Research on the Evaluation and Strategy of Streets in the Central Urban Districts of Beijing from the Perspective of the Healthy Streets

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Abstract

Urban greenways are landscaped, traffic-calmed pathways that connect natural and artificial elements within urban environments (Ngo et al. 2018). Active travel corridors, a key typology of urban greenways, emphasize upgrading existing streets to accommodate walkers and cyclists (Horte and Eisenman 2020). Streets, as a critical component of non-motorized traffic systems, play a pivotal role in providing infrastructure that supports the health benefits of active travel (Scheepers et al. 2015). Health-oriented street design is vital in addressing global urban health challenges (Ge et al. 2020). Establishing a Healthy Streets Evaluation System is essential for guiding street upgrades that foster a supportive environment for active travel. However, China lacks a systematic and localized framework for evaluating healthy streets, and there is a lack of extensive research on healthy street evaluation and related strategies. This paper, based on the current situation of Beijing’s urban streets, improves upon the Healthy Streets framework from London, UK, and develops a comprehensive evaluation system with 22 indicators. The evaluation covers 1,510 streets in the central urban districts of Beijing, identifying key issues and their underlying causes. Results show that the overall score for Beijing’s Healthy Streets is relatively low. While urban street greening and bicycle path quality received high ratings, the insufficient effective lane width for walking and cycling emerged as a critical issue many streets face. The paper concludes that Beijing’s streets face dual challenges in spatial design and governance, recommending systematic governance by relevant authorities to foster healthier street environments. We believe our evaluation and proposed strategies will assist policymakers in developing active travel corridors, promoting the sustainability of urban greenways, and maximizing their health benefits.

Keywords: urban greenway, active travel corridors, urban street, the Healthy Streets, evaluation system

Introduction

Urban greenways are linear public spaces that connect natural and artificial elements within cities, gaining increasing attention in recent years (Fábos and Ryan 2006). Active travel positively impacts cardiovascular and mental health (Adamos et al. 2020). Active travel corridors, a subset of urban greenways, focus on transforming existing streets to improve the convenience and safety of walking and cycling (Horte and Eisenman 2020). Streets are key components of urban public spaces (Jacobs 1961) and play an essential role in supporting the development of a healthy city (Yu et al. 2021). Healthy street design aims to enhance urban health by improving the quality of public spaces. London's Healthy Streets initiative, through the creation of active travel corridors,

significantly increased the accessibility and safety of non-motorized traffic (Plowden 2019). The Beijing government views healthy streets as a core strategy for building a healthier city. However, Beijing's streets currently face challenges such as the ineffective protection of pedestrian and cyclist rights, uneven spatial resource allocation, rough design practices, and insufficient consideration of human-centered design (Zhang 2023).

Establishing a health-oriented street evaluation system is crucial for assessing and enhancing the health benefits of streets while providing a reference for creating active travel corridors. The Healthy Streets Approach, initially developed in London, has been adopted by countries such as Australia, Singapore, and New Zealand. However, China's localized evaluation system for healthy streets remains underdeveloped and has limited application (Ding and Wang 2024). This hinders the accurate identification of urban street health issues, as well as the sustainable development of active travel corridors and urban greenways.

This paper proposes a healthy street evaluation system tailored to Beijing, providing scientific evidence for street design and renovation, and contributing to the development of active travel corridors and urban greenway systems.

Background and Literature Review

The concept of greenway planning dates back to the 19th century, with the Boston Park System, designed by Frederick Law Olmsted, being recognized as the first greenway (Fábos 2004). By the latter half of the 20th century, urban greenways had become integral to sustainable urban planning, serving as a core component of "green infrastructure." These greenways help mitigate urban heat island effects, enhance biodiversity, and contribute to the development of healthy urban transportation networks (Lyapin and Druzhinina 2019).

