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RESEARCH ARTICLE

Observational Findings about Outdoor Space of Elderly-Oriented Residential Areas in Zhengzhou, Henan Province, China

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ABSTRACT

China is experiencing a rapidly aging population, creating an urgent need for elderly-oriented residential design that prioritizes accessibility and safety. As the capital city of Henan Province in China, Zhengzhou has experienced the development of residential buildings in the past 30 years (1978 to present). At present, it is unable to meet the needs of modern elderly residents for function and environment, and it is inconvenient for the elderly to move around, so the problem needs to be improved urgently. The aim of this observation study is to analysis and summary the problems existing in the current situation of home care in elderly-oriented residential areas through an in-depth understanding of the old residential areas in Zhengzhou. The research method is based on the Observation Checklist and on-site research to achieve the research objectives. The research object is old residential areas with typical representation in Zhengzhou. Through observation on the original old residential areas in Zhengzhou, the common problems of outdoor space about ageing-friendly residential areas can be summarized, so as to make great efforts to realize the convenience of travel for the elderly in old residential buildings.

Contribution/Originality: This study documents critical accessibility deficiencies in Zhengzhou's old residential areas through systematic on-site observation, identifying key issues such as inadequate ramp facilities, obstructed pathways, and lack of elevators in multi-story buildings, which are summarized in sub-entries.

1. Introduction

As the capital city of Henan Province in China, Zhengzhou City has experienced the development of residential buildings in the past 30 years (1978 to present) along with China (Shen et al., 2023; Wang & Tomaney, 2019), through the period of reform and opening up, the period of planned commodity economy, the period of commercialization and the period of diversification (Zhang, 2016), and the construction development of the

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city in Zhengzhou area is in line with the general trend of China's construction development, during which Zhengzhou residential area has increased a lot (Li & Yang, 2021). The survey shows that due to the long age and low construction standard of the residential environment, there are many design problems both indoors and outdoors, such as: unreasonable vertical traffic structure, confusion in the function of indoor space, no detailed design, and lack of outdoor activity room design (Ru, 2017). At present, it is unable to meet the needs of modern elderly residents for function and environment, and it is inconvenient for the elderly to move around, so the problem needs to be improved urgently (Chen & Zhang, 2022). In this study, through field research on the original old residential buildings in Zhengzhou, the common problems of outdoor space about ageing-friendly in old residential buildings can be summarized, so as to make great efforts to realize the convenience of travel for the elderly in old residential buildings.

1.1. Research Objectives

The research objectives of this study are as follows:

i. To present the case studies from the aspect of outdoor space.
ii. To summarize the actual implementation and the ageing-friendly problems that have arisen in the surveyed old residential areas.

2. Literature Review

2.1. Adaptation of activity venues for aging

As noted in the frequency of use of the elderly place and population distribution, different scale activity venues should be reasonably configured, including community/social areas and play areas for ageing (Ismail et al., 2023; Peng et al., 2022; World Health Organization, 2007). In the perception of the line of sight should be accessible, the activities of a clear and other characteristics; public open space and private space should be combined with the layout, appropriate configuration of the old and young with the space, to facilitate the elderly and children living together with the common; in addition to this should also give full consideration to the physical environment of the In addition, due consideration should be given to the correct needs of the physical environment, such as summer should pay attention to ventilation and sunshade, winter should pay attention to sunshine and wind (Salmistu & Kotval, 2023).

2.2. Green landscape suitable for aging

The elderly-oriented residential area should not only consider the plant varieties and forms safe, healthy, interesting and ornamental effect; but also consider the reasonable configuration of trees, shrubs, and grass (Jarzebski et al., 2021). These should be adapted to the needs of the elderly activities. The same community should be set up in different colors and types of gardens, which not only helps the elderly to enjoy their visual enjoyment; but also helps to guide the elderly to participate in planting and conservation activities and increase their enjoyment of life (Salmistu & Kotval, 2023).

2.3. Outdoor facilities for ageing

Outdoor facilities for ageing should feature clear information signage, elderly-friendly public toilets, and accessible seating areas to ensure accessibility and convenience for

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older adults. the signage system should be sound, the signage information should be complete and accurate, and the regional introduction and direction guidance should be done well; in the process of the activities of the elderly, there will inevitably be some activities or dangerous areas that are beyond the capacity of their physical condition or age, and these should be set up with safety warning signs in order to ensure the safety of the elderly (Salmistu & Kotval, 2023). For the elderly with mobility disabilities such as the need to rely on a wheelchair to pay attention to its accessibility, in the design process should be considered to meet the requirements of accessibility (Ismail et al., 2020; World Health Organization, 2007).

