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MICRO EVIDENCE FOR MACRO POLICY: HIDDEN BARRIERS TO AGING-IN-PLACE IN HIGH DENSITY CHINESE HOUSING ENVIRONMENT

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Abstract

Aging in place policy relies on community, but policy priorities often top-down and miss lived barriers in dense apartments. This study aims to identify environmental barriers that constrain older adults' priority everyday activities in high density Chinese apartments, to inform evidence-based aging-in-place policy and priorities. This research conducted activity-based in-home assessments for 30 old adults over 60 years, with 41 activities categories in 22 high density estates, using a culturally adapted In-home occupational performance evaluation (I-HOPE), observation and unstructured interviews. In total, 226 barrier instances were coded and scored. The results indicate that digital media use, public transport access, carrying items, cleaning, and bathing were repeatedly identified as priority difficulties. Frequent barriers involved high-reach storage, digital usability, and external mobility interfaces. Many constrained activities were still self-rated as high performance, revealing hidden barriers. So, performance-based micro-evidence can refine priorities and evaluation for policy, which need focus on every day activity chains across unit, building, and urban mobility interfaces, instead of one activity or only at home.

Keywords: High Density Housing, Aging in Place, Housing Environment, Hidden Barriers

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INTRODUCTION

Aging in place have become major policy concerns worldwide, as governments seek ways to support older adults to remain in their homes and communities rather than rely excessively on institutional care (Ay & Götze, 2025). This challenge is particularly acute in most of high-density urban settings. High-density residential development with built environment has been identified as creating layered planning challenges if not addressed through proper planning and mitigation measures (Chen et al., 2023; Husin et al., 2021). In response, China has promoted aging in place because institutional care alone is unlikely to meet demand (Fang et al., 2015), and policy attention has shifted from service provision toward improving the physical home environment to enhance the feasibility and quality of aging at home (State Council, 2022). Urban regional planning is inherently an iterative process. The frictions observed in post-development phases underscore the critical need for planners to utilize experiential feedback as empirical evidence to adjust and optimize subsequent macro-level policies (Husin et al., 2021).

China is promoting the renovation of old urban residential communities, focusing on existing residential areas with insufficient supporting facilities and services but strong resident demand for renovation. The renovation content is divided into basic, improvement, and enhancement categories. The improvement category explicitly includes installing elevators in buildings where conditions permit, to address the vertical mobility difficulties commonly faced by residents of multi-story buildings, especially the elderly (General Office of the State Council, 2020). According to official statistics from the Ministry of Housing and Urban-Rural Development (2025), during the 14th Five-Year Plan period, China launched renovation projects for over 240,000 old urban residential communities and installed approximately 129,000 renovated elevators. Furthermore, digital technology is also encouraged to be integrated into home-based elderly care services, such as smart health and elderly care products, aiming to alleviate the shortage of caregivers and improve monitoring and service coordination (Hung, 2022; Zhang et al., 2020). Overall, China's current policy mix constitutes a comprehensive support system covering building renovation, home renovation, and technology enabled care, aiming to create a suitable living environment for most elderly people who age at home.

Despite this ambitious policy agenda, a substantial gap remains between what aging-in-place policies deliver and what older adults need in everyday life. Aging-related welfare measures are not fully integrated with broader urban sustainability and community planning frameworks, limiting the extent to which neighborhood resources can function as coordinated support systems for ageing in place (Jia et al., 2025). However, age-friendly city planning, requires coordinated attention to housing, mobility, facilities, and neighborhood

design rather than isolated interventions (Rashid et al., 2021). This need is especially evident in high-density housing, where high-rise residential development creates multiple planning challenges and requires proper planning and mitigation to address mobility, accessibility, and density-related pressures (Husin et al., 2021). Meanwhile, existing policy and implementation logics often privilege visible and measurable outputs, such as service coverage, technological deployment, and infrastructure upgrading, even though policy-led interventions do not necessarily align with older adults' actual capacity, preferences, or convenience (Jung, 2025; Zhang et al., 2020). In such environments, everyday independence depends less on any single facility than on whether activity can be supported continuously across housing environments. Therefore, the key planning gap is not simply whether more policies or technologies are introduced, but whether planners have sufficiently fine-grained evidence to identify which activities, spaces, and environmental interfaces should be prioritized in high-density urban renewal.

