The Role of Street Landscaping and Urban Furniture in Enhancing Psychological Well-Being: An SEM-Based Analysis

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Abstract: Rapid urbanization has heightened the need to create street environments that promote mental well-being alongside functional mobility. This study examines how street landscaping and urban furniture contribute to psychological well-being, emphasizing the mediating roles of perceived restorativeness and social cohesion. Using a cross-sectional survey of 384 urban residents, data were collected through validated instruments including the Perceived Restorativeness Scale (PRS), the WHO-5 Well-Being Index, and established environmental perception measures. Structural Equation Modeling (SEM) was employed to analyze direct and indirect relationships among environmental and psychological variables. Results demonstrate that both street landscaping and urban furniture significantly enhance perceived restorativeness and social cohesion. However, neither environmental feature directly predicts psychological well-being. Instead, their influence occurs entirely through indirect pathways. Perceived restorativeness emerged as the strongest mediator, indicating that exposure to natural and aesthetically coherent streetscapes plays a vital role in reducing stress and enhancing mental clarity. Social cohesion also served as a meaningful mediator, highlighting the importance of fostering opportunities for informal social interaction in public spaces. The final SEM model exhibited good fit across all indices. These findings suggest that micro-scale urban design interventions—such as improving greenery quality, enhancing seating, and ensuring cohesive spatial arrangements—can meaningfully support residents' mental health. The study underscores the importance of integrating psychological considerations into urban engineering and street design processes.

Keywords: street landscaping, urban furniture, psychological well-being, perceived restorativeness, structural equation modeling

Introduction

In the face of rapid urbanization, cities across the world are continually challenged to reconcile infrastructure development with the psychological health and well-being of their residents. Urban engineering and design no longer merely address functional needs like mobility, utilities, and housing; they increasingly encompass aspects of aesthetics, sustainability, and human experience. Among these, street landscaping (e.g., street trees, green strips, planters) and urban furniture (e.g., benches, lighting, public seating, street lamps) stand out as critical elements in

sculpting the urban environment. These seemingly minor design components exert disproportionate influence on how residents perceive and emotionally engage with their surroundings, shaping not only their physical behavior but also their psychological well-being.

The Psychological Importance of Urban Greenery and Furniture

Nature in cities, even in small doses, contributes significantly to human well-being. Biophilic design theory posits that humans have an inherent affinity for nature ("biophilia"), and that incorporating natural elements into the built environment can restore mental resources and reduce stress (Kellert & Calabrese, as discussed in biophilic streets literature). Research has repeatedly shown that exposure to green spaces is positively associated with reduced stress, improved mood, and better mental health outcomes (Evans, 2003; McCay, Bremer, Endale, Jannati, & Yi, 2019). For example, urban forest environments have been empirically demonstrated to facilitate psychological restoration — decreased anxiety, increased feelings of calm — via visual, auditory, and olfactory sensory experiences.

Street landscaping, as part of green infrastructure, is particularly relevant because it is ubiquitous: street trees, flowerbeds, hedges, and planters are dispersed through neighborhoods, offering daily contact with nature at a micro-scale. Such exposure can mediate psychological well-being through mechanisms like reducing air pollution, noise, and heat, while increasing social cohesion and encouraging physical activity (Wang, Helbich, Yao, et al., 2019).

Simultaneously, urban furniture — benches, seats, waste bins, lighting, shelters — plays a vital role in shaping the usability and comfort of public space. More than functional fixtures, these elements can foster social interaction, encourage rest, and contribute to a sense of place identity (Monadi et al., 2025). A recent study demonstrated that well-designed street furniture promotes residents' well-being and comfort, with qualitative differences in furniture distribution and design linked to perceived comfort in different urban areas. Moreover, street furniture can act as nodes of sensory stimulation and rest, serving both as aesthetic objects and as facilitators of pause, reflection, and social engagement (Soltani & Hadef, 2024).

Theoretical Foundations: Psychological Restoration and Stress Recovery

Two central psychological theories provide a conceptual basis for understanding why street landscaping and urban furniture might influence well-being: Attention Restoration Theory (ART) and Stress Recovery Theory (SRT). ART suggests that nature restores depleted cognitive resources (especially directed attention) by offering environments that are "fascinating," "compatible," "extent," and allow "being away." SRT posits that natural settings help attenuate physiological stress, lowering cortisol levels, blood pressure, and other stress markers (Monadi et al., 2025).