2.4. Transportation system in the community

The design of the community's elderly-oriented carriageway network should be as closed as possible, so as to reduce the incidence of internal hazards due to excessive external vehicular traffic crossing the old settlements (Ismail et al., 2023; World Health Organization, 2007). Community roads are generally divided into four levels, including the main road, secondary roads, side roads and front of house paths, set up in the level should be clear, level separation. Speed bumps can be added to the main carriageway to prevent motor vehicles from threatening the slow-walking elderly due to excessive speed, and strips can also be used to separate the sidewalk from the carriageway (Hoof & Marston, 2021).

The review led to the development of a set of residential environmental characteristics that were identified as relevant to the health and wellbeing of elderly people (Table 1). The table lists each characteristic and cites relevant literature sources that support the inclusion of these features.

Table 1 Residential environmental characteristics

Main Elements	Sub Elements	Details/Examples	Literature Source
1. Adaptation of activity venues for ageing	①Community/social areas for ageing	i). Gathering Spaces ii). Level & Safe Surfaces iv). Accessibility to Amenities	Steels (2015), Tobi et al. (2018), Peng et al. (2022), Salmistu and Kotval (2023)
	②Play areas	i). Level & Safe Surfaces ii). Wide Pathways & Ramps iii). Accessibility to Amenities	Steels (2015), Tobi et al. (2018), Peng et al. (2022), Salmistu and Kotval (2023)
2. Green landscape suitable for ageing	①Increasing green space	i). Abundant green space ii) Sustainable planning and management	World Health Organization (2007), Jarzebski et al. (2021), Peng et al. (2022), Salmistu and Kotval (2023),
	②Rich Plant Configurations	i). Plant Selection ii). Visual Interest & Engagement	World Health Organization (2007), UNESA (2015), Jarzebski et al. (2021),

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			Crews (2022), Salmistu and Kotval (2023)
3 . Outdoor facilities for ageing	①Elderly-oriented public toilets	i). Wide Entryways& Doors ii). Wheelchair-Accessible Stalls iii). Emergency Alarms & call Buttons	World Health Organization (2007), Mulliner et al. (2020), Peng et al. (2022), Tine et al. (2020)
	②Seating areas	i). Accessible Seating Options ii). Appropriate Height & Stability iii). Clear Access to Seating	World Health Organization (2007), Peng et al. (2022), Crews (2022), Mulliner et al. (2020)
4. Transportation system in the community	①Pedestrian road design for ageing	i). Wide and Level Pathways ii). Non-Slip, Smooth Surfaces iii). Safe Crossings and Intersections iv). Convenient Access to Destinations	van Hoof et al. (2021), World Health Organization (2007), Peng et al. (2022), Ding et al. (2023), Sengers and Peine (2021), Crews (2022)
	②Pedestrian-vehicle separation	i). Dedicated Pedestrian Pathways ii). Buffer Zones iii). Traffic Calming Measures	van Hoof et al. (2021), World Health Organization (2007), Ding et al. (2023), Crews (2022), Sengers and Peine (2021)
	③Rationalization of car parking	i). Accessible Parking Spaces ii). Accessible Pathways from Parking Areas	van Hoof et al. (2021), Peng et al. (2022), Ding et al. (2023)

3. Research Methods

This study adopts a qualitative approach, utilizing structured observations guided by the Observation Checklist for Ageing-Friendly Design (Lewinson et al., 2017). Qualitative methods are appropriate for this research as they allow for in-depth evaluation of design features in outdoor spaces, capturing contextual nuances that quantitative metrics might overlook. The checklist enables systematic documentation of ageing-friendly design gaps across six residential areas in Zhengzhou, China. The research was guided by the Observation Checklist for Ageing - Friendly Design, which has been widely recognized and used in relevant studies (Harrison et al., 2017). The primary tool for data collection is the Observation Checklist for Ageing-Friendly Design (Lewinson et al., 2017), which assesses outdoor spaces, including activity areas for the elderly (Salmistu & Kotval, 2023), ageing friendly green space landscape design (Jarzebski et al., 2021), outdoor public facilities (Mulliner et al., 2020) and community transport system (Ding et al., 2023). Supplementary tools included photographs and sketches to document physical environments, along with semi-structured field notes capturing contextual

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observations such as user behavior and maintenance issues. The location of this study focuses on six elderly-oriented residential areas in Zhengzhou, Henan Province, China: (i) Ruhe Unit, (ii) Lvyun Unit, (iii) Tongle District, (iv) Garden Xincun, (v) Dihu Garden, and (vi) Zhenghong Lanbaowan. The selected residential areas vary in construction time (ranging from 1980s to 2010s), residential form (e.g., low-rise vs. high-rise), and density of elderly residents, ensuring diverse insights into design adaptability.

The collected data will be analyzed through thematic analysis (Braun & Clarke, 2006), beginning with coding to categorize checklist responses and field notes into key themes such as "barriers to accessibility" and "inclusive green spaces." Subsequently, a comparative analysis will be conducted to identify patterns and disparities across the six neighborhoods. Finally, findings will be triangulated by cross-verifying them with photographic evidence and existing literature to enhance reliability and validity.