To advance evidence-based urban planning, scholars emphasize the critical need for methodologies that reduce bias and enhance the certainty of evidence (Ravensbergen & El-Geneidy, 2023). This means planners urgently require high-fidelity data that better captures how built environments shape older adults' everyday lives. Aging in place has been discussed as a multidimensional issue involving housing features, housing environment, and technology (Azmi et al., 2021), assessing it solely through subjective feedback often obscures the true friction between the user and the environment. So, this study adopts an activity-based approach that combines self-report and direct observation to identify environmental barriers affecting functional independence in high-density housing. Specifically, it aims first, to identify which housing-related daily activities older adults most frequently priorities as difficult; second, to determine which types of environmental barriers, and in which domestic spaces, most strongly constrain the performance of these priority activities; and third, to reveal barriers to aging in place that may remain hidden when assessment relies on self-report alone.

LITERATURE REVIEW

Person-environment (P-E) fit explains aging in place as the interaction between older adults' capabilities, needs, and preferences and the demands and affordances of their housing environments (Van Vianen, 2018). In high-density apartments, compact layouts, standardized forms, and reliance on vertical circulation can turn minor frictions into sustained environmental press on daily activities. Fit is also temporal. Older adults often adapt through routines, workarounds, and adjusted expectations, so appearing to manage well may still

involve hidden constraints and long-term risk (Vleugels et al., 2023). This temporal lens motivates repeated, in-situ observations.

Performance-based assessment links daily activity to the environmental features that enable or constrain them, which translate P-E fit into actionable design and policy evidence. The In-Home Occupational Performance Evaluation (I-HOPE) operationalizes this logic by identifying resident-prioritized activities, capturing self-rated performance and satisfaction, and observing activities to document environmental barriers affecting functional independence in context (Keglovits et al., 2015; Susan Stark et al., 2009; Susan L. Stark et al., 2010).

Observation in natural settings reveals how activities actually unfold and what demands environments impose (Baker, 2006; Kawulich, 2005), which self-report may understate because of habituation and coping. Accordingly, this study defines hidden barriers as situations where participants report high performance or satisfaction despite observed environmental constraints during activity performance.

RESEARCH METHODOLOGY

Study Design and Setting

This study used an activity-based, performance-oriented assessment to examine how housing environments shape older adults' ability to perform everyday activities. In-home assessments covered dwellings and their surrounding environments in high-density urban housing in China, characterized by compact layouts and standardized building forms. Observation and unstructured interviews captured environmental constraints, perceived sources of difficulty, coping strategies, and priorities for change. The aim was to identify constraints that may remain hidden in building-centered audits but are crucial for aging in place. The findings are not intended for statistical generalization. Instead, recurring activity-environment patterns may be transferable to other high-density housing contexts, including those in Malaysia, where participant, housing, and service characteristics are comparable.

Participants and Recruitment

Participants were community-dwelling adults aged 60 years or older who lived independently, had resided in their current dwelling for at least six months, and could communicate and participate in the assessment. Individuals with acute medical instability or severe cognitive impairment preventing meaningful engagement were excluded. Purposive sampling through community organizations and neighborhood networks captured typical housing conditions. Thirty older adults from 22 residential estates participated. Recorded characteristics included age, sex, living arrangement, residence duration, Lawton IADL score, building type, floor level, toilet type, and balcony availability.

Sample size was guided by analytic depth. Information saturation was approached around the 14th participant, when principal activity priorities and environmental barrier patterns became recurrent. Subsequent cases mainly extended contextual variation. Therefore, the final sample was considered adequate for the pattern-oriented analysis.

Instruments

Functional competence was assessed using the Lawton Instrumental Activities of Daily Living (IADL) scale for descriptive and interpretive purposes (Graf, 2008). Housing environments and activities were assessed using an adapted In-Home Occupational Performance Evaluation (I-HOPE), a performance-based assessment of environmental barriers to everyday activities (Keglovits et al., 2015; Susan Stark et al., 2009; Susan L. Stark et al., 2010).