Research on urban greenways primarily examines their ecological, social, and health impacts. Ecologically, urban greenways function as corridors that facilitate species movement and promote urban ecosystem balance (Ren et al. 2015). Proper plant configurations within greenways can significantly reduce air temperatures and improve the overall thermal environment (Li et al. 2020). Socially, studies indicate that the public prioritizes the social and recreational functions of urban greenways over their environmental benefits (Larson et al. 2016). Additionally, urban greenways play a crucial role in fostering community development and enhancing social cohesion (Li et al. 2024). From a health perspective, urban greenways are vital for promoting active travel and improving public health (Horte and Eisenman 2020). They encourage walking and cycling, which reduce the risk of chronic diseases, enhance quality of life, and improve mental health (Berglund et al. 2016). Proximity to urban greenways has been shown to increase physical activity, particularly low-intensity activities such as walking (Zhang et al. 2019).

Recent studies highlight the significance of active travel corridors as essential components of urban greenways. These corridors aim to transform existing streets into spaces conducive to walking and cycling (Horte and Eisenman 2020). Streets play a crucial role in supporting public health and urban well-being (Wang 2016). The concept of healthy streets originated from public health and healthy city initiatives (Ge et al. 2020). Early strategies for renewing healthy streets

were based on the "Complete Streets" concept, which sought to provide equitable road systems for all modes of transportation through improved infrastructure (Ritter 2007). In 2014, Lucinda Saunders introduced the "Healthy Streets Approach" , a method for evaluating the impact of urban and transport elements on public health (Wei 2021). Chinese scholars have extensively researched the evaluation indicator system of the Healthy Streets Approach (Ge et al. 2020). One category of research established a new evaluation framework (Li et al. 2019), while another category revised the original indicator system based on the UK's "Healthy Streets Approach" (Cao et al. 2023). Although these evaluation systems provide valuable insights, their applicability is limited, and they fail to fully capture the practical challenges faced by urban streets (Ding and Wang 2024). This paper applies the optimized Healthy Streets Approach to evaluate streets in the central urban districts of Beijing, identifies spatial issues, and proposes strategies to enhance active travel corridors.

Method and Data

The Healthy Streets approach empirically evaluates people's sensory experiences on streets through a combination of qualitative and quantitative evaluation, structured around 10 indicators (Saunders 2019) (Fig. 1). The Healthy Streets Check for Designers is the primary evaluation tool of the Healthy Streets Approach, featuring a matrix with 10 indicators and 31 sub-indicators, each categorized into four levels (0 to 3) according to spatial quality.

The Healthy Street approach is characterized by a flexible and open indicator framework. Since 2019, countries such as Australia, Singapore, and New Zealand have adapted sub-indicators based on localized street characteristics, thereby developing context-specific evaluation systems. To enhance accuracy and applicability,the Healthy Street approach should take into account factors such as urban scale, demographic composition, and street functionality, allowing for appropriate adjustments（McIntosh et al. 2021）.

Building upon the 31 sub-indicators of the London Healthy Streets approach, the paper applies the SMART principles (Street Nature, Relevant, Measurable, Timeliness, Attainable) to refine the selection process, ensuring both scientific rigor and practical feasibility. The selected indicators must align with the intrinsic characteristics of streets, accurately reflecting their functions while maintaining relevance to local conditions. The selection process also prioritizes measurability, ensuring efficient data collection and cost-effectiveness. Moreover, the evaluation standards remain up-to-date by incorporating the latest design guidelines. Finally, the evaluation targets must be attainable, bridging theoretical frameworks with real-world applications to establish a scientifically robust and practically viable evaluation system for healthy streets. Following these principles, the paper ultimately identifies 10 primary indicators and 22 sub-indicators, forming a structured and comprehensive assessment framework.

Before the survey, the research team gathered data such as CAD street layout maps, traffic volume statistics, and speed limits. Team members employed photography and GoPro recordings to document street images and footage. Using the adjusted HSCD evaluation tool, the team assessed street spatial elements against predefined criteria, calculating the final scores accordingly.