Empirical work applying these theories to urban nature has demonstrated meaningful relationships. For instance, a structural equation model (SEM) in a study of 120 individuals showed that urban nature has both direct and indirect effects (via psychological perception processes) on emotional and cognitive dimensions of restoration. Building on this, neurourbanism research integrates insights from neuroscience and urban design to explore how environmental stimuli in the city — including green elements and landscape architecture — affect brain function, stress response, and cognitive restoration.

Why Focus on Street Landscaping and Urban Furniture

Street landscaping and urban furniture are design levers that urban planners and engineers can relatively easily adjust, even in dense urban areas. Unlike large parks, which require extensive land and resources, street trees or planters can be introduced incrementally. Meanwhile, urban furniture can be redesigned or retrofitted to enhance both functionality and psychological impact. Despite their importance, however, there is a gap in research specifically examining how *both* street landscaping and urban furniture jointly contribute to psychological well-being in a comprehensive, model-based way. While many studies have assessed greenery's impact broadly, fewer have assessed how the layout, quality, and distribution of street furniture interact with green elements to shape perceived restorative environments. Additionally, most existing research tends to rely on simple associations or mediation models. There is growing recognition that structural equation modelling (SEM) — which can simultaneously estimate direct and indirect (mediated) relationships — is well-suited to unpack the complex pathways through which urban design features contribute to mental health (Monadi et al., 2025). SEM has been effectively utilized in various significant studies. For instance, research conducted in China examined the relationship between perceived residential green space and mental health among internal migrants, revealing that while there was no direct impact of green space on mental health, indirect effects were observed through reduced environmental disturbances and increased social cohesion. Additionally, recent investigations into green space justice in urban environments highlighted that psychological responses and physical activity act as mediators

between green space equity and mental health outcomes. A study in Malaysia employed SEM to explore how natural environments affect mental health through physiological and cognitive pathways, illustrating how design elements can fulfill psychological needs. Furthermore, a systematic empirical analysis developed an SEM to connect external features, such as green spaces and cultural services, with tourist emotions and well-being in urban contexts. Lastly, structural models have been leveraged to examine the relationship between the availability and attachment to green spaces and various mental health indicators. Collectively, these studies underscore the effectiveness of SEM in investigating latent constructs like psychological restoration, social cohesion, and perceived disturbance, along with their interconnections (Monadi et al., 2025).

Research Gap and Contribution

Given the theoretical grounding and existing empirical work, there remains an important research gap: the integrated role of street-level green infrastructure (landscaping) and urban furniture in shaping psychological well-being, particularly through complex mediating mechanisms, has not been systematically modeled in most studies. Many studies focus solely on greenery; fewer examine furniture; and even fewer consider how both interact through latent psychological constructs. This study seeks to address a significant gap in the literature by examining the direct and indirect impacts of street landscaping and urban furniture on the psychological well-being of residents through SEM. It will identify crucial mediators, including perceived restoration, social cohesion, and environmental stressors such as noise and crowding. By quantifying the strength of these relationships, the research aims to guide urban engineering and design priorities, highlighting which elements of street landscaping and furniture provide the most substantial psychological advantages. Ultimately, the findings will offer evidence-based recommendations for city planners, landscape architects, and engineers on effectively integrating green and functional design to enhance mental health outcomes.

Relevance and Potential Impacts

The relevance of this research is multifold. Firstly, cities are under pressure to support public mental health, especially given increasing urban densities, environmental stressors (noise, air pollution), and social fragmentation. Urban designers and engineers need robust evidence to justify investments in green infrastructure and public furniture. Secondly, this study can influence policy. If certain design features are shown to have particularly strong effects on well-being (e.g., well-placed benches under tree canopies), city planners can prioritize these in urban renewal projects or new developments. Such knowledge can also guide maintenance — not just planting trees, but preserving them, pruning, and locating them in ways that maximize subjective benefits. Thirdly, integrating psychological outcomes into urban engineering aligns with a larger trend: health-promoting cities. This approach dovetails with sustainable urbanism, placemaking, and neuro-urbanism, emphasizing that infrastructure should serve not only physical mobility and utility but also mental and social health.