The English-language materials were translated into Chinese by qualified personnel. The original 44-activity set was adapted to high-density Chinese housing, retaining its focus on everyday activity performance. Before pilot testing, adaptations addressed gardening (A8), movement within the housing environment (A19), digital media consumption (A17), and writing or typing (A41). A formal pilot involved six older adults, all included in the final sample of 30. Following the pilot, activity content was adjusted to incorporate getting into and out of public transport (A11) and collecting express deliveries (A23), based on participants' reports. The assessment procedure and scoring criteria remained unchanged. The final set comprised 41 activities covering basic activities, instrumental activities, leisure activities, and social participation.

Data collection

The assessment followed the three-step I-HOPE procedure. First, participants sorted activities into five categories: (1) I do not do and do not want to do; (2) I do now with no problem; (3) I do now with difficulty; (4) I do not do but wish to do; and (5) I do now but am worried about my ability in the future. Second, participants ranked activities in Categories 3-5 by importance and selected up to ten priorities. Performance and satisfaction were self-rated on five-point scales (1 = very poor/very dissatisfied; 5 = very good/very satisfied).

Third, where privacy and practical conditions permitted, the researcher directly observed priority activities in the relevant settings, identified environmental barriers, and rated their influence on functional independence using the original 0-5 I-HOPE scale, on which higher scores indicated greater independence. The complete scoring anchors are reported in the Barrier Coding and Scoring section. Observations took place across one or more visits as needed.

Locations were recorded using predefined spatial codes: bathroom (O1), bedroom (O2), function room (O3), kitchen and dining (O4), living room

(O5), balcony and hallway (O6), roads and trails (O7), community square and green space (O8), streets and commercial areas (O9), and block-level square and green space (O10).

Barrier Coding and Scoring

The barrier typology was developed from the literature and refined during fieldwork. It comprised 29 environmental barrier types (EB01-EB29), covering dwelling circulation, surfaces, fixtures, storage, indoor conditions, building and estate access, logistics, digital connectivity and interfaces, thermal comfort, and external mobility. Each type had an operational definition and inclusion and exclusion rules. These rules distinguished related conditions, such as high-reach storage from low-level access and internet connectivity from digital-interface usability. EB30 denoted reported-only evidence without direct performance observation. It was treated as an evidence-status code rather than an environmental barrier type.

Quantitative coding and scoring were restricted to directly observed activity performance. For each retained activity instance, the single environmental condition judged to impose the greatest constraint was coded as the primary barrier. Its influence on functional independence was rated using the original per-instance 0-5 I-HOPE anchors: 0 = no activity; 1 = total dependence; 2 = moderate assistance; 3 = minimal assistance; 4 = standby assistance, safety risk, or extreme energy expenditure; and 5 = independence with or without a device. Thus, higher ratings indicated greater independence rather than greater barrier severity. One researcher conducted all field assessments and completed the initial coding and scoring. A second researcher reviewed the coding framework and ambiguous cases, which were resolved through discussion with reference to the operational definitions and boundary rules.

Ethical Considerations

Ethical safeguards focused on informed consent and privacy protection. All participants provided informed consent. Privacy-sensitive activities, including those performed in bathrooms and bedrooms, were not directly observed. Participant codes and predefined spatial codes were used in analytical records to support privacy protection.

Data Analysis

Qualitative and quantitative data were analyzed in an integrated manner. Descriptive statistics summarized participant characteristics, housing features, and Lawton IADL scores. Analyses focused on activity, spatial, and barrier patterns rather than individual comparisons. Frequencies and mean self-rated performance and satisfaction identified priority problem activities.

The quantitative barrier analysis retained 226 directly observed, coded, and scored instances. 71 records without direct performance observation were excluded. Counts, affected participants, rating distributions, typical locations, and associated activities were summarized by barrier type. Observation and linked interview accounts informed the qualitative cause patterns reported in Table 4; interview accounts did not generate quantitative barrier scores.

Barrier impact ratings were grouped into three tiers: assistance needed (1-3); standby assistance, safety risk, or extreme energy expenditure (4); and independent performance (5). These tiers were compared with self-rated performance and satisfaction, with scores ≥ 4 considered high. Hidden barriers were defined as observed environmental constraints in activities participants felt they managed well. Analysis identified recurrent activity-environment configurations.

ANALYSIS AND DISCUSSION

Sample characteristics and housing context

The study included 30 older adults living in 22 high density housing unit. Table 1 shows the sample context.

