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Effects of Seating Layout on Older Adults' Social Interaction in an Older Residential Community: Evidence from 30 Seating Nodes in Xiaqiao Garden

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Abstract. Against the dual backdrop of population aging and neighborhood regeneration, seating has evolved from a basic resting facility into a small-scale spatial element that can shape older adults' everyday staying behavior and social contact. This study examines 30 seating nodes in Xiaqiao Garden through systematic field observation. Seating configuration, spatial organization, proximity to activity spaces and residential entrances, shade conditions, and observed use and social behavior were recorded at the node level. Pearson correlation was used for pairs of continuous variables, while Spearman correlation was used whenever a non-continuous variable was involved. Results show that seating capacity was positively associated with both older-user count ($r = 0.792$, $p < 0.001$) and social participation rate ($r = 0.686$, $p < 0.001$). Concentrated or node-based distribution, face-to-face orientation, proximity to activity spaces and residential entrances, and fixed shade also showed significant associations with use and/or social interaction. By contrast, seat spacing, facility completeness, and functional occupation did not exhibit stable statistical relationships. Based on these findings, four design priorities are proposed: hierarchical placement, optimization of seating combinations, shade-first siting, and coordination with compound everyday uses. The study provides quantitative evidence for low-cost, behavior-oriented age-friendly renewal in older residential communities.

Keywords: older residential community, seating layout, older adults, social interaction, age-friendly renewal

1. Introduction

1.1. Research background

Population aging and neighborhood regeneration are increasing the social importance of community public space. Because older adults' daily activity ranges are often concentrated near home, internal streets, plazas, fitness areas, and building-front spaces become frequent settings for rest, observation, encounter, and conversation. Public open space can therefore support active aging and social well-being [1]. Seating is especially relevant because benches function not only as resting

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facilities but also as small-scale social infrastructure that supports mobility, place use, and neighborhood contact [2].

The social role of seating depends on more than its presence. Capacity, configuration, orientation, proximity to activity spaces, and shade can alter the likelihood of staying and face-to-face interaction. Evidence from neighborhood open spaces links seating, shade, and landscape conditions with older adults' walking and social interaction [3], while seating-design studies emphasize the need to address ergonomic and social requirements together [4].

1.2. Research questions and objectives

Age-friendly renewal often evaluates seating through provision quantity or compliance with standards, although identical quantities may perform differently across locations and micro-environments. Community environments can also influence peer and intergenerational interaction in different ways [5]. Using independent seating nodes as the unit of analysis, this study asks: (1) which seating characteristics are associated with older adults' use intensity; (2) which spatial characteristics are significantly associated with social interaction; and (3) which factors should receive priority in community-scale renewal. The objective is to provide behavior-based evidence for low-cost seating interventions in older residential communities.

2. Literature review

2.1. Community public space and older adults' social interaction

Older adults' social interaction is shaped by both social networks and neighborhood environments. Non-participant observation has shown that staying and chatting are common forms of interaction in neighborhood streets, and that supportive street environments can increase social participation [6]. Spatial settings facilitate interaction first by creating opportunities to arrive and stay, and then through activity nodes, facilities, vegetation, and enclosure. Recent evidence also links seating area, fitness facilities, and green enclosure with older adults' sitting behavior [7].

The value of public space extends to longer-term health. Accessibility, shade, leisure facilities, and social interaction in public open space have been associated with older adults' functional ability and mental health [8]. Research in Singapore likewise indicates that physical activity and social participation occur both at route-based resting points and at destination nodes with facilities and services [9]. Accordingly, evaluation should focus on whether public-space features actually support sustained use and participation rather than on facility provision alone.

2.2. Spatial characteristics of seating and research gap

Seating can influence behavior through three related pathways: capacity support, spatial organization, and environmental comfort. Capacity constrains simultaneous use; distribution, orientation, and spacing affect visual contact and conversational convenience; and shade and supporting facilities influence the ability to remain in place. A recent systematic review identifies natural environment, accessibility and spatial layout, and facilities and functions as core dimensions affecting older adults' social interaction, while calling for more direct quantitative space–behavior evidence [10]. This study therefore links seating configuration, spatial relationships, environmental conditions, and observed behavior at the node scale.

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3. Research design and methods

3.1. Study area and sample

Xiaqiao Garden was selected as the case community. Thirty relatively independent seating nodes were sampled; the same physical node was not counted repeatedly across observation periods. The sample covers building-front spaces, roadside locations, plazas, fitness areas, pergolas, community service points, and drying areas, providing variation in capacity, distribution, orientation, activity proximity, and shade.



