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Does One Size Fit All? Well-Being Environmental Assessment Criteria in Low- And Middle-Income Aging Communities in Thailand

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ABSTRACT

The effectiveness of well-being environment assessment criteria for aging communities in diverse contexts, particularly in developing countries, remains underexplored. This study aimed to fill this gap by employing Thailand Well-Being Environment and Age-Friendly Communities criteria to assess the living environment of 15 low- and middle-income aging communities in Thailand and determine their well-being status. The results of the overall quantitative assessment showed an average score of 60.78/100. Findings indicated high scores in categories such as healthy food environment, community open space, community asset, and street lighting, indicating a strong foundation for the well-being of low- and middle-income communities. Medium-scoring categories like housing, air quality, drinking water quality, and heat mitigation showed varied results, indicating the need for targeted interventions. Conversely, low scores were found in the categories of roads and sidewalks, public transportation, and noise mitigation, indicating to a critical gap in infrastructure for older people. Considering the scores for each main category, it was found that only the heat mitigation category showed a statistically significant difference between urban and rural areas. However, a deeper qualitative analysis by local experts revealed that 24 indicators in urban contexts, across three categories (housing, roads and sidewalks, and public transportation), were not aligned with the reality of rural contexts, underscoring the ineffectiveness of the "one size fits all" approach. This study highlights the need for context-specific criteria to guide targeted policy and resource allocation to improve the quality of life for older people.

Keywords: older people, community assessment, well-being environment, developing country, urban and rural communities

INTRODUCTION

The global population is currently aging, a fact that, given the potentially significant repercussions of frailty, a gerontological health condition associated with aging, necessitates that solutions for the senior demographic be established. Once such solution is better aging-in-place infrastructure (Li et al., 2022). In developing countries such as Brazil, India, Iran, Malaysia, Vietnam, and Thailand where a majority of the population living in low- and middle-income communities, many older individuals inhabit urban areas; conversely, in several other countries, a growing proportion of the older people reside in rural and remote communities (World Health Organization, 2023). Evaluations the well-being conditions of people in low- and middle-income communities are therefore crucial, as these populations frequently encounter numerous obstacles, including poverty, environmental concerns, limited access to healthcare, restricted access to essential services, inadequate health, and social inequalities (Larimian et al., 2025). Assessing the quality of life in these communities enables us to formulate tools to enhance their living conditions. It also facilitates investigation of inequalities between groups, such as those in urban vs. rural areas.

Assessment criteria and guidelines for promoting health in communities have been established globally. In the U.S., these are often aligned with the WELL Community Standard (International Well Building Institute, 2020) and Fitwel Community (Center for Active Design, 2020) aiming to improve health benefits in neighborhood projects. The BREEAM Community in the UK (BREEAM Assessment UK, n.d.) emphasizes ecological footprints and community health through amenities like green spaces. Japan's CASBEE for Urban Development (Japan Sustainable Building Consortium and Institute for Building Environment and Energy Conservation, n.d.) evaluates the environmental performance of buildings with a focus on human effort, and Singapore's Environment Audit Toolkit (MOHT Office for Healthcare Transformation, 2022) explores the interaction between inhabitants and their built environment to assess health-related behaviors and outcomes. However, international criteria lack specificity for communities with older populations. Environmental evaluation standards must incorporate indicators consistent with the contexts of developing countries. Crucially, existing research has been fragmented, largely focusing on developed countries whose infrastructure and governance frameworks significantly differ from those in developing countries. There is a distinct lack of comprehensive, quantitative assessments comparing overall environmental quality between urban and rural settings in these rapidly aging, low- and middle-income communities, though planning and design for individuals with specific needs can yield benefits for everyone (Haglund et al., 1996). Despite various initiatives to create well-being and age-friendly communities, little has been done to formally evaluate the effectiveness of these efforts. Toward addressing this gap, this study employed the Thailand Well-Being Environment and Age-Friendly Communities assessment criteria (ThaiWBAFC), the first comprehensive assessment tool in the Thai context that meticulously integrates global guidelines from the WELL Community, Fitwel Community, and WHO Age-Friendly Community (AFC). Critically, This study employs the Analytic Hierarchy Process (AHP) for weighting indicators, a robust methodological strength ensuring the scores reflect the relative importance of local needs.

Even after its creation, however, the ThaiWBAFC remained untested in real-world contexts. This study aimed to address this through three objectives: (1) assess the quality of community environmental components in 15 low- and middle-income aging communities across Thailand using the ThaiWBAFC criteria, (2) identify significant differences in environmental factors between urban and rural communities, and (3) examine contextual limitations and potential measurement biases of the ThaiWBAFC to inform its practical and policy applications. The findings are expected to provide a foundation for policy planning and local development, enabling authorities and stakeholders to better address the needs of aging populations across diverse geographical contexts. Guided by these objectives, this study posed three research questions: (1) What is the current status and performance of environmental well-being (ThaiWBAFC scores) in these aging communities? (2) Are there statistically significant differences between urban and rural communities? and (3) What are the contextual limitations or measurement biases of the ThaiWBAFC across diverse urban and rural settings?

LITERATURE REVIEW

A review of previous literature revealed that most researchers have focused on developing tools to assess environmental factors that promote well-being or independent living for older people, with an emphasis on evaluating each aspect separately. These tools have been used to assess communities in diverse contexts. Research from Korea (Lee, 2022) used the Senior Park Environment Assessment in Korea (SPEAK) audit tool in 42 parks across four districts of two Korean cities. The field test revealed significant disparities in park quality for older people between high- and low-socioeconomic status (SES) areas, with low-SES parks being inferior in terms of access, amenities, and safety. A study in Europe (Mishra et al., 2021) utilized the Blue Health Environment Assessment Tool (BEAT) to evaluate 16 sites in Stage 1 and 21 sites in Stage 2. The study measured inter-rater reliability (IRR) using the intraclass correlation coefficient and found that reliability improved after enhanced training for subjective items. In Singapore (Sun & Fleming, 2021), the Singaporean Environmental Assessment Tool (SEAT) was adapted to the local culture, showing satisfactory usability and moderate reliability across all subscales in its assessment of public buildings for older people. The assessors were required to be knowledgeable about dementia care environments to ensure reliable use. A study in Taiwan (Chi et al., 2022) found that the World Health Organization Quality of Life Brief (WHOQOL-BREF) questionnaire revealed four domains influencing older people's quality of life (QoL), emphasizing the need for government attention to QoL-related independent factors in long-term care policy development. Although assessment tools like SPEAK, BEAT, SEAT, and WHOQOL-BREF provided significant frameworks for fostering healthy environments, their relevance in developing countries is limited. Developed countries—where infrastructure, resources, and governance frameworks significantly diverge from those in developing countries—have established most of these standards.

Conceptually, these tools often prioritize the presence of high-standard amenities (e.g., green building certification, separated bicycle lanes) rather than evaluating the availability and quality of fundamental infrastructure and basic services, a key challenge in developing countries. Furthermore, the assessment methodology often lacks a mechanism to weight indicators according to local priorities, making the interpretation of scores inconsistent with the reality of resource allocation.

Environmental exposures and their health effects might differ significantly between urban and rural communities. The urban–rural divide in developing countries leads to distinct policies and environmental complexities. Urban areas must cope with unique challenges such as high population density, severe air pollution, and informal settlements, while rural communities primarily suffer from a profound lack of basic services, including reliable public transportation, formal waste management, and adequately maintained public spaces (Turner et al., 2018; Wu et al., 2022). These structural differences necessitate assessment criteria that are flexible and sensitive to context. Nevertheless, varying methodologies for categorizing these areas may result in inconsistencies in environmental exposure as well as wellness research, which are often overlooked (Song et al., 2024). Therefore, there is an urgent need for a comprehensive quantitative assessment criteria capable of rigorously comparing these distinct environmental realities to establish a policy baseline sensitive to the context of developing countries. In Russia, Chaplitskaya et al. (2024) found that there was no significant difference in well-being between rural and urban areas. Rural residents experience psychological comfort, safety, better family relationships, and more tradition, while urban residents enjoy better economic and social conditions (e.g., infrastructure, healthcare, education, and internet accessibility), suggesting that there is a deeper understanding of local needs and unique qualities.

Prior studies on physical environments promoting the well-being of older people in the community have been conducted. Curl and Mason (2019) suggest that improving urban environments, particularly in underprivileged communities, may increase walking, therefore promoting the mental health of older people, which highlights the need for the development of walkable neighborhoods. A Taiwanese study (Han et al., 2021) discovered that the quality of greenways, perceived pollution, recreational activities, local social capital, and sense of place strongly influence well-being. Lush vegetation significantly benefits older people with a higher sense of place connection, enhancing their overall well-being. Luoma-Halkola and Jolanki (2021) examined special transport services as a method to assist older people in a Finnish suburb. Shared dial-a-ride bus services can be employed to enhance physical and social environments that more effectively facilitate older individuals' mobility and promote healthy aging within the community. These reinforced that these principles are also applicable and vital within the context of low- and middle-income communities in a developing country.

Previous studies have also focused on the environment of older people in low-income communities. In India, Ehsan et al. (2021) found that heat mitigation solutions, such as planting trees and developing public parks with dense canopies, help reduce ambient temperatures. This mirrors the situation in Sri Lanka, where Sajjad et al. (2025) highlight the vulnerability of older people to heat. For this group, heat was more than just discomfort; it threatened to exacerbate the symptoms of chronic diseases such as cardiovascular disease, diabetes, and hypertension, and lead to severe complications. Gillam and Charles (2019) emphasize the importance of community leadership in enhancing the well-being of slum dwellers in impoverished urban areas, focusing on collective well-being, community perspectives, racism, and inequality, and highlighting the interrelation of these factors. The study indicated that environmental actions and the engagement of community leaders and active citizens significantly contribute to improved well-being in low-income communities.

