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Focusing on two cases in Northern China

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Defining indicators for evaluating the residential environment in historic districts based on human needs: focusing on two cases in Northern China

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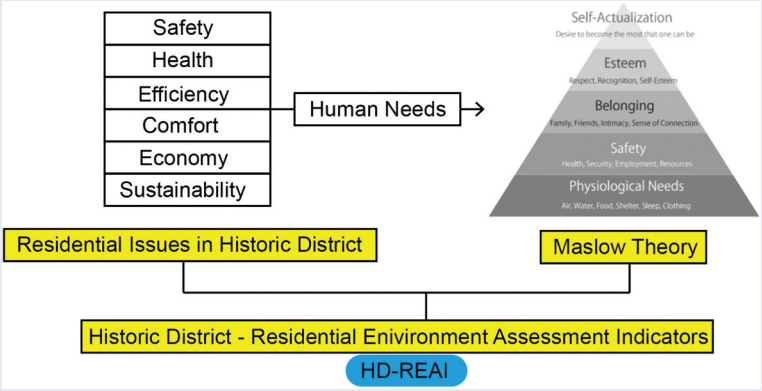
ABSTRACT

Compared to traditional communities, the residential environment in historic districts (HDs) is generally poor. Tourism development within HDs has affected these environments. As tailored assessment indicators are absent in HDs, this study introduces the historic district residential environment assessment indicator (HD-REAI) – a framework designed for the urban setting of HDs. The HD-REAI integrates Maslow's theory and addresses the challenges and attributes of HDs. HD-REAI focuses on factors like housing property rights and district culture, which are pivotal for HDs. This enables a more nuanced and relevant evaluation of the residential environment in these areas. This study details the development of the HD-REAI and validates its efficacy through its application in two Northern Chinese HDs. The results demonstrate that the HD-REAI effectively assesses the environment, offering a specialized and context-sensitive tool. Moreover, different socioeconomic attributes have different effects on the assessment results. This study could provide a basis for constructing more refined and context-specific assessment tools to enhance residential environments in HDs



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Historic district; residential environment assessment indicator; socioeconomic attributes; human needs

1. Introduction

Residential environment is a collective term for the residents' physical, cultural, and social environments. A residential environment consists mostly of dwellings, residential buildings, public services, and outdoor spaces where people meet their needs, participate in various activities, and build social, economic, and neighborhood relationships. Research on residential environments has become increasingly important, given the rapid population growth and urbanization globally over the past three decades (Ng et al. 2017).

Numerous indicators are used to evaluate residential environments to improve residents' lives or urban development. For example, the residential environment assessment indicators (REAIs) were proposed to gauge the fulfillment of basic human needs, including safety, health, efficiency, and comfort (World Health Organization [WHO] 1961). Subsequently, Asami (2001) expanded these indicators by incorporating sustainability and creating a novel assessment approach. Recently, Xiao (2019) added two indicators – district environment and economy – and London incorporated heritage and cultural indicators (Greater London Authority 2021). Regardless of the assessment method, the primary objective is to identify issues and improve residential environments through assessments (Marques and Pitarma 2018).

Despite numerous distinct methods for evaluating residential environments, the evaluation of historic

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districts (HDs) has been overlooked. Hence, studies have failed to uncover the underlying factors, such as the potential cultural and historical aspects that affect residents' residential environments or issues linked to relationships with tourists or neighbors. Given the current absence of tailored assessment frameworks for residential environments in HDs, this study aimed to establish an assessment system for this purpose that can provide a deep and nuanced understanding.

An HD is a section of a city containing historically or architecturally valuable buildings. The criteria for HDs vary from one place to another. In the United States, Charleston's HD showcases a blend of 18th-century residences and cobblestone streets (Harrill and Potts 2003). In Europe, the Jewish Quarter in Prague is a notable HD, preserving medieval synagogues and a rich history (Gaižutytė-Filipavičienė 2020). Globally, HDs have evolved from having singular functions, such as religious (e.g., the Temple Bar in Dublin), commercial (e.g., Le Marais in Paris), and ceremonial (e.g., The Royal Mile in Edinburgh), to contemporary mixed-use, blending commercial, residential, and touristic elements (Shin 2010). This global perspective highlights the challenges in assessing HDs using traditional residential environmental assessment methods, necessitating nuanced approaches.

In Chinese cities, HDs are predominantly commercial and residential mixed-use tourist areas, such as the Wenshu Monastery, the Kuanzhai Alley in Chengdu City, and the Sanxue Street in Xi'an City. Issues have arisen concerning the coexistence of residents and tourists (Dai et al. 2017; Rêgo and Almeida 2022; Romão et al. 2018). Inadequate management has led to problems related to unclear residential property ownership (Qian and Li 2017). Alternatively, owing to prolonged development and a lack of organized and disciplined maintenance, spontaneous and unregulated renovations have led to extensive shanty-town-like areas within HDs. If the existing methods for evaluating residential environments were applied to HDs, the conclusions would likely be incomprehensive, highlighting issues, such as history, culture, and tourism.

In theory, the earliest REAI can be traced back to the four fundamental human needs proposed by WHO in 1961, namely safety, health, efficiency, and comfort (WHO 1961). Therefore, when discussing REAIs, it is imperative to consider the basic human needs. In this regard, Maslow's hierarchy of human needs theory (Maslow 1943) provides a compelling explanation of the aforementioned issue. Maslow proposed that basic human needs comprise five levels – physiological, safety, love and belonging, esteem, and self-actualization. Subsequent research concerning human needs has predominantly built on Maslow's theory (Allen, Muñoz, and Ortúzar 2019; De Haan et al. 2014; Doost Mohammadian and Rezaie 2019; Han et al. 2021; Sheikh and van Ameijde 2022; Zavei and Mohd Jusan 2012). The subject of this study, namely REAIs, is fundamentally concerned with basic human needs. Therefore, this study establishes an HD-REAI based on Maslow's theory.