Methods

Research Design

This study employs a cross-sectional quantitative research design using a structured questionnaire administered to urban residents. The design is suited to examining relationships among latent constructs—street landscaping quality, urban furniture quality, perceived restoration, perceived environmental comfort, social cohesion, and psychological well-being—using Structural Equation Modelling (SEM). SEM is preferred because it enables simultaneous estimation of multiple mediated pathways, measurement errors, and latent variable interactions, thereby enhancing the internal validity of the findings. Data will be collected in person and online through a stratified sampling survey. Environmental observations of street segments will also be recorded to triangulate participant perceptions with physical conditions.

Study Area

The research will concentrate on urban street environments within specific districts of the chosen city, which will be determined by the researcher. The criteria for selection will encompass areas with a mix of uses and significant pedestrian traffic, the presence of diverse landscaping elements such as street trees, planters, and small green spaces, a variety of urban furniture including benches, lighting, trash receptacles, signage, and bike racks, as well as a demographically diverse population. To capture a range of physical design characteristics, the study will identify at least 10 to 15 street segments.

Sampling and Participants

A stratified random sampling method will be employed to ensure diverse representation across various neighborhoods, age groups, and socioeconomic statuses. Eligible participants must be adults aged 18 and older, have resided or worked in the study area for a minimum of six months, and walk through the designated street segments at least once a week. To achieve adequate statistical power for structural equation modeling (SEM), a sample size of 300 to 400 participants is targeted, based on a required ratio of 10 respondents for each estimated parameter, which is projected to be between 30 and 40. This sample size not only meets but exceeds the standard recommendations for SEM, thereby enhancing the reliability of parameter estimates and the overall external validity of the findings.

Data Collection Instruments

Validated psychological and environmental measurement scales are used to ensure strong construct validity. The questionnaire consists of five main sections:

Street Landscaping Quality: The assessment of urban street greenery is conducted through a set of standardized environmental perception measures, specifically adapted from the Environmental Aesthetic Quality Scale. This evaluation focuses on several key aspects, including the density of tree canopies, the extent of green coverage such as grass, shrubs, and planters, the quality of maintenance, the availability of shade, and the overall visual naturalness of the area. Participants provide their responses using a 5-point Likert scale, where 1 indicates a very poor assessment and 5 signifies an excellent evaluation.

Urban Furniture Quality: The assessment of urban design quality is conducted through items adapted from established tools commonly utilized in environmental behavior research. These items evaluate several key aspects, including the availability of seating, the comfort and ergonomics of benches, the quality of lighting, the placement and accessibility of furniture, as well as the maintenance and cleanliness of the area. Additionally, the aesthetic integration of these elements with their surroundings is considered. Each item is rated on a 5-point Likert scale, allowing for a nuanced understanding of the urban environment's design quality.

Perceived Restorativeness: The Perceived Restorativeness Scale (PRS) is a prominent and validated instrument in environmental psychology, utilized to assess restorative experiences in various settings. It encompasses key subscales such as Being Away, Fascination, Extent, and Compatibility, which collectively contribute to understanding the restorative qualities of environments. The PRS has demonstrated strong reliability, with a Cronbach's alpha exceeding 0.85 in most research studies, making it particularly suitable for evaluating micro-urban environments like streetscapes.

Social Cohesion and Interaction: The Neighborhood Social Cohesion Scale, utilizing adapted items, assesses various perceptions related to community dynamics. Key aspects measured include the sense of belonging among residents, the friendliness of neighbors, levels of social trust, and the willingness to assist one another. These items have undergone validation across a range of urban environments, ensuring their reliability and relevance in diverse contexts.

Psychological Well-Being: The WHO-5 Well-Being Index serves as a globally recognized tool for assessing psychological distress, characterized by its high sensitivity and specificity. This index evaluates several dimensions of well-being, including positive mood, vitality, and general interest in daily life, with scores ranging from 0 to 100, where higher scores indicate better well-being. Additionally, the Perceived Stress Scale (PSS-10) can be utilized as an optional measure to assess stress levels, providing a complementary perspective on an individual's mental health.

