

Article

Influence of Outdoor Living Environment on Elders' Quality of Life in Old Residential Communities

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Abstract: The population is getting older in Mainland China, which presents a huge challenge of how to support these increasing elders to enjoy a high quality of life (QoL). Due to the limited nursing institutions and Chinese traditional culture, aging in place is the most common choice for elders. Up to now, most elders in cities are living in old residential communities (ORCs) rather than new ones. Poor quality of outdoor living environment (OLE) in these ORCs cannot well support the daily life of the elders, especially for those with physical problems. A questionnaire study was conducted to explore the influence of OLE on the QoL of elders living in ORCs. A total of 107 questionnaires were completed by both elderly residents in ORCs (45.79% were male and 54.21% were female). The data was analyzed by a mix of reliability analysis, correlation analysis, and regression analysis. The results showed that physical health of elders was influenced by distance, safety, greenery, seat, recreational facilities; psychological health was predicted by width, height, and greenery; social relationship was affected by distance, safety, and recreational facilities. Based on the research results, recommendations were proposed to property management service providers and local governments, including providing more seats at a reasonable height, setting handrails alongside the long ramp, installing folding seats along building stairs, and so on.

Keywords: old residential communities; quality of life; outdoor living environment

1. Introduction

Most of the countries in the world are experiencing continuous growth in the number and proportion of older persons in their population these years. According to the United Nations, by 2050, one in six people in the world will be over age 65 (16%), up from one in 11 in 2019 (9%) [1]. China has been going through the same situation. With the rapid economic development, continuous improvement of residents' living standards and medical techniques, the average life span of Chinese residents increased from 35 years old before 1949 to 76.34 years old in 2015 [2]. Currently, China has the world's largest number of elders. Up to 2017, there were 240.9 million elders aged 60 and above, covering 17.3% of the total population [3]. It was estimated that the number of elders in China would grow up to 483 million, making up 34.1% of the population in 2050 [4].

Meanwhile, many elders face inconveniences and hazards in their daily life due to the P–E unfit situation between declining physical function (P) and living environment (E) which is not purposely designed for them. How to help elders to live conveniently and happily in their later life (i.e., a good

quality of life) becomes an important and challenging issue for society. In fact, improving elders' quality of life not only benefits the elderly population, but also helps to promote one country's social and political image and international competence in the era of globalization [5].

Many researchers have revealed the influence of outdoor living environment (OLE) on elders' quality of life in different institutions. Parker (2004) reported a positive relationship between OLE characteristics and elders' quality of life (QoL) [6]. Schootman et al. also revealed that low quality of road and sidewalk had a negative influence on elders [7]. Evidence from Hong Kong uncovered the positive influence of living environment characteristics (e.g., distance, height, recreational facilities) on the QoL of elders living in different types of buildings and institutions [8,9]. Although many former researches mainly focus on the residential communities and buildings which may not be similar with the one in China, these findings tend to confirm the influence of the living environment on the QoL of elders.

However, rare empirical studies were conducted in Mainland China on the relationship between QoL of elders and OLE of old residential communities. To provide an aging-friendly outdoor living environment for elders in old residential communities (ORCs), one question should be addressed in advance: which OLE factors in ORCs have significant influences on QoL of elders. The present study aimed to settle this question using a questionnaire study. Literature study was taken to investigate and summarize a group of OLE and QoL factors for elders. A conceptual model was then developed. The methodology part mainly described the method used in this research including sampling, surveying, and data analysis. The result was then provided including factor reliability analysis, correlation analysis, and regression analysis. Significant and interesting findings were discussed in the discussion part. Practical recommendations and research limitations were finally provided.

2. Literature Review

To better understand the related factors of outdoor living environment and quality of life, as well as the living place preference of elders in China, a literature study was conducted to review the extensive previous literatures. The literature is summarized in three aspects: (1) aging in place and old residential communities, (2) quality of life, and (3) outdoor living environment.

2.1. Aging in Place and Old Residential Communities

Aging in place is the prevalent choice for many elders who can stay at home rather than in nursing institutions for the aged [10,11]. Elders aging in place usually live more independently and freely, compared with those in aged homes. Although elders living at home cannot get better service and facilities than those in aged homes, they can still get a healthy and active lifestyle and a good quality of life with the help of their families, neighbors, as well as the government [12,13].

People in the cities of China mostly live in gated residential communities with walls or fences around them. Younger adults mainly tend to live in new residential communities, while elders mainly reside in the old residential communities due to financial and other causes. According to the Ministry of Housing and Urban-Rural Development, old residential communities (ORCs) refers to those which were built more than 20 years ago and have fewer public services and aging municipal facilities [14]. Due to early construction, poor quality of equipment and material applied in the ORCs, and poor maintenance, most of the old residential communities could not support the elders' later daily life. Many researchers revealed lots of outdoor living environment problems in these areas, such as fewer facilities, poor maintenance, parking problems, fewer recreational areas, and so on [15,16]. It is necessary to find and improve the OLE factors that have important influences on the QoL of elders in ORCs.