There are several reasons for choosing Maslow's theory to evaluate the residential environment in HDs. Maslow's hierarchy of human needs provides a comprehensive framework, from physiological to self-actualization needs, helping understand and prioritize improvements in residents' satisfaction and requirements. This framework is particularly adaptable to the unique cultural, historical, and social structures of HDs where traditional residential assessment indicators often fall short. By incorporating basic human needs into the evaluation, it identifies and implements measures to enhance the quality of life, addressing physical, functional, social, and emotional dimensions. This bridges research and practice, guiding policymakers and urban planners to focus on residents' needs and well-being while considering the conservation and development of historic districts. This method effectively analyzes and addresses the complexities and diversities of the living environments in historic districts, creating suitable living conditions for the residents.

In the next sections, this study summarizes current issues with HDs via a literature review and, by combining existing REAIs, we identify the indicators needed for HD-REAIs. Furthermore, it discusses the development of the HD-REAI by incorporating Maslow's theory of human needs. The established indicators are applied to evaluate two HDs – Sanxue Street in Xi'an and Dongxinanyu in Luoyang. The final sections present the results, discussion, and conclusion.

2. Literature review

2.1. Residential environment assessment indicators

The residential environment is a vital component of urban areas and occupies the largest portion of the urban space (Zapušek Černe and Kučan 2009). It primarily consists of housing, residential buildings, public service facilities, and outdoor spaces where people spend time to meet their needs and engage in various activities. Furthermore, the residential environment is defined by spatial and social indicators (Skalicky and Čerpes 2019; Urban Planning Institute of the Republic of Slovenia 2000).

As a part of this study, we conducted an extensive literature review to elucidate the current research gaps pertaining to REAIs. The earliest evaluation indices originated from the fundamental human needs proposed by WHO, which included safety, health, efficiency, and comfort (WHO 1961). Various REAIs have

been proposed for numerous domains. Koizumi (1985) expanded these criteria to include urban infrastructure, district environments, durability, economy, and social aspects. Asami (2001) added sustainability to provide a detailed explanation of each subdomain, while Skalicky and Čerpes (2019) proposed four indicators – environmental, social, functional, and cultural. Furthermore, Harrison et al. (2023) developed the Residential Environment Impact Scale for Clinical Medicine. In China, the Ministry of Housing and Urban-Rural Development (2010) put forth specific requirements for urban infrastructure, district environment, economy, and social aspects. Chinese scholars, such as Xiao (2019), have emphasized the importance of the district environment and economy. In addition, the Greater London Authority (2021) incorporated heritage and culture into its indices. Table 1 presents the major indicators (1–7) proposed in each of the above studies.

2.2. Issues in historic districts

To understand the issues in HDs, we evaluated them within the context of four essential human needs – safety, health, efficiency, and comfort (WHO 1961) – before exploring additional concerns pertinent to the unique traits of HDs based on a literature review.

In residential environments, safety in HDs is crucial for protecting life and property (Asami 2001). WHO emphasizes disaster protection for overall safety (WHO 1961). HDs comprise aging structures, posing structural risks (Qian and Li 2017) and leading to everyday hazards. Traffic safety is a concern because of narrow, busy streets. Moreover, fires in traditional buildings with flammable materials can cause significant losses (Wallace and Wallace 2011; Yuan et al. 2018; Zhou, Zhou, and Chao 2012). HDs pose environmental health risks in buildings with limited spacing, which adversely affect sunlight exposure and ventilation (Chu, Hsu, and Hsieh 2015). Poor housing conditions, exacerbated by inadequate policies, negatively affect health.

The efficiency of HDs can be defined by social infrastructure and transportation facilities. While accommodating tourist amenities (Zhu et al. 2017), the daily needs of residents are often neglected. Balancing historical preservation with modern traffic demands is challenging and impacts the urban fabric and ecological sustainability (Downs 2005; Evans 2002; X. Li et al. 2019; Wang, Sun, and Rodrigues 2019). Building density and public spaces in HDs are crucial factors affecting comfort, while high density and low residential space per capita exceed the recommended levels (Ministry of Housing and Urban-Rural Development of the People's Republic of China 2005).

Safety concerns related to HDs stem from interactions between residents and tourists, leading to disputes over space and resources (Rêgo and Almeida 2022). Urban tourism sustainability requires balancing inhabitants' quality of life with their business needs, with issues arising from tourism saturation and competition for space (Cheung and Li 2019; Milano, Novelli, and Cheer 2019; Postma and Schmuecker 2017; Zhang and Kwong 2017). Property rights in HDs, which have been complex since the 1970 reforms, involve significant institutional management, which affects preservation (Hall and Zhang 1988; Qian and Li 2017). Sustainability in HDs involves focusing on maintaining educational value, public engagement, local identity, and cultural significance, as well as balancing

Table 1. Comparison of existing REAIs.