In the Thai context, existing literature indicates a primary focus on specific aspects of community life. Studies by Jiravanichkul et al. (2020); Suwanprasop and Tontisirin (2020); Thongsawang and Kaewkumkong (2025); Wang (2014) have successfully applied design for older people to public spaces like piers, a historical park, and satisfaction assessment of community features. Several studies used assessment criteria focusing on evaluating the overall environment of urban community characteristics (Ansusinha, 2022; Sreshthaputra, 2013), while others focused on environmental assessment of older people's homes (Chindapol, 2025; Tuicomepee et al., 2025).

However, previous literature still has gaps, primarily due to the limited scope of the studies and a lack of quantitative assessment of the community as a whole. This makes it impossible to fully understand all the factors affecting the well-being of older people. Additionally, there is no use of comprehensive assessment criteria with diverse indicators to systematically compare environmental quality between urban and rural communities in developing countries. the results of our research are, therefore, crucial in addressing these gaps by using comprehensive assessment criteria to assess the environmental well-being of low- and middle- income communities in both urban and rural areas.

METHODOLOGY

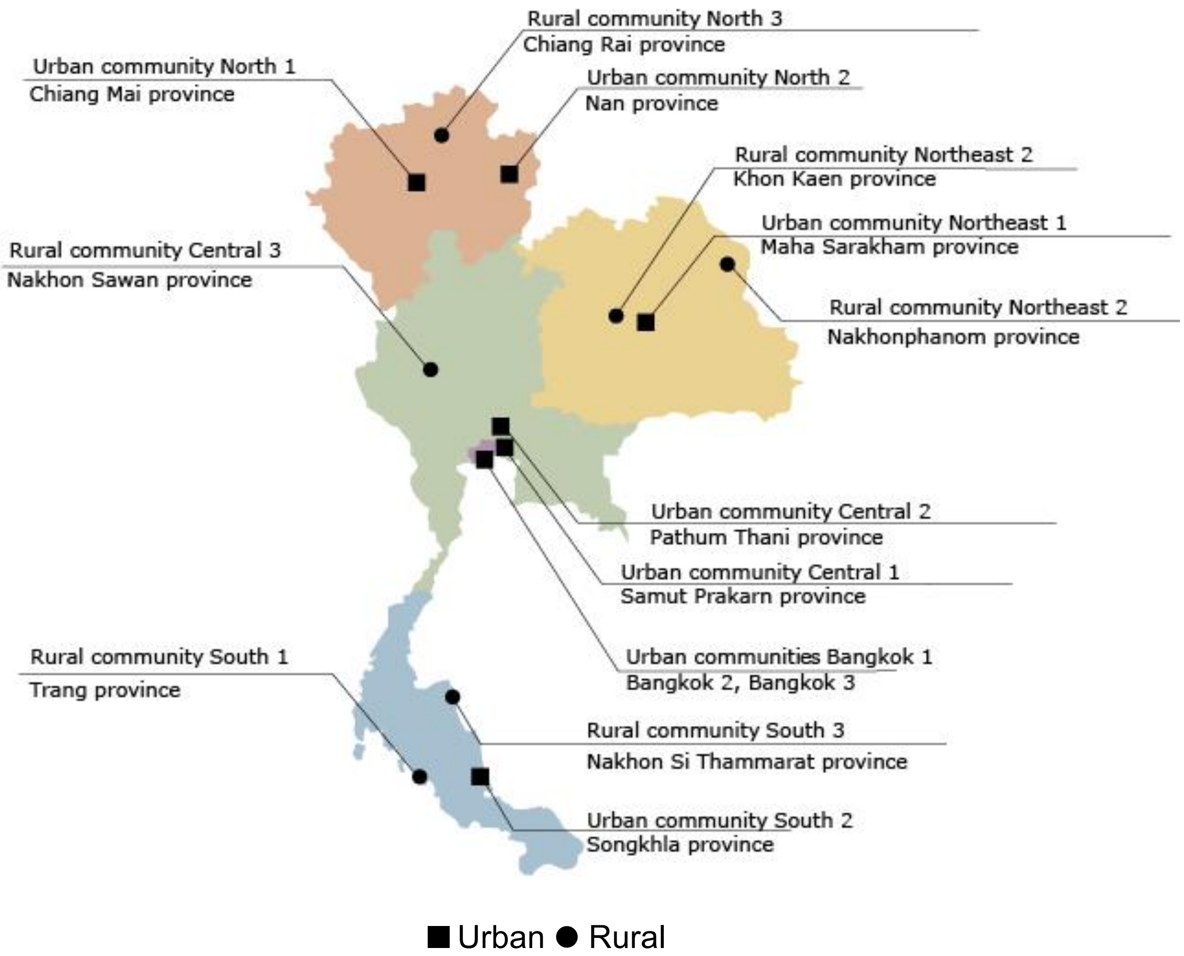
This study employed a cross-sectional, mixed-method design to achieve a comprehensive understanding of community well-being. We utilized a qualitative component, based on in-depth interviews with executives, community leaders, representatives of older people, and local experts from 15 communities. Concurrently, a quantitative approach to assess and analyze the communities' well-being status using the ThaiWBAFC criteria was conducted to complement the numerical findings. This mixed-method approach not only allowed for a statistical analysis of the scores but also provided crucial contextual insights, helping to explain the underlying factors and validate the assessment indicators.

Selection of Study Site

This study employed a purposive sampling strategy, specifically maximum variation sampling, to select 15 communities from various regions of Thailand. This method was chosen to guarantee geographical coverage and to illustrate the complexity of socio-economic and cultural contexts within the country. The selected communities had to meet specific criteria to ensure their relevance to aging-in-place and well-being assessment. They required a history of intervention through prior research projects for older people, definable social boundaries, an older population of at least 10%, and local support from organizations or leaders for coordination and information dissemination. The communities spanned different geographical regions, including urban and rural areas, and were governed by various administrative structures. Socioeconomic diversity was noted, featuring varying income and occupational groups, while the target populations also met specific demographic criteria, including a significant older population. Additionally, cultural and religious diversity is represented by both Thai-Buddhist and Thai-Muslim communities, facilitating a thorough understanding of the country's complex aging demographics. Three communities were selected in each of Thailand’s five primary regions, resulting in fifteen communities total: North (N1-N3), Northeast (NE1-3), South (S1-3), Central (C1-C3), and Bangkok Metropolitan (BKK1-3), as illustrated in Figure 1.

Figure 1

Study Sites



Note. The distribution of the 15 communities studied in this research.

Assessing the Community

Assessment Criteria

The ThaiWBAFC provided a comprehensive set of criteria that complies with international standards while addressing the particular requirements of Thailand, facilitating review and selection of indicators essential for creating community environments that promote overall well-being and are age-friendly. The criteria were developed through a rigorous process involving a carefully selected panel of 15 qualified experts from diverse disciplines, employing the Analytic Hierarchy Process (AHP) methodology to create a weighting system for relevant main and subcategories. Subsequently, based on field testing results and mandatory legal requirements, minimal standard indicators were determined. The final score was calculated by multiplying the observed score for each specific indicator (on a scale of 0 to 100) by its corresponding AHP weight and then aggregating these weighted scores to yield the overall score for the entire community. This ensured that the score reflects expert-driven priorities reflective of the local context. The criteria and scoring system comprised 11 main categories, 43 subcategories, and 81 indicators (details are shown in Table 1) selected from the review process (Jiravanichkul et al., 2024). The total score value was 100 points.

Assessor Training and Reliability

Before data collection, assessors participated in standardized online training sessions to ensure a consistent understanding of each component and indicator in the ThaiWBAFC . The two assessors, from research teams and local experts, were assigned to each community, possessing extensive familiarity with the communities they managed due to ongoing study.

To establish Inter-Rater Reliability (IRR), which measures the consistency among assessors (Mishra et al., 2021; Osi, 2023), Cohen's Kappa (k) statistics are employed in scenarios involving two raters, particularly with nominal data. The accuracy of this measure depends on the nature of the variables, measurement levels, and the number of raters. The process of calculating IRR and interpreting Cohen’s Kappa is further explained below, with a detailed interpretation (Datatab, 2022) provided in Table 2.

$$k = (p_o - p_e) / (-1 \; p_e) \qquad (1)$$

Where **p_o** is the number of matching ratings or the total number of ratings and

p_e indicates the hypothetical probability of a random match.

The overall agreements between the two assessors were calculated using Cohen's Kappa (k) for a subsample of 10 communities, with agreement levels as follows: 40% of the communities saw “Moderate” agreement (C2, BKK3, N1, NE2), 30% “Strong” (C1, BKK1, S1), 10% “Almost Perfect” (NE1), and 20% “Weak” (BKK2, S2). This distribution suggested that the ThaiWBAFC maintained an acceptable level of inter-rater reliability, with a majority of communities (80%) scoring within the “Moderate” to “Almost Perfect” range, as shown in Table 3.

Table 1

Details of the ThaiWBAFC Community Assessment Criteria

Main Categories	Points	Example of subcategories / Indicators
1. Air (AI)	17.48	- Air quality standards, i.e., PM2.5 and PM10 levels - Smoking control, i.e., no-smoking areas
2. Drinking Water (DW)	17.38	- Contaminant-free drinking water - Water quality inspections conducted biannually
3. Healthy Food Environment (HF)	15.47	- Grocery stores, markets, and convenience stores within walking distance - Nutrition education on public relations materials
4. Housing (HO)	14.88	- Services offered to aging-in-place

Table 1 (Continued)

Main Categories	Points	Example of subcategories / Indicators
		- New residential projects with accessible facilities for older people
5. Street Lighting (SL)	9.05	- Enough electric lighting for pedestrians - Anti-glare street lighting
6. Heat Mitigation (HM)	5.96	- Tree canopy shades along walkways or plazas - Heat alarm system alerts for older people during days of extreme heat
7. Roads and Sidewalks (RS)	5.65	- Well-maintained sidewalk and crosswalks - Separate sidewalks and roadways
8. Noise Mitigation (NM)	4.61	- Community policies to mitigate or regulate noise pollution - Sound planning
9. Public Transportation (TR)	4.25	- Accessible vehicles for older people - Bus stops with lighting, seating, and shelter - Special community transportation service system
10. Community Assets (CA)	2.69	- Accessible public buildings and restrooms - Primary healthcare located near the community
11. Community Open Spaces (CO)	2.58	- Accessible public restrooms - Benches and accommodations for all physical conditions in gardens - Exercise space
Total	**100**	

Note. This table demonstrates the main categories and their associated points, as well as examples of subcategories or Indicators of the ThaiWBAFC. Adapted from “The development of a well-being environment and age-friendly communities assessment criteria using the analytic hierarchy process: A case of Thailand,” by S. Jiravanichkul, S. Pinich, A. Sreshthaputra, & T. Jarutach, 2024, *Nakhara: Journal of Environmental Design and Planning, 23*(3) (https://doi.org/https://doi.org/10.54028/NJ202423416

Table 2

Interpretation of Cohen’s Kappa

Value of Kappa (k)	Level of Agreement	% of Data that are Reliable
0–0.20	None	0–4%
0.21–0.39	Minimal	4–15%
0.40–0.59	Weak	15–35%
0.60–0.79	Moderate	35–63%
0.80–0.90	Strong	64–81%
Above 0.90	Almost Perfect	82–100%

Note. Adapted from “Interrater reliability: The kappa statistic,”by M. L. McHugh, 2012, *Biochemia medica*, *22*(3), pp. 276–282. Copyright 2012 by McHugh.

