service system, from user segmentation, to information framework design afterwards, and the final interface presentation design [20]. Due to the difference between the East and the West in the concept of aging, Chinese elderly people prefer the "aging in place" and "aging at home" models. However, it is found that the urban-rural distribution of services in public space is very uneven, so the academic community proposes to improve and update the facilities in aging communities by both stock mining and differentiated allocation [8][21]. Liu and Yang study the "Jiefang" model surrounded by streets from the perspective of spatial scale, emphasizing the combination of residential space and public space to meet the different needs of different people and improve the quality of communication among similar people [22].

2.2.3 Summary of Urban Design Ideas for Age-Friendly Squares and Parks in Public Space

Among urban public spaces, squares and parks are important places for recreation and rest for the elderly, as well as important spatial nodes connecting the street system. Due to the special characteristics of the elderly group, they have special needs for urban public space [13].

Improving the quality of public spaces through landscape ecology is also applicable in the design of plazas and parks, so it is recommended that natural elements such as water bodies, woods, and flowers are combined with the layout of plazas and parks to regulate the microclimate of urban spaces, to make users happy, and to increase the activity of people in the area [13] [23].

Another major aspect of the design of public space for the elderly is the improvement of the comfort of the related supporting infrastructure. Urban public space infrastructure not only requires the introduction of national regulations to regulate the elderly-friendly and barrier-free design from the policy, but also requires relevant regulations to depart from the encroachment and destruction in the process of use, and to maintain the facilities through the system for dedicated personnel [13][24]. The improvement of facilities can start from the following aspects: to improve the target of public fitness equipment to make it more convenient and friendly to the elderly groups; to mobilize the elderly to participate in activities through visual and tactile intuitive design, especially for the physically challenged people to innovate the recreation methods; to add distance signs to runways, garden paths and other activity places to achieve interaction, and the relevant signs should be in bright colors and easy for the elderly to recognition; constructing interactive space, especially adding facilities for children groups, can add fun to the space and facilitate the elderly to watch over children [23][25][[26][27]. Fang, on the other hand, points out that attention should be paid to behavioral practices in urban life, especially through the city's preservation of urban culture and urban characteristics, respect for regional religious customs, and attention to the experience and humane design of public facilities [28].

2.2.4 Summary of Other Aspects of Urban Design Concepts

Older people are key carriers of urban history and culture and influence the succession and development of urban history and culture, so history-related tourism can be developed to provide employment opportunities for older groups [8]. With regard to the safety of transportation, urban areas should optimize the pedestrian transportation system, and rural areas need to pay attention to the rate and standard of road hardening.

2.3 Analysis of Design Rules and Specifications for Age-friendly Design

According to the relevant age-appropriate urban design ideas proposed by scholars, many studies have given specific urban design details and specifications, so this paper composes the specific design requirements based on the retrofitting objects.

2.3.1 Design Specifications for Streets

Guided by the principles of age-appropriate design and related design ideas, the design specifications for urban streets are as follows:

(1) The intersections and entrances of pedestrian walkways need to be set up with rim ramps, and the slopes need to be smooth, non-slip, and no height difference with the carriageway, Barrier-free handrail material to ensure sturdy, the form of easy to grip, two layers of handrail height of 850mm and 650mm, respectively, is appropriate. [12][15][17][24].

(2) Steps should be set up in the form of gradient transition, and flyovers and underpasses should meet wheelchair access and set up barrier-free signs; For every 1.5m increase in ramp, set up an intermediate platform transition of more than 2m in depth [9][24].

(3) Mountain trail railings should be higher than 1.1m, and the use of metal railings imitation wood grain material, trail surface should also be selected non-slip material [12][15].

(4) The length of the block should be short and narrow, with the length controlled within the reach of the human eye at about 50 to 100 meters [12].

(5) The entrances and exits of buildings and places should be clear and distinct, with different styles, colors and materials to make the signs clear and obvious, and the height of the signs should be between 1.1 and 1.8 meters [11].

(6) If the streets are too long, seats or public spaces should be set up at intervals of 80 to 120 meters to provide resting space for the elderly [12].

(7) The slope angle of the site instead of steps should not be greater than 1:12 [12][15].

(8) The required pushing force of the entrance door of the venue should be less than two kilograms, and easy-to-force handles should be set [12].

(9) Steps with high differences should be clearly marked to avoid falls of the elderly [12][13][15].