Indicators of Residential Environment	1	2	3	4	5	6	7
Safety	✓	✓	✓	✓	✓	✓	✓
Natural disasters, traffic hazards, industrial risks, life and property safety							
Health	✓	✓	✓	✓	✓	✓	✓
Physical and mental health, noise, pollution, sunlight exposure, ventilation, natural lighting							
Efficiency	✓	✓	✓	✓	✓	✓	✓
Convenience of daily life, facilities, transportation							
Comfort	✓	✓	✓	✓	✓	✓	✓
Aesthetic quality of the environment, relaxation of body and mind							
Urban Infrastructure		✓	✓				
Water, electricity, gas, roads							
District Environment		✓	✓	✓		✓	
Quality of residences, amount of open space, connectivity of residences to roads							
Durability			✓				
Environmental stability							
Economy		✓	✓	✓		✓	✓
Land fees, residential expenses, environmental maintenance costs, efficient land use							
Social Aspects		✓	✓				
Residential habits, crime prevention, population structure							
Sustainability					✓	✓	✓
Economic sustainability, social sustainability, environmental sustainability							
Resource conservation		✓					
Energy conservation, water conservation							
Heritage and Culture						✓	
Heritage conservation and growth, creative industries							

*Meaning of 1–7: 1. WHO (1961); 2. Ministry of Housing and Urban-Rural Development (2010); 3. Koizumi (1985); 4. Xiao (2019); 5. Asami (2001); 6. Greater London Authority (2021); 7. Indicators considering the HD context

preservation with modern livability (Heath, Oc, and Tiesdell 2013; Yung, Chan, and Xu 2014; Zhong and Kou 2018).

2.3. REAI for HDs

The evolution of residential environment evaluation indices reflects changes in social, economic, and cultural contexts, and an increasing emphasis on environmental sustainability and urban identity. The focus and innovations in the evaluation indices across regions and periods provide valuable perspectives and tools for understanding and improving modern urban residential environments (Table 1). We conducted a detailed categorization of each assessment indicator system. Each indicator included primary and secondary indicators. We list the primary indicators, with their respective secondary indicators, in Table 1.

Currently, there are no REAIs specifically designed for HDs. Based on the issues summarized above and the literature review, we conclude that the essential REAIs for HDs can include safety, health, efficiency, comfort, economy, and sustainability (Column 8 of Table 1).

3. Research design

3.1. Research flow

This study aimed to evaluate HD residential environments and provide implications for enhancing residents' quality of life. Due to the inadequacy of the existing REAIs in accurately describing the living conditions of HD residents, this study proposed refined assessment indicators suitable for HDs by combining the current REAIs with the human needs theory and considering the real situation of HDs. This is termed "HD-REAI" and the process is illustrated in Figure 1. The details of Maslow's hierarchy of human needs theory and the reason for using it to construct the HD-REAI are discussed later.

This study constructed the HD-REAI based on the determined weight of each indicator. For weight determination, the Analytic Hierarchy Process (AHP) was selected. The AHP helps quantify these differences through pairwise comparisons and results in a mathematically-operable weighting system, allowing for an objective assessment of each factor's impact on the residential environment. The AHP can assist decision-makers in systematically analyzing and balancing options in complex, multi-criteria situations to support reliable decision-making (Lipovetsky 2021; Madzík et al. 2022). To facilitate these comparisons, this study utilized the Yaahp software, which is designed for performing AHP analyses and facilitating decision-making by systematically evaluating and prioritizing options based on multiple criteria (Wang and Yan 2023).

This study applied the HD-REAI to two HDs in Northern China, namely Sanxue Street in Xi'an City and Dongxinanyu in Luoyang City. Xi'an and Luoyang are two of China's oldest cities and these two HDs are still in an uncommercialized development stage, preserving their authenticity. Thus, they are considered suitable for studying residential environments. We adopted a questionnaire survey to evaluate the residential environments of the two cities based on the proposed HD-REAI.

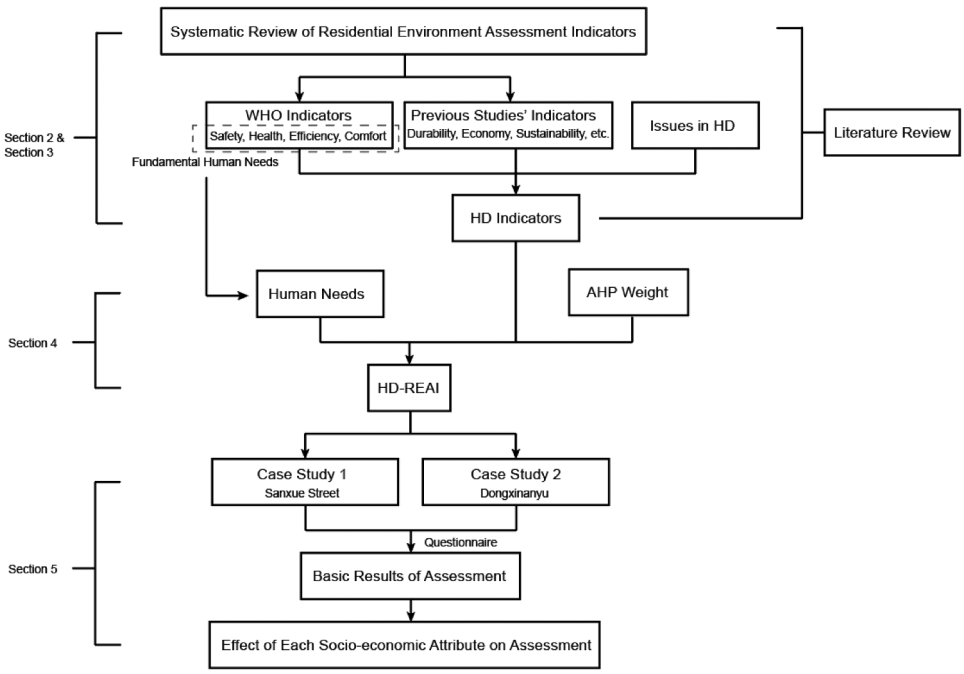


Figure 1. Research flow.

3.2. Introduction of the research cases

This study summarizes the current issues in HDs, such as poor housing quality, lack of basic infrastructure, and confusion over property rights. To ensure the accuracy and depth of research, this study chose two HDs – Xi'an and Luoyang – as case studies. We opted for two case studies instead of one to reduce the potential randomness in the assessment results and enhance the universality of the conclusions. As the oldest cities in China, Xi'an, and Luoyang possess rich cultural and historical values and represent unparalleled significance in the study of residential environment assessments in Chinese historic areas. These two districts have avoided excessive commercial development, preserving their historical authenticity. Hence, they provide an authentic context for assessments that are relatively unaffected by modern commercial influences. Furthermore, in both districts, the majority of the area is residential, with historical areas scattered throughout (Table 2).