Table 2 presents information about the six old residential areas in Zhengzhou that need to be researched for this study. Each area varies in location, construction time, residential form, and the number of elderly residents.

The Observation Checklist form (Table 3) contains the following indicators: (i) Adaptation of activity venues to ageing; (ii) Green landscape suitable for ageing; (iii) Outdoor facilities for ageing; (iv) Transportation system in the community.

Table 2: List of the observation cases

Name	Location	Years of Development	Residential Form	Ageing Situation
Ruhe Unit	Zhongyuan District of Zhengzhou City	1985	6 Multi-storey residential buildings (6 floors)	895 persons aged 60 or above
Tongle District	Guancheng District of Zhengzhou City	1988	4 Multi-storey residential buildings (6 floors)	262 people aged over 60
Lvyun Unit	Erqi District of Zhengzhou City	1996	12 Multi-storey residential buildings (6 floors)	734 people aged 60 or above
Garden Xincun	Jinshui District of Zhengzhou City	1999	8 Multi-storey residential buildings (7 floors)	556 people aged 60 or above
Dihu Garden	Zhongyuan District of Zhengzhou City	2005	10 high-rise residential buildings (33 floors)	619 people aged 60 or above
Zhenghong Lanbaowan	Huiji District of Zhengzhou City	2007	6 high-rise residential buildings (34 floors)	836 people aged 60 or above

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Table 3: Observation Checklist

Outdoor Space Characteristics	Sub Elements	Details/Examples	Availability of accessible design (√/×)					
			Ruhe Unit	Tongle District	Lvyun Unit	Garden Xincun	Dihu Garden	Zhenghong Lanbaowan
1. Adaptation of activity venues to ageing	(i)Community/social areas for ageing	i). Gathering Spaces ii). Level & Safe Surfaces iii). Accessibility to Amenities	×	×	√	√	√	√
	(ii)Play areas	i). Level & Safe Surfaces ii). Wide Pathways & Ramps iii). Accessibility to Amenities	×	√	√	√	×	√
2. Green landscape suitable for ageing	(i)Increasing green space	i). Abundant green space ii) Sustainable planning and management	×	×	√	×	×	√
	(ii)Rich Plant Configurations	i). Plant Selection ii). Visual Interest & Engagement	×	×	√	×	×	×
3． Outdoor facilities for ageing	(i)Elderly-oriented public toilets	i). Wide Entryways & Doors iii). Wheelchair-Accessible Stalls iv). Emergency Alarms &call Buttons	×	×	×	√	√	√
	(ii)Seating areas	i). Accessible Seating Options ii). Appropriate Height & Stability iii). Clear Access to Seating	×	×	√	×	√	√
4. Transportation system in the community	(i)Pedestrian road design for ageing	i). Wide and Level Pathways ii). Non-Slip, Smooth Surfaces iii). Safe Crossings and Intersections iv). Convenient Access to Destinations	×	×	×	×	√	×
	(ii)Pedestrian-vehicle separation	i). Dedicated Pedestrian Pathways ii). Buffer Zones iii). Traffic Calming Measures	×	×	×	×	√	√
	(iii)Rationalization of car parking	i). Accessible Parking Spaces ii). Accessible Pathways from Parking Areas	×	×	×	×	×	√

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4. Results

4.1. Issues from Adaptation of activity venues for ageing

4.1.1. Issues of Community/social areas for ageing

Through the research, we found that this type of space is often lack of design or even abandoned and neglected. The specific performance is as follows:

(i) Cluttered gathering spaces

The study found that residents in the old residential areas often like to pile up debris in the public activity space, which not only affects the daily leisure activities of the elderly in this space, but also greatly affects the overall image and appearance of the neighborhood. Figure 1 shows the social areas for ageing in Garden Xincun and Figure 2 shows the social areas for ageing in Tongle District.

Figure 1 : Community areas for ageing in Garden Xincun (cluttered space)

Figure 2 : Community areas for ageing in Tongle District (cluttered space)

(ii) Poor ground surface conditions in public community areas of old residential areas

Some of the ground surfaces of activity squares for the elderly are heavily damaged and uneven, making it extremely easy for elderly people to trip and fall while walking, and posing a major safety hazard (as shown in Figure 3, which illustrates the community area of Dihu Garden. It can be seen that the ground is clearly worn and uneven, with obvious signs of patching and unevenness in the activity areas). In particular, the ground around some outdoor gathering places, such as around pavilions and passageways, is slippery in rainy or wet weather, making it easy for the elderly to slip and get hurt while walking (Figure 4 presents the community area at Garden Xincun. There are some stains and tears on the ground after the rains, with varying shades of color, indicating the poor condition of the ground).