2.2. Quality of Life

Quality of life refers to the individual's well-being and a certain living status, which involves many different fields, such as medicine, sociology, psychology and so forth [17,18]. Up to now, there is

no consensus on the content of quality of life. For instance, according to Shumaker and colleagues [19], QoL should include: physical functioning, emotional well-being, social functioning, and role activities, as well as health perceptions and global assessment of life satisfaction. Other researchers measured QoL using dimensions including health, independence, home and neighborhood, psychological and emotional well-being, and leisure, activities, and religion [20]. Among all the QoL measurements, the World Health Organization Quality of Life Questionnaire (WHOQoL) version was adopted by many scholars in their researches (e.g., [21,22]). In this study, the measurement of elders' QoL was mainly based on WHOQoL and generally contains three aspects: physical health, psychological health, and social relationship [23].

The physical health is considered to be a perceived health status, which includes aspects such as sleep disorders, mobility, and pain. The physical health objectively reflects the physical condition of the elders and may have a positive or negative influence on their subjective feelings, such as happiness or depression [4,5]. To some extent, physical condition may indicate the QoL of elders. For instance, elders with better functional abilities usually have greater perceived QoL [24]. Due to the natural deterioration of functioning of body systems and organs with age, elders are more susceptible to their living environment. Poor quality of environment may hurt elders' physical health (e.g., hurt by falls) [25]. A supportive environment should be provided for elders to maintain a good condition of physical health [26].

The psychological health refers to one's psychological or mental qualities, which should involve autonomy, emotional problems, behavioral disorders, depression, and self-esteem [18,27]. Elders often feel empty and lonely after retirement, especially when their children rarely visit them. The common negative psychological feelings for elders were depression and anxiety [6]. Some of the negative psychological feelings may even lead to suicide [8]. Evidence shows that the loss of function which is common for elders will lead to negative psychological health [28]. Although a poor living environment may hurt elders' psychological feelings, a favorable environment may bring some psychological benefits including stress reduction, satisfaction, and sense of well-being [29].

The term social relationships of elders means the interpersonal relationships of elders with other people (family members, residents, friends, and so on) that elders often fill leisure time and recreation activities with [22]. Unlike younger adults, the social network and lifestyle of elders have significantly changed, such as children leaving home, retirement, and the experience of widowhood, which may lead to social isolation and/or loss of social roles [30]. A good social relationship may help elders to achieve a sense of satisfaction as well as subjective health status [31,32], while lack of social relations may give rise to some severe results, such as mortality [33]. To maintain a satisfactory social relationship, a supportive environment is indispensable for elders to take social activities in, such as favorable green space [34].

2.3. Outdoor Living Environment

The outdoor living environment (OLE) of the residential communities is crucial to their end-users (especially the elders), since it has great influences on many aspects of their daily life when they live in the environment. To well support elders' daily life, a reasonable and qualified OLE should be provided and kept in good maintenance. According to the related researches on elders' living environment, there are many OLE factors that can have direct and/or indirect effects on the end-users (i.e., elders), which at least include distance, height, width, accessibility, greenery, safety, road, seat, recreational facilities, security, cleaning, and so forth [6,7,35].

Due to increased functional limitations, elders gradually fail to afford a long-time and/or long-distance walking. Distances between different places and facilities matter a lot to the elders. A short distance between elders' houses and their destination will encourage them to walk, which brings many health benefits. If the distance is too long, elders may hesitate to go since it could bring much trouble and inconvenience to them [36,37]. Improper height could increase the inconveniences of daily life and risks of accidents (e.g., high doorsill can easily stumble elders) [38]. Width usually means the walkable

width [39]. Width restrictions in certain places may influence an individual's safety and even decisions about whether or not to walk to the planned destinations [40]. Accessibility refers to barrier-free to physically go to the locations they planned to [41,42]. Due to gradually reduced mobility, elders have to suffer an increasing number of barriers in their living environment, especially when the environment was not designed and built considering elders' special needs. Poor transportation, discontinuous or uneven sidewalks, curbs, and noise were always a complaint in terms of environmental barriers by elders [43]. Good greenery and a beautiful landscape will induce a pleasant feeling in people. It can not only cultivate people's sentiment, enable people to get close to nature and relax, but also attract people to stay, exercise, and communicate in the green space [44]. Good greenery in the elders' living environment would lead to favorable psychological health and a longer life span [45,46].

Safety is an important element in designing or altering an outdoor living environment for the elderly [47,48]. To keep elders safe in the outdoor environment in ORC, many safety precautions should be adopted, especially for those with mobility limitations [49]. Roads in the ORC provide a convenient path for residents to go to their destinations by walking, bikes, motorbikes, and cars. Roads in the residential community with a poor design usually have many curbs, pots, and uneven surfaces, which are dangerous for elders to walk on and increase the risk of falls and injuries [50,51]. Seats can help elders to take a rest since they cannot walk or stand for a long time. An environment with a lack of seats may be difficult to walk around; hence, seat availability is one of the elders' concerns [52]. Recreational facilities involved facilities and places that can support leisure activities. A lack of them in the residential communities may lead to less physical activities for elders [53], while accessible recreational facilities may encourage elders to walk to them [54]. Security plays an important role in protecting the safety and health of residents and a lack of it may lead to the fear of moving outdoors [55]. Hence, to protect residents, especially elderly residents, security in residential communities should be provided. Cleaning refers to the removal of surface debris (e.g., dust, trash, organic material) on the public area in the residential communities, such as roads, stairways, recreational areas, and so forth [56,57].