In Table 3, we compare two HDs, Sanxue Street and Dongxinanyu. Although both have ancient histories and a high degree of cultural preservation, they differ in terms of commercial development, planning

Table 2. Characteristics of the research cases (illustrated by the Author based on Baidu Map, Baidu 2004).

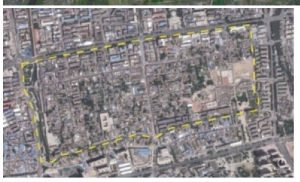
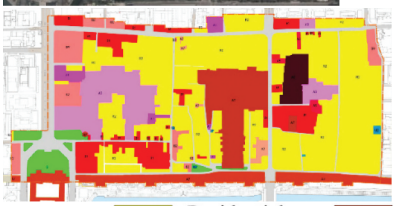
	Sanxue Street	Dongxinanyu
Location of Cities		
Location of Districts		
Satellite Photos of Districts		
Land Use Map (Legend)		

Table 3. Features of Sanxue Street and Dongxinanyu.

Feature	Sanxue Street	Dongxinanyu
City History	Ancient	Ancient
Commercial Development	Minimal	Minimal
Authenticity Retention	High	High
Start of Planning	2020	2018
Primary Issues	Poor housing quality, lack of basic infrastructure, property rights confusion	Traditional residence preservation, historical atmosphere with HD issues
Current Research Focus	Urban Morphology (Qian and Li 2017), District Protection (Qian 2007)	District morphology (Chinese Research), historical space preservation (Chinese Research)
Lack of Research	Resident-focused studies	Resident-focused studies
Land Use	Mostly residential with scattered historical areas	Mostly residential with scattered historical areas
Figure Reference	Middle part of Figure 2	Bottom part of Figure 2

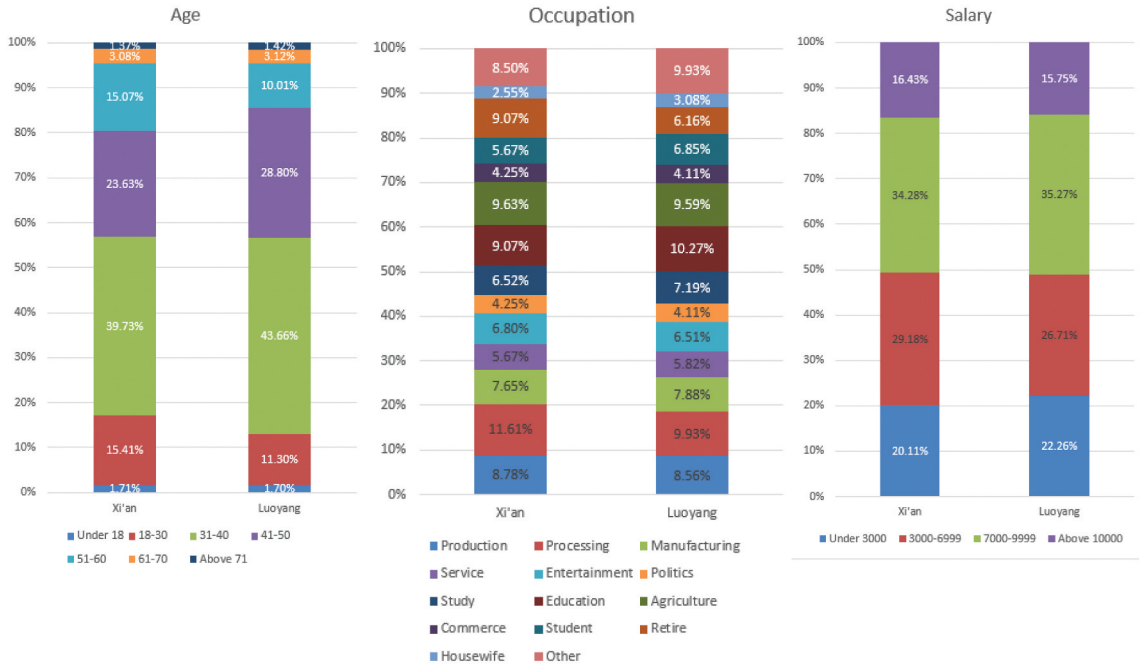


Figure 2. Questionnaire attributes.

periods, challenges, and research focus. Sanxue Street faces poor housing quality and property rights, whereas Dongxinanyu emphasizes traditional residential protection and historical ambiance, with research concentrating on regional morphology and shop rents. Both areas require further research regarding their residents, the prevalence of residential zones, and the scattered historical areas.

The HD-REAI was applied to conduct a comprehensive assessment of living conditions in these areas. Owing to the difficulty in quantifying certain indicators, such as district memory and cultural identity, a questionnaire survey was implemented to allow the residents to subjectively score these indicators, reflecting their thoughts and opinions.

3.3. Questionnaire content

A questionnaire was designed to evaluate the HDs' residential environments. This survey was based on the HD-REAI established in the current study, to gain a deeper understanding of residents' subjective perceptions and satisfaction with their residential environments.

As different socioeconomic attributes affect residents' assessment of the residential environment (Kabisch et al. 2022; J. Li et al. 2023; Umar et al. 2021), the questionnaire surveyed the socioeconomic attributes of the respondents, including their age, occupation, and salary. This information is crucial in revealing residents' perceptions and needs regarding HD residential environments based on their socioeconomic backgrounds. Understanding these details helps to identify potential patterns and trends in the assessment results.