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Figure 3 : Community areas for ageing in Dihu Garden (uneven ground surface)

Figure 4 : Community areas for ageing in Garden Xincun (uneven ground surface)

(iii) Lack of barrier-free facilities

Activity venues are generally equipped with only basic leisure and fitness facilities but lack spaces and facilities that are accessible and promote social interaction among the elderly, and the spaces are confusing and undermarketed from each other, making it difficult for the elderly to establish a connection and a sense of belonging. Figure 5 and Figure 6 show the Lvyun Unith and Dihu Garden studied, where there is a lack of facilities to promote interaction among the elderly. The outdoor space plaza has a single design that is easy to see and lacks a more comfortable spatial feel.

Figure 5 : Social areas in Lvyun Unit (lack of facilities)

Figure 6 : Social areas in Dihu Garden (lack of facilities)

4.1.2. Play areas

(i) Problems of uneven surfaces and lack of non-slip measures:

These problems can become safety hazards in old residential areas. Elderly people are prone to accidents such as falls and sprains when they move around in these areas (uneven ground surface shown in Figure 7 and Figure 8).

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Figure 7: Play areas in Ruhe Unit (uneven surfaces)

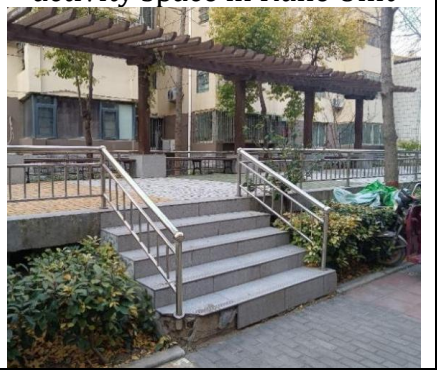
Figure 8: Play areas in Garden Xincun (uneven surfaces)

(ii) Poor accessibility:

Some activity venues may be located far from residential buildings or restricted by factors such as terrain and roads, making it difficult for the elderly to reach them easily. Lack of accessible facilities (e.g. ramps, handrails, etc.) can also further exacerbate the problem. (e.g. Figure 9 Roads leading to activity spaces all have elevation differences, and Figure 10 lacks ramp accessibility, which is not conducive to access by the elderly).

Figure 9: Pathway to activity space in Garden Xincun

Figure 10: Pathway to activity space in Ruhe Unit



(iii) Inadequate accessible facilities

The study found that there are general inadequacies in accessible facilities in Play areas in older neighborhoods, especially the lack of assistive facilities suitable for the elderly, such as resting chairs and shading devices. The lack of such facilities can directly affect the activity experience and comfort of the elderly. Taking Tongle District and Zhenghong Lanbaowan as examples (Figure 11 and Figure 12), the play areas in Tongle District are not only limited in size, but also not equipped with resting seats, which prevents the elderly from having timely rest after exercise or activities. In Zhenghong Lanbaowan, although the activity area is more spacious and newly designed, there is also a lack of shade and seating.

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Figure 11 : Play areas in Tongle District

Figure 12 : Play areas in Zhenghong Lanbaowan

4.2. Issues of Green landscape suitable for ageing

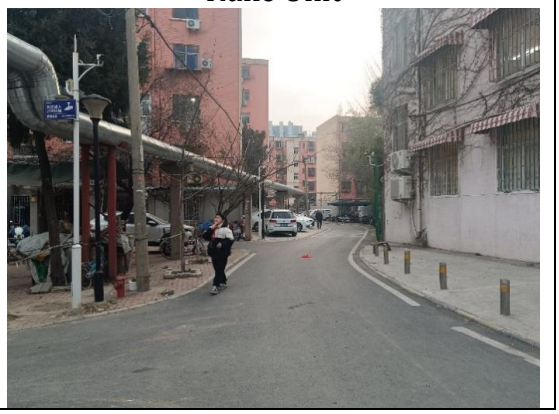
4.2.1. Issues of green space

(i) Inadequate green space

The generally low green space coverage found in the six older residential areas studied resulted in a less than rich and pleasant ecological environment throughout the neighborhood (Less green space shown in Figure 13 and Figure 14).

Figure 13: Inadequate green space in Tongle District

Figure 14: Inadequate green space in Ruhe Unit



(ii) Lack of sustainable planning and management

Some of the green spaces are not properly planned and managed, with inadequate maintenance and serious abandonment (Figure 15 shows deficiencies in the planning and management of green spaces in Dihu Garden). Green spaces are disorganized due to the lack of timely maintenance measures such as pruning, watering and fertilizing, affecting aesthetics and safety. The presence of weeds, rubbish and other debris within green spaces that are not cleared in a timely manner leads to a deterioration in the quality of the environment (Figure 17 shows poorly maintained green space conditions in Lvyun Unit). Some green spaces have been left unmaintained for a long time and are overgrown with weeds (neglected Green Space in Garden Xincun shown in Figure 16).