Table 3

Inter-Rater Reliability (Cohen's Kappa) of the ThaiWBAFC Assessment for a Subsample of Communities

Community	C1	C2	C3	BKK 1	BKK 2	BKK 3	N1	N2	N3	NE1	NE2	NE3	S1	S2	S3
Cohen's Kappa (k)	0.86	0.78	0.85	0.82	0.41	0.60	0.64	0.74	0.78	0.61	0.95	0.60	0.90	0.3 9	0.51
Level of Agreement	S	M	S	S	W	M	M	M	M	M	A	M	S	W	W

Note. The Kappa calculation is based on the overall assessment scores for each community in a subsample (n=15). A=Almost Perfect, S=Strong, M= Moderate, W=Weak

Data Collection Procedure

The assessment period spanned from November 2023 until August 2024, with the procedure in each community consisting of two main phases:

1. In-depth Interviews: Firstly, semi-structured interviews (approx. 45–60 minutes each) were conducted with key informants, including local government executives, community leaders, senior leaders, and village public health volunteers. This was essential to gather data on policy and implementation.

2. Field Assessment: Second, following the interviews, the two trained assessors conducted the field survey walk (approx. 90–120 minutes per community). They used the assessment form to find demonstrative evidence, take photographs, and independently score the indicators based on direct observation. This objective observational data was then used to triangulate and cross-check the subjective claims made during the interviews. This two-part process was crucial to mitigate potential informant bias and to validate the final scores.

RESULTS

Community Assessment Results

Score Results for Each Community

Assessors evaluated the 15 communities using ThaiWBAFC criteria based on actual on-site audits, revealing the well-being environment and support for independent living among older people. The average score of participating communities was 60.68. The scores for each community are illustrated in Figure 2.

The three best-scoring communities were C1, C2, and N1, with scores of 91.62%, 79.24%, and 78.80%, respectively. All three communities are urban. The community with the lowest score was S2, at 13.81%; it, too, is classified as an urban community.

Community C1, a retirement community in Samut Prakarn province located approximately 30 minutes from Bangkok, received the highest score. Operated by the Thai Red Cross Society, it was established in 1995, and Phase 2 was finished in 2013. It comprises 468 units (Jiravanichkul & Jarutach, 2013). C1 achieved a perfect score of 100% in seven categories (AI, DW, HF, HI, NM, CA, CO). Figure 3 illustrates these health-promoting elements in the C1 community.

The high rating for Drinking Water (DW) was supported by resident trust in the affordable, on-site system. A resident (age: 65) highlighted the importance of transparency, stating,

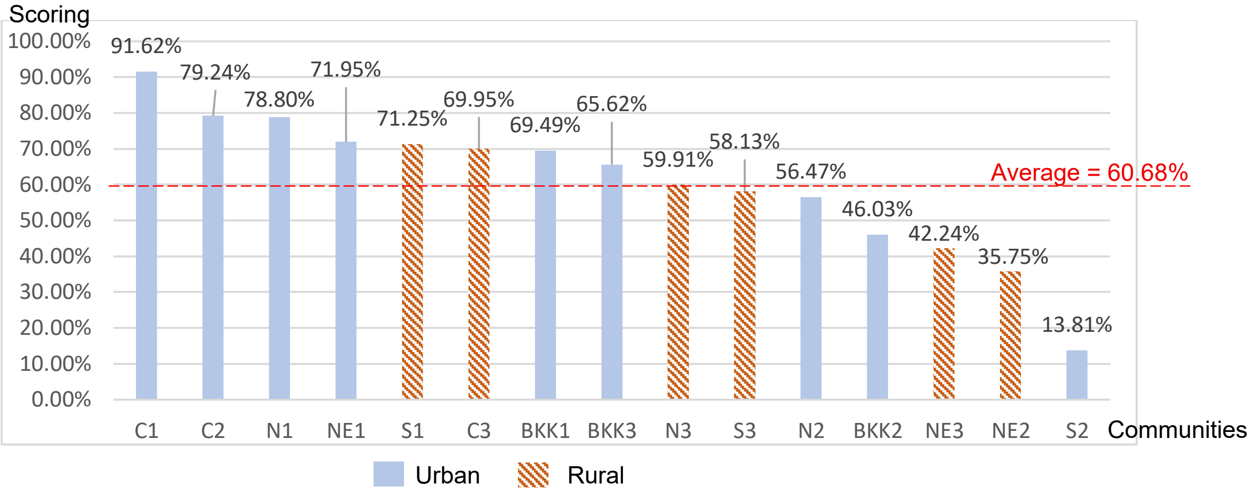
> "*I always come to get drinking water from this dispenser. I'm quite confident in the cleanliness because they clearly post the filter change schedule*"
>
> (personal communication, December 25, 2023).

Similarly, community support and ownership contributed to the perfect score for Healthy Food Environment (HF). According to the manager,

> *"The community supports mobile vendor spaces and vegetarian food stalls two days a week.*
>
> (personal communication, December 25, 2023).

Figure 2

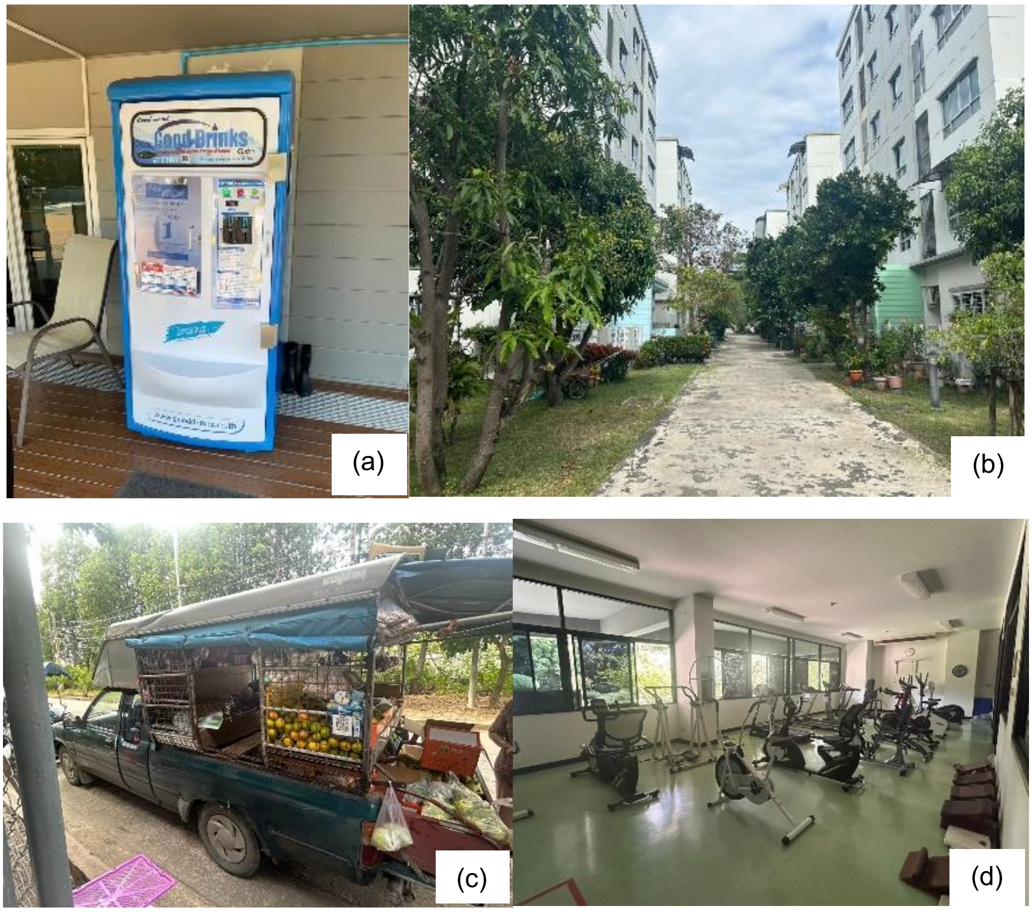
The Scores for Each Community, Divided into Urban and Rural Communities



Note. This figure demonstrates total scores for each community, ranked from highest to lowest.

Figure 3

Health-Promoting Elements in Community C1.



Note. Figure (a): Drinking water dispenser provided at lower cost to residents at the community center. Since tap water in Thailand is not drinkable, the availability of an affordable water dispenser is essential for the community; Figure (b): Shaded pedestrian walkway in the community; Figure (c): Fresh produce mobile kiosk that routinely operates within the community; Figure (d): Free-to-access gym.

Furthermore, as shared by another older resident (age: 68), who maintains the community garden,

> *"I planted this vegetable garden myself. Other residents sometimes pick vegetables for cooking, but only what is necessary for their consumption"*
>
> (personal communication, December 25, 2023).

This is done to maintain air quality and control smoking. They designated a smoking area far from the building.