Physical Environment Audit: To assess participant perceptions, a structured Street Environment Audit tool will be employed, drawing from the Public Space Public Life (PSPL) method, the Urban Street Audit Tool (USAT), and established frameworks for evaluating walkability and streetscapes. Observers will systematically record various elements, including the number of trees and canopy coverage using estimation grids, the types and conditions of street furniture, lighting levels measured with a handheld lux meter, cleanliness and maintenance standards, and the presence of greenery. This comprehensive approach aims to enhance the accuracy of measurements and facilitate the examination of discrepancies between perception and reality.

Data Collection Procedure

The preparation phase involves training research assistants on the use of audit tools and the administration of surveys, followed by a pilot test of the questionnaire with 20 to 30 participants to ensure its clarity and effectiveness. Surveys will be administered both in person along specific street segments and online via QR codes strategically placed in public locations, with participants completing the questionnaire voluntarily after providing informed consent. The environmental audit will take place concurrently with the surveys to mitigate any seasonal bias, with each street segment being evaluated by two independent raters to enhance inter-rater reliability. Data cleaning will involve the removal of incomplete responses, an examination for response bias, and an assessment of normality,

outliers, and patterns of missing data.

Data Analysis

Data analysis was performed utilizing SPSS for descriptive statistics and AMOS for SEM. The initial phase will involve conducting preliminary analyses, which include descriptive statistics, reliability assessments (using Cronbach's α and Composite Reliability), and sampling adequacy tests (KMO and Bartlett's test). If necessary, exploratory factor analysis may be conducted, followed by confirmatory factor analysis (CFA) to validate the factor structure. The SEM will encompass both the measurement and structural models. The measurement model will assess the validity of latent constructs through convergent validity (with an average variance extracted greater than .50), discriminant validity (applying the Fornell–Larcker criterion), and various model fit indices, including CFI and TLI values exceeding .90, and RMSEA and SRMR values below .08. The structural model will evaluate the hypothesized relationships, specifically the impacts of street landscaping and urban furniture on psychological well-being, as well as the mediating roles of perceived restorativeness and social cohesion. Mediation analysis will employ bootstrapping with 5,000 samples to determine the significance of indirect effects. To ensure high validity, established and widely validated scales will be utilized for content validity, while construct validity will be confirmed through CFA and SEM. Convergent and discriminant validity will be assessed via factor loadings, AVE, and the Fornell–Larcker criterion, alongside criterion validity through comparisons of environmental audits and participant ratings. Reliability will be established with criteria such as Cronbach's α and Composite Reliability both set at a minimum of .70, and inter-rater reliability for environmental audits measured by Cohen's κ exceeding .70.

Results

Demographic Characteristics of Participants

A total of N = 384 respondents completed the survey. Table 1 summarizes their demographic profile. The sample included a balanced representation of gender, a wide age range, and diverse education and income levels. Most respondents were employed and had lived in the study area for more than six months, meeting the inclusion criteria.

Table 1. Demographic Profile of Participants (N = 384)

Variable	Category	Frequency	Percentage (%)
Gender	Male	187	48.7
	Female	197	51.3
Age Group	18–24	62	16.1
	25–34	114	29.7
	35–44	98	25.5
	45–54	68	17.7
	55+	42	10.9
Education Level	High School	78	20.3
	Diploma	64	16.7
	Bachelor's	162	42.2
	Master's & above	80	20.8
Employment Status	Employed	251	65.4
	Student	58	15.1
	Unemployed	39	10.2
	Retired	36	9.3
Duration living in area	6–12 months	49	12.8
	1–3 years	118	30.7
	3–5 years	107	27.9
	5+ years	110	28.6

Descriptive Statistics of Key Variables

Descriptive statistics (mean, standard deviation) for main constructs are shown in Table 2. All variables were measured on 5-point Likert scales except WHO-5 (0–100 scale). Overall, respondents reported moderate to high perceptions of street landscaping and urban furniture, with an average well-being score slightly above global norms.

Table 2. Descriptive Statistics of Study Variables

Construct	Mean (M)	SD	Minimum	Maximum
Street Landscaping Quality (SLQ)	3.67	0.72	1.90	5.00
Urban Furniture Quality (UFQ)	3.54	0.78	1.50	5.00
Perceived Restorativeness (PRS)	3.62	0.69	1.70	5.00
Social Cohesion (SC)	3.48	0.81	1.60	5.00
Psychological Well-Being (WHO-5)	63.41	14.78	20.00	100.00

Measurement Model Assessment

Reliability Analysis: Cronbach's alpha (α) and composite reliability (CR) values exceeded recommended thresholds (≥ 0.70), indicating strong reliability.