Figure 1. Study area and distribution of the 30 seating nodes

Field observation recorded seating-space attributes, distances, facility conditions, and older adults' use. Social interaction was defined as observable conversation, card or board games, or other shared activities involving at least two older adults; co-presence without observable communication was not counted. Typical settings are shown in Figure 2.



Figure 2. Typical seating nodes and observed behavioral settings

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3.2. Variable construction and quantification

Variables were classified as continuous or non-continuous. Continuous variables retained original counts or measurements, whereas non-continuous variables were numerically coded from observable site characteristics. Older-user count represented use intensity; social participation rate (social participants/older users) was the primary interaction outcome, supplemented by interaction-group indicators. Table 1 summarizes the operationalization.

Table 1. Research variables and operationalization

Dimension	Variable	Type	Operationalization
Seating configuration	Seat units	Continuous	Number of independent benches/seating groups
Seating configuration	Capacity	Continuous	Theoretical simultaneous seating capacity
Seating configuration	Seat form	Non-continuous	Single-person = 0; multi-person = 1
Spatial organization	Distribution	Non-continuous	Concentrated/node-based = 0; dispersed = 1
Spatial organization	Orientation	Non-continuous	Same direction = 0; face-to-face = 1
Spatial organization	Seat spacing	Continuous	Distance between adjacent seats/seating groups (m)
Spatial relationship	Distance to activity space	Continuous	Distance to nearest plaza/fitness/recreation space (m)
Spatial relationship	Distance to residential entrance	Continuous	Distance to nearest residential entrance (m)
Spatial relationship	Accessibility score	Non-continuous	≤15 m = 3; 15–50 m = 2; 50–100 m = 1; >100 m = 0
Facilities / environment	Facility completeness	Non-continuous	Neither backrest nor armrest = 1; one present = 2; both present = 3
Facilities / environment	Fixed shade	Non-continuous	No = 0; yes = 1
Facilities / environment	Functional occupation	Non-continuous	No = 0; drying/vehicles/objects = 1
Behavioral outcome	Older-user count	Continuous	Number of older adults using the seating during observation
Behavioral outcome	Social participation rate	Continuous	Social participants / older users

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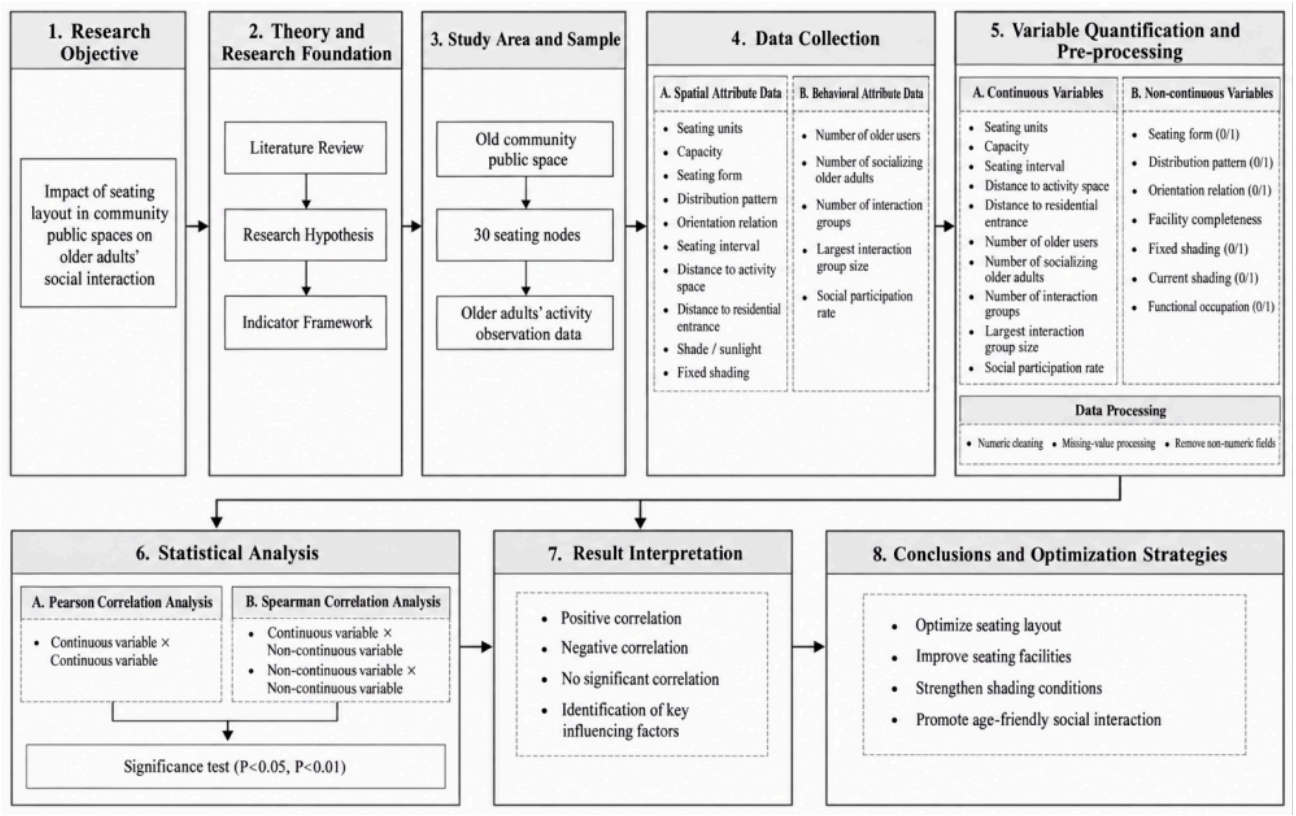