Table 1: Participant and housing characteristics (n = 30)

Variable	Category / Statistic	Value
Age (years)	Mean (SD)	66.9 (5.1)
	Range	60-78
Sex	Male	17 (56.7%)
	Female	13 (43.3%)
Living arrangement	live Alone	5 (16.7%)
	With spouse only	16 (53.3%)
	With family	9 (30.0%)
Years in current home (year)	Mean (SD)	17.5 (4.0)
	Range	11-25
Lawton IADL total (0–8)	Mean (SD)	6.6 (0.9)
	Median (min–max)	7.0 (5-8)
Building type	Elevator building	25 (83.3%)
	No elevator	5 (16.7%)
Floor level	Mean (SD)	9.6 (5.3)
	Range	2-21
Toilet type	Sitting toilet	22 (73.3%)
	Squat toilet	8 (26.7%)
Number of estates	Distinct housing estates	22

Source: Data and Author's Calculation

Participants were on average 66.9 years old (SD = 5.1, range 60-78), with 17 men and 13 women. Most lived with a spouse (53.3%), followed by living

with family (30.0%) and living alone (16.7%). On average, they had resided in their current homes for 17.5 years. Lawton IADL scores indicated relatively preserved functional competence (mean = 6.6/8; median = 7). Most lived in elevator-served apartments (83.3%), at a mean floor level of 9.6.

Priority problem activities

Across the 41 predefined activities, several tasks were repeatedly prioritized as problematic in Table 2.

Table 2: Priority problem activities and self-rated performance (n = 30)

Code ¹	Activity name	n selected	% selected	n in Top3	% in Top3	Mean perf. ² (SD)	Mean satisf. ³ (SD)
A17	Media consumption-Digital	28	93.33	17	56.67	3.36 (0.68)	3.25 (0.52)
A11	Public transport	27	90	15	50	3.00 (0.88)	2.74 (0.59)
A4	Carrying Items	27	90	10	33.33	3.00 (0.78)	2.81 (0.83)
A5	Cleaning Living Area	27	90	10	33.33	3.59 (0.57)	3.26 (0.81)
A33	Taking a Bath/Shower	26	86.67	17	56.67	3.04 (0.77)	2.50 (0.58)
A26	Reaching for Things Up High	23	76.67	0	0	3.87 (0.55)	3.52 (0.73)
A23	Pick up express delivery	15	50	2	6.67	3.27 (0.96)	3.13 (0.74)
A41	Writing or typing	14	46.67	2	6.67	3.57 (0.76)	3.21 (0.70)
A13	Getting Up from Chair/Sofa	13	43.33	1	3.33	4.00 (0.41)	3.77 (0.60)
A30	Responding to an Emergency	12	40	3	10	3.83 (0.58)	3.50 (0.67)

Source: Data and Author's Calculation

Note: ¹ The complete adapted 41-item activity set comprised: basic activities: A4 Carrying Items, A7 Eating, A9 Getting Dressed, A10 Getting In/Out of Bed, A13 Getting Up from Chair/Sofa, A14 Going Up/Downstairs, A15 Grooming, A24 Picking Something Up off the Floor, A32 Sleeping, A33 Taking a Bath/Shower, and A37 Toilet; Instrumental activities: A5 Cleaning Living Area, A6 Controlling the Environment (air conditioning and light switches), A8 Gardening, A11 Getting In/Out of Public Transport, A12 Getting In/Out of Entrance Doors, A16 Ironing Clothes, A20 Opening Bottles or Packaged Food, A21 Opening/Closing Doors, A22 Paying Bills, A23 Picking Up Express Deliveries, A25 Preparing a Meal, A26 Reaching for Things Up High, A28 Repairing Clothing, A29 Repairing Household Objects, A34 Taking Medication, A35 Taking Out the Trash, A39 Washing and Drying Clothes, and A40 Washing Dishes; Leisure activities: A3 Caring for Pets, A17 Digital Media Consumption, A18 Television Viewing, A27 Reading, and A31 Resting; And social participation: A1 Answering the Door or Phone, A2 Caring for Children, A19 Moving Around in the Housing Environment, A30 Responding to an Emergency, A36 Talking on the Phone, A38 Visiting Family and Friends, and A41 Writing or Typing. ² Performance score: 1 = very poor to 5 = very good (lower scores indicate greater difficulty). ³ Satisfaction score: 1 = very dissatisfied to 5 = very satisfied.