(10) Street plants should be selected from species with few and small leaves to prevent slippery road surface caused by falling leaves adhering to rainwater [12].

(11) Street lighting system should be clear and bright [9][12][15].

(12) Intersections are set up with visual and audible dual cue signals.

(13) The D/H ratio of the street should be controlled between 1.24 and 1.55[15].

(14) The stores along the street adopt glass windows, optimize the planting configuration and intersperse small spaces to shorten the "sensory distance" of the elderly [15].

(15) The seat form is more popular in "U" and "L" shape, the height is 42~47cm, the width is 40~60cm, and the space for wheelchair is 1.5m×1.5m. The seat material is wooden as much as possible, with armrest and backrest [15].

(16) The brightness, luminance, saturation and contrast of the colours of the street landscape should be more on the warm side, and the materials should try to use natural materials such as wood to avoid the coldness and negative psychological implication of cold high iron [15].

2.3.2 Design Specifications for Communities

(1) With the idea of aging in place, the same floor refers to a combination of household types of varying sizes, a combination where the elderly and adult children can both care for each other and gain spatial independence [7].

(2) Basic public services should be provided within 400 meters of residential areas [12].

(3) Public facilities and artworks can incorporate local cultural elements to spread aesthetics and urban culture [13].

(4) The security fence installation in the community at the lower level should not be convex and a walking space of 2200 mm from the first-floor exterior wall should be reserved [17].

(5) The corner of the balcony on the exterior wall of the building should be 2 m above the ground and the use of PVC protective material including the first floor to prevent collision [17].

(6) Induction floor lights are provided at night at flowerbeds, staircase side walls, and roofs [17].

(7) Emergency call devices are installed on the exterior walls of the building and are 1200mm from the ground to prevent children from accidentally touching them, and warning slogans are set [17].

(8) LED lights in bright colours are installed on each of the building door signs to ensure that they are clearly marked at night [17].

(9) The cell phone software of smart travel system should be easy to operate, with main text no less than 18pt, line spacing at least 1.3 times, clear and easy to understand icons, and voice control function [20].

(10) Children's recreational facilities such as small sand piles are added to the public activity space to meet the needs of other age groups' activities [26].

2.3.3 Design Specifications for Plazas and Parks

(1) The root mean square difference of the comprehensibility of the plaza should be greater than 0.5 to ensure the comprehensibility of the public space and attract people to gather [10].

(2) The natural style of still water is preferred in the water landscape, followed by running water [15].

3. Conclusion

Based on the CNKI database, this paper summarizes the research results of Chinese scholars in the field of urban design since 2011, based on the theme of population aging, at three levels: macro design principles, meso design ideas, and micro design details, with the aim of providing reference for the future response to population aging in related fields.

Through the review of related literature, this paper concludes that there are some problems and shortcomings in the field of urban design to cope with population aging, and the following three aspects can be taken as the focus of future research.

First, after combing through the related responses, some ideas are found to be contradictory and conflicting. The main reason for this is that the researchers' opinions are based on the conditions and perspectives of different study areas, so in the actual adoption and application process, it is necessary to conduct an in-depth analysis of the study areas and combine relevant measures according to local conditions.

Secondly, in terms of research methods, qualitative research was generally adopted, basically through subjective analysis of the problems faced by the elderly in the study area or through some in-depth interviews and surveys to understand the needs of the elderly group. Therefore, in future research on this issue, quantitative research methods such as mathematical models can be used to analyze the outstanding problems in the study area and then propose constructive measures on this basis.

Finally, the response in the field of urban design should strengthen interdisciplinary thinking, such as combining ideas from the fields of landscape, architecture, computer science, and management, and combining tools from other fields to enhance the effectiveness of the measures.

References

[1] National Bureau of Statistics of the People's Republic of China [M]. China Statistical Yearbook, Beijing: China Statistics Press, 2021.

[2] Randel, Judith, Tony German. United Nations principles for older persons [M]. The Aging and Development Report. Routledge, 2017: 197-198.

[3] Yao Dong. Soft city: Urban design for the aging society [J]. Urban and Architecture, 2014(05): 48-51.

[4] World Health Organization. Active aging: A policy framework (No. WHO/NMH/NPH/02.8) [M]. World Health Organization, 2002.

[5] Ann Forsyth, Jennifer Molinsky, Har Ye Kan. Improving housing and neighborhoods for the vulnerable: older people, small households, urban design, and planning [J]. Urban Design International, 2020, 35(01): 8-19.

