

Enhancing Walking Accessibility in Urban Transportation

Subjects: Transportation

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The rise in “urban diseases” like population density, traffic congestion, and environmental pollution has renewed attention to urban livability. Walkability, a critical measure of pedestrian friendliness, has gained prominence in urban and transportation planning.

Keywords: walkability ; perceived accessibility

1. Introduction

Modern urban planning often prioritizes functional zoning, focusing primarily on developing and constructing spaces for production and industry, sometimes neglecting the city’s essential role as a living space for its inhabitants. In recent years, a rise in “urban diseases” such as population density, traffic congestion, and environmental pollution has compelled society to reevaluate the livability of cities for human well-being. This has led to a renewed focus on the quality of life for urban dwellers.

Japan, as a pioneer, introduced the concept of the “living circle”. This concept represents a fundamental unit designed to meet the daily work and life needs of residents within a reasonable walking distance. Moreover, it aims to cater to both the material and spiritual needs of inhabitants, taking into consideration the well-being of individuals of all ages ^[1]. Carlos Moreno advocated the “15-minute city” concept, emphasizing that cities should be developed in a way that allows residents to access all essential amenities within a 15 min walk or bike ride ^[2]. The community living circle emphasizes a more humane and personalized design, integrating functions such as work, life, recreation, and transportation to create a convenient and comfortable living environment while also providing novel ideas and directions for sustainable urban development. Wei et al. highlighted the ideal living space characteristics, including moderate scale, high walkability, open and inclusive public spaces, and convenient transportation based on the balance of supply and demand ^[3].

Walkability refers to the pedestrian friendliness of the built environment and serves as a measure of how effectively it encourages walking. Studying walkability plays a critical role for urban and transportation planners in creating more pedestrian-friendly cities. Moreover, improving walkability proves to be an effective way to encourage residents to walk more, thereby maintaining their physical and mental health. Hence, it becomes meaningful to study walking accessibility. He et al. quantified walkability based on four pedestrian needs: safety, convenience, continuity, and attractiveness ^[4]. Ha et al. studied the walkability characteristics of TRIS’ first and last miles using household travel survey data from Seoul’s metropolitan area ^[5]. Xiao et al. conducted a spatial analysis of survey data collected across the United States to assess the spatial accessibility of National Park System units for different racial groups, considering the relationship between limited spatial accessibility, marginalization, subcultural differences, and discrimination ^[6]. Other experts utilized the walkability index calculation to conduct walkability analysis and provide insights for future urban construction and transportation planning ^{[7][8]}.

2. Walking Perceived Accessibility

Accessibility plays a crucial role in various aspects, including the evaluation and design of public transportation systems. It enables individuals to engage in social interactions and participate in activities that mitigate social exclusion, discrimination ^{[9][10]}, and enhance overall well-being ^[11]. Despite the introduction of the accessibility concept as early as the 1950s ^[12], perceived accessibility has often been neglected ^[13]. Perceived accessibility refers to the ease with which individuals can attain life satisfaction through the transportation system ^[14]. It serves as a complementary approach to the conventional and objective accessibility studies. Objective measures may not adequately capture accessibility in terms of life experiences and feelings ^[15].

Among the factors affecting the use of transportation systems, a growing number of scholars recognize that people's participation in daily activities depends on their perception of the safety ^{[16][17]} and quality ^[18] of transportation services. Appropriate facility design can promote walking without compromising safety and convenience ^{[19][20]}. Frimann et al. argued that perceived accessibility is closely linked to perceptions of safety and service quality ^[21]. The level of pedestrian satisfaction with walking accessibility is closely linked to the perceived ease of access to daily living facilities, which are necessary for fulfilling walking needs in urban environments. **Table 1** presents a comprehensive list of factors identified in various studies that have an impact on the perceived walkability.

Table 1. Factors influencing perceived walkability.

No.	Authors	Methods	Influencing Factors
1	Hagen ^[22]	Survey	Health, mobility, safety, reliability, convenience, comfort