

Determining the Suitability of the Outdoor Environment for the Elderly in Badahu Park, Qingdao, China

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ABSTRACT

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A residential outdoor environment is crucial for the elderly. With the growth of the elderly population in China, more and more old residential outdoor environment needs to be more suitable for the elderly. The Seniors Outdoor Survey (SOS) tool was developed as an effective and reliable assessment tool to determine the needs and preferences of seniors in outdoor Spaces. This study used SOS tools to assess the environment outside the Bahu Lake Park residential area in Qingdao, Shandong Province, China. The outdoor environment is divided into two sections for five assessment domains. The final mean score of the whole environment was 85.85, the percentage compared with the total score was 88.37%, the interrater ICC of the trainer was 0.879, and the T-test value was 0.903. All five areas scored above 84%, indicating that Badahu Park is an age-friendly and safe outdoor space. The scoring of each project by the SOS tool can quickly identify existing problems and point the way for future construction. The results of this study can help project managers and designers determine the essential outdoor features for future construction and maintenance priorities.

Keywords: Residential, Environment, Elderly, Seniors' Outdoor Survey Tool, outdoor space

INTRODUCTION

Population ageing is an established trend in countries around the world. It is estimated that by 2050, there will be nearly 2 billion people over 60 (WHO, 2022). Equally important is urbanization, with more than half of the world's population (54%) currently living in urban areas. This is expected to increase to about two-thirds by 2050 (United Nations, 2018). The ageing of the urban population is one of the world's problems. According to China's seventh population census, China's 60-year-old elderly population has reached 2.64 million, accounting for 18.7%. (Office for National Statistics, 2021). As China's elderly population grows, so does the need for their well-being. The residential outdoor environment is the main space for physical activity for the elderly, positively affecting their physical and mental health. Under the background of ageing in China, an environmental assessment was used to evaluate whether the outdoor environment suits the elderly.

Outdoor Environment for The Elderly

Getting old can bring health challenges. Regarding physical health, as people age, they lose muscle mass and bone density. The elderly will also face balance problems, and they are more prone to falls and often have difficulty sleeping; they are also more prone to depression (Rodiek, 2005; Babyak et al., 2001). Fortunately, a recently rediscovered body of evidence supports the view that nature, generally and everyday living environments, can profoundly affect health and well-being. Outdoor activities can improve the physical health and mental health of the elderly. Specific findings include lowering blood pressure, reducing stress, improving sleep, delaying ageing, etc. (Fuente et al., 2021; Kadariya et al., 2019; Chaudhury et al., 2018; Jacobs et al., 2008; Berto, 2007). In addition, long-term Better outdoor environments in the residential area also increase

residents' satisfaction with the environment, indirectly increasing the occupancy rate (Rodiek et al., 2013). It is critical to improve the residential outdoor environment of the elderly.

Problems Statement

Despite the potential benefits of contact with natural elements, extensive surveys have found that most residential outdoor environments need more to be utilized. Especially the senior community is a relatively concentrated ageing population community, living a lot of older adults. These communities have been built long, and various facilities must be completed more. The elderly also face various obstacles in their daily travel. Old residential areas often lack the consideration of suitability for the elderly, and home-based elderly care puts forward special requirements for the residential environment, supporting facilities, and travel conditions (Yao & Qin, 2021). The ageing transformation of the old residential outdoor environment is necessary for development. How to make the best of the residential outdoor environment is a concern for researchers and designers, as well as for facility managers and administrative decision-makers.

The Importance of Assessment

Evaluating whether the environment is suitable for the elderly is an important task. Multiple studies have shown that the elderly spend more time near their living environment than other age groups. Therefore, the residential outdoor environment is crucial for the life of the elderly (Carlson et al., 2012).