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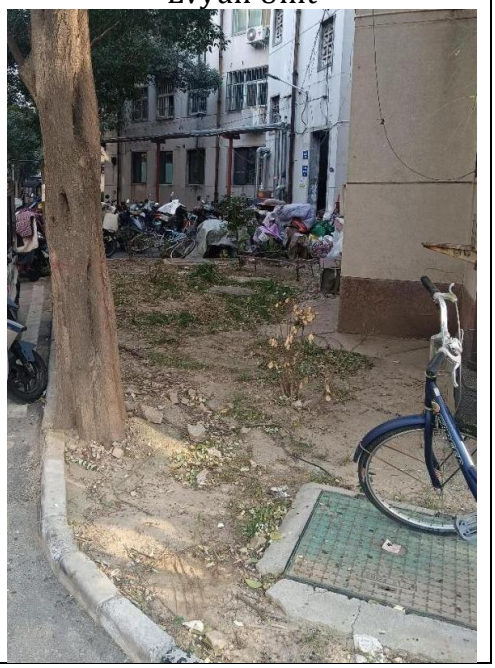
Figure 15: Outdoor green space in Dihu Garden

Figure16: Outdoor green space in Garden Xincun

Figure 17: Outdoor green space in Lvyun Unit



4.2.2. Not abundant Plant Configurations

(i) A single type of plant selection

Improperly configured greenery that lacks the necessary ornamental qualities and a sense of hierarchy, making the landscape appear monotonous and boring. This leads to poor visual experience for the elderly. In addition, the plant species and configuration within the green space do not take into account the preferences and physical health needs of the elderly (Non-Age-Friendly Design in Garden Xincun shown in Figure 18). The banded plants are arranged in equidistant rows and columns, and the greening layout is too mechanical and neat, lacking natural and dynamic aesthetics, and at the same time restricting the activity space for residents (overly mechanical planting arrangement in Zhenghong Lanbaowan shown in Figure 19).

Figure 18: Plants on both sides of the road in Garden Xincun

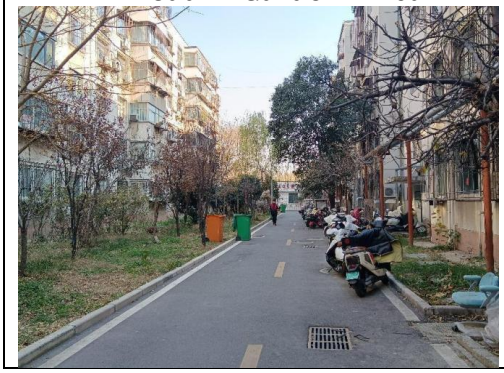
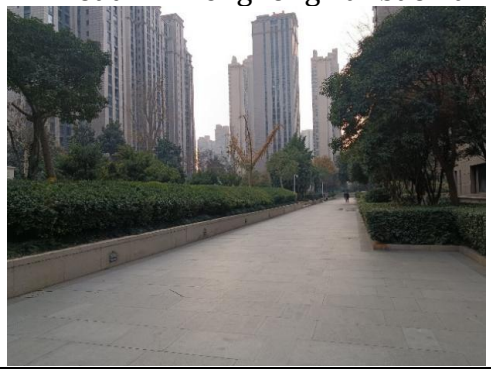


Figure 19: Plants on both sides of the road in Zhenghong Lanbaowan



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(ii) Insufficient visual interest and participation:

The green space lacks design for interaction with the elderly, e.g. there are not enough seats in the green space for the elderly to rest and chat, Figure 20 and Figure 21 are not equipped with seats, which makes the elderly stay for a shorter period of time.

Figure 20: Green Activity Area in Zhenghong Lanbaowan

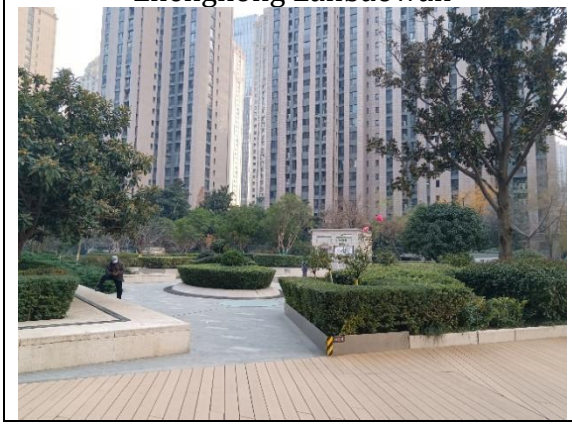

Figure 21: Green Activity Area in Garden Xincun

4.3. Outdoor facilities for ageing

4.3.1. Elderly-oriented public toilets

(i) Spatial layout

The spatial layout of some accessible toilets is too compact and does not fully take into account the physical characteristics and usage needs of the elderly. For example, the width of the passageway inside the toilets is insufficient, making it difficult for wheelchairs to pass through or turn around; the design of the doors is too narrow, making it impossible for wheelchairs to enter and exit smoothly.