The paper focuses on the central urban districts of Beijing, as defined in the *Beijing Urban Master Plan (2016－2035)*. Excluding inaccessible urban roads, such as internal roads within residential complexes, campuses, and institutions, a total of 1,510 roads were selected as the evaluated subjects.(Fig. 3).

Figure 1. The 10 Healthy Streets Indicators

	Everyone feels welcome	Easy to cross	Shade and shelter	Things to see and do	Not too noisy	People choose to walk and cycle	People feel safe	Things to see and do	People feel relaxed	Clean air
Bidirectional Motorized Traffic Flow	✓	✓	_	_	_	✓	✓	_	✓	_
Impact of Large Vehicles on Cycling	✓	_	_	_	_	✓	✓	_	✓	_
Motorized Traffic Noise During Peak Hours	✓	_	_	_	✓	✓	_	_	✓	_
Crossing Facilities on Road Sections	✓	✓	_	_	_	✓	✓	_	✓	_
Types and Applicability of Crossing Facilities at Intersections	✓	✓	_	_	_	✓	✓	_	_	_
Pedestrian Crossing Convenience at Signalized Intersections	✓	✓	_	_	_	✓	✓	_	✓	_
Clear and Continuous Pedestrian Path Width	✓	_	_	✓	_	✓	✓	_	✓	_
Pedestrian and Cycling Shared Lane Conditions	✓	✓	_	_	_	✓	✓	_	✓	_
Conflict Between Cycling and Turning Vehicles	✓	_	_	_	_	✓	✓	_	✓	_
Effective Width of Bicycle Lanes	✓	_	_	_	_	✓	✓	_	✓	_
Impact of Roadside Activities on Cycling	✓	_	_	_	_	✓	✓	_	✓	_
Quality of Road Surface for Motor Vehicles	✓	_	_	_	_	✓	✓	_	✓	_
Quality of Pedestrian Path Surface	✓	✓	_	_	_	✓	✓	_	✓	_
Public Space Surveillance	✓	_	_	✓	_	✓	✓	_	✓	_
Lighting	✓	_	_	_	_	✓	✓	_	✓	_
Bicycle Parking Facilities	✓	_	_	_	_	✓	✓	_	✓	_
Street Greening	✓	_	✓	✓	✓	✓	✓	✓	✓	✓
Walking Distance Between Rest Areas	✓	_	_	✓	_	✓	_	✓	✓	_
Factors Affecting Public Transit Travel Time	✓	_	_	_	_	✓	_	_	✓	_
Accessibility of Bus Stops	✓	_	_	_	_	✓	✓	_	✓	_
Connectivity Between Public Transport and Other Modes	✓	_	_	_	_	✓	_	✓	✓	_
Free Accessibility from Street to Station	✓	_	_	_	_	✓	_	✓	✓	_