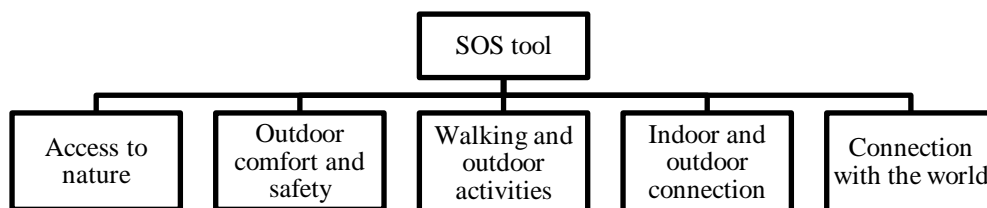
To better understand how the elderly perceive and use outdoor spaces, several studies have assessed residents' attitudes and use of various environmental features. There are currently few validated instruments that can guide an effective and reliable assessment of the outdoor environment for the elderly. The Seniors' Outdoor Survey (SOS) tool has now been developed, many scholars have been actively using SOS tools in recent years, so this study will use them to evaluate environmental characteristics. Thus, this study's purpose is to survey the outdoor environmental area in Badahu residential outdoor environment using SOS to the suitability and safety of the local and current elderly.

METHODOLOGY

The SOS tool (the Seniors' Outdoor Survey) was developed as a convenient and effective tool for assessing the outdoor environment for the elderly. The use of SOS tool was used on the extent to which they support the needs and preferences of elderly residents all over the world based in the USA (Bardenhagen et al., 2017; Chong & Shukor, 2016; Bardenhagen & Rodiek, 2015; Rodiek et al., 2014). The SOS tool developed through the research project has been extensively tested.

Using the SOS Tool

In a multiregional study, a preliminary SOS Tool (Seniors' Outdoor Survey) was developed and pilot-tested in nearly 200 outdoor spaces across 68 assisted living facilities (Bardenhagen et al., 2018; Bardenhagen et al., 2017; Bardenhagen & Rodiek, 2015). The finalized tool is designed to evaluate 60 items of outdoor environment characteristics on a 1-7 scale (1= worst, 7= best). These characteristics are organized according to the categories of environmental aspects contained in five domains as follows (Figure1):



Source: (Author, 2023)

Figure 1: Five domains of the categories of environmental aspects

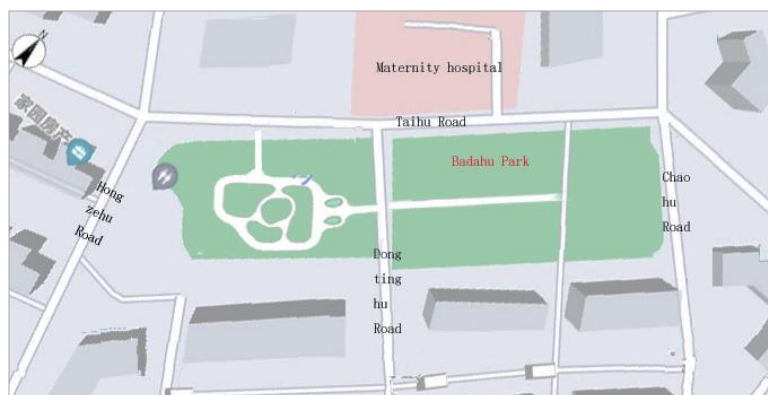
The SOS tool is free to download. This application-oriented tool can consistently assess and compare outdoor spaces to aid decision-making (Chong & Shukor, 2016). The tool was developed in assisted outdoor environments for the elderly. While there are often substantial differences in residents' physical, functional, and cognitive levels in different settings, most of the items in the tool are related to the elderly (Kondo et al., 2018; Detweiler et al., 2012; Cranz & Young, 2005).

Environmental Profiles

Study Sites

This study site is the outdoor environment of Badahu Park residential areas in Qingdao, Shandong Province, China. Qingdao is in the northern temperate East Asian monsoon region. Summer is hot and humid and rainy, but there is no heat; Autumn has high air, less precipitation, and intense evaporation; Winter wind is high temperature low, lasting for a long time. The climate characteristics are very suitable for outdoor activities.