(ii) Missing or imperfect handrails and grab bars

Handrail setting: some accessible toilets lack the necessary handrails and grab bars, resulting in a lack of support for the elderly in the process of toileting and washing, making them prone to accidents such as falls.
Quality of handrails: Some of the handrails that have been set up are of low quality and poor stability, making it difficult to provide effective support.

(iii) Lack of emergency call equipment

Some accessible toilets are not equipped with emergency call equipment, resulting in the elderly not being able to seek help in time in case of emergency.

4.3.2. Seating areas

(i) Lack of accessible facilities

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Some seating areas in older residential areas lack the necessary assistive devices, such as handrails and non-slip mats, which increase the risks for the elderly when using the seats (as shown in Figure 22 and Figure 23 lack of accessible facilities).

Figure 22: Seat in Lvyun Unit (lack of accessible facilities)

Figure 23: Seat in Garden Xincun (lack of accessible facilities)

(ii) Unreasonable seat height and width and poor seat stability

The height and width of some seats were not designed to suit the physical characteristics of the elderly, resulting in them having difficulty in sitting down and getting up, or feeling uncomfortable after sitting down. Figure 24 Seats were too low in height and had no armrests, making it more difficult for elderly people to sit down and stand up. Some seats have been left uncleaned for long periods of time, resulting in the accumulation of dust and dirt on the surface, which affects the experience of the elderly. There are also seats that have been damaged or broken due to prolonged use or vandalism but have not been repaired in a timely manner, resulting in poor stability and inability to use them (Damaged Seating in Ruhe Unit as shown in Figure 25).

Figure 24: Seat in Lvyun Unit

Figure 25: Seat in Ruhe Unit

(iii) Unreasonable location and poor accessibility of seating areas

Some of the seating areas were set up far away from residential areas, resulting in the elderly having to walk longer distances to reach them, increasing their physical burden. In addition, the accessibility of some seating areas is low and there is no accessible route (As shown in Figure 26 and Figure 27 there is a height difference and there are no accessible features such as railings, handrails and ramps). The lack of attractiveness leads to a reluctance for elderly people to travel to use them.

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Figure 26: Seats in Garden Xincun (poor accessibility)

Figure 27: Seats in Garden Xincun (poor accessibility)

4.4. Transportation system in the community

The problems of Outdoor facilities for ageing in the research are summarized as follows:

4.4.1. Problems of Pedestrian Road design for ageing

(i) Narrow pedestrian roads with poorly designed gradients and steps

Pedestrian roads are too narrow (Figure 28) to meet the comfort and safety needs of the elderly when walking. Especially during peak hours, elderly people may face difficulties in walking due to road congestion. In addition, the interface between the walking path and the carriageway, plaza or flat entrance is often designed with single or multiple steps (e.g. Figure 29), which is a major obstacle for the elderly who have a small leg span and difficulty in lifting their legs. The design of ramps in some areas is too steep (Figure 30) and lacks gentle transitions, making it easy for the elderly to strain or fall while walking.

Figure 28: pedestrian roads in Tongle District

Figure 29: pedestrian roads in Dihu Garden

Figure 30: pedestrian roads in Ruhe Unit

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(ii) Poor slip resistance and uneven surface

Some of the walking paths are made of materials with poor anti-skid properties, such as ice-patterned paths with wide gaps or designs such as steppingstones and timber steps (as shown in Figure 31 the non-slip pedestrian walkways in Lvyun Unit), which tend to become slippery in wet or rainy or snowy weather, increasing the risk of falls for the elderly. Walking paths have unevenness such as potholes and cracks (as shown in Figure 32 the uneven surface pedestrian roads in Lvyun Unit), all of which can cause inconvenience and safety hazards to the elderly.