3. The Conceptual Model

In sum, various factors of outdoor living environment in old residential communities may affect the quality of life involving the physical health, psychological health, and social relationship of elders. Hence, it is hypothesized in this study that OLE factors in outdoor living environment of old residential communities can predict elders' quality of life via physical health, psychological health, and social relationship. In addition, to provide a supportive outdoor living environment for the elders, complementarity and compatibility should also be carefully considered [58]. OLE factors should be deliberately checked if they are compatible for the good of elders, especially in the modification stage. The conceptual model was displayed in Figure 1. All the factors were obtained based on the literature study and were important OLE factors in ORCs.

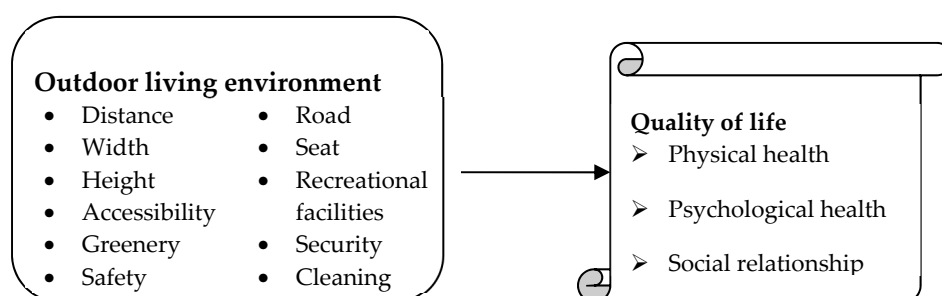


Figure 1. Model of OLE and QoL for elders in old residential communities. OLE: outdoor living environment; QoL: quality of life.

4. Research Method

4.1. Survey Design

To investigate the influence of OLE on QoL for elders, a questionnaire was designed based on the literature study. Normally, the questionnaire should at least include factors of outdoor living environment and quality of life. To make the results more representative, demographic characteristics information should be included to recruit respondents with different backgrounds. Finally, a questionnaire was designed into three sections: (1) demographic characteristics, (2) quality of life components, and (3) outdoor living environment components [9]. In the first section, such demographic characteristics of respondents as gender, age, education level, period of residence, etc., are collected to describe the background information of respondents.

In the second section, three components of quality of life (QoL), namely, physical health, psychological health, and social relationships, were adopted based on the WHOQoL and previous studies [22,23], which were used in many researches on elders (e.g., [8,59]).

In the third part, based on the literature study and “Property management regulation” in Mainland China, eleven OLE factors were adopted in this study [60]. There were 9 questions to measure quality of life and 38 questions to measure outdoor living environment.

Elders were asked to report their true feelings on these QoL components and OLE components by using 1 (extremely unsatisfied/extremely disagreed) to 7 (extremely satisfied/extremely agreed).

4.2. Sample

To make the research more representative, a stratified random sampling method was employed to obtain more reliable respondents in old residential communities [61]. Currently, there are 11 districts in Nanjing: Xuanwu, Qinhuai, Gulou, Jianye, Yuhuatai, Qixia, Pukou, Luhe, Jiangning, Lishui, and Gaochun, the first six of which are the main and old districts. The last five districts were just established as district in recent years and excluded in this study due to the different developing level and process (refer to Figure 2). This study was finally conducted in the six districts in Nanjing city. To improve the representation of the survey results, different types of old residential communities were purposively selected. The selection process mainly referred to the following selection criteria based on the previous study: (1) age of the residential communities; (2) size of the residential communities; and (3) location of the residential communities [9]. Between 4 and 6 old residential communities (ORCs) were purposively selected in every district in Nanjing. Likewise, elderly respondents with different backgrounds should be deliberately selected. The elders in these residential communities were selected with the following criteria: (1) ages (aged 60 and above); (2) years of residency (1 year and above); and (3) health condition [35]. In the end, between 3 and 6 older adults in every surveyed ORC were invited to take part in this study.

Many elders in China usually obtained poor education and may have problems filling out the questionnaire. To improve the response rate and ensure that each respondent understood every question listed in the questionnaire, each questionnaire was distributed to a certain elder by a well-trained surveyor. Questionnaire surveyors read and explained every item listed in the questionnaire so that the respondents could understand well and reply to the most appropriate answer. This contributes to a high response rate.

Of the 125 distributed questionnaires, 107 valid ones were returned, representing a response rate of 85.60%. Among the respondents, 55.14% were in the second age group (60 years old–69 years old), 29.91% were in the third age group (70 years old–79 years old); 13.08% were in the fourth age group (80 years old–89 years old), and the remaining 1.87% of the respondents were in the fifth age group (≥ 90 years old). All respondents in this survey who were valid for inclusion had a good mix of characteristics, which ensured the reliability of the study (refer to Table 1). The detailed information of the respondents was listed in Table 1.