The outdoor environment of the residence is in the south district of Qingdao, surrounded by residential areas (shown in Figure 2). The park is east of Chaohu Road, west of Hongze Lake Road, south of Taihu Road, and north of the old residential area. Many old residential areas around Badahu Park were primarily built in the 1980s. The park is divided into eastern and western parts. It was built in the 1980s and rebuilt in 2008, covering an area of 6,500 square meters.



Source: (Author mapping, 2022)

Figure 2: Site plan of Badahu Park residential outdoor environment

The outdoor environment of the Badahu Park residential area was chosen because it has a relatively large population density and a large elderly population, so it is of great significance to create a better outdoor space. The area around Badahu Park belongs to the Badahu Street Neighbourhood Committee, which governs four communities. Taihu Road District and Gaoyou Lake Road District are within 10 minutes' walking distance. The buildings around this neighbourhood were built in the 1990s. In addition, some new residential buildings have been built in recent years. During the investigation, the researcher went to the neighbourhood committee to survey the number of households. The population of the two communities within a 10-minute walking radius of Badahu Lake Park is 3,000 and 6,000 households, respectively, from a total population of over 20,000. There are about 5,000 elderly people, accounting for about 24% of the resident population, consisting of 2,400 men and about 2,600 women.

Residential Outdoor Environment

Because the residential outdoor environment of Qingdao Badahu Park is relatively large, it is divided into two parts according to the environmental characteristics. The western part is supplemented by green space; The eastern part is in the east with various facilities, such as the fountain, tree formation, etc. The density of use in the elderly differs in each area at different times. Due to the different environmental characteristics of the two spaces, the activities of the elderly on weekdays are also very different.

The trainers assess residential outdoor environments in these spaces by observing the spatial environment and usage. The primary concern of the SOS tool is using the outdoor area for the elderly. However, these areas were initially designed for residents of all ages; special care for the elderly is considered less. The SOS tool scored the area to find the problems and make it more suitable for the elderly in the future renovation design.

Data Collection

Six were selected for this evaluation to increase the study's validity. During the scoring process, trained raters collected all the data for each study space. Two senior citizens were selected who regularly used the park for exercise and recreation. The two middle-aged men majored in architectural design and environmental design. Two 21-year-old students are majoring in environmental design. Data collection for each outdoor space takes an average of about 1 hour or more, and they select their own suitable time to evaluate individually without interfering with each other. After the evaluation was completed, the research institute collected the scores of all trainers and analyzed the data statistically.

The collected data is entered into a Microsoft Excel™ spreadsheet, where each trainer calculates the score of the five domains. Then the data was calculated on the SPSSPRO website using reliability statistics. The Inter-rater (ICC) was used to assess inter-rater reliability, and t-tests were used to check for statistically significant differences in each item score. ICC values range from 0 to 1, representing the lowest to highest possible protocol levels. Despite the lack of consensus on determining acceptable ICC values, higher than 0.60 or 0.75 is generally considered an acceptable level of reliability (Anastasi & Urbina, 1997; Portney & Watkins, 1993).

RESULTS

Table 1 compares the assessment and reliability of six trainers. Each area uses SOS tools to calculate “access to nature” (14 items), “outdoor comfort safety” (15 items), “Walking and Outdoor Activities” (14 items), “Indoor Outdoor Connection” (11 items), “Connection to the World” (6 items) with an average score to evaluate the environmental characteristics of each area. Tables 1 and 2 show that the Inter-rater (ICC) is above 0.6, and the t-test value is generally higher than 0.7. It shows that the evaluation score has a high degree of reliability. The SOS tool assessment allows environmental problems to be sorted out and prepared for later reconstruction.

The six trainers in Table 1 all rated the Great Lakes Park above 80 points, with the lowest score of 80.98 and the highest score of 86.01 for the west part. The lowest score for the east part is 87.54, and the highest is 89.72. SOS Tool scores 60-100 (from poor to excellent), with a minimum score of 62.4 and a maximum score of 116. A score above 80 indicates that the park is relatively comfortable for the elderly, as assessed by the SOS tool. All areas of SOS tools are equally important.