> *"Older residents do not smoke, but some contractors come in to smoke, so the manager designated a smoking area,"* said the assistant manager (age: 59)
>
> (personal communication, December 25, 2023).

The community scoring second was C2, an urban community in Pathum Thani province located approximately 50 minutes from Bangkok. The municipality leased the clubhouse area in the community and transformed it into a senior community center. Community C2 achieved a full score in five categories (HF, SL, HM, CA, CO). Figure 4 shows instances of health-enhancing components in community C2.

The mayor emphasized the municipality's commitment to modern governance, stating

> *"Effective care relies on integrated data. We developed the 'Beungyitho City Data' website, the second in Thailand, to centralize community information. This digital platform provides officials with real-time access to key resident details, including seniors' allowances and basic health data, as well as street lighting data. These allow us to deliver proactive and highly targeted public services tailored to the needs of our senior inhabitants"*
>
> (personal communication, January 29, 2024).

Figure 4

Health-Enhancing Components in Community C2

Note. Figure (a): Bulletin board updated with various information, some related to the environment for older people's safety environment, including restroom safety design and non-smoking signage; Figure (b): Shaded garden, featuring a pavilion where older residents gather every morning; Figure (c): Garden around the community center featuring pathways and outdoor exercise equipment, offering exercise options for older residents and various age groups: Figure (d): Daytime activities at the senior day care and day service center.

The utility of this digital system was highlighted by the Director of the Public Health Division (age: 54),

> *"Online group chat rooms exist to inform the members about various events, as well as to alert them on days with higher PM2.5 levels"*
>
> (personal communication, January 29, 2024).

The provision of social and physical support in the municipality is robust. Infrastructure includes the Senior Quality of Life Development Center, functioning as a daily daycare facility (with an accessible environment enhanced by ramps, restrooms, and handrails). Additionally, social housing is available for older people needing temporary accommodation during caregiver absence or short-term recovery. The effectiveness of these facilities is underscored by high resident engagement. The center serves as a vital social hub, where a senior resident (age: 72) described their routine:

> *"At the community center, a coffeehouse forum allowed older members to join and gather every morning or share lunch together. Subsequently, individuals disperse to exercises such as yoga or the gym for one to two hours."*
>
> (personal communication, January 29, 2024).

Another resident (age: 69) highlighted their fulfillment and high mobility, stating they participate in activities across multiple centers:

> *"In the morning, after completing yoga at this center, I drive to another municipality's senior center to participate in a line dance class. I feel fulfilled with the activities I do every day"*
>
> (personal communication, January 29, 2024).

The community with the lowest score was S2, a low-income urban area located in Mueang District, Songkhla Province. There was only one open space, a sport field, which has become a rough lawn, inconvenient for older people (Angkasith et al., 2022). This community scored zero marks in six categories (HO, SL, RS, NM, PT, CA). The components of community well-being are illustrated in Figure 5.

The interview with the community leader emphasized the profound challenges faced by this densely populated area, particularly concerning the environment and mobility for older residents,

> *"We did receive a budget from the local government agency under the 'Stable Home Project,' which helped us enhance some older people's residences to install grab bars in their bathrooms."*
>
> (personal communication, February 23, 2024).

However, the main problem is the surrounding environment. An older resident (age: 72) described the limited green space,

> *"We are a very densely populated community. The only open area we really have is the field, which is used for a flea market every Saturday. Unfortunately, this area lacks maintenance funding. The surface is irregular and full of potholes"*
>
> (personal communication, February 23, 2024).

Furthermore, the lack of transportation infrastructure severely impacted mobility. Regarding transport, the leader stated,

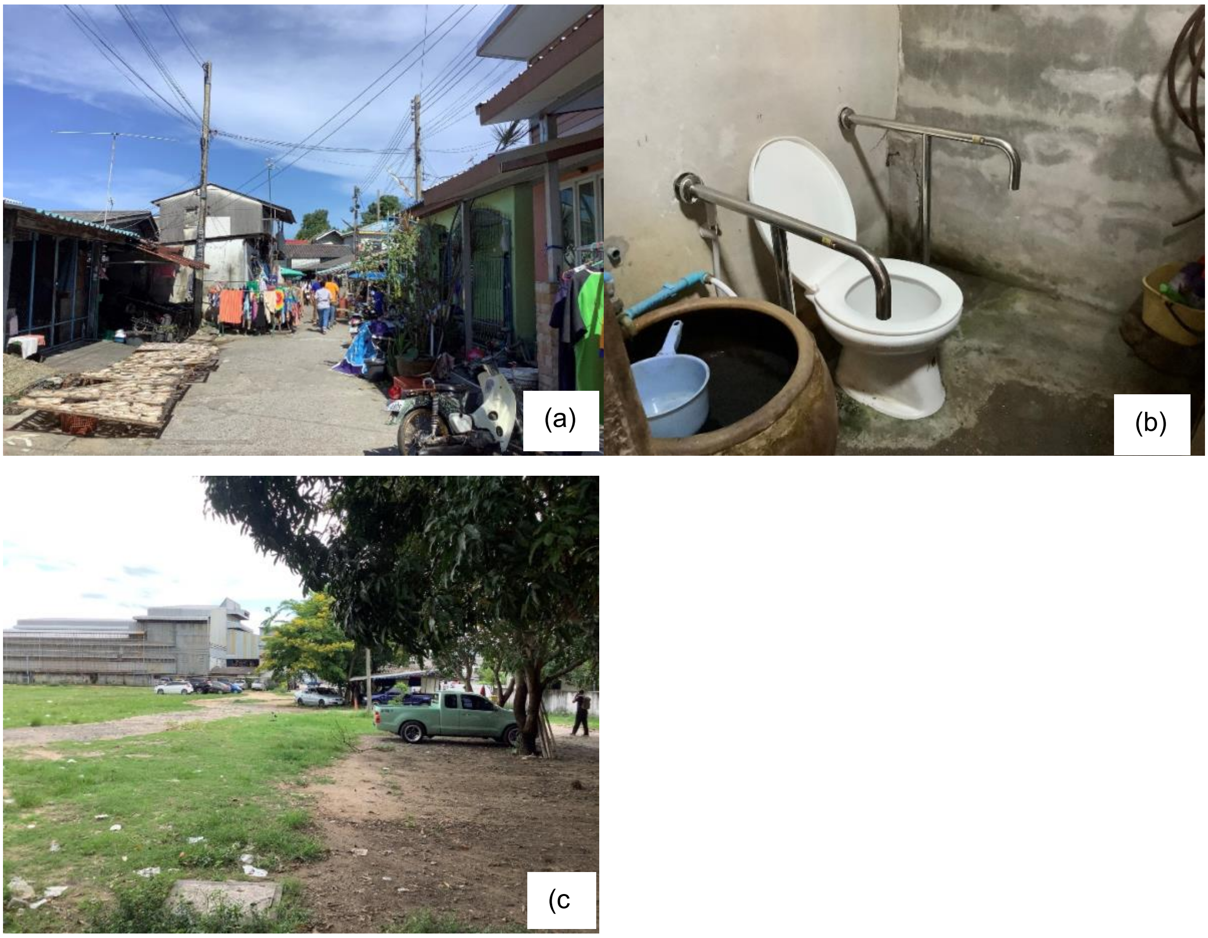
> *"There is no public transit infrastructure in this area at all."* This forces older residents to rely on private vehicles, as confirmed by another older resident (age: 70), *"I must rely on my son to take me to hospital, using motorcycles"*
>
> (personal communication, February 23, 2024).

Score Results by Category

From Table 4, we divided the scores of each community into 3 levels: (1) High-scoring categories, including healthy food environment, with the highest average score at 0.91; community open space, with an average of 0.80; community assets, with an average of 0.77; and street lighting, with an average score of 0.76, (2) Medium-scoring categories, including housing, with an average score of 0.64; drinking water quality, with an average score of 0.57; air quality, with an average score of 0.56; and heat mitigation, with an average score of 0.52, (3) Low-scoring categories, including roads and sidewalks, with a score of 0.31; public transportation, with a score of 0.25; and noise mitigation, the lowest, with a score of 0.07. These low scores, particularly for transportation, reflect the reality described by one of older residents in NE3, “Our community has no inter-city bus passing through. We have to ride a motorcycle into the city.” This quote illustrates why standardized public transit indicators are often inapplicable in rural settings.

Figure 5

The Components of Community S2



Note. Figure (a): Houses in the community are densely packed and built with unstable materials; Figure (b): A government agency has initiated a project to improve safety in bathrooms for the older residents; Figure (c): Public places that are poorly maintained, devoid of exercise facilities, and include a grass field riddled with holes, rendering them unsuitable for older people to engage in walking for exercise. Use with permission of Angkasith, R. Adapted from *Public space for seniors activities with the local wisdom contex*, by R. Angkasith, A. S. Thepma, S., Choomket, K. Hawsutisima, & S. Tanmongkol, 2022, National Research Counsil of Thailand (https://cmudc.library.cmu.ac.th/frontend/Info/item/dc:165468). Copyright 2023 by Angkasith, R.