Digital media use (A17), using public transport (A11), carrying items (A4), cleaning the living area (A5), and bathing or showering (A33) were most often selected as problems, each by more than 85% of participants and frequently ranked within the top three concerns. These activities were self-assessed by participants regarding performance and satisfaction, which showed moderate perceived difficulty, with mean performance scores around 3 on a 5-point scale.

While relatively low satisfaction for bathing, getting in/out of public transport and carrying. Second, reaching for things up high (A26), picking up express delivery (A23), writing or typing (A41), getting up from a chair or sofa (A13), and responding to an emergency (A30) formed a second tier of commonly perceived difficulties.

Environmental barrier types

Table 3 summarizes 226 observed and scored environmental barriers across 24 coded types. The most frequently recorded barriers were high-reach storage/fixtures (EB12; n=39, 27 participants), digital interface usability (EB27; n=35, 26 participants), and external mobility system barriers (EB29; n=27, all 27 participants). A second cluster included load-handling logistics (EB25; n=19), low-level access demands (EB13; n=14), and unsuitable seating/transfer surfaces (EB06; n=13). Across barrier types, ratings were predominantly moderate (3) or mild (4-5), while EB29 showed a comparatively higher share of severe (0-2) ratings (14.8%), indicating stronger constraints at mobility interfaces. Additional commonly observed barriers included storage depth/organization (EB17; n=11), level changes (EB03; n=11), poor lighting (EB05; n=10), and building access control (EB21; n=9). Spatially, barriers clustered in hallways (O6), key interior rooms (O4/O5), and around building/neighborhood entrances (O7/O10), most often linked to carrying (A4), reaching up high (A26), digital media use (A17), bathing (A33), and public transport access (A11). Several further barrier types were reported only in interviews and are examined in the subsequent qualitative analysis.

Table 3: Environmental barrier types, severity and spaces (n = 226 observed barriers)

Barrier code	Barrier name	n barriers	n participants	Severe ¹ 0-2 n (%)	Moderate 3 n (%)	Mild ² 4-5 n (%)	Top locations	Top activities ³
EB12	High-reach storage	39	27	2 (5.1)	13 (33.3)	24 (61.5)	O4, O6	A4, A26
EB27	Digital interface	35	26	2 (5.7)	15 (42.9)	18 (51.4)	O5, O6	A17, A41
EB29	External mobility	27	27	4 (14.8)	14 (51.9)	9 (33.3)	O6, O10	A11, A38
EB25	Load-handling	19	17	1 (5.3)	7 (36.8)	11 (57.9)	O6, O5	A4, A23
EB13	Low-level access	14	13	0 (0.0)	4 (28.6)	10 (71.4)	O6, O10	A33, A25
EB06	Seating/transfer surface unsuitable	13	13	0 (0.0)	0 (0.0)	13 (100.0)	O6, O10	A33, A5
EB17	Storage depth constraint	11	10	2 (18.2)	3 (27.3)	6 (54.5)	O4, O6	A4, A26
EB03	Level change	11	11	1 (9.1)	4 (36.4)	6 (54.5)	O5, O6	A4
EB05	Poor lighting	10	8	0 (0.0)	1 (10.0)	9 (90.0)	O5, O6	A41, A27
EB21	Building access control barrier	9	9	0 (0.0)	0 (0.0)	9 (100.0)	O10, O7	A38, A12

Source: Data and Author's Calculation

Note: Barrier codes: EB01-EB29 denote the 29 environmental barrier types in the full coding framework, of which 24 occurred in the observed dataset. The table presents the ten most frequently recorded types, accounting for 188 of the 226 observed instances; the remaining 38 instances were distributed across 14 lower-frequency types and are not shown individually. EB30 was a reported-only evidence-status code, rather than an environmental barrier type. ¹ Severe = barrier score ≤ 2 ; Moderate = score 3; Mild = scores 4-5. ² Although scores 4-5 is reported as one group, 99.3% of these instances were scored 4, indicating standby assistance, safety risk, or extreme energy expenditure; only one instance was scored 5. Location codes: O4 Kitchen and Dining Area, O5 Living Room, O6 Balcony and Hallway, O7 Roads and Trails, and O10 Block-Level Square and Green Space. ³ Activity codes are defined in the note to Table 2.