Figure 3. Research workflow

3.3. Data preprocessing and statistical analysis

Preprocessing included numeric conversion and field screening. Missing values required for analysis were converted to 0 according to the predefined coding rules; text fields such as location and observation period were retained only as identifiers. Because fixed shade and observed shade were highly overlapping in the sample, fixed shade was retained in the main analysis. Pearson correlation was used between continuous variables, and Spearman correlation whenever a non-continuous variable was involved. Statistical significance was set at $p < 0.05$, with $p < 0.01$ indicating a higher level of significance. Correlations were interpreted as associations rather than causal effects.

4. Results

4.1. Descriptive statistics

The 30 nodes varied substantially in configuration and observed use. Mean seat-unit count was 4.63, mean capacity was 8.00 persons, mean older-user count was 4.37, and mean social participation rate was 49.5%. Multi-person seats accounted for 93.3% of nodes, concentrated/node-based layouts for 66.7%, face-to-face orientation for 63.3%, and fixed shade for 70.0%. Mean distance to a major activity space was 7.37 m and mean distance to a residential entrance was 28.70 m. Use ranged from zero to 13 older adults, indicating that provision quantity alone did not explain performance.

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Table 2. Descriptive statistics for major continuous variables (N = 30)

Variable	Mean ± SD [Range]	Variable	Mean ± SD [Range]
Seat units	4.63 ± 2.59 [1, 13]	Capacity	8.00 ± 2.79 [2, 14]
Seat spacing (m)	2.67 ± 2.06 [0, 12]	Distance to activity space (m)	7.37 ± 8.31 [1, 30]
Distance to residential entrance (m)	28.70 ± 16.74 [9, 75]	Older-user count	4.37 ± 2.97 [0, 13]
Social-participant count	2.80 ± 2.57 [0, 11]	Social participation rate	49.5% ± 27.8% [0, 84.6%]

4.2. Associations between seating spatial characteristics and use/social outcomes

Capacity showed the strongest positive association with use. It correlated with older-user count ($r = 0.792$, $p < 0.001$) and social participation rate ($r = 0.686$, $p < 0.001$). Seat-unit count was also related to older-user count ($r = 0.624$, $p < 0.001$), but not to social participation rate ($r = 0.309$, $p = 0.096$), indicating that adding seats mainly increases carrying capacity rather than the proportion of users who interact.

Spatial organization was also important. Distribution was coded 0 for concentrated/node-based and 1 for dispersed arrangements; it was negatively associated with older-user count ($\rho = -0.535$, $p = 0.002$) and social participation rate ($\rho = -0.512$, $p = 0.004$). Orientation was coded 0 for same-direction and 1 for face-to-face arrangements and was positively associated with older-user count ($\rho = 0.503$, $p = 0.005$) and social participation rate ($\rho = 0.562$, $p = 0.001$).

Greater distance from activity spaces was associated with lower older-user count ($r = -0.518$, $p = 0.003$) and social participation ($r = -0.578$, $p < 0.001$). Distance from residential entrances showed the same direction, while fixed shade was positively related to older-user count ($\rho = 0.482$, $p = 0.007$) and social participation rate ($\rho = 0.425$, $p = 0.019$). Shade thus appears to be an important support for sustained use.