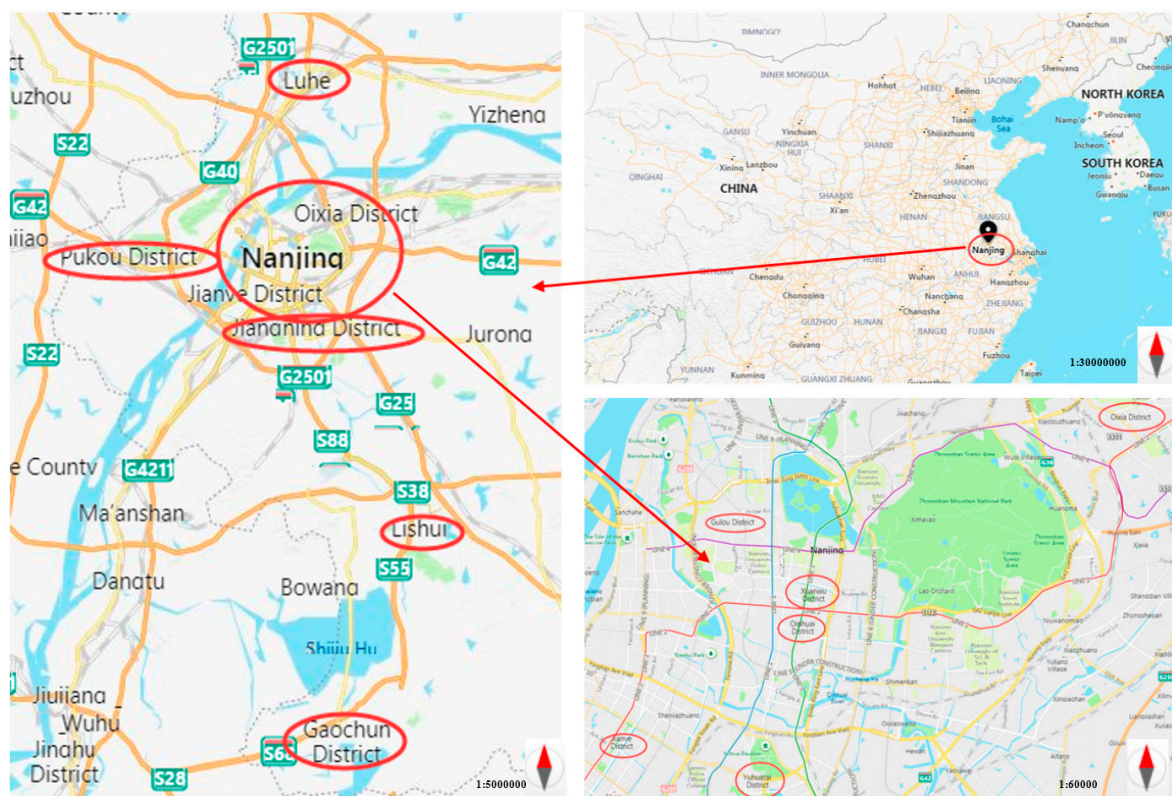


Figure 2. Locations of six surveyed districts in Nanjing City.

Table 1. The detailed information of the respondents.

Items	Details	Amount	Proportion (%)
Age	61–69	59	55.14%
	70–79	32	29.91%
	80–89	14	13.08%
	>90	2	1.87%
Gender	Male	49	45.79%
	Female	58	54.21%
Period of resident	1–5 yrs	18	16.82%
	6–10 yrs	14	13.08%
	11–15 yrs	41	38.32%
	16–20 yrs	8	7.48%
	>20 yrs	26	24.30%
Education level	Primary school	75	70.09%
	Junior middle school	22	20.56%
	Senior middle school	7	6.54%
	Bachelor	3	2.80%
Marital status	Never married	2	1.87%
	Married	86	80.37%
	Widowed	19	17.76%
Faith	Christianity	2	1.87%
	Buddhism	6	5.61%
	No faith	98	91.59%
	Others	1	0.93%
Walking ability	Normal	93	86.92%
	Needing walking assistance	9	8.41%
	Needing Wheelchair	4	2.73%
	Others	1	0.93%

4.3. Data Analysis

SPSS 22.0 was used in the data analysis process, in which reliability analysis, correlation analysis, and regression analysis were adopted. Reliability analysis was conducted to assess internal consistency by determining Cronbach's alpha coefficient [62]. Pearson correlation analysis was used to test the relationship between different variables [63,64]. Linear regression analysis was taken for examining the linear relationships between targeted variables [65].

5. Results

5.1. Construct Reliability

Reliability analysis of QoL of elders and OLE in ORCs was conducted to determine the extent to which items in the questionnaire were related to each other and to provide an overall index of the internal consistency of the scale. The reliability coefficient was measured using Cronbach alpha [66]. Value 0.6 was taken as the threshold of Cronbach alpha in our study [67]. After checking the reliability of this construct, all the ratings of these items were summed up respectively to predict the 11 OLE factors: distance (F1), width (F2), height (F3), accessibility (F4), greenery (F5), safety (F6), road (F7), seat (F8), recreational facilities (F9), security (F10), and cleaning (F11) (refer to Table 2). Three factors of quality of life (i.e., physical health (Q1), psychological health (Q2), and social health (Q3)) were also reliable based on the reliability analysis (refer to Table 3).

Table 2. Statement and reliability analysis of OLE factors in old residential communities.