Figure 31: pedestrian roads in Lvyun Unit（non-slip）

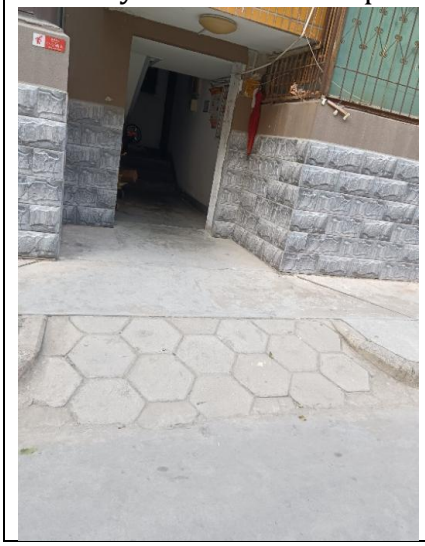
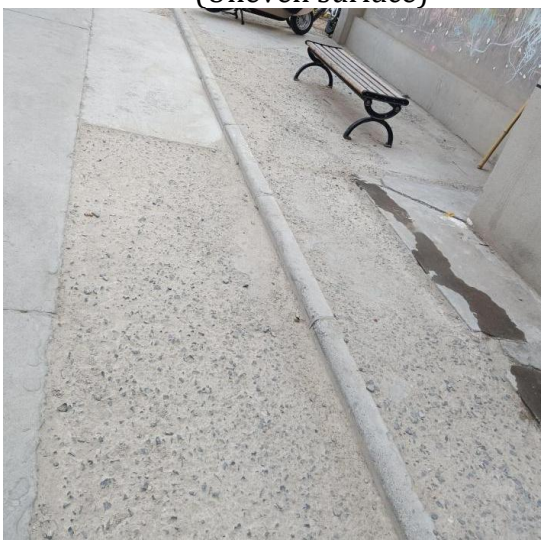


Figure 32: pedestrian roads in Lvyun Unit (Uneven surface)



(iii) Lack of accessible assistive facilities

The lack of assistive facilities such as handrails and non-slip mats results in the lack of necessary support and protection for the elderly when they walk. Figure 33 shows the walking ramp at Lvyun Unit, which is not equipped with handrails and non-slip measures.

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Figure 33: pedestrian roads in Lvyun Unit (lack of accessible facilities)

4.4.2. Pedestrian-vehicle separation

(i) Inadequate design of pedestrian-vehicle segregation, no dedicated footpaths

Many old residential areas have not fully considered the need for pedestrian-vehicle segregation when they were built, leading to serious pedestrian-vehicle mixing in the area (mixed pedestrian and vehicular traffic shown in Figure 34 and Figure 35). With the increase in the number of private cars, the traffic flow in residential areas has become chaotic, and the lack of dedicated footpaths poses a safety hazard for the elderly.

Figure 34: Road in Lvyun Unit (mixed pedestrian and vehicular traffic)

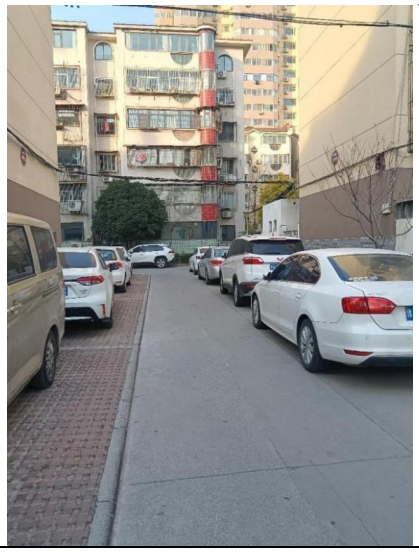
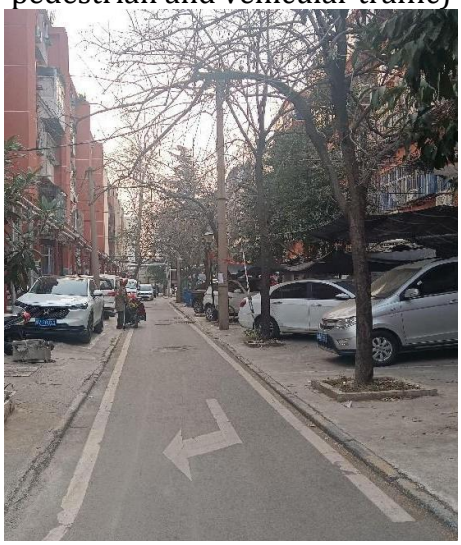


Figure 35: Road in Ruhe Unit (mixed pedestrian and vehicular traffic)



(ii) No buffer zone due to limited road space

As shown in Figure 36 and Figure 37, Some residential areas have no buffer zone due to limited road space. During peak hours, vehicles and pedestrians compete for road resources, increasing the risk of travelling for the elderly.

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Figure 36: Road in Ruhe Unit

Figure 37: Road in Tongle District

(iii) Chaotic traffic organization

Many residential areas lack regulated car parks or parking spaces, resulting in motor vehicles and non-motorized vehicles being parked at random (Figure 38 shows the poorly organized road conditions in Ruhe Unit), occupying road space within the area. Poor parking management not only affects traffic order and chaotic traffic organization in residential areas (disordered road conditions in Tongle District shown in Figure 39) but also increases the difficulty of travelling and safety hazards for the elderly.