Based on a score from 0–10 (minimum to maximum) for the tertiary indicators, an assessment of the residential environment was collected from each respondent. Offering 11 levels allowed the participants to quantitatively and subjectively rate each indicator. The survey was conducted between October 8 and 2 November 2023. The surveys were distributed in person on Sanxue Street and in Dongxinanyu, and through mobile platform deployment. A total of 353 responses were obtained from Xi'an and 292 from Luoyang. During the analysis, the average score of each indicator was analyzed, providing a preliminary analysis of the districts' evaluations. Subsequently, we analyzed the impact of the socioeconomic attributes (age, occupation, and salary) on the results.

4. Historic district residential environment assessment indicator

4.1. Human needs theory in relation to REAIs

The research indicators originate from the initial concepts put forth by WHO and are deeply rooted in the understanding of fundamental human needs. These original concepts from WHO are based on Maslow's hierarchy of needs theory. Maslow categorized human needs into five levels – physiological, safety, love and belonging, esteem, and self-actualization (Maslow 1943; Maslow et al. 1987). This theory provides a comprehensive framework for understanding human needs and guides the systematic evaluation of residential environments. The most common criticism of Maslow's theory concerns the rigidity and linearity of the hierarchy of needs (Wahba and Bridwell 1976). Maslow et al. (1987) later revised his writings, stating that the hierarchy of needs is "almost never

that strict," and that it is inaccurate to assume "a need must be 100% satisfied before a new need emerges." Therefore, this study does not strictly adhere to the hierarchical divisions when applying Maslow's theory. Instead, each level of need is integrated with relevant urban domains. Consequently, within the framework constructed in this study, there is no rigid hierarchical division.

Relatively limited research exists in the field of urban studies based on Maslow's hierarchy of needs. The focus of such research includes emphasizing the connection between sustainability and livability (De Haan et al. 2014; Doost Mohammadian and Rezaie 2019; Sheikh and van Ameijde 2022), satisfaction with public transportation (Allen, Muñoz, and Ortúzar 2019), housing attributes (Zavei and Mohd Jusan 2012), and resident demands (Han et al. 2021). Maslow's theory is largely associated with the human experience within urban research.

4.1.1. Physiological needs

Physiological needs are the most fundamental human needs (Maslow 1943). Maslow emphasized that physiological needs primarily pertain to essential bodily needs that humans must fulfill for survival, ensuring the minimal conditions for human existence. In urban studies, alongside the demand for oxygen, water, and food, elements, such as natural lighting, sunlight, and ventilation, which ensure good health (Waheeb and Hemeida 2022), are included in the category of physiological needs.

4.1.2. Safety needs

These requirements drive the pursuit of protection, stability, and order. Safety needs encompass personal, housing, and financial security. These interpretations are consistent with the safety indicators proposed in this study. In addition, we believe that ensuring residential safety through housing, transportation facilities, and welfare services (Sheikh and van Ameijde 2022) is an essential element that caters to safety needs.

4.1.3. Love and belonging needs

These needs include giving and receiving affection, enjoying friendships and companionship, and establishing close and frequent interpersonal relationships. Appleyard (1980) emphasized that livable streets can foster a sense of play and activity, providing places for community engagement and building. Gehl (2013) highlighted the importance of public space quality and design in promoting social integration. Community facilities, such as daycare centers, senior support centers, and centers for individuals with physical or mental disabilities, contribute to enhancing social integration and a sense of belonging.

4.1.4. Esteem needs

These needs represent a desire for a high sense of self-worth. They involve self-esteem, respect, and appreciation. Satisfying these needs brings confidence, a sense of competence, and a belief in being valuable, useful, and necessary for society. Opportunities to acquire new skills, face challenges, and provide quality housing that reflects user values can fulfill these needs (Donovan 2010). Other urban planning measures supporting the need for respect include sports, education, culture, retail, and recreational facilities.

4.1.5. Self-actualization needs

This need refers to the desire to fulfill one's true nature, realize one's potential, and achieve one's ideal life. Measures to promote self-actualization in urban planning contribute to the long-term development of individuals and communities, such as promoting health and well-being, education, skill training, and artistic expression. Schools and vocational training centers can assist in career improvement or entrepreneurship, thereby, facilitating social mobility. Donovan (2010) suggested that residents' involvement in community service and facility planning can help individuals realize their potential, and better meet the needs and desires of the local community.

4.1.6. Summary

Table 4 summarizes the relationship between Maslow's hierarchy of human needs and the HD-REAI. Physiological needs are linked to health and sustainability, safety needs are linked to safety, efficiency, and economy, love and belonging needs are linked to efficiency, comfort, and

Table 4. Correlation between human needs and HD-REAI.

		HD REAI					
	Conditions of Indicators	Safety	Health	Efficiency	Comfort	Economy	Sustainability
Physiological Needs	Environment Needs		●				
	Personal Health		●				●
Safety Needs	Living Safety	●					
	Security Facilities			●			
	Financial Security					●	
Love & Belonging Needs	Community Care Facilities			●			
	Public Space				●		
	Community Belonging						●
Esteem Needs	Cultural & Recreation Facilities			●			
	Housing Quality	●					
	Relation with Society						●
Self-actualization Needs	Community Safety	●					
	Self-improvement Facilities			●			
	Community Participation						●

sustainability, and esteem and self-actualization needs are linked to safety, efficiency, and sustainability.

4.2. HD assessment indicators based on the Human needs theory

By incorporating the analysis of human needs and their relationship with the HD issues identified previously, we established an HD-REAI comprising 6 primary indicators, 14 secondary indicators, and 30 tertiary indicators. The AHP methodology was employed to determine the weights of the assessment indicators for the HDs' residential environments, which decomposed the problem into a hierarchical structure, starting from goals, criteria, and sub-criteria. This study invited five experts to participate in determining the weights to ensure the comprehensiveness of the results. Two of these experts were academic specialists in urban planning and architecture from Xi'an University of Architecture and Technology, while the other three were project experts from China Northwest Architectural Design and Research Institute Co., Ltd., with practical experience in HD renovation projects. After receiving feedback from all five experts, their results were averaged. The final indicators and the corresponding weights are shown in Table 5.