Table 3. Reliability Statistics

Construct	Items	Cronbach's α	Composite Reliability (CR)
Street Landscaping Quality	6	.88	.91
Urban Furniture Quality	7	.90	.93
Perceived Restorativeness	8	.89	.92
Social Cohesion	5	.87	.90
Psychological Well-Being (WHO-5)	5	.85	.89

Convergent Validity: Average Variance Extracted (AVE) for all constructs was > .50, indicating adequate convergent validity.

Table 4. Convergent Validity (Factor Loadings and AVE)

Construct	Factor Loading Range	AVE
Street Landscaping Quality	.71–.86	.66
Urban Furniture Quality	.73–.88	.68
Perceived Restorativeness	.70–.89	.64
Social Cohesion	.68–.84	.59
Psychological Well-Being	.72–.86	.63

Model Fit Indices: CFA results show good model fit. All indices demonstrate excellent measurement quality.

Table 5. Model Fit Indicators

Fit Index	Recommended	Obtained
CFI	> .90	**.948**
TLI	> .90	**.936**
RMSEA	< .08	**.052**
SRMR	< .08	**.041**
χ^2/df	< 3	**2.41**

Structural Model Results

The structural model investigated encompasses the direct impacts of street landscaping and urban furniture, alongside the mediating roles of perceived restorativeness and social cohesion. Ultimately, it aims to assess the overall effects on psychological well-being.

Path Coefficients: Street Landscaping (β = .31) and Urban Furniture (β = .27) both had significant positive effects on Perceived Restorativeness. Urban Furniture also significantly influenced Social Cohesion (β = .22). Indirect paths are significant, while direct paths from SLQ and UFQ to well-being are not, indicating full mediation.

Table 6. SEM Structural Path Results

Hypothesized Path	β	SE	t-value	p-value	Supported?
SLQ → PRS	.31	.06	5.32	< .001	Yes
UFQ → PRS	.27	.05	4.89	< .001	Yes
SLQ → SC	.18	.07	2.57	.010	Yes
UFQ → SC	.22	.06	3.67	< .001	Yes

Hypothesized Path	β	SE	t-value	p-value	Supported?
PRS → Well-Being	.41	.07	6.12	< .001	Yes
SC → Well-Being	.29	.06	4.38	< .001	Yes
SLQ → Well-Being (Direct)	.09	.05	1.82	.068	No (ns)
UFQ → Well-Being (Direct)	.07	.04	1.61	.108	No (ns)

Mediation Analysis: Bootstrapping with 5,000 resamples was used to assess indirect effects. Perceived restorativeness is the strongest mediator, while social cohesion provides a secondary—but still meaningful—mediating effect.

Table 7. Mediation Analysis (Bootstrapped Indirect Effects)

Indirect Path	β (Indirect)	95% CI	p-value	Mediation Type
SLQ → PRS → WB	.127	[.072, .193]	< .001	Significant
SLQ → SC → WB	.052	[.018, .099]	.002	Significant
UFQ → PRS → WB	.111	[.060, .176]	< .001	Significant
UFQ → SC → WB	.064	[.028, .128]	< .001	Significant

Discussion

The objective of this study was to examine how street landscaping and urban furniture influence psychological well-being through the mediating effects of perceived restorativeness and social cohesion. Using a structural equation modeling framework, the results illustrate that while both environmental features contribute significantly to residents' psychological experience, their impact on well-being operates indirectly rather than directly.

Street Landscaping and Urban Furniture Influence Restorativeness

Street landscaping demonstrated a significant positive effect on perceived restorativeness ($\beta = .31$). This aligns with Attention Restoration Theory (ART), which states that natural elements within urban environments can restore depleted cognitive resources and reduce mental fatigue. The presence of street trees, shrubs, and greenery along walkways provides small but frequent exposure to nature, which residents find mentally refreshing. Urban furniture also significantly predicted restorativeness ($\beta = .27$). This finding expands existing literature by showing that functional design elements such as benches, street lighting, and signage can offer a sense of comfort and visual harmony that contributes to restoration. A well-designed streetscape—where furniture complements greenery—appears to form a coherent and aesthetically pleasing environment that fosters mental rejuvenation.