Table 3. Correlations between seating-space characteristics and use/social outcomes

Variable	Method	Older-user count r/ρ	p	Social participation rate r/ρ	p
Seat units	Pearson	0.624**	<0.001	0.309	0.096
Capacity	Pearson	0.792**	<0.001	0.686**	<0.001
Seat form	Spearman	0.358	0.052	0.375*	0.041
Distribution	Spearman	−0.535**	0.002	−0.512**	0.004
Orientation	Spearman	0.503**	0.005	0.562**	0.001
Seat spacing	Pearson	−0.228	0.226	−0.193	0.307
Distance to activity space	Pearson	−0.518**	0.003	−0.578**	<0.001
Distance to residential entrance	Pearson	−0.389*	0.034	−0.554**	0.002

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Table 3. (continued)

Accessibility score	Spearman	0.279	0.135	0.382*	0.037
Facility completeness	Spearman	−0.065	0.733	−0.115	0.544
Fixed shade	Spearman	0.482**	0.007	0.425*	0.019
Functional occupation	Spearman	−0.233	0.215	−0.125	0.511

Note: * p < 0.05; ** p < 0.01. Pearson correlation was used between continuous variables; Spearman correlation was used whenever a non-continuous variable was involved.

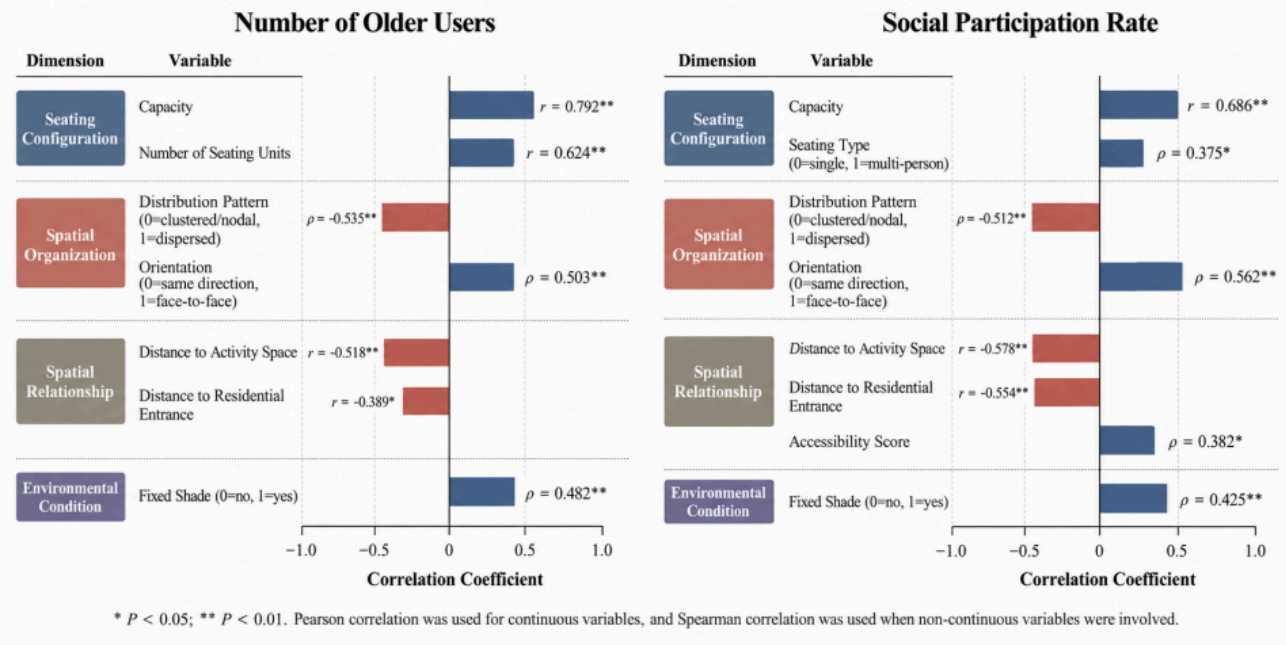


Figure 4. Visualization of statistically significant correlations

4.3. Non-significant relationships and interpretive boundaries

Seat spacing and facility completeness were not significantly associated with either core outcome. Functional occupation produced negative coefficients, but p-values exceeded 0.05; no stable effect direction can therefore be inferred. Because larger-capacity nodes also tended to be concentrated, closer to activity spaces, and better shaded, bivariate correlations cannot fully separate covarying factors. The results should be interpreted as node-scale associative evidence.

5. Discussion and design strategies

5.1. From facility quantity to "social affordance"

The results suggest that socially supportive seating depends on capacity, spatial organization, location, and shade rather than on seat quantity alone. Capacity was related to both use intensity and social participation, whereas seat-unit count was related only to use intensity. Concentrated/node-based arrangements and face-to-face orientation were consistently associated with stronger social outcomes, supporting earlier arguments that seating can promote social connection when it enables visual contact and co-presence [2-4].