OLE Factors	Items	Description	Alpha (α)
F1-Distance	1.	Distance from the living building to the gate of the residential communities.	0.778
	2.	Distance from the living building to the public recreational area.	
	3.	Distance from the living building to the garbage can.	
F2-Width	4.	Space of the stairway in the building.	0.717
	5.	Width of the entry door in the building.	
	6.	Width of the road in the residential communities.	
F3-Height	7.	Width of the recreational area in the residential communities.	0.703
	8.	Height of stairs in stairwell.	
	9.	Height of handrail in the stairwell.	
F4-Accessibility	10.	Height of ramp out of entry door.	0.691
	11.	Height of entry door sill.	
	12.	Accessibility in the building.	
F5-Greenery	13.	Accessibility on the road.	0.777
	14.	Accessibility of the recreational facilities.	
	15.	Green coverage rate in the area.	
F6-Safety	16.	Quantity of the greenery (pavilion, artificial hill, etc.).	0.786
	17.	Greenery maintenance measures (trimming grasses and shrubs).	
	18.	Safety of walking up and down the stairs.	
F7-Road	19.	Safety of walking on the road in the residential communities.	0.782
	20.	Safety of the recreational facilities.	
	21.	The levelness of the road.	
F8-Seat	22.	No debris on the road.	0.862
	23.	Quality of manhole covers.	
	24.	Quantity of the seat for rest in the area.	
F9-Recreational facilities	25.	Quality of the seat for rest in the area.	0.713
	26.	Reasonability of the seat (the location, size, etc.) for rest in the area.	
	27.	Variety of public recreational facilities (e.g., fitness location).	
F10-Security	28.	Quality of public recreational facilities (e.g., fitness location).	0.793
	29.	Protection measures of public recreational facilities (e.g., plastic ground)	
	30.	Security of the ORC's walls and gate.	
F11-Cleaning	31.	Security of the building entry doors.	0.906
	32.	Security measures of the low-rise houses of the building (burglary-resisting window, etc.).	
	33.	Visuality of the critical places through closed circuit television.	
	34.	Reliability of the security systems.	
	35.	Registration management of the visitors in and out of the area.	
	36.	Cleanliness on the road.	
	37.	Frequency of emptying the rubbish bins.	
	38.	Cleanliness in the building.	

Table 3. Statement and reliability analysis of quality of life for elders.

Factors	Items	Details	Alpha Value (α)
Q1-Physical health	1.	Your quality of sleeping.	0.711
	2.	Your daily activities.	
	3.	Your chest disease.	
Q2-Psychological health	4.	How you rate your current life.	0.648
	5.	Your frequency of negative feelings.	
	6.	Your frequency of positive feelings.	
Q3-Social relationships	7.	Your relationship with neighbors.	0.785
	8.	Your relationship with family.	
	9.	Your relationship with community staff.	

5.2. Correlation between OLE Factors and QoL (Pearson's Correlation Analysis)

The correlation analysis (refer to Table 4) showed that physical health (Q1) was significantly correlated with five types of OLE factors (i.e., distance (F1: 0.156), width (F2: 0.396) and accessibility (F4: 0.551), safety (F6: 0.573), and recreational facilities (F9: 0.363)). Psychological health (Q2) was significantly correlated with five kinds of OLE factors, i.e., width (F2: 0.396), height (F3: 0.388), safety (F6: 0.267), greenery (F6: 0.761), and layout (F7: 0.801)). Social relationship (Q3) was significantly correlated to privacy (F4: 0.253). The result also revealed that total QoL of the elders was significantly correlated with distance (F1: 0.629), height (F2: 0.635), width (F5: 0.661), greenery (F6: 0.572), layout (F7: 0.398), psychological health (Q2: 0.390), and social relationship (Q3: 0.226).

Table 4. Correlation between QoL and OLE factors.

Scales	Factors	Q1	Q2	Q3
Outdoor living environment	F1-Distance	0.641 **	0.163	−0.051
	F2-Width	0.221 **	0.396 **	0.009
	F3-Height	0.207 *	0.388 **	−0.030
	F4-Accessibility	0.551 **	0.127	0.136
	F5-Greenery	−0.016	0.320 **	0.233 **
	F6-Safety	0.573 **	0.267 **	0.296 **
	F7-Road	0.120	0.128	0.024
	F8-Seat	−0.107	0.210 *	0.185 *
	F9-Recreational facilities	0.363 **	0.126	0.152
	F10-Security	−0.007	0.277 **	0.159
	F11-Cleaning	−0.094	0.067	0.123

Note: **—Correlation is significant at the 0.01 level (2-tailed). *—Correlation is significant at the 0.05 level (2-tailed).