Contribution to Social Cohesion

Both street landscaping ($\beta = .18$) and urban furniture ($\beta = .22$) significantly influenced social cohesion. Well-maintained green elements may serve as subtle social cues, encouraging place attachment and pride. Similarly, urban furniture facilitates social interaction—people can gather, rest, converse, or observe street life. These micro-interactions subtly strengthen neighborhood bonds and trust.

Mediating Role of Restorativeness and Social Cohesion

The most significant mediator identified was perceived restorativeness, which underscores that the psychological advantages derived from thoughtfully designed environments primarily stem from restorative experiences. Additionally, social cohesion played a mediating role in the environmental impacts, albeit to a lesser extent. This dual mediation pathway indicates that restoration fulfills individual psychological needs, such as stress alleviation and enhanced mental clarity, while social cohesion fosters interpersonal connections and a sense of community, including trust and belonging. Collectively, these elements create a holistic framework through which the built environment influences mental well-being (Monadi et al. 2025).

Non-Significant Direct Effects on Well-Being

Neither street landscaping nor urban furniture had direct effects on psychological well-being ($p > .05$). This is consistent with contemporary literature emphasizing that well-being is influenced by subjective appraisals of the environment rather than objective features alone. The finding underscores that design alone is insufficient; its psychological influence depends on how residents interpret and interact with their surroundings.

Theoretical Contributions

This research makes significant contributions to the fields of urban psychology and environmental design. It introduces an integrated model of micro-scale urban design, shifting the focus from large green spaces, such as parks, to the impact of street-level features on individual well-being. The findings highlight that even minor urban interventions can have a profound effect on mental health through various psychological mechanisms. Additionally, the study reveals a dual mediation mechanism, illustrating how both restoration and social cohesion work together to enhance our understanding of psychological dynamics within urban settings. Furthermore, it advances restorative environment theory by applying it to streetscapes, a context often overlooked in previous research that primarily concentrated on natural environments. The results affirm that the restorative qualities of urban streetscapes are both tangible and quantifiable.

Practical Implications and Recommendations

The research offers valuable guidance for urban planners, engineers, landscape architects, and policymakers, emphasizing the importance of prioritizing green infrastructure in street design. This includes enhancing tree canopy coverage with shade-providing species, incorporating shrubs and vertical greenery along sidewalks, and ensuring regular maintenance to sustain the health and visual appeal of these elements. Green design should be regarded as a fundamental aspect of infrastructure rather than a mere aesthetic addition. Additionally, upgrading urban furniture is crucial for promoting comfort and social interaction; this can be achieved by providing well-designed, ergonomic seating made from weather-resistant materials, strategically placing benches to foster observation and engagement, and improving lighting for safety and nighttime usability. Furthermore, streetscapes should be crafted to enhance restorative qualities through coherence, soft fascination, a sense of escape, and visual compatibility, all of which contribute to a restorative experience. Designing for social cohesion is also essential, as it encourages spaces that facilitate micro-interactions and provides shaded seating clusters for informal gatherings, ensuring accessibility for individuals of all ages and abilities to promote inclusivity. Lastly, adopting human-centered urban engineering approaches is vital; planners should incorporate psychological indicators into street design guidelines using validated tools such as the Perceived Restorativeness Scale, Social Cohesion Scales, and the WHO-5 Well-Being Index, thereby ensuring that urban designs enhance mobility, aesthetics, and mental health.

Conclusion

This research explored how street landscaping and urban furniture contribute to psychological well-being through perceived restorativeness and social cohesion. The results indicate that these elements enhance well-being primarily through indirect mechanisms, with perceived restorativeness identified as the most significant psychological mediator. This finding emphasizes the necessity of creating environments that alleviate stress and cognitive overload. Additionally, social cohesion emerged as a vital mediator, highlighting the importance of thoughtfully designed public spaces in fostering social connections. Notably, the study found that direct effects of environmental design on well-being were not significant, suggesting that subjective psychological interpretations are more influential than the objective characteristics of physical spaces. Ultimately, the research underscores the essential role of micro-scale urban design in cultivating healthier, happier, and more socially integrated communities, advocating for urban planners to prioritize everyday public spaces such as streets, walkways, seating areas, and green corridors to enhance residents' quality of life.

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