Figure 38: Roads in Ruhe Unit (disordered)

Figure 39: Roads in Tongle District (disordered)

4.4.3. Rationalization of car parking

(i) Insufficient parking spaces

In all the existing old residential areas studied, the vast majority of them were designed and built without parking spaces, resulting in a large amount of outdoor public space occupied by motorized and non-motorized vehicles when parking. It was found that most bicycles were parked in a very random manner, with some discarded bicycles occupying much of the existing parking space (Irregular Parking of Non-Motorized Vehicles in Lvyun Unit and Ruhe Unit shown in Figure 40 and Figure 41). As for motor vehicles, although motor vehicle parking spaces were re-designated in the residential areas during the later renovation process, the parking spaces are still stretched. Motor vehicles are encroaching heavily on the open spaces between the homes within the residential areas, as shown in Figure 42 Irregular parking of motor vehicles in Garden

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Xincun, Figure 43 Irregular parking of motor vehicles in Ruhe Unit and Figure 44 Irregular parking of motor vehicles in Tongle District.

Figure 40: Parking in Lvyun Unit (Irregular parking of non-motorised vehicles)

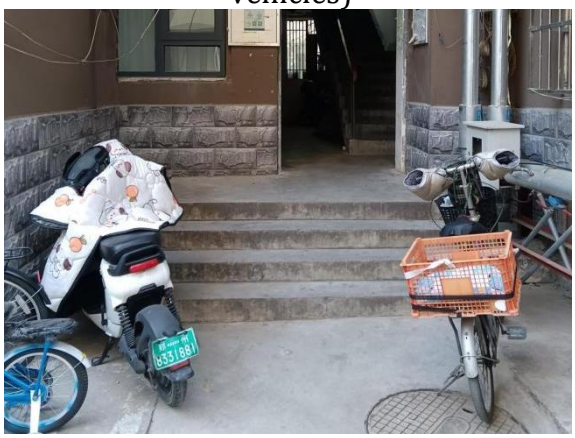

Figure 41: Parking in Ruhe Unit (Irregular parking of non-motorised vehicles)

Figure 42: Parking in Garden Xincun (Irregular parking of motor vehicles)

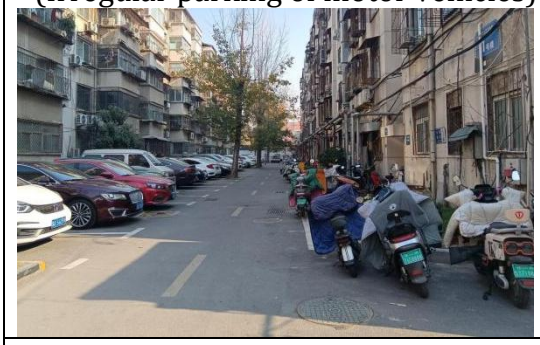

Figure 43: Parking in Ruhe Unit (Irregular parking of motor vehicles)

Figure 44: Parking in Tongle District (Irregular parking of motor vehicles)

(ii) Lack of accessible facilities

Accessible routes and accessible parking spaces are often lacking in car parks, resulting in serious limitations for elderly people to move around and park in car parks (e.g. Figure 45 shows the access route of the Garden Xincun car park, where the lack of handrails and the uneven surface of the broken paths cause inconvenience for elderly people to enter and exit the car park).

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Figure 45: Car parking Access Route in Garden Xincun

5. Conclusion

An observational study of outdoor spaces in residential areas for elderly people in Zhengzhou has provided valuable insights into the design and function of these outdoor spaces. The study shows that while many areas are trying to meet the needs of elderly residents, there is still room for improvement in several key areas.

Firstly, the creation of accessible community/social and play areas with level surfaces, wide paths and close proximity to amenities is essential for elderly people to safely engage, and this includes incorporating features such as ramps, handrails and clear signage to ease mobility and improve safety (Peng et al., 2022; Salmistu & Kotval, 2023). Secondly, increasing the quantity and quality of green spaces with accessible garden paths, seating areas and water features can greatly enhance the connection of the elderly with nature and promote their physical and mental well-being (Crews, 2022; Jarzebski et al., 2021; van Hoof et al., 2021). At the same time, public seating areas and other amenities can greatly enhance the comfort and independence of the elderly in the outdoor environment (Crews, 2022). In addition, the design of pedestrian-friendly pathways that provide wide and level roads, safe crossings and easy access to destinations is crucial to the mobility of the elderly (Sengers & Peine, 2021; World Health Organization, 2007).

It is important to consider the unique needs and preferences of older residents in the design and planning of outdoor spaces in residential areas. By incorporating these insights into future development, Zhengzhou can create more livable, inclusive, and enjoyable environments for its elderly population.

Ethics Approval and Consent to Participate

The researchers used the research ethics provided by the Research Ethics Committee of Universiti Teknologi Mara. All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional research committee. Informed consent was obtained from all participants according to the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of Interest.

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