Table 4

The Scores of Each Community by Category, Color-Coded by Level

Main Category	Urban Communities											Rural Communities								AVG	S.D.
	N1	N2	NE1	C1	C2	S2	BKK 1	BKK 2	BKK 3	AVG	S.D.	N3	NE 2	NE 3	C3	S1	S3	AVG	S.D.		
AI	1.00	0.60	0.60	1.00	0.60	0.06	0.60	0.00	0.60	0.56	0.35	0.60	0.54	0.06	1.00	0.60	0.60	0.57	0.30	**0.56**	**0.32**
DW	0.81	0.07	0.94	1.00	0.88	0.07	0.93	0.07	0.62	0.60	0.41	0.75	0.00	0.06	0.68	0.94	0.69	0.52	0.39	**0.57**	**0.39**
HF	1.00	1.00	1.00	1.00	1.00	0.47	0.74	1.00	1.00	0.91	0.19	0.74	1.00	1.00	1.00	1.00	0.74	0.91	0.13	**0.91**	**0.16**
HO	0.62	0.71	0.68	0.81	0.81	0.00	0.64	0.84	0.71	0.65	0.25	0.71	0.42	0.51	0.70	0.71	0.69	0.62	0.13	**0.64**	**0.21**
SL	0.83	0.83	1.00	0.83	1.00	0.00	0.83	0.83	0.83	0.78	0.30	0.83	0.00	0.83	1.00	1.00	0.83	0.75	0.38	**0.76**	**0.32**
HM	0.78	0.46	0.00	1.00	1.00	0.54	1.00	0.46	1.00	0.69	0.35	0.22	0.00	0.54	0.22	0.54	0.00	0.25	0.24	**0.52**	**0.38**
RS	0.55	0.50	0.46	0.72	0.68	0.00	0.49	0.31	0.00	0.41	0.26	0.00	0.00	0.19	0.13	0.34	0.32	0.16	0.15	**0.31**	**0.25**
NM	0.00	0.00	0.00	1.00	0.00	0.00	0.05	0.00	0.00	0.12	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.07**	**0.26**
PT	0.76	0.09	0.65	0.43	0.42	0.00	0.18	0.49	0.00	0.34	0.28	0.09	0.00	0.02	0.09	0.09	0.51	0.13	0.19	**0.25**	**0.26**
CA	0.58	1.00	1.00	1.00	1.00	0.00	0.74	0.58	0.82	0.75	0.33	1.00	0.75	0.89	0.68	0.76	0.73	0.80	0.12	**0.77**	**0.26**
CO	1.00	1.00	0.92	1.00	1.00	0.34	1.00	0.43	1.00	0.85	0.27	0.94	1.00	1.00	0.56	0.72	0.16	0.73	0.33	**0.8**	**0.29**
Total	**0.79**	**0.56**	**0.72**	**0.92**	**0.79**	**0.14**	**0.69**	**0.46**	**0.66**	**0.64**	**0.23**	**0.60**	**0.36**	**0.42**	**0.70**	**0.71**	**0.58**	0.56	0.14	**0.61**	**0.20**

Note. This table demonstrates the scores for each community, by category, divided into urban and rural communities. The main categories are as follows: AI = Air Quality; DW = Drinking Water Quality; HF = Healthy Food Environment; HO = Housing; SL = Street Lighting; HM = Heat Mitigation; RS = Roads and Sidewalks; NM = Noise Mitigation; PT = Public Transportation; CA = Community Assets; CO = Community Open Spaces. Author's calculations using MS Excel, (2025).

Comparison of Results for Urban and Rural Communities

Statistical Analysis *(*Qualitative Analysis*)*

An independent sample t-test was conducted to compare the scores of all 11 main categories between urban (n=9) and rural (n=6) communities. The overall average scores between urban communities (mean = 63.67, SD = 22.93) and rural communities (mean = 56.21, SD = 14.46) showed no statistically significant difference (t(13)=0.71, p=0.49), which aligns with the initial finding. Furthermore, a detailed examination of each main category, as presented in Table 4, revealed a disparity in only one category, Heat Mitigation (HM), which saw a statistically significant difference between the two groups (t(13)=2.65, p=0.020). Urban communities scored significantly higher (mean = 69.31, SD = 35.35) than rural communities (mean = 25.26, SD = 24.45). This finding directly supported the initial analysis (Table 5) which indicated urban communities have better access to heat mitigation strategies. Roads and Sidewalks (RS) similarly showed a noteworthy distinction, with the p-value being close to the significance threshold (t(13)=2.11, p=0.054). This indicates a potential trend for better infrastructure in urban areas, though it did not meet the conventional α=0.05 threshold for statistical significance. Other categories yielded high p-values (p > 0.150), confirming that there was no statistically significant difference in these environmental components between the urban and rural groups.

To determine whether there is a statistically significant difference in the ThaiWBAFC scores between urban and rural communities, an independent sample t-test was employed for the overall score and for each of the 11 main categories, as shown in Table 5. The statistical hypotheses for this test were: (a) Null Hypothesis (H_0): There is no significant difference in the mean ThaiWBAFC score (or mean score of a specific category) between urban and rural communities, (b) Alternative Hypothesis (H_α): There is a significant difference in the mean ThaiWBAFC score (or mean score of a specific category) between urban and rural communities. All tests were conducted using a significance level of α= 0.05.

The quantitative analysis demonstrated that only the heat mitigation category showed a statistically significant difference between urban and rural communities (p=0.020). This significant finding was highly consistent with the qualitative and descriptive data obtained from field surveys. Specifically, the field surveys revealed that, in 4 of the 6 rural communities, pathways lack any shade from trees or structures. Moreover, the roofs of residences are colored blue and red, which further increases heat absorption. This difference led to rural communities obtaining significantly lower ratings in this category compared to urban areas that benefit from the shade provided by trees or other buildings.

Table 5

Descriptive and Inferential Statistics for All Main Categories Comparing Urban and Rural Communities

Main Category	Urban (n=9)		Rural (n=6)		t	df	Levene's Sig.	p-value (Two-Sided)	Statistical Significance (α=0.05)
	Mean	S.D.	Mean	S.D.					
1. AI	56.34	34.55	56.75	29.81	-0.023	13	0.644	0.982	No
2. DW	59.89	41.05	52.01	38.99	0.371	13	0.766	0.716	No
3. HF	91.31	18.51	91.44	13.26	-0.017	13	0.683	0.986	No
4. HO	64.61	25.5	62.38	12.36	0.198	13	0.572	0.846	No
5. SL	75.91	28.96	74.99	37.64	0.054	13	0.532	0.958	No
6. HM	69.31	35.35	25.26	24.45	2.645	13	0.241	0.020	Yes
7. RS	41.3	26.29	16.16	14.77	2.114	13	0.201	0.054	No

Table 5 (Continued)

Main Category	Urban (n=9)		Rural (n=6)		t	df	Levene's Sig.	p-value (Two-Sided)	Statistical Significance (α=0.05)
	Mean	S.D.	Mean	S.D.					
8. NM	11.63	33.18	0	0	0.384	13	0.848	0.712	No
9. PT	33.46	27.94	13.41	19.03	1.528	13	0.116	0.150	No
10. CA	74.61	33.13	79.93	12	-0.441	13	0.374	0.715	No
11. CO	85.47	26.88	73.01	33.1	0.705	13	0.647	0.494	No
Overall Average	63.67	22.93	56.21	14.46	0.705	13	0.62	0.494	No

Note. Author's calculations using SPSS (2025).

Qualitative Analysis

While the overall statistical analysis showed no significant difference between urban and rural communities, a more detailed examination of individual indicators revealed a critical limitation of the assessment criteria. Our findings, supported by field surveys and interviews with six local environmental experts for older people, revealed that the low scores in various categories were not caused by the same factors. Specifically, low scores for heat and noise mitigation were a result of a lack of implementation, even though they were theoretically feasible in rural settings. Conversely, as many as 24 indicators within the housing, roads and sidewalks, and public transportation categories were found to be inconsistent with the rural context, rendering them practically unusable for assessment. For instance, the housing category included four indicators that were not applicable, such as universal design and alternative housing options. The roads and sidewalks category had six unusable indicators, including sidewalks and crosswalks, while the transportation category had as many as 14, including those for public transportation stops and fare systems. Overall, this analysis clearly indicates that the assessment criteria have limitations when used in diverse settings and requires careful adaptation to accurately reflect the characteristics of rural communities.

FINDINGS AND DISCUSSION

Despite the development of the ThaiWBAFC assessment criteria, they remain untested in real-world contexts, rendering verification of their efficacy or use in practice unattainable. Our study addressed this gap by employing the ThaiWBAFC a to assess low- and middle-income communities in Thailand.

Community Scores

A field assessment of 15 communities was conducted using the ThaiWBAFC criteria. The study sites were selected using a maximum variation sampling strategy (Ardebili et al., 2021; Thomas, 2022) to capture the complexity and diversity (i.e., level of governance, socio-economic status, and religious background) of low- and middle-income aging communities across Thailand. This deliberate approach was crucial to establish a high contextual validity for the subsequent statistical comparison (using a t-test) between the urban and rural groups, ensuring that the findings accurately reflected genuine environmental variations rather than sampling bias.

Before analysis, the reliability of the assessors was formally established using Cohen's Kappa (k) (Harden et al., 2024; Yu et al., 2024) to calculate the Inter-Rater Reliability (IRR) of the tool (Lee, 2022; Mishra et al., 2021; Sun & Fleming, 2021). The resulting high k-value strongly suggested that the ThaiWBAFC is a reliable instrument for environmental assessment, ensuring that the measured scores were not significantly influenced by the individual subjective bias of the assessors. This validation confirmed that the scores subsequently used for comparative analysis are accurate and comparable.

The overall average score of 60.78 out of 100 served as crucial baseline data for understanding the current well-being status of low- and middle-income communities in Thailand. This quantitative finding provided evidence of the community's efforts to create a well-being and age-friendly environment, demonstrating that even with limited resources, these communities can establish a strong foundation of necessary facilities. Additionally, the results obtained are valuable criteria for community stakeholders and policymakers, as they can concretely measure success and help identify specific indicators for improvement (Agost-Felip et al., 2021). This discovery has helped communities strategically allocate resources and develop targeted solutions, enabling them to truly monitor progress and improve the quality of life for older people in the community. A crucial qualitative insight from our field interviews with local government executives, community leaders, and older people revealed that the communities with high scores are characterized by strong collaboration. That is, positive outcomes were a direct result of strong local government organizations, community leadership, and active citizen participation, which aligns with the findings of Gillam and Charles (2019). Their research highlighted the vital importance of community leadership in enhancing the quality of life of residents in poor urban areas by emphasizing the importance of a community-centric perspective, collective well-being, and the interplay of social factors.