Figure 2. The 22 sub-indicators

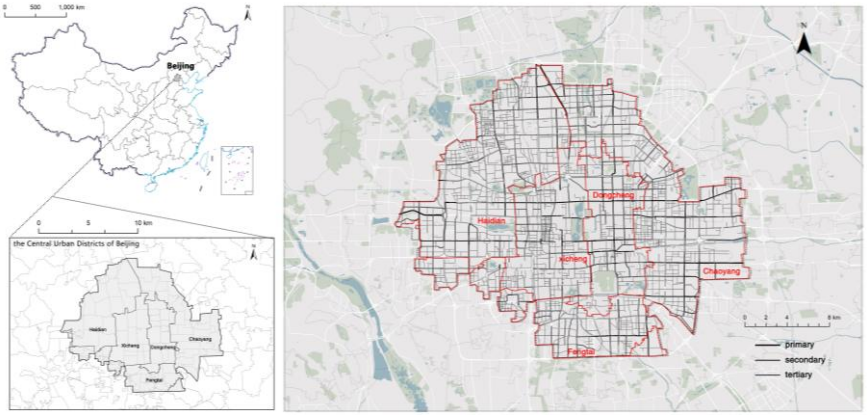

Figure 3. Scope of the study and evaluated streets

Results

The average score for healthy streets in the central urban districts of Beijing is 65.08. Among the ten primary indicators, the two highest-scoring items are "People feel safe" (70.06) and "Easy to cross" (69.81). Low-scoring items are primarily concentrated in "Shade and shelter" (61.25), "Things to see and do" (60.73), and "Not too noisy" (59.57) (Fig. 4). Among the 22 sub-indicators, high-scoring items include "Street greening" (2.84), "Quality of vehicle road surfaces" (2.84), "Shared use of walking and cycling lanes" (2.82), and "Traffic signal intersection efficiency" (2.73). These high scores indicate that the central urban districts of Beijing has good street greening, high-quality cycling lanes, minimal pedestrian-cycling conflicts, and well-equipped traffic signal control facilities at intersections (Fig. 5). Low-scoring items are concentrated in "Clear and continuous pedestrian space width" (1.16), "Motorized traffic noise during peak hours" (1.33), "Walking distance between rest points" (1.43), "Bidirectional motorized traffic flow" (1.51), and "Conflicts between cyclists and turning vehicles" (1.71).

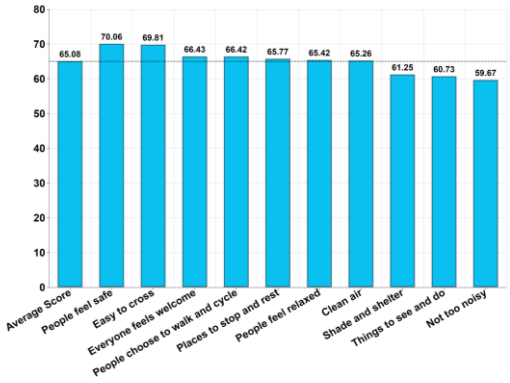

Figure 4. Scores of 10 primary indicators

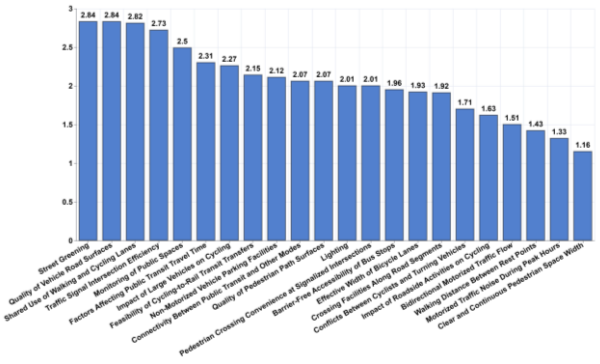

Figure 5. Scores of 22 sub-indicators

Among the five administrative districts in the central urban districts of Beijing, Dongcheng District scores the highest (67.72), while Fengtai District scores the lowest (61.90) (Fig. 6). In the ten primary indicators, the scores of Xicheng, Dongcheng, and Haidian are relatively close, while Fengtai District lags behind in the items of "Shade and shelter," "Places to slop and rest," "Not too noisy," and "Clean air" (Fig. 7). Analysis of the 22 sub-indicators shows that the main reason for Fengtai's lower score is the relatively low level of street greening.