5. Results

5.1. Results of the questionnaire survey

A questionnaire was administered to evaluate the HDs' residential environments. Of the 353 participants in Sanxue Street and 292 in Dongxinanyu who provided valid responses, 51.8% were male and 48.2% were female in Xi'an, while 52.1% were male and 47.9% were female in Luoyang. The average salary of the respondents was 6,800 CNY, which conformed to Chinese standards (based on the average annual wage of employees in large-scale enterprises in 2022). Since the research focused on a specific target area, all the questionnaires were gathered from the residents living on Sanxue Street and Dongxinanyu. The socioeconomic distribution of the respondents, including age, occupation, and salary, is illustrated in Figure 2.

The statistical results are presented in Table 6. To analyze the scores for each primary and secondary indicator, calculation of weights was omitted, focusing solely on computing the averages to assess each indicator. The scores for the indicators in Xi'an and Luoyang were consistent. In the subdivision areas, among the primary indicators, efficiency and comfort were rated high, while safety and health received lower scores. The tertiary indicators of efficiency and comfort are related to social infrastructure, which demonstrates that the social infrastructure in these two districts is relatively well-developed. However, the indicators for safety and comfort, which are mostly related to resident care, show that, although the infrastructure is well-established, it does not adequately consider residents' needs.

5.2. Evaluation results of residential environments combining the proposed indicators and questionnaire

After obtaining the results, this study first conducted a correlation analysis to determine whether the six

Table 5. HD-REAI with weight.

HD-REAI		
Primary indicators	*Secondary indicators*	*Tertiary indicators*
Safety (0.22)	Basic Safety (0.52)	Building Quality (0.44)
		Traffic Safety (0.24)
		Fire Safety (0.32)
	Esteem Safety (0.26)	Residence Quality (0.64)
		Relation with Tourists (0.36)
	Self-actualization Safety (0.22)	Welfare (0.5)
		Community Safety (0.5)
Health (0.20)	Physiological Health (1)	Sunlight (0.52)
		Ventilation (0.22)
		Lighting (0.26)
Efficiency (0.22)	Safety Efficiency (0.35)	Medical Facility (0.52)
		Transportation Facility (0.37)
		Police Facility (0.11)
	Love & Belonging Efficiency (0.20)	Community Center (0.43)
		Elderly Daycare Center (0.57)
	Esteem Efficiency (0.33)	Culture Facility (0.40)
		Recreational Facilities (0.60)
	Self-actualization Efficiency (0.12)	Education Facility (0.75)
		Entrepreneurship Center (0.25)
Comfort (0.16)	Love & Belonging Comfort (1)	Public Space (0.52)
		Building Density (0.48)
Economy (0.09)	Safety Economy (1)	Property Security (0.46)
		Housing Property Right (0.54)
Sustainability (0.11)	Physiological Sustainability (0.21)	Personal Health (1)
	Love & Belonging Sustainability (0.39)	Community Activity (0.61)
		District Memory (0.39)
	Esteem Sustainability (0.17)	Cultural Identity (0.62)
		Neighborhood Relation (0.38)
	Self-actualization Sustainability (0.23)	Community Service Participation (0.71)
		Community Planning Participation (0.29)

Table 6. Results of the evaluation based on HD-REAI using questionnaire surveys.

Primary indicators	A	B	Secondary indicators	A	B	Tertiary indicators	A	B
Safety	6.06	6.00	Basic Safety	6.15	6.10	Building Quality	6.37	6.34
						Traffic Safety	5.92	5.96
						Fire Safety	6.02	5.89
			Esteem Safety	5.93	5.97	Residence Quality	5.85	5.97
						Relation with Tourists	6.07	5.97
			Self-actualization Safety	5.99	5.79	Welfare	6.00	5.90
						Community Safety	5.98	5.67
Health	6.25	6.29	Physiological Health	6.25	6.29	Sunlight	6.52	6.52
						Ventilation	6.02	5.99
						Lighting	5.89	6.08
Efficiency	6.67	6.66	Safety Efficiency	6.84	6.81	Medical Facility	7.22	7.20
						Transportation Facility	6.38	6.39
						Police Facility	6.60	6.40
			Love & Belonging Efficiency	6.65	6.60	Community Center	6.67	6.45
						Elderly Daycare Center	6.64	6.71
			Esteem Efficiency	6.54	6.57	Culture Facility	6.76	6.66
						Recreational Facility	6.39	6.51
			Self-actualization Efficiency	6.53	6.54	Education Facility	6.54	6.59
						Entrepreneurship Center	6.49	6.39
Comfort	6.53	6.57	Love & Belonging Comfort	6.53	6.57	Public Space	6.78	6.78
						Building Density	6.25	6.34
Economy	6.21	6.15	Safety Economy	6.21	6.15	Property Security	6.34	6.31
						Housing Property Right	6.09	6.01
Sustainability	6.27	6.31	Physiological Sustainability	6.63	6.63	Personal Health	6.63	6.63
			Love & Belonging Sustainability	6.16	6.24	Community Activity	6.06	6.22
						District Memory	6.31	6.28
			Esteem Sustainability	6.18	6.27	Cultural Identity	6.23	6.23
						Neighborhood Relation	6.11	6.32
			Self-actualization Sustainability	6.21	6.15	Community Service Participation	6.15	6.08
						Community Planning Participation	6.35	6.32

*A. Sanxue Street; B. Dongxinanyu.

primary indicators were independent or interrelated. Due to the close similarity between the two sets of data, this study combined them and performed a Pearson correlation analysis. The Pearson correlation coefficient measures the degree of linear association between two variables, ranging from −1 to 1. Values close to 1 or −1 indicate a strong correlation, suggesting that as one variable increases, the other either increases (positive correlation) or decreases (negative correlation) accordingly. Conversely, values near zero suggest no or weak correlations between the variables. Significance testing was conducted to determine whether the observed correlation was statistically significant, implying that the correlation was unlikely to have occurred by chance. The results are shown in Table 7.