Table 1. A Score of The Five Domains of the SOS

Outdoor Space	Access to Nature	Outdoor Comfort and Safety	Walking and Outdoor Activities	Indoor Outdoor Connection	Connection to the World	Average Score	
The west part	T1	78.96	77.05	81.73	89.45	86.67	83.02
	T2	83.47	80.35	84.31	94.51	87.57	86.01
	T3	77.41	75.41	80.11	90.07	81.23	80.98
	T4	80.97	77.93	82.86	91.05	86.77	83.99
	T5	80.13	76.87	84.26	93.78	90.43	85.40
	T6	82.8	77.64	81.26	90.13	83.8	82.66
	Average	80.62	77.54	82.42	91.50	86.08	83.68
The east part	T1	83.4	82.2	88.1	91.82	92.65	88.07
	T2	88.39	83.15	91.83	94.87	90.67	89.72
	T3	82.6	81.32	88.74	93	87	86.92
	T4	84.87	81.94	89.47	92.38	90.98	88.17
	T5	87.46	81.2	93.07	96.22	92	89.69
	T6	88.15	81.95	88.26	92.31	89.43	87.54
	Average	85.81	81.96	89.91	93.43	90.46	88.35

Note: T1 and T2 are for middle-aged trainers; T3 and T4 are for elderly trainers; T5 and T6 are for students.

Source: (Author, 2022)

Table 2. Analysis of SOS score results and validated by Inter-rater ICC and T-test

Outdoor Space	Average Score	Full Score	Percentage	Inter-rater ICC	T-test
Access to Nature	83.22	95.5	87.14%	0.913	0.932
Outdoor Comfort and Safety	79.15	94.82	84.11%	0.879	0.974
Walking and Outdoor Activities	86.16	99.3	86.77%	0.845	0.979
Indoor Outdoor Connection	92.47	101.72	90.9%	0.913	0.742
Connection to the World	88.27	95	92.92%	0.845	0.887
Average Score	85.85	97.27	88.37%	0.879	0.903

Notes: 1) A computable form was downloaded directly from the website: Accesstonature.org and a scale of 1-7 were filled in to display the different scores. Because of the weighting, the full score for each item is different.
 2) Percentage=Average Score/ Full Score.

Source: (Author, 2022)

Table 2 shows that the lowest ICC value is 0.845, and the highest score is 0.913. The highest T-test value is 0.979, and the lowest is 0.742. Higher than 0.60 or 0.75 is generally considered an acceptable level of reliability (Anastasi & Urbina, 1997; Portney & Watkins, 1993). This indicates that the detection is very credible.

DISCUSSION

The SOS tool is reliably used, as indicated by the scores given by trainers on a 7-point test. Although trainers of different ages and genders have different scores, The T-Test Significance (p-value), the Mean Reliability (ICC), and the average value of the overall space score reflect that the SOS tool is very suitable for the elderly outdoor environment facilities. The specific analysis of the outdoor environment is as follows:

The western part of the park

The six trainers' average score was 83 to 86, the lowest of the three spaces. Of the five domains, "Outdoor Comfort and Safety" scored the lowest (77.54). This field mainly includes selecting seat numbers, seat safety, comfort, and other items. According to the field investigation with the SOS tool, the west part only has a circle of seats in the corridor, and the number of seats in other positions is tiny. Corridor seat height is low, for the elderly to sit and stand up complicated and uncomfortable. From the picture, many elderly people bring their chairs to use (Figure 3). In addition, one of the SOS items also mentioned whether there is a table or a swinging lamp facility. The landscape elements of the west part are single, and there is almost no other scenery except the corridor and the hedge. In the later maintenance and renovation, the regional landscape elements should be considered to enrich, add drinking facilities, tables, and chairs, and improve the comfort of seats.