Figure 6. Distribution of streets scores by district

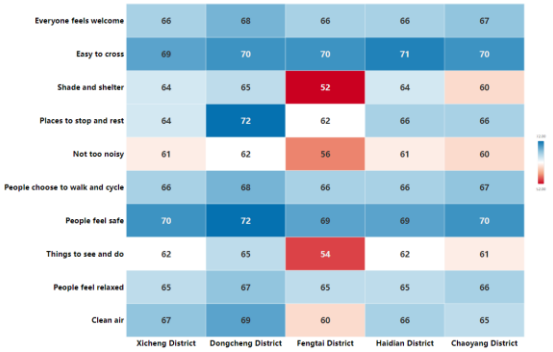

Figure 7. Heat map of street scores on 10 primary indicators by district

0-point items represent the critical shortcomings and key factors limiting healthy street scores. Among the 1,510 streets evaluated, 42.94% had 0-point items (Fig. 8). The results show that the streets with the most 0-point items are "Insufficient Effective Width for Walking," with 348 streets (60.1%), and "Insufficient Space for Cycling," with 125 streets (21.6%) (Fig. 9). These figures indicate that in the central urban districts of Beijing, urban streets offer insufficient space for both pedestrians and cyclists, and the cycling environment lacks basic stability and safety. Further analysis reveals that the main reasons for insufficient effective walking width in central Beijing include insufficient design width (27.3%) and illegal parking obstructing the sidewalk (40.31%). Additionally, the main reasons for the insufficient effective width of bicycle lanes are insufficient design width (56.78%) and illegal parking by motor vehicles (36.68%).

Figure 8. Distribution of Streets with 0-point Items

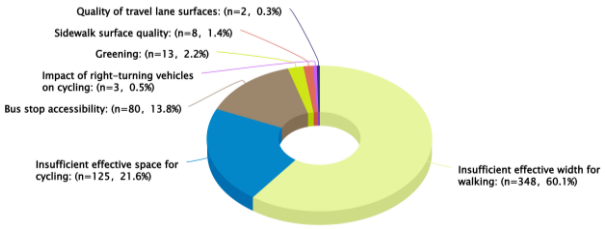

Figure 9. Analysis of the Causes of 0-point Items

Discussion and Conclusion

For a long time, street design in Chinese cities has prioritized motor vehicles, emphasizing traffic efficiency over spaces for walking and cycling (Li 2011). This concept traces its origins to the 1950s, when Beijing's urban planning was heavily influenced by Soviet concepts, resulting in a city layout characterized by "large blocks and wide roads" (Ding and Liang 2019). Since the 1960s, debates in Beijing's urban planning have primarily focused on road widths to accommodate increasing vehicle numbers and improve traffic efficiency (Li 2023). In the 1990s, Beijing initiated extensive greening and street tree planting projects (Ye 2004). In the 21st century, Beijing's street planning has increasingly prioritized human-centered design, emphasizing pedestrian- and bicycle-friendly development in government policies. However, despite these evolving policies, pedestrian spaces remain precarious, as sidewalks continue to be encroached upon in favor of vehicle traffic and urban greening. Beijing's urban street challenges extend beyond planning and design, encompassing issues related to project management, approval, implementation, and maintenance (Ding and Liang 2019). An unclear division of responsibilities among government departments of Beijing leads to overcrowded and disorganized street spaces, as well as functional conflicts during the design phase. Furthermore, poor coordination in departmental roles and timing creates overlapping responsibilities and governance blind spots (Guo et al. 2019), which undermine the effectiveness of street renewal and long-term management.

To effectively address deep-rooted contradictions at their source, refined policy tools are essential (Wei 2021). Therefore, street planning must integrate "technology, management, and governance" into a unified framework. Comprehensive street evaluations are crucial for identifying key problems and deficiencies, which can then inform the formulation of targeted strategies for street improvement (Ding and Wang 2024). Additionally, establishing unified management objectives and a clear framework for departmental responsibilities is essential to ensure efficient coordination and implementation. At the spatial level, expanding slow-traffic spaces can be achieved by removing inefficient motor vehicle lanes and integrating street facilities. Furthermore, integrating building frontages with municipal roads, along with greenery and public facilities to connect street spaces, can improve spatial quality and foster high-quality active travel corridors (Fig. 10).

Figure 10. Integrated Design for the Building Frontage

This paper employs an enhanced Healthy Streets evaluation system to evaluate 1,510 streets in the central urban districts of Beijing, revealing relatively low overall scores. The primary issues identified are the insufficient effective width for walking and cycling. Additionally, the paper highlights significant contributing factors, including a lack of connectivity in street planning and disorganized street management. To address these challenges, the paper proposes integrating 'technology, management, and governance' into street planning, with a focus on systematic planning and spatial improvements. This paper provides valuable references for constructing active travel corridors in other major cities and offers scientific insights to enhance the health benefits of urban greenways.

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