As shown in Table 7, the significance between the variables is all at the 0.01 level, indicating a strong statistical significance among the indicators. Additionally, the Pearson correlation coefficients between the variables all fall between 0 and 1, indicating a positive correlation among the indicators. In other words, as one indicator increases, the others tend to increase as well.

To further examine the influence of the socioeconomic attributes on the evaluation results, a multivariate regression analysis was employed. The total score calculated using the AHP was designated as the dependent variable, while age and salary were set as independent variables.

Table 8 presents the results of the multiple regression analyses conducted for Sanxue Street and Dongxinanyu. The aim was to investigate the impact of the independent variables on the dependent variable's "overall" score.

"Unstandardized coefficients" represent the magnitude of the impact of each independent variable on the "overall" score. For instance, in Xi'an, the unstandardized coefficient for age was −.147, while in Luoyang, it was −.208. This indicated that for every unit increase in age, the "overall" score decreased by .147 in Xi'an and .208 in Luoyang. "Standardized coefficients" (beta) allow for a comparison of the relative impact of different variables while accounting for their varying scales. In Xi'an, the standardized coefficient for age was −.142, whereas in Luoyang, it was −.191. This implied that age negatively impacted the "overall" score in both cities, with a slightly stronger influence in Luoyang.

"t-values" measure the statistical significance of each variable's coefficient. In Xi'an, the t-value for age was −2.735, and in Luoyang, it was −3.308. These indicated that the impact of age on the "overall" score was statistically significant in both cities, as they significantly exceeded the threshold (typically used for a significance level of $p < 0.05$). "Significance" represents the p-value associated with each coefficient, indicating its statistical significance. In Xi'an, the p-value for age was .007 and in Luoyang, it was .001. These low p-values further confirmed the highly significant effect of age on the "overall" score in both cities.

The regression analyses revealed that as residents age, their assessment of the residential environment

Table 7. Results of the Pearson correlation analysis.

		Safety	Health	Efficiency	Comfort	Economy	Sustainability
Safety	P	1	.123**	.136**	.150**	.121**	.132**
	S		.002	.001	.000	.002	.001
Health	P	.123**	1	.165**	.229**	.128**	.130**
	S	.002		.000	.000	.001	.001
Efficiency	P	.136**	.165**	1	.237**	.235**	.114**
	S	.001	.000		.000	.000	.004
Comfort	P	.150**	.229**	.237**	1	.194**	.181**
	S	.000	.000	.000		.000	.000
Economy	P	.121**	.128**	.235**	.194**	1	.139**
	S	.002	.001	.000	.000		.000
Sustainability	P	.132**	.130**	.114**	.181**	.139**	1
	S	.001	.001	.004	.000	.000	

P. Pearson Correlation Coefficient.
S. Significant
**. The correlation is significant at the 0.01 level.

Table 8. Multiple linear regression analysis.

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Standard Error	Beta	t-value	Significance
Xi'an	(Constant)	6.292	.258		24.372	<.001
	Age	−.147	.054	−.142	−2.735	.007
	Salary	.228	.062	.191	3.669	<.001
Luoyang	(Constant)	6.993	.300		23.137	<.001
	Age	−.208	.063	−.191	−3.308	.001
	Salary	.055	.072	.045	.770	.442

declines. In addition, occupation and monthly salary do not significantly impact the final evaluation results.

6. Discussion

In constructing the HD-REAI, this study employs Maslow's hierarchy of human needs theory, which, despite its flaws – specifically the criticism regarding the rigidity and linearity of the need sequence (Wahba and Bridwell 1976) – avoids this issue. The application of the need hierarchy in this study does not strictly follow a linear order, instead discusses each need separately. Based on the established system and the actual feedback gathered from residents through questionnaire surveys, this study posits that in urban studies, it is not necessary to strictly adhere to the linear sequence of Maslow's hierarchy of human needs; discussing each need separately is viable.

Our assessment of the residential environment in HDs in China indicates that occupation and salary have a relatively minor impact on residents' assessments. This finding challenges the traditional notion in Western countries that socioeconomic attributes are the primary determinants of satisfaction with the residential environment (Kabisch et al. 2022; Umar et al. 2021). In the context of Chinese HDs, residents' assessments of their residential environment are influenced by the area's unique historical and cultural factors (Zhang and Han 2022). This suggests that in evaluating HD residential environments, reliance on traditional socioeconomic models is insufficient due to the significant differences between the HDs and traditional community residential environments.

Compared with ordinary communities, HDs comprise aging structures, which have structural risks (Qian and Li 2017) and lead to everyday hazards. Traffic safety is a concern due to the narrow, busy streets. Moreover, fires in traditional buildings with flammable materials can cause significant losses (Wallace and Wallace 2011; Yuan et al. 2018; Zhou, Zhou, and Chao 2012). HDs pose environmental health risks in buildings with limited spacing, which adversely affect sunlight exposure and ventilation (Chu, Hsu, and Hsieh 2015). Poor housing conditions, exacerbated by inadequate policies, negatively affect health. Hence, the convenience of HDs can be defined by social infrastructure and transportation facilities. While accommodating tourist amenities (Zhu et al. 2017), the daily needs of residents are often neglected. Balancing historical preservation with modern traffic demands is challenging and impacts urban and ecological sustainability (Downs 2005; Evans 2002; Wang, Sun, and Rodrigues 2019). Building density and public spaces in HDs are crucial factors affecting comfort, while high density and low residential space per capita exceed the recommended levels (Ministry of Housing and Urban-Rural Development of the People's Republic of China 2005).