Causes of key environmental barriers

Table 4 summarizes the main cause patterns for selected barrier clusters derived from both observed performance and interview accounts. Each row combines barrier codes that were frequently observed or repeatedly self-reported by participants, and that have been synthesized into environmental evidence pointing towards specific policy and design directions. Vertical circulation and entrance systems in no elevator estates (EB21, EB22, EB03) were repeatedly described as making going out and returning home the most exhausting part of daily life. Interior storage and layout barriers (EB12, EB17, EB13) reflected cupboards and storage cabinet placed too high, too low or too deep. Ground height difference (EB25, EB21) made carrying groceries and parcels difficult. Digital accessibility barriers (EB26, EB27) were linked to unstable connections, complex interfaces and fear of making mistakes. External mobility barriers (EB29, EB23) were tied to unclear wayfinding and fast-moving crowds. Thermal comfort and indoor environmental quality (EB28, EB20) have a significant impact on daily life activities, especially bathing. The lack of appropriate space (EB10) constrained the elderly from attempting interest activities such as gardening and caring for pets.

Table 4: Main causes of environmental barrier from interview

Barrier code	Environmental evidence for policy direction	Paraphrased from interviews	Key activities affected
EB21, EB22, EB03	Building entrance and vertical circulation systems	No lift and repeated stair flights make going out the hardest part; heavy doors and thresholds add to the effort.	A14, A11, A23, A38
EB12, EB17, EB13	Interior storage design and layout	Cupboards too high or low and deep cabinets force reaching or deep bending, especially for seasonal storage/cleaning.	A26, A5, A4, A33
EB25, EB21	Load-handling and parcel logistics	Routes for carrying groceries or parcels are long and segmented, with distant lockers and no resting or trolley support.	A4, A23, A12
EB26, EB27	Home internet and digital interface design	Connections feel unstable and app interfaces confusing; older adults fear “pressing the wrong button” and cannot read small text.	A17, A41

Barrier code	Environmental evidence for policy direction	Paraphrased from interviews	Key activities affected
EB29, EB23	External mobility and public transport interface	Wayfinding is unclear, and crowded, fast-moving flows at stops and doors make it hard to follow the pace.	A11, A38
EB28, EB20, EB04	Thermal and (semi-)outdoor environmental conditions	Winter bathrooms and balconies are very cold; hot water and wet, slippery tiles increase discomfort and fall concerns.	A33, A5, A32, A8
EB20, EB30	Access to restorative outdoor/pet-friendly micro-spaces	Residents would like to garden or keep pets but feel there is no suitable or neighbor-friendly place to do so.	A8, A3

Source: Data and Author's Calculation

Hidden barriers

For each activity instance with an observed barrier score ($n = 226$), self-rated performance and satisfaction from Step 2 were explained parallelly with observer-rated environmental impact from Step 3, rather than treating these as equivalent scales. Self-ratings were used as indicators of how well older adults felt they managed an activity, while barrier scores indexed how strongly the home environment constrained that performance. For every activity, the most constraining barrier score was used to classify observed impact into three tiers: assistance needed (any barrier scored 1-3), standby support / safety risk or extreme effort (any barrier scored 4), and independent (all barriers scored 5). In Table 5, 86 instances (38.1%) required some assistance, and 139 instances (61.5%) involved standby support or safety risk, yet within these constrained tiers 38.4-59.7% of activities were still rated as high performance (≥ 4), and 25.6-43.9% as high satisfaction. Overall, 51.3% of constrained activities were self-rated as high performance and 36.7% as high satisfaction, indicating that a substantial share of environmental constraints would remain partially hidden if assessment relied on self-report alone.