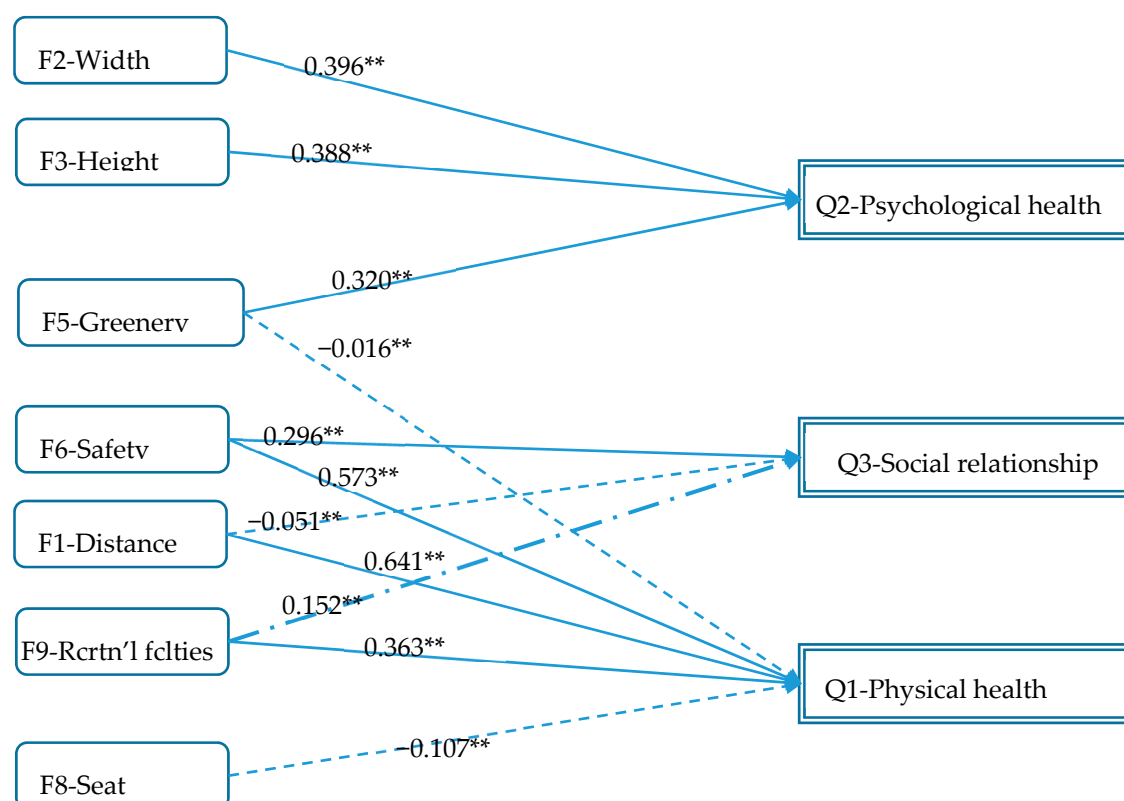
5.3. Interdependent Relationship between OLE Factors and QoL (Multiple Regression Analysis)

Multiple regression analysis was conducted to explore the stricter interdependent relationship of QoL of elders and outdoor OLE in ORCs. The stepwise method was selected in this multiple regression analysis. All OLE factors were selected as independent variables in the multiple regression analysis to investigate the linear relationships between thirteen OLE factors and three kinds of QoL. The result of multiple regression analysis is shown in Table 5 and Figure 3.

Table 5. Result of Multiple Regression Analysis of QoL and OLE Factors.

Model		B	St. Error	t	Sig.	VIF	R	R2	Significance (ANOVA)
1	Physical health	← OLE							
	(Constant)	0.305	0.230	0.681	0.000		0.789	0.623	0.000
	F1 Distance	0.341	0.061	0.604	0.000	0.531			
	F6 Safety	0.460	0.065	0.125	0.000	0.875			
	F5 Greenery	−0.170	0.048	−0.530	0.001	0.377			
	F8 Seat	−0.216	0.060	−0.604	0.000	0.638			
2	Psychological health	← OLE							
	(Constant)	0.200	0.425	0.470	0.639		0.683	0.466	0.000
	F2 Width	0.307	0.067	0.580	0.000	0.345			
	F3 Height	0.291	0.060	0.816	0.000	0.081			
3	Social relationship	← OLE							
	(Constant)	0.447	0.354	0.736	0.000		0.487	0.237	0.000
	F6 Safety	0.212	0.079	0.670	0.009	0.710			
	F1 Distance	−0.216	0.078	−0.759	0.007	0.537			
	F9 Recrtn'l facilities	0.175	0.080	0.197	0.030	0.736			

Note: VIF—Variance Inflation Factor.



Note: — Significant positive relationship shown in correlation *and* regression models
 - - - Significant negative relationship shown only in regression models
 - . - . Significant positive relationship shown only in regression models
 [] — Outdoor environment scale
 [] — Quality of life scale
 ** — Correlation is significant at the 0.01 level

Figure 3. Interrelationships between OLE factors and QoL of elders.

Model 1 showed that Physical health (Q1) was positively associated with distance (F1), safety (F6), and recreational facilities (F9), while negatively with greenery (F5) and seat (F8), interpreting 62.3% of the variance. Psychological health (Q2) in Model 2 was found to be positively associated with width (F2), height (F3), and greenery (F5), accounting for 46.6% of the variance. Social relationship (Q3) in Model 3 was revealed to be positively predicted by safety (F6) and recreational facilities (F9), while negatively predicted by distance (F1) explaining 23.7% of the variance.

6. Discussion

6.1. Distance, Safety, and Recreational Facilities Positively Predict Physical Health While Seat and Greenery Negatively Trigger It

The regression result shows that if they are satisfied with distance, safety, and recreational facilities, they usually enjoy good physical health. Due to declining physical health, it is difficult for elders to take a long-distance walk. A favorable distance will encourage elders going to destinations by walking. Regular walking everyday can increase elders' exercise time and strength, which, in turn, accounts for better mobility and physical health [68]. On the other hand, elders may hesitate to go if the destination of the elders (e.g., markets, shops, or recreational facilities) is too far for them, since they can hardly overcome the physical barriers due to their functional limitations [69]. They would rather stay at home and miss a chance for practice.