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Proximity and shade further show that seating operates as micro-scale infrastructure embedded in daily activity chains. Nodes near fitness areas, plazas, recreation spaces, community services, and residential entrances benefit from passing activity and opportunities for encounter, while shade increases the practical usability of roadside and building-front seats. These patterns are consistent with evidence on destination nodes, rest points, and supportive micro-environments [8, 9].

5.2. Age-friendly seating optimization strategies

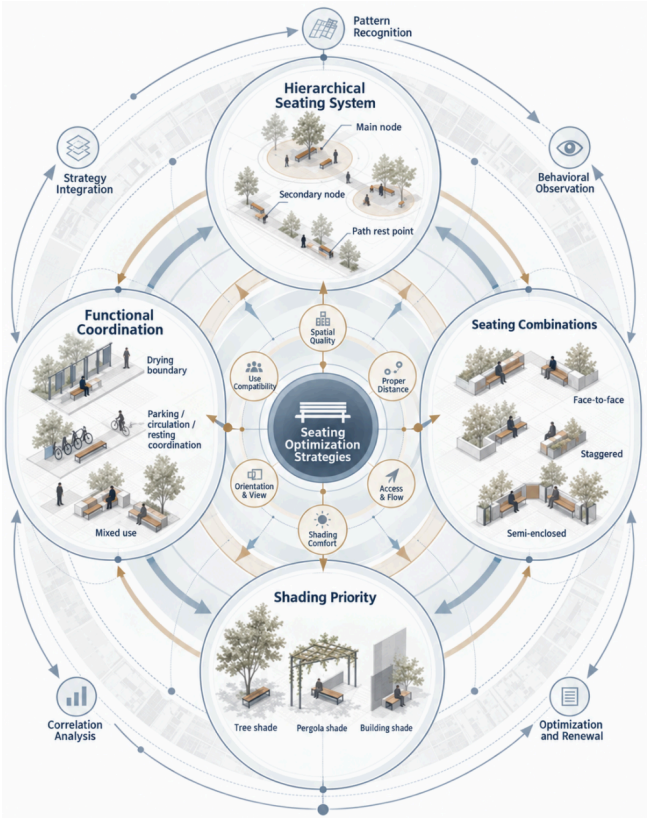


Figure 5. Integrated strategy framework for age-friendly seating optimization

Four strategy groups follow from the results. First, seating should form a hierarchy of primary nodes, secondary nodes, and path rest points. High-activity plazas, fitness areas, recreation spaces, and community-service locations should receive larger-capacity combinations; residential entrances and main walking routes should contain medium-scale rest nodes; purely circulatory routes require only necessary short-stay seats.

Second, seating relationships should be optimized before simply increasing quantity. At socially active nodes, face-to-face, offset-opposing, or semi-enclosed arrangements can replace uniform same-direction rows while retaining wheelchair clearance and transfer space. Third, shade should be treated as a siting precondition by using mature trees, building shade, pergolas, or lightweight structures at exposed high-demand nodes.

Fourth, seating should be coordinated with compound everyday functions. Drying areas, bicycle or vehicle parking, and similar uses may compete with resting activity during certain periods. Rather than removing these functions, renewal should define functional boundaries, preserve clear circulation, offset seating locations, and provide shaded rest areas that remain usable during high-demand periods.

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Figure 6. Typical seating-node optimization strategies; post-renewal scenes are design simulations rather than built outcomes

5.3. Limitations

Three limitations should be noted. The sample is limited to 30 nodes in one community, and several non-continuous variables are unevenly distributed. Observations do not systematically cover weekdays/weekends, multiple daily periods, or seasons. In addition, converting structural missing values and true zeros to the same value may affect some variables, while bivariate analysis cannot isolate the independent contribution of correlated spatial factors. Future work should expand samples, repeat observations, and use multivariable or before–after designs.

6. Conclusion

This node-scale study shows that seating capacity, spatial organization, proximity, and shade are meaningfully associated with older adults' use and social interaction. Capacity supported both use intensity and social participation, whereas adding seat units alone did not necessarily increase the interaction proportion. Concentrated/node-based and face-to-face arrangements were associated with stronger social outcomes; nodes closer to activity spaces and residential entrances and those with fixed shade also performed better. Seat spacing, facility completeness, and functional occupation did not show stable statistical relationships in the current sample.

Age-friendly seating renewal should therefore move from a quantity-oriented approach toward a socially supportive network that prioritizes high-frequency nodes, socially enabling combinations, shade-first siting, and compatibility with everyday functions. Such small-scale interventions can strengthen opportunities for staying and neighborhood contact while providing behavior-based evidence for incremental renewal in older residential communities.

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