Table 5: Self-rated outcomes by observed impact tiers ($n = 226$ activity instances)

Barrier score based on observed activities	n instances	% with high performance (≥ 4)	% with high satisfaction (≥ 4)
Assistance needed (any barrier scores 1-3)	86	38.4	25.6
Standby / safety risk or extreme effort (any barrier score =4)	139	59.7	43.9
Independent with/without device (all barrier scores =5)	1	100	100

Source: Data and Author's Calculation

Discussion

This study shows that the difficulties older adults face when aging in place in high-density apartments are concentrated in a limited set of recurring daily activity chains and are shaped by both domestic and external environmental conditions. First, difficulties in high-density housing are often chain-like. The high frequency of barriers related to storage height, depth, and low-level retrieval reflects the importance of storage, retrieval, and cleaning to the organization of compact homes. When these constraints intersect with carrying activities, individually minor obstacles can accumulate into substantial recurring burdens (Cha, 2025; Sheth & Cogle, 2023). Although home modifications often emphasize fall prevention and physical safety, long-term adaptation, individualized contexts, and technological interventions receive less attention (Cha, 2025; Sheth & Cogle, 2023). Therefore, interventions should support the continuity of everyday activity chains rather than address isolated spatial features.

Second, external mobility systems formed an important barrier category. Aging in place does not occur only within the dwelling but across connections among the home, building, community, and city. Older adults may experience transportation inequalities and psychological stress in everyday travel (Jahangir et al., 2022), while declining mobility can progressively reduce independence (Dilian et al., 2025). Barriers such as absent ramps, long walking or waiting times, and unavailable station information can restrict public-transport use (Mwaka et al., 2024). The present findings therefore position external mobility barriers as part of aging in place itself, rather than as separate transport problems. Planning should address neighborhood circulation, short-distance mobility, and usable public-transport interfaces as connected supports for everyday living.

Third, digital media use was a high-frequency difficulty, showing that digital systems are embedded in daily errands, communication, service access, and information management. The observed usability barriers should not be attributed solely to individual inadequacy. Older adults' digital engagement is also shaped by self-efficacy, technology anxiety, perceived usefulness, and digital-risk perceptions (Aleti et al., 2025; An et al., 2024; Zian Fang et al., 2024). Together with participants' interview accounts, the observed interface difficulties suggest that essential daily activities increasingly depend on digital systems. When interfaces offer limited opportunities for low-cost trial, error, and recovery, technology can shift from support to burden. Age-friendly planning and service guidance should therefore treat usability and error recovery as components of everyday infrastructure. Figure 1 synthesizes three recurring activity-environment chains identified across the observed barrier patterns and interview accounts.

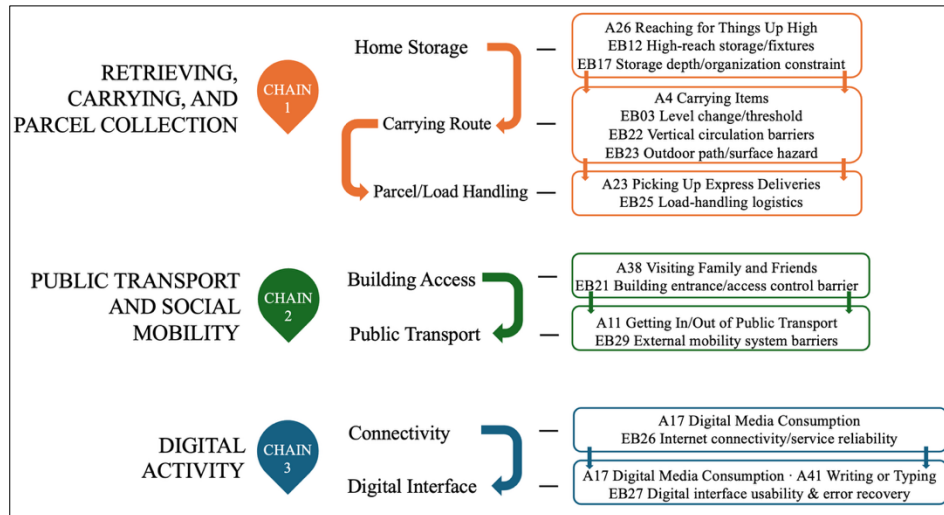


Figure 1: Activity-environment Chains

Source: Author's Drawing

Fourth, the key finding is not that most barriers were severe, but that many activities remained apparently manageable while involving safety risks, standby assistance, or extreme effort. Such conditions may be treated as minor when assessment focuses only on task completion, visible accidents, or minimum accessibility thresholds. However, for older adults, continued completion may require greater physical effort, time, and risk tolerance. This represents constrained or forced adaptation rather than an absence of environmental difficulty. The coexistence of high self-rated performance with observed constraints shows how reliance on self-report alone may normalize difficult conditions and underestimate threats to the sustainability of independent living. Therefore, more rigorous, multi-source evidence is needed to reduce bias in planning decisions (Ravensbergen & El-Geneidy, 2023).