Main Category Scores

An in-depth investigation of the main categories revealed three distinct performance levels:

Level 1: High-score categories. This study found that communities consistently scored well in categories like healthy food environment (0.91), community open spaces (0.80), community assets (0.77), and street lighting (0.76). These high scores are consistent with prior research highlighting the importance of local food systems and accessible green spaces for older people's well-being (Brown & Corry, 2020; Kelly et al., 2022; Ren et al., 2023; Turner et al., 2018). Most low- or middle-income communities have vegetable gardens, grocery stores selling fresh produce, or local markets nearby (Turner et al., 2018), which are sources of fresh, healthy food that are more accessible than convenience stores or large supermarkets. These supported findings from healthy food policies in South Asia to combat Non-Communicable Diseases (NCDs) (Pineda et al., 2024). The study revealed that green areas, safety facilities, senior centers, medical services, and social services significantly influence the social and health statuses of older people (Somsopon et al., 2022). But barriers limited access to open spaces or community assets, including poor maintenance, unfriendly infrastructure, and crime. To maximize older residents' benefits, a collaborative, multi-sectoral approach (from urban planning to public health) is necessary, especially in low-income communities, as emphasized by studies in India and China (Adlakha et al., 2021; Li et al., 2021). Additionally, inadequate street lighting poses a safety risk, causing older people to avoid traveling at night. This finding is consistent with research in India, Bangladesh, Sub-Saharan Africa, and Southeast Asia that highlights the critical role of lighting in public safety and quality of life(Abdullah et al., 2024; Parida et al., 2022). These results confirm that such vital assets are accessible even in low- and middle-income Thai communities, making them key indicators of a supportive environment.

Level 2: Medium-scoring categories, including housing (0.64), drinking water quality (0.57), air quality (0.56), and heat mitigation (0.52), showed varied results across communities. This inconsistency suggests that these issues have not uniformly addressed and require targeting, aligning with previous research on diverse environmental challenges. In the housing category, our findings aligned with studies that emphasize the importance of home modifications for reducing the risk of falls and improving the quality of life for older people (Chindapol, 2025; Jarutach & Lertpradit, 2020; Tuicomepee et al., 2025). The need for external support, such as community handymen and relevant agency staffs, are crucial for assisting low- and middle-income older people in accessing necessary home improvements. Similarly, our findings on drinking water quality and air quality reflect a complex challenge with global implications. While the impact of air pollution varies between developed and developing countries (Ailshire & Brown, 2021; Sun & Gu, 2008), the core issue remains inconsistent policy enforcement and varied budgets at the local level. Moreover, as highlighted by studies in India (Kumar et al., 2022) and Italy (Sacchetti et al., 2015), access to clean water is a universal concern for older people, requiring not only infrastructure but also consistent maintenance and public awareness to prevent health risks. Our results also underscore the urgent need for heat mitigation strategies. The low scores in this category confirm the vulnerability of older people to thermal stress, which can exacerbate chronic health issues (Ehsan et al., 2021). The solutions, such as increasing tree plantations and developing public parks with dense canopies, water features, benches, and accessibility factors (e.g., walkability) (Saneinejad et al., 2014; Vasconcelos et al., 2024) are directly applicable to the communities assessed in our study. In sum, providing a clear scoring system for these categories identifies areas of weakness and offers a practical criterion for stakeholders to pinpoint specific deficiencies and allocate resources effectively. The varied results among communities reinforce the need for flexible, context-aware strategies that address the unique challenges of each locality.

Level 3: Low-scoring categories, including roads and sidewalks (0.31), public transportation (0.25), and noise mitigation (0.07), were critical weaknesses that require urgent attention. These consistently low scores point to a critical gap in community infrastructure, particularly for older people. The findings align with research conducted in other developing countries, particularly in Latin America and the Caribbean, where inadequate pedestrian infrastructure has been identified and highlight an urgent need to enhance accessibility for low-income communities (Rivas & Serebrisky, 2021). On the other hand, the approach here contrasted with that taken in countries like Iran, which focused on citizen awareness and participation. Furthermore, while city managers often prioritize walkability in sustainable transportation, several studies indicate that they overlook adapting policies for walkable communities (Qazimirsaeed et al., 2022). The low scores for transportation infrastructure imply that current public transit systems were not conducive to the needs of older people in these communities, which could severely limit their mobility, access to services, and social participation. In developed countries, studies show that promoting an active lifestyle for older people involves providing essential facilities such as priority parking spaces, metro services, accessible buses, and bus stops (Guo et al., 2024; Park et al., 2013; Tiraphat et al., 2021), which promote an active lifestyle for older people to supermarkets, local markets, or mixed-use facilities. However, the Thailand study's findings indicate that in Thai rural communities, older people primarily rely on motorcycles (Tontisirin et al., 2024). Nevertheless, this study found that some local administrative organizations have Special Community Transportation Service Systems (SCTS) for essential destinations like hospitals or senior centers. A score close to zero for noise mitigation indicates that no policies have been implemented in our target communities, which is consistent with research from developing countries in Asia, such as Vietnam (Nguyen et al., 2025), as well as countries in Africa and Latin America (Schwela, 2023), which face similar problems. Even though there are laws regarding noise pollution, clear implementation processes such as measurement, mapping, or enforcement are still lacking. Therefore, a strategic framework is needed to sustainably manage this issue, which should include specific recommendations such as raising awareness, categorizing noise sources, using technology for monitoring, and amending laws and promoting social responsibility to prevent the health and economic impacts of noise pollution.

Statistical Analysis

Although the overall statistical analysis using a t-test did not show a significant difference between the average scores of urban and rural communities, this finding is consistent with research conducted in Russia (Chaplitskaya et al., 2024). However, a more detailed analysis of each main category found a clear and statistically significant difference in the heat mitigation category ($p=0.02$), with urban communities having significantly better access to heat mitigation strategies than rural communities. This disparity can be attributed to key factors, including investment in infrastructure such as parks and streetscape-greenery elements (Rugel et al., 2022), as well as contextual limitations in rural areas lacking technology and warning policies. However, field surveys revealed that Thai urban communities have developed local solutions, such as village health volunteers using online group chat rooms to send extreme heat warnings to older people or their family members, providing a critical informal communication channel. This finding was consistent with research from developed countries like Europe and Australia, which indicates that the physical environment (home design, green space), social networks, and local risk management (warning systems) are crucial for older people's adaptation to heatwaves (De Gea Grela et al., 2024). In contrast, a study from China's centralized rural communities (Du et al., 2024) documented a different approach, with policies implemented to install solar panels on rooftops. This not only helped mitigate heat but also reduced energy costs, providing an interesting example of a sustainable and context-appropriate solution for rural areas. In summary, our study not only confirmed the disparity in heat management between urban and rural areas but also highlighted that inequality was a practical reality and a crucial issue to consider in future policy planning to ensure solutions are appropriate for each area's context and truly meet the needs of older people (Hasan et al., 2021).

Qualitative Findings from Local Experts

A detailed analysis with six local experts on the issues older people face revealed important distinctions and limitations. First, the key reason for poor scores was the lack of formal community policies, rather than a lack of actual implementation, resulting in weak performance in heat and noise mitigation categories. This difference is important for future policy development: If a community is aware of the evaluation criteria and uses them to develop policies, it can improve their scores in these categories.

Second, the assessment criteria itself had limitations in rural contexts. It was found that 24 indicators across three categories, such as housing (e.g., universal design in residential projects and residential alternative social housing), roads and sidewalks (e.g., sidewalks, crosswalks, and separate traffic lanes), and transportation (e.g., public transportation stations, bus stops, and vehicles) were not consistent with rural reality because houses were often far apart, reducing the need for standard sidewalks, and public transportation systems were often not cost-effective due to low ridership.

The low scores for public transportation and inapplicability of most indicators in rural areas found here strongly align with the challenges found in developed countries as well. A study in Finland (Luoma-Halkola & Jolanki, 2021) pointed out that traditional public transit systems cannot meet the needs of older people in remote areas and suggested that "dial-a-ride" services are a necessary solution. Our findings from the Thai context therefore internationally reinforce that policymakers must move away from adhering to international standard indicators and instead support flexible alternative transportation systems in communities that better address rural contexts.

This narrative analysis revealed a limited amount of prior research investigating disparities in access to resources for healthy aging between urban and rural areas. By identifying and clarifying these contextual limitations, our findings will help create interventions tailored to the specific needs of these communities.

CONCLUSIONS

This study employed the Thai Well-Being Environment and Age-Friendly Communities (ThaiWBAFC) assessment criteria to evaluate the well-being environment of 15 low- and middle-income communities in Thailand. Our findings revealed four key points.

First, the overall average score of 60.78 serves as a crucial baseline, confirming that low- and middle-income Thai communities are successfully building a foundation for a well-being and age-friendly environment. These positive outcomes were a direct result of strong collaboration between local government organizations, community leadership, and active citizen participation. This quantitative data, along with the qualitative insight on strong community networks, provided valuable criteria for policymakers and stakeholders to measure progress and strategically allocate resources. Ultimately, our findings not only validate the existence of these supportive environments but also provide a practical framework for improving the quality of life for older people by emphasizing the importance of a community-centric perspective and social factors.

Second, these communities have a solid foundation of environmental assets that support well-being, as evidenced by high scores in categories like healthy food environment, community open space, and community assets and street lighting. This indicates that low- and middle-income communities possess an excellent basis for providing essential resources that promote well-being. This success is largely attributed to strong collaboration among local government, community leaders, and active citizens. Medium-scoring categories, include housing, air quality, drinking water quality, and heat mitigation—i.e., issues regarding the environment—were not uniformly handled throughout all communities, emphasizing the need for more focused interventions to address inconsistent performance, while consistently low scores in roads and sidewalks, public transportation, and noise mitigation point to serious problems that necessitate urgent action.

Third, a comparative analysis showed that while the overall scores of urban and rural communities were not statistically different, a significant disparity was found in the heat mitigation category ($p=0.02$). This highlighted a critical urban-rural divide in infrastructure and policy implementation.