[6] Chuang Kenghua. Creative aging: co-designing with Seniors [J]. New Architecture, 2018(02): 20-25.

[7] Li Wei, Yuan Yixian. The strategy adjustment and optimization for the existing

problems of space for senior in city [J]. Architecture and Culture, 2014(02): 83-85.

[8] Zhou Yongsi. Challenges and coping strategies for urban and rural planning in the context of aging [J]. Architectural design management, 2018, 35(12): 85-87.

[9] Ling Su Yang, Xue Yuxin. Barrier-free urban design in the new era-taking Beijing as an example[J]. Construction Science and Technology, 2020(11):36-40+49.

[10] Deng Yi, Hu Bin. A framework for planning and designing urban public space for aging based on spatial syntax [J]. Urban Issues, 2016(06): 53-60.

[11] Xu Miao, Chen Rui, Sun Kun, Yang Mengyuan. A healthy city design exploration for the ladder trails from the perspective of the elderly people: A case study of Chongqing Mountain trails [J]. Shanghai Urban Planning Review, 2017(03): 6-16.

[12] Yang Junhui, Li Honglin, Zhang Wangyang. An introduction to inclusive design in urban design [J]. Rural Economy and Technology, 2020, 31(06): 235-236.

[13] Quan Ying, Jin Donglai. Discussion on space design of city suitable for old people [J]. Journal of Anhui Agricultural Science, 2015, 43(09): 206-207+357.

[14] Zhang Yi, Wei Haoyan. The Evaluation Research of Urban Streets' Suitability For Elderly: A Case Study Of Daping, Chongqing [J]. Architecture and Culture, 2016(03): 231-233.

[15] Yu Xueqing, Lu Jinsen, Zhang Lvshui. Urban street landscape design strategies based on the usage needs of the elderly [J]. Journal of Green Science and Technology, 2019(19): 1-5.

[16] Lu Feng, Kang Kai. Inclusive design of mountainous city--design strategies of informal use for the elderly [J]. Journal of Human Settlements in West China, 2017, 32(06): 25-30.

[17] Wang Lei, Xie Qing. Study on age-appropriate micro-renovation measures of outdoor environment in old neighborhoods in Guangzhou city--Example of Sanyuanli Jiaodian new village in Baiyun district, Guangzhou city [J]. Architectural Design Management, 2018, 35(12): 78-81.

[18] Xie Bo, Zheng Yiling, Li Zhigang, An Zihao. Planning model for the elderly outdoor space from the perspective of behavior activities: a case in Wuhan [J]. Modern Urban Research, 2019(02): 30-37.

[19] Zhao Wanmin, Fang Guochen, Wang Hua. Creating a senior friendly pedestrian space system from life circle viewpoint [J]. Planners, 2019, 35(17): 69-78.

[20] Chen Yuhan, Jiang Lin. Research on the design of travel service system for the elderly in smart cities [J]. Design, 2021, 34(21): 20-23.

[21] Xie Bo, Wei Wei, Zhou Jie. Senior community space evaluation and planning [J]. Planners, 2015, 31(11): 5-11+33.

[22] Liu Ze, Yang Chunhong. Exploration on the new residential neighborhood model in the open community [J]. Urban Housing, 2020, 27(09): 68-71.

[23] Zhai Yujia. Urban Park design characteristics that promote seniors walking-exploration bases on content analysis method [J]. Landscape Architecture, 2016(07): 121-128.

[24] Luo Yunzhou. Analysis of age-friendly city design--Hangzhou City as an example[J]. Engineering Technology Research, 2021, 6(08): 240-241.

[25] An Yingli, Ma Guangtao. Study on aging design of community public fitness facilities [J]. Design, 2021, 34(23): 114-116.

[26] Dong Hexuan, Liu Xiaomeng, Pan Huanhuan. Analysis of influences of space elements in community parks on aging communication and design adjustments based on SEM—take Jiangbei Park in Jilin city as an example [J]. Journal of Human Settlements in West China, 2018, 33(04): 18-26.

[27] Ke Jia, Jin Yunfeng. Planning and design research of urban community parks suitable for the needs of the elderly: a case study of Shanghai [J]. Guangdong garden, 2017, 39(05): 62-66.

[28] Fang Haidong. Study on classification of typical outdoor activity space of the elderly in Lhasa [J]. Urbanism and Architecture, 2019, 16(33): 34-35.