This study indicated that age plays a more significant role than occupation or salary in assessing the residential environment in HDs in China. This reflects the significant differences in residential environmental needs among different age groups. Younger residents prefer areas with vibrant social atmospheres and convenient transportation (Shin and Tilahun 2022); however, older residents prioritize safety and accessibility to medical services (Chen et al. 2022). This difference involves lifestyle choices and changes in needs at different life stages. Therefore, planning and improvement efforts in HDs must consider residents' age distribution to ensure that the needs of all age groups are met. For example, cultural activities and social spaces for young people should be provided while offering better medical facilities and a safe residential environment for the elderly.

Regarding specific socioeconomic attributes, older people in China have higher satisfaction with the residential environment than younger people (Mridha 2020), which is similar to the findings of this study. Thus, age is significantly and positively correlated with evaluations of the residential environment. Regarding occupation and salary, which represent social status (Hollingshead 1975), the higher the social status, the higher the satisfaction with the residential environment (Rigby and Vreugdenhil 1987). However, this study shows that social status is not significantly related to the assessment of the residential environment. Owing to the lack of recent research, there is a need for further exploration of the relationship between the residential environment in Chinese HDs and social status.

In addition to occupation, salary, and age, other factors influencing residents' satisfaction with Chinese HDs should be considered. These include education level, length of residence, and individuals' attitudes toward history and culture (Sadeghlou and Emami 2023). Long-term HD residents in China may have developed deep emotional connections with the area, influencing their community evaluation (Li et al. 2023); however, newcomers may have greater expectations regarding modern facilities and services. In addition, residents' attitudes toward history and culture can impact their evaluation of the residential environment, especially in districts that value cultural heritage preservation (Fabbricatti, Boissenin, and Citoni 2020). For residents in these areas, maintaining and promoting their historical and cultural heritage can be as important as access to modern facilities.

The major contribution of this study is that it challenges the traditional notion that socioeconomic attributes are the primary determinants of residential environment satisfaction. Through the assessment of HD residents, this study found that occupation and salary had a lower impact on residential environment satisfaction; age being a more significant factor. This finding contrasts with the emphasis on socioeconomic

attributes in Kabisch et al. (2022) and Umar et al. (2021). Moreover, this study underscores the influence of historical and cultural factors on residential satisfaction – aspects that have not been sufficiently addressed in the studies by Zhang and Han (2022) and Gu et al. (2022).

The study revealed significant differences in residential environment needs among various age groups. Young residents prefer areas with vibrant atmospheres and convenient transportation, while older residents prioritize safety and accessibility to medical services (Chen et al. 2022). Moreover, opportunities to meet others are essential for the elderly. These arguments highlight the necessity for planning and improvement efforts in HDs, considering the age distribution of the residents.

Based on the discussion of Maslow's hierarchy of needs theory and the socioeconomic indicators derived from survey results, this study contends that the established HD-REAI is a robust indicator system for effectively assessing the residential environment within HDs. This indicator system, originating from the existing REAI and tailored for HDs, incorporates unique indicators relevant to HDs, such as those related to history, culture, and tourism.

7. Conclusion

This study contributes to residential environment assessment in HDs by addressing the gaps in existing research, that is, a lack of an REAI specifically for HDs. This study, based on Maslow's theory of human needs, constructs an REAI tailored to HDs, filling this gap. Recognizing the unique characteristics of HDs and their challenges, such as coexistence issues between residents and tourists, this study underscores the need for a specialized approach to assess residential environments. Drawing on WHO's foundational work on human needs and Maslow's widely recognized theory of human needs, we constructed a comprehensive assessment system tailored to HDs. This system integrates a broad spectrum of needs, ranging from physiological to self-actualization, reflecting the multidimensional nature of human experiences in these HD environments.

A key aspect of this study was the systematic review and analysis of existing residential environment assessment methods juxtaposed with the conditions unique to HDs. This process led to the identification and adaptation of relevant indicators that aligned with the reality of life in HDs. Furthermore, the application of these indicators in the case studies of Sanxue Street and Dongxinanyu, through questionnaire surveys, provided valuable insights into how these indicators function in real-world scenarios. The results highlight the importance of socioeconomic attributes, such as age, in shaping residents' perceptions and needs within HDs.

The newly developed indicators of the HD-REAI can effectively assess the residential environment in HDs, offering a pathway for feedback on current living conditions and targeted improvements. This is crucial in the context of rapidly urbanizing societies where the preservation of cultural heritage and improvement of residential quality must coexist harmoniously.

This study paves the way for further research and application of these indicators to other HDs, potentially leading to more refined and context-specific assessment tools. It opens avenues for policymakers and urban planners to integrate these indicators into their decision-making processes, ensuring that development and preservation strategies in HDs align with the actual needs and aspirations of their residents.

However, the study has certain limitations. The socioeconomic attributes queried in the questionnaire were inadequate. In the SPSS statistical analysis, it was found that occupational attributes do not adequately explain the model, and there is some overlap with salary attributes. If occupational attributes were excluded, relying solely on age and salary would be insufficient to fully reflect the impact of socioeconomic attributes. Other related attributes, such as duration of residence and educational level, should be considered. This study only considered residents' attitudes. Other factors, such as land use and transportation conditions, ought to be incorporated in future analysis.

In conclusion, this study marks a significant step toward a more humancentric and culturally-sensitive approach to assessing and enhancing residential environments in HDs, providing a template that can be adapted and applied in similar contexts globally.

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