Finally, this study identified a significant methodological limitation of the assessment criteria itself: the presence of contextual measurement bias. Our qualitative analysis revealed that as many as 24 indicators were inapplicable in the rural context, unequivocally demonstrating that the “one-size-fits-all” approach is ineffective and that the criteria lack contextual validity in diverse settings. This finding addresses a crucial research gap, underscoring the necessity of developing a context-specific assessment criteria for diverse communities. A key limitation of this study is its small sample size, which may have contributed to the non-significant overall t-test result. Therefore, future research should aim to study a larger and more representative national sample to validate these findings and establish a comprehensive national baseline. Furthermore, a larger sample would enable the use of multivariate analysis to determine the joint contextual factors (e.g., socio-economic status and administrative type) influencing well-being scores, which was statistically infeasible in the current study. Additionally, this study strongly recommends the development of context-specific indicators for rural communities to ensure assessment criteria are both scientifically sound and practically relevant to diverse settings. Future research must prioritize (1) scaling up the sample size for national validation and enabling multivariate analysis, and (2) addressing the contextual measurement bias by developing specific, alternative indicators for rural infrastructure (e.g., SCTS). This ensures interventions accurately target the identified disparities. This research serves as a foundational step for future policy planning, urging stakeholders to move beyond universal standards and create interventions that truly meet the specific needs of all populations, particularly older people.

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REFERENCES

Abdullah, A. Z., Azizan, N., & Bohari, Z. (2024). Implementation of solar street lighting for empowering rural communities. *BIO Web of Conferences, 137*, Article 03001. https://doi.org/10.1051/bioconf/202413703001

Adlakha, D., Chandra, M., Krishna, M., Smith, L., & Tully, M. A. (2021). Designing age-friendly communities: Exploring qualitative perspectives on urban green spaces and ageing in two Indian megacities. *International journal of environmental research and public health*, *18*(4), Article 1491. https://doi.org/10.3390/ijerph18041491

Agost-Felip, R., Rua, M. J., & Kouidmi, F. (2021). An inclusive model for assessing age-friendly urban environments in vulnerable areas. *Sustainability*, *13*(15), Article 8352. https://doi.org/10.3390/su13158352

Ailshire, J., & Brown, L. L. (2021). The importance of air quality policy for older adults and diverse communities. *Public Policy & Aging Report*, *31*(1), 33–37. https://doi.org/10.1093/ppar/prab001

Angkasith, R., Thepma, A. S., Choomket , S., Hawsutisima, K., & Tanmongkol, S. (2022). *Public space for seniors activities with the local wisdom context.* National Research Council of Thailand. https://cmudc.library.cmu.ac.th/frontend/Info/item/dc:165468

Ansusinha, P. (2022). The appropriate outdoor environment for age-friendly urban community in Bangkok Metropolis. *NAJUA: History of Architecture and Thai Architecture*, *19*(1), 316–353. https://so04.tci-thaijo.org/index.php/NAJUA/article/view/259560

Ardebili, M. E., Naserbakht, M., Bernstein, C., Alazmani-Noodeh, F., Hakimi, H., & Ranjbar, H. (2021). Healthcare providers experience of working during the COVID-19 pandemic: A qualitative study. *American journal of infection control*, *49*(5), 547–554. https://doi.org/10.1016/j.ajic.2020.10.001

BREEAM Assessment UK. (n.d.). *Understanding BREEAM health and wellbeing*. https://breeamassessment.co.uk/breeam-health-and-wellbeing-in-the-uk/

Brown, R. D., & Corry, R. C. (2020). Evidence-based landscape architecture for human health and well-being. *Sustainability*, *12*(4), Article 1360. https://doi.org/10.3390/su12041360

Center for Active Design. (2020). *Reference guide for the fitwel certification system: Community (beta) V2.1* https://static1.squarespace.com/static/6294f761bc48c512bfad618b/t/62f131b21bacac35940782d3/1724120681920/Fitwel+Reference+Guide_Community_Jan2022_Reduced.pdf

Chaplitskaya, A., Heijman, W., & van OPHEM, J. (2024). Exploring well-being disparities between urban and rural areas: A case study in the Stavropol Territory, Russia. *Regional Sustainability*, *5*(1), Article 100114. https://doi.org/10.1016/j.regsus.2024.100114

Chi, Y. C., Wu, C. L., & Liu, H. T. (2022). Assessing quality of life with community dwelling elderly adults: A mass survey in Taiwan. *Int J Environ Res Public Health*, *19*(22), Article 14621. https://doi.org/10.3390/ijerph192214621

Chindapol, S. (2025). Influence of sociocultural aspects and home modification on fall risks mitigation among the elderly in Thailand. *Nakhara: Journal of Environmental Design and Planning*, *24*(1), Article 501. https://doi.org/10.54028/NJ202524501

Curl, A., & Mason, P. (2019). Neighbourhood perceptions and older adults' wellbeing: Does walking explain the relationship in deprived urban communities? *Transportation Research Part A: Policy and Practice*, *123*, 119–129. https://doi.org/10.1016/j.tra.2018.11.008

Datatab. (2022). *Cohen's Kappa*. https://datatab.net/tutorial/cohens-kappa

De Gea Grela, P., Sánchez-González, D., & Gallardo Peralta, L. P. (2024). Urban and rural environments and their implications for older adults' adaptation to heat waves: A systematic review. *Land*, *13*(9), Article 1378. https://doi.org/10.3390/land13091378

Du, Y., Zhang, A., Zhen, Q., Taleghani, M., Zheng, C., Zhu, L., Zheng, Y., & Zhang, Q. (2024). Rural heat island effect of centralized residences in China: Mitigation through localized measures. *Sustainable Cities and Society*, *114*, Article 105782. https://doi.org/10.1016/j.scs.2024.105782

Ehsan, S., Abbas, F., Ibrahim, M., Ahmad, B., & Farooque, A. A. (2021). Thermal discomfort levels, building design concepts, and some heat mitigation strategies in low-income communities of a South Asian city. *International Journal of Environmental Research and Public Health*, *18*(5), Article 2535. https://doi.org/10.3390/ijerph18052535

Gillam, C., & Charles, A. (2019). Community wellbeing: The impacts of inequality, racism and environment on a Brazilian coastal slum. *World Development Perspectives*, *13*, 18–24. https://doi.org/10.1016/j.wdp.2019.02.006

Guo, N., Xia, F., & Yu, S. (2024). Enhancing elderly well-being: Exploring interactions between neighborhood-built environment and outdoor activities in old urban area. *Buildings*, *14*(9), Article 2845. https://doi.org/10.3390/buildings14092845

Haglund, B. J., Pettersson, B., Finer, D., Tillgren, P., & World Health Organization. (1996). *Creating supportive environments for health: Stories from the third International Conference on Health Promotion, Sundsvall, Sweden*. World Health Organization.

Han, B., Li, D., & Chang, P.-J. (2021). The effect of place attachment and greenway attributes on well-being among older adults in Taiwan. *Urban Forestry & Urban Greening*, *65*, Article 127306. https://doi.org/10.1016/j.ufug.2021.127306

Harden, S. R., Schuurman, N., Larson, H., & Walker, B. B. (2024). The utility of street view imagery in environmental audits for runnability. *Applied Geography*, *162*, Article 103167. https://doi.org/10.1016/j.apgeog.2023.103167

Hasan, F., Marsia, S., Patel, K., Agrawal, P., & Razzak, J. A. (2021). Effective community-based interventions for the prevention and management of heat-related illnesses: A scoping review. *International journal of environmental research and public health*, *18*(16), Article 8362. https://doi.org/10.3390/ijerph18168362

International Well Building Institute. (2020). *The well community standard pilot.* https://v2.wellcertified.com/en/community/overview

Japan Sustainable Building Consortium and Institute for Building Environment and Energy Conservation. (n.d.). *CASBEE for urban development*. https://www.ibecs.or.jp/CASBEE/english/toolsE_urban.htm

Jarutach, T., & Lertpradit, N. (2020). Housing conditions and improvement guidelines for the elderly living in urban areas: Case studies of four Bangkok's districts. *Nakhara: Journal of Environmental Design and Planning*, *18*, 117–138. https://doi.org/10.54028/NJ202018117138

Jiravanichkul, S., & Jarutach, T. (2013). *Behavior and living condition of the elderly in Sawangkanives* [Master's thesis, Chulalongkorn University]. Chula Digital Collection. https://digital.car.chula.ac.th/chulaetd/71921

Jiravanichkul, S., Pinich, S., Sreshthaputra, A., & Jarutach, T. (2024). The development of a well-being environment and age-friendly communities assessment criteria using the analytic hierarchy process: A case of Thailand. *Nakhara: Journal of Environmental Design and Planning*, *23*(3), Article 416. https://doi.org/10.54028/NJ202423416

Jiravanichkul, S., Pongprasert, S., & Jarutach, T. (2020). Universal design guidelines for Pontoon Pier : Moo-7 Pier (Kru Tew Pier),Ko Kret Island and Pak Kret Pier, Nonthaburi. *Journal of Architectural/Planning Research and Studies (JARS)*, *17*(1), 173–188. https://doi.org/10.56261/jars.v17i1.205396

Kelly, D., Davern, M., Farahani, L., Higgs, C., & Maller, C. (2022). Urban greening for health and wellbeing in low-income communities: A baseline study in Melbourne, Australia. *Cities*, *120*, Article 103442. https://doi.org/10.1016/j.cities.2021.103442

Kumar, P., Srivastava, S., Banerjee, A., & Banerjee, S. (2022). Prevalence and predictors of water-borne diseases among elderly people in India: Evidence from Longitudinal Ageing Study in India, 2017–18. *BMC public health*, *22*(1), Article 993. https://doi.org/10.1186/s12889-022-13376-6

Larimian, T., Sadeghi, N., Erfani, G., & Palaiologou, F. (2025). Enhancing the understanding of social wellbeing among elderly populations in developing nations: A place-based approach. *Cities & Health*, 1–19. https://doi.org/10.1080/23748834.2025.2535245

Lee, H. S. (2022). Developing and testing the senior park environment assessment in Korea (SPEAK) audit tool. *Landscape and urban planning*, *227*, Article 104545. https://doi.org/10.1016/j.landurbplan.2022.104545

Li, R. Y. M., Shi, M., Abankwa, D. A., Xu, Y., Richter, A., Ng, K. T. W., & Song, L. (2022). Exploring the market requirements for smart and traditional ageing housing units: A mixed methods approach. *Smart Cities*, *5*(4), 1752–1775. https://doi.org/10.3390/smartcities5040088

Li, S.-J., Luo, Y.-F., Liu, Z.-C., Xiong, L., & Zhu, B.-W. (2021). Exploring strategies for improving green open spaces in old downtown residential communities from the perspective of public health to enhance the health and well-being of the aged. *Journal of Healthcare Engineering*, *2021*(1), Article 5547749. https://doi.org/10.1155/2021/5547749

Luoma-Halkola, H., & Jolanki, O. (2021). Aging well in the community: Understanding the complexities of older people's dial-a-ride bus journeys. *J Aging Stud*, *59*, Article 100957. https://doi.org/10.1016/j.jaging.2021.100957

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia medica*, *22*(3), 276–282.