Safety is another focus of the elders. A safe environment is necessary for elders since it is good for their autonomy, privacy, sense of direction, and sense of safety [70]. A dangerous environment usually induces the insecurity and displeasure of elders [71]. Unlike youngsters, any unsafe environment will decrease the willingness of elders to get into it, since their fragile physical health cannot bear any bad outcome (e.g., tumble or slip, and so on). The outcome would even be fatal or costly. A safer environment in ORCs will not only decrease the possibility of any accidents for elders and may even encourage elders to walk, which will obviously lead to a better physical health condition for elders than a dangerous environment. Evidence of researches shows that elders living in unsafe areas are usually at risk of injuries or even death [72]. Furthermore, a safe living environment is necessary for a good quality of life [73].

The regression result also reveals that *recreational facilities* have a positive influence on elders' health. This is reasonable since, the more satisfied with recreational facilities, the more chances there will be for elders to exercise using these facilities, which will improve their physical health. Researchers found that the distance and quantity of recreational facilities influenced elders' daily exercises like walking, which related to their physical health [74,75].

It is *interesting* that *seat* and *greenery* were found to have a negative influence on elders. Elders can take a rest on outdoor seats in ORCs. However, if elders take these seats for a very long time, they will have little time to practice. In fact, it is very common for elders in ORCs to do some household work and/or chat with other people sitting on the seats in China. Furthermore, researches also showed that sedentariness would lead to poor health consequences [76,77]. Likewise, good scenery may attract elders to stay around, and even contribute substantially to psychological well-being [78]. However, elders may spend more time enjoying the scenery and even talking with others beside them, and thus decrease their practicing time (say, walking) in the end.

6.2. Width, Height, and Greenery Positively Predict Psychological Health

The psychological health of the elders was found to be predicted by width in the outdoor environment. Elders usually prefer wide *widths* to narrow ones. In fact, outdoor space plays an important role in elders' health [79]. Elders would like to stay in a spacious place rather than a narrow one. For example, elders like to walk on sidewalks wide enough for the residents to go next to each other, and even to easily pass with walking aids and wheelchairs [39]. If the sidewalk is too narrow, elders will have difficulty walking on it and can even be bumped by others. To some extent,

width restrictions may impede the elders' plan to markets or recreational facilities [80]. Then they might be anxious and worried about walking on it.

Height is another OLE factor revealed in the regression analysis to positively predict elders' psychological health. Stairs, thresholds, handrails, and curbs are common building components in any residential communities and the proper height of these components will be supportive of elders. If the height of the building components is not suitable for elders (e.g., too-high stairs, thresholds and curbs, too-high or -low handrails, etc.), elders will be frustrated or nervous since it will be too dangerous for them to pass. In fact, many fall accidents of elders occurred beside the stairs [81]. What is worse, the improper height of these building components may even impede elders to go outside and they would have to stay at home for a very long time alone. This will make their mood become bad.

The result shows that better *greenery* in the residential communities usually predicts better psychological health of elders. Greenery (e.g., trees, grass, shrubs, etc.) usually provides a feeling of peace for people [44]. If the quality of greenery in the old residential communities is satisfactory, elders would often go out to sit beside, walk around, or even prattle with neighbors beside the greenery. The fresh air and beautiful scenery will make elders feel good physically and psychologically. A nice experience will enhance them to stay in the greenery environment frequently and they will benefit a lot. On the other hand, if there is no greenery or the greenery in the residential communities is in poor condition, elders will not go there since it cannot arouse their interest. Then they would lose the chances of being tranquil or happy in the old residential communities. In such a situation, the frequency of elders' poor psychological feelings and quality of life will be more than those enjoying good greenery. Furthermore, researchers in Japan found that the elders living in communities with more greenery (trees, grasses, and/or flowers) enjoyed a longer life span than those with less [46]. Researches have also revealed the psychological health maintenance function of the greenery, such as relieving stress and diseases it induces, and improving satisfaction and happiness [45,78,82,83]. Hence, if elders in ORCs are satisfied with the greenery, they usually enjoy good psychological health and less stressful things.

6.3. *Safety and Recreational Facilities Positively Predict Social Relationship While Distance Negatively Triggers It*

The social relationship should be maintained by frequent interactions with other people. The regression analysis showed that *safety* and *recreational* facilities could positively predict social relationships. If elders feel safe outside of the ORCs, they would go out and meet more neighbors, friends, or facilities management staff. On the other hand, if the elders were satisfied with the recreational facilities, they would usually like to use them. In fact, elders are always chatting with each other when they do exercises using recreational facilities. In such situations, elders will have a good social relationship compared to those not going out or doing exercise on recreational facilities. The public square and/or parks in neighborhoods are conducive to exercise and improve social relationships [84]. Elders walking or gardening outside usually have more chances to chat with their friends and neighbors, which is helpful for their social relationship. Generally, social activities usually happen outside, and the process would be seeing each other, saying hello to each other, and starting a short conversation [85]. Many researches confirmed the connection between outdoor space and social activities between neighbors, e.g., a green public area will attract residents to go there, which is helpful for the formation of social relationships between residents [86]. *What is interesting* is that *distance* was found to negatively predict social relationship. Perhaps satisfied distance will encourage elders directly going to where they want to go and they do not need to take a rest. Hence, they may have little chance to stop communicating with other people.