The study's potential transferability lies in these recurring patterns: linked constraints across activity chains, dependence on interfaces beyond the dwelling, and high self-rated performance despite observed environmental barriers. These patterns may be relevant to high-density housing contexts where residents' functional profiles, housing layouts, shared circulation systems, and dependence on transport and digital services are comparable. This conditional relevance is consistent with a capability-oriented understanding of aging in place across home and neighborhood environments (Bigonnesse & Chaudhury, 2022). Malaysian strata-housing research similarly identifies housing features, the wider housing environment, and technology as relevant domains (Azmi et al., 2021), providing a basis for contextual comparison but not evidence of identical barriers.

The sample's relatively preserved IADL functioning and predominance of elevator-served apartments further limit direct extrapolation. Therefore, local activity priorities, climate, family support, management arrangements, and service systems must be reassessed before applying the findings elsewhere.

Implications for Urban and Housing Planning

Broad principles of accessibility, safety, and inclusion do not indicate which activities, spaces, and interfaces should receive priority in high-density housing. Activity-based evidence can make these priorities more specific and reduce assumptions in planning decisions (Ravensbergen & El-Geneidy, 2023). The findings suggest coordinated action at five levels.

At the unit level, retrofit priorities should address high- and low-reach storage, deep cabinets, level changes, inadequate lighting, unsuitable transfer surfaces, and bathing conditions. Interventions should support activity chains such as retrieving, carrying, cleaning, and bathing rather than isolated physical features. At the building level, vertical circulation, entrances, and load-handling routes should be planned as connected elements. Elevator access, manageable doors and thresholds, and resting or trolley support between dwellings, entrances, and parcel points can reduce the accumulated burden of leaving home and carrying items. At the estate level, barrier-free walking routes should connect entrances with communal spaces, parcel facilities, neighborhood services, and transport. Path continuity, surfaces, lighting, resting opportunities, and access arrangements require attention because interruptions can undermine otherwise accessible dwellings and buildings. At the digital-interface level, stable connectivity should be accompanied by readable displays, clear feedback, simple navigation, and error-recovery options. Assisted or alternative channels are needed when essential tasks cannot be completed digitally. Digital usability should be treated as everyday service infrastructure rather than solely an individual skill issue. At the transport-interface level, routes to stops, waiting conditions, wayfinding, service information, and boarding accessibility should be evaluated together. Planning should consider whether older adults can complete the journey from the dwelling to essential destinations rather than assessing vehicles, stops, and pedestrian routes separately.

Across these levels, performance-based assessments can complement compliance checklists by revealing where apparently independent activity still involves excessive effort or safety risk. Planners, housing authorities, estate managers, transport providers, and digital-service designers can use this evidence to set local priorities and evaluate activity continuity.

CONCLUSION

In summary, this study demonstrates how micro-level activity evidence can optimize macro-level aging in place policies in China's high-density apartment environments. Using performance-oriented home assessments combined with unstructured interviews, the study found that older adults most frequently cited key aspects of daily life. Difficulties with digital media use, public transportation, carrying items, and bathing were listed as priorities. Within these activity chains, compact layouts and systemic constraints amplify minor frictions into recurring burdens. Crucially, participants tended to rate their performance and satisfaction relatively well, yet many limitations were still observed. This discrepancy suggests that relying solely on self-reporting may normalize limitations and underestimate potential barriers crucial for long-term autonomy and security. The findings indicate that aging-in-place policies should shift from checklist-based upgrades to an activity chain-based approach. Priorities should include accessibility of carrying; digital availability and recovery as part of daily infrastructure; connectivity between the home, community, and urban interface. Although the study was conducted in China, its contribution extends to other high-density Asian urban contexts with similar structural housing conditions, including compact apartment layouts, standardized residential forms, ageing building stock, and growing reliance on community facilities, public transport, and digital services in everyday life. These shared conditions are increasingly visible across high-density Asian cities such as those in Malaysia, where ageing in place is also being discussed through strata housing, age-friendly neighborhoods, and the interrelated roles of housing environment, accessibility, and technology.

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