Mishra, H. S., Bell, S., Grellier, J., & White, M. P. (2021). Testing the reliability and effectiveness of a new tool for assessing urban blue spaces: The BlueHealth environmental assessment tool (BEAT). *Health & Place*, *68*, Article 102526. https://doi.org/10.1016/j.healthplace.2021.102526

MOHT Office for Healthcare Transformation. (2022). *Shaping age-friendly and healthy neighbourhoods with the environment audit toolkit (EAT)*. https://moht.com.sg/shaping-age-friendly-and-healthy-neighbourhoods-with-the-environment-audit-toolkit-eat/

Nguyen, Q. C., Chu, A. T. T., Truong, B. G., & Nguyen, D. H. T. (2025). Noise pollution in developing countries: Loopholes and recommendations for Vietnam law. *City and Environment Interactions*, *25*, Article 100187. https://doi.org/10.1016/j.cacint.2025.100187

Osi, S. (2023). Statistics in endodontics part2: Reliability. *Thai Endodontic Association*, *2*(2), 97–110. https://he03.tci-thaijo.org/index.php/thaiendod/article/view/1649

Parida, D., Khan, R. R., & Lavanya, K. N. (2022). Urban built environment and elderly pedestrian accessibility: Insights from South Asia. *SN Social Sciences*, *2*(6), Article 86. https://doi.org/10.1007/s43545-022-00391-y

Park, S. J., Lee, H., & Kim, M. J. (2013). Mixed-use facility model for the welfare of the elderly based on lifestyle. *Journal of Asian Architecture and Building Engineering*, *12*(2), 245–252. https://doi.org/10.3130/jaabe.12.245

Pineda, E., Atanasova, P., Wellappuli, N. T., Kusuma, D., Herath, H., Segal, A. B., Vandevijvere, S., Anjana, R. M., Shamim, A. A., & Afzal, S. (2024). Policy implementation and recommended actions to create healthy food environments using the Healthy Food Environment Policy Index (Food-EPI): A comparative analysis in South Asia. *The Lancet Regional Health-Southeast Asia*, *26*, Article 100428. https://doi.org/10.1016/j.lansea.2024.100428

Qazimirsaeed, A., Khosravi, H., Rafieian, M., Mirzahossein, H., & Forciniti, C. (2022). Walkability policies in developing countries: What do people need and prefer in Iran? *Sustainability*, *14*(17), Article 10808. https://doi.org/10.3390/su141710808

Ren, K., Sun, X., Cenci, J., & Zhang, J. (2023). Assessment of public open space research hotspots, vitalities, and outlook using CiteSpace. *Journal of Asian Architecture and Building Engineering*, *22*(6), 3799–3817. https://doi.org/10.1080/13467581.2023.2208200

Rivas, M. E., & Serebrisky, T. (2021). *The role of active transport modes in enhancing the mobility of low-income people in Latin America and the Caribbean*. Inter-American Development Bank. http://dx.doi.org/10.18235/0003216

Rugel, E. J., Chow, C. K., Corsi, D. J., Hystad, P., Rangarajan, S., Yusuf, S., & Lear, S. A. (2022). Developing indicators of age-friendly neighbourhood environments for urban and rural communities across 20 low-, middle-, and high-income countries. *BMC public health*, *22*(1), Article 87. https://doi.org/10.1186/s12889-021-12438-5

Sacchetti, R., De Luca, G., Guberti, E., & Zanetti, F. (2015). Quality of drinking water treated at point of use in residential healthcare facilities for the elderly. *Int J Environ Res Public Health*, *12*(9), 11163–11177. https://doi.org/10.3390/ijerph120911163

Sajjad, M., Rajapaksha, I., Rijal, H. B., & Siriwardana, C. (2025). Ageing in place in low-income communities in tropics: A field investigation on overheating, thermal comfort, and well-being of young elders. *Building and Environment*, *270*, Article 112480. https://doi.org/10.1016/j.buildenv.2024.112480

Saneinejad, S., Moonen, P., & Carmeliet, J. (2014). Comparative assessment of various heat island mitigation measures. *Building and Environment*, *73*, 162–170. https://doi.org/10.1016/j.buildenv.2013.12.013

Schwela, D. (2023). Guidelines for environmental noise management in developing countries. In J. K. Summers (Ed.), *Management of noise pollution*. IntechOpen. https://doi.org/10.5772/intechopen.109952

Somsopon, W., Kim, S. M., Nitivattananon, V., Kusakabe, K., & Nguyen, T. P. L. (2022). Issues and needs of elderly in community facilities and services: A case study of urban housing projects in Bangkok, Thailand. *Sustainability*, *14*(14), Article 8388. https://doi.org/10.3390/su14148388

Song, Y., Deziel, N. C., & Bell, M. L. (2024). Delineating urbanicity and rurality: Impact on environmental exposure assessment. *Environmental science & technology*, *58*(43), 19178–19188. https://doi.org/10.1021/acs.est.4c06942

Sreshthaputra, A. (2013). *Ecovillage evaluation manual: NHA*. Papermate (Thailand).

Sun, J., & Fleming, R. (2021). The development and reliability of the Singaporean environmental assessment tool (SEAT) for facilities providing high levels of care for people living with dementia. *HERD*, *14*(2), 289–300. https://doi.org/10.1177/1937586720980175

Sun, R., & Gu, D. (2008). Air pollution, economic development of communities, and health status among the elderly in urban China. *American journal of epidemiology*, *168*(11), 1311–1318. https://doi.org/10.1093/aje/kwn260

Suwanprasop, N., & Tontisirin, N. (2020). Assessing the appropriateness of and development guidelines for an age-friendlyc ommunity in physical aspect: A case study of Rangsit municipality. *Journal of Architectural/Planning Research and Studies (JARS)*, *17*(1), 157–172. https://doi.org/10.56261/jars.v17i1.175203

Thomas, F. B. (2022). The role of purposive sampling technique as a tool for informal choices in a social Sciences in research methods. *Just Agriculture*, *2*(5), 1–8. https://justagriculture.in/files/newsletter/2022/january/47.%20The%20Role%20of%20Purposive%20Sampling%20Technique%20as%20a%20Tool%20for%20Informal%20Choices%20in%20a%20Social%20Sciences%20in%20Research%20Methods.pdf

Thongsawang, S., & Kaewkumkong, A. (2025). The sociopolitical manifestation of built environment in rural Thailand: Holistic development for an aging society? *Nakhara: Journal of Environmental Design and Planning*, *24*(2), Article 510. https://doi.org/10.54028/NJ202524510

Tiraphat, S., Kasemsup, V., Buntup, D., Munisamy, M., Nguyen, T. H., & Hpone Myint, A. (2021). Active aging in ASEAN countries: Influences from age-friendly environments, lifestyles, and socio-demographic factors. *International journal of environmental research and public health*, *18*(16), Article 8290. https://doi.org/10.3390/ijerph18168290

Tontisirin, N., Anantsuksomsri, S., & Laovakul, D. (2024). Spatial-temporal distribution of debt and delinquency of the elderly in Thailand: Perspectives from the National Credit Bureau data. *Plos one*, *19*(7), Article e0306626. https://doi.org/10.1371/journal.pone.0306626

Tuicomepee, A., Sirisuk, K.-o., Wiwattanapantuwong, J., Gulsatitporn, S., & Jarutach, T. (2025). The impact of home environmental hazards on subjective health among healthy elderly adults in Thailand. *Nakhara: Journal of Environmental Design and Planning*, *24*(1), Article 507. https://doi.org/10.54028/NJ202524507

Turner, C., Aggarwal, A., Walls, H., Herforth, A., Drewnowski, A., Coates, J., Kalamatianou, S., & Kadiyala, S. (2018). Concepts and critical perspectives for food environment research: A global framework with implications for action in low-and middle-income countries. *Global food security*, *18*, 93–101. https://doi.org/10.1016/j.gfs.2018.08.003

Vasconcelos, L., Langemeyer, J., Cole, H. V., & Baró, F. (2024). Nature-based climate shelters? Exploring urban green spaces as cooling solutions for older adults in a warming city. *Urban Forestry & Urban Greening*, *98*, Article 128408. https://doi.org/10.1016/j.ufug.2024.128408

Wang, Y.-F. (2015). Assessing age-friendly features and needs of elderly toward age-friendly city in Muang district, Ratchaburi province, Thailand. *Journal of Health Research*, *29*, 159–167. https://he01.tci-thaijo.org/index.php/jhealthres/article/view/78009

World Health Organization. (2023). *National programmes for age-friendly cities and communities: A guide*. https://www.who.int/publications/i/item/9789240068698

Wu, C., Zhang, Z., Elahi, E., Mu, G., & Zhao, P. (2022). Urban-rural income disparities and atmospheric contamination: Aggravating or restraining? *Frontiers in Environmental Science*, *10*, Article 1015857. https://doi.org/10.3389/fenvs.2022.1015857

Yu, T., Ren, B., & Li, M. (2024). Regard to assessing agreement between two raters with kappa statistics. *International Journal of Cardiology*, *15*(403), Article 131896. https://doi.org/ 10.1016/j.ijcard.2024.131896