7. Recommendations

7.1. Practical Implications

The findings in this study provide some practical implications on how to enhance the elders' quality of life by improving main outdoor living environment factors. Based on the data analysis, the results revealed that the distance, height, width, safety, recreational facilities, and greenery could positively or negatively predict the quality of life for elders living in old residential communities. To improve elders' latter life, several practical suggestions were proposed to both ORCs and new-built elderly communities as follows.

The distance between elders' houses to their daily destinations should be "shortened." The stores or other destinations should provide internet or telephone service so that elders can buy things or other services at home if these destinations are too far for elders. The delivery charge should be free for elders or be covered by the government fund. More seats at a reasonable height should be installed along the road they usually walk on so that they can take a rest on it and chat with others.

The height of stairs in buildings was suggested to be 17.5 cm by the specification of the Ministry of Housing and Urban-Rural Development [87]. It is inconvenient for the elders to climb. The height of the stairs was suggested to be "lowered" (e.g., 10 cm–15 cm) so that elders can walk on the stairs more easily and safely. Ramps should be set alongside the stairs where elders may easily stumble. If there are too many stairs or the ramps are too long, handrails should be installed along them at a proper height (e.g., 666–778 mm as optimal [88]). Folding seats are also suggested to be installed on the walls along the building stairs, which can help elders to take a rest. To support those needing a wheelchair to go out, Stair-Climbing Wheelchairs are suggested to be installed in the buildings without elevators in ORCs.

The space of the exit doors and roads for new buildings should be wide enough for elders, especially the ones in which wheelchairs pass. Since the exit doors and stairways cannot be widened in ORCs if the buildings already were built for years, it is suggested to install lifts for the elders.

More greenery like trees and grasses should be planted in the old residential communities. If there is no free place to plant them, bonsais are suggested to be arranged in the places elders usually gather and pass. Lawns should be mowed timely to provide good scenery for elders.

To provide a safe environment, it is suggested to regularly clean clutter in the stairs of the buildings, and on the road. Uneven roads with potholes should be filled and repaired and warning boards should be set beside the potholes before being repaired. Curbs and stairs should be replaced by ramps on the usual pathways.

7.2. Further Research

In order to improve the quality of life for elders living in ORCs in Mainland China, a study focused on the relationship between OLE and QoL was conducted. Three kinds of QoL were identified in this research, including physical health, psychological health, and social relationship. Eleven OLE factors were also identified. Based on correlation and regression analysis, several findings were revealed: physical health was positively predicted by distance, safety, recreational facilities, and psychological health, while negatively predicted by greenery and seat. Psychological health was positively associated with space, height, greenery and social relationship. Social relationship was positively predicted by safety, recreational facilities, and psychological health, and negatively predicted by distance and space.

Despite important findings revealed in this study, some potential limitations should be noted. First, the relatively small sample size of this study and self-reporting survey measurement may limit the generalizability of the results and the potential common method variance and the validity of data may be questioned. However, several factors decrease this possibility. First, all scales for measurement of OLE factors and quality of life were adopted based on an extensive literature review. Second, the respondents in this study were intentionally selected with different backgrounds, such as education level, period of resident, and so on. Third, all respondents in our study were selected from

different old residential communities and from different districts in Nanjing City. Forth, all the elderly respondents had lived in different types of ORCs for at least one year, and had a direct understanding of the outdoor living environment. Fifth, all the factors used in this study were statistically tested as reliable (all factors were greater than 0.6) [66]. Therefore, we have confidence that the results of this research have not been biased by different responses to the measured variables and can be used as baseline information for further, larger-scale studies about the impact of OLE in ORCs on QoL of elders. It also gives pointers for the future directions of large-scale studies with different types of residential communities (e.g., old residential communities, new-built residential communities, public rental housing, and so on).

Secondly, correlation analysis and multiple regression analysis were adopted to investigate the relationship between OLE factors and QoL of elders in ORCs. Daily activities were reported in many researches to have an influence on QoL of elders. It is recommended to further explore the inter-relationship between OLE factors, daily activities and QoL for elders in ORCs.

Lastly, quantitative data analysis was used in the current study, by which relationships between OLE and QoL factors were explored for elders in ORCs. In order to better and profoundly explore their relationships, some of the qualitative research methods are suggested to conduct in further studies, such as case study and focus group research.

8. Conclusions

Aging society has already come to China. Since elders mostly live in old residential communities with poor living outdoor environments, it is urgent to improve the environment to well support elders' quality of life. To reach this, a questionnaire study was conducted in Nanjing City, Jiangsu Province. This research identified three types of quality of life (i.e., physical health, psychological health, and social relationship) and eleven factors of outdoor environments in ORCs.

The result of statistical analysis reveals that elders' physical health was positively predicted by distance, safety, and recreational facilities, while negatively predicted by seat and greenery. Psychological health was positively associated with space, height, greenery, and social relationship. Social relationships had a positive interrelationship with safety, recreational facilities, and psychological health, yet a negative interrelationship with distance and space.

Many recommendations, such as providing convenient ways for elders to get the daily necessities, setting up folding seats along the stairs in the building, providing greeneries and/or bonsais with good quality, regularly cleaning clutter along the stairs, and repairing the uneven roads were suggested to improve the quality of life for elders living in ORCs.

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