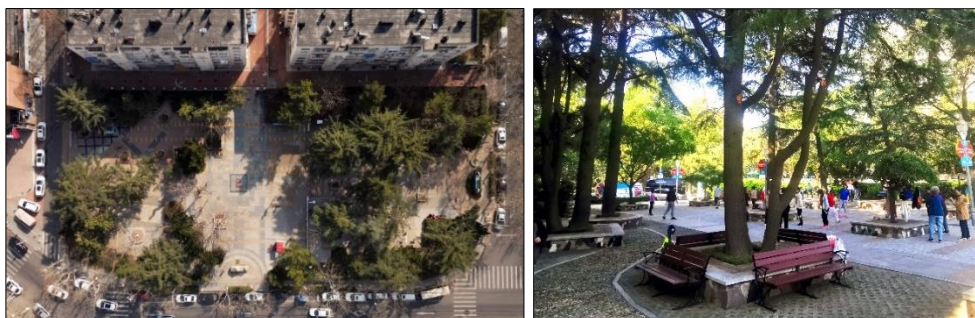
Source: (Author, 2022)

Figure 3: The western part of the park

In the western part, "Access to Nature" is also not exceptionally high (80.62), which is also related to the environment having a single plant variety and fewer colours. Plants can bring pleasure to the elderly, especially colourful flowers so that they can feel the charm of nature and vitality. In the outdoor environment design, a variety of trees and flowers are added to make the environment more beautiful and colourful to create an outdoor environment suitable for the elderly.

The eastern part of the park

The six trainers' average score was 81 to 94, higher than Space-A. Of the five domains, the "Outdoor Comfort and Safety" score is also the lowest in the east part; it is 81.96. The garden seats are in various positions, such as under the tree in front of the entrance (Figure 4). There are wooden seats and stone seats on both sides of the square. There is a half-meter height difference within the site, which is also transitioned naturally through ramps.



Source: (Author, 2022)

Figure 4: The eastern part of the park

Low marks were given to the single seat form, the lack of seat cushions, swing, microclimate, and other landscape facilities. As a result, the average score of the residential outdoor environment could be higher. Setting up comfortable seating next to the plants and setting the site's layout is recommended. The height of the seat can be slightly higher. Sometimes it is difficult for the elderly to sit and stand, and the low height of the seat makes them uncomfortable. In this space, drinking water facilities, swings, and other facilities can also be considered.

The other four domains scored above 85, and two were above 90. Shows that the area meets the needs of the elderly. In the east part, there are many tall trees and good shade trees. Especially in hot weather, this square is a place for people to chat. The disadvantage is that there are no shade facilities such as a pergola. In addition, the site walking activities are comfortable, the ground is non-slip, and the ramps are reasonable, but there needs to be an apparent walking path. Many elderly people walk in random spots. Because the square is located in an old neighbourhood and the western part needs to be more accessible, it is a concentrated entertainment environment. The square is surrounded by residential buildings, which are reasonably set up with the overpopulation connected to the interior, and are closely connected to the surrounding world, so these two scores are good.

CONCLUSION

Through the analysis of Qingdao Badahu Park, it can be concluded that this residential outdoor environment is suitable for the elderly. Around the old residential building, an outdoor environment is a good place for residents to communicate, exercise and walk. During the investigation, there were many elderly people here at different times of the day. They exercise, chat, and play chess, and have many smiles. The outdoor environment is critical to them. Overall, SOS tools have been used successfully and effectively in all areas of the outdoor environment in the Badahu residential area, providing suitable and safety surrounding for the elderly.

Through SOS tools, there are 60 specific items in the five domains of the SOS tool, and the score value for each item can identify the environmental problems. The SOS tool makes it easy and quick to understand the significant problems in the park's environmental features. SOS results will be combined with questionnaire surveys and interviews in the future for more in-depth research. SOS tools are practical, extensive, simple, straightforward, accurate, and helpful for investigating outdoor environments. The key findings of this study are important in helping project managers and designers identify the most critical outdoor features to prioritize in future construction and maintenance.

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AUTHOR CONTRIBUTIONS & CONFLICT OF INTEREST

Introduction and conceptualization, L.J. and A.M.; methodology, L.J.; software, L.J. and A.M.; investigation, L.J.; data curation, L.J.; writing—original draft preparation, L.J. and A.M.; writing—review and editing, L.J. and A.M.; supervision, A.M. All authors have read and agreed to the published version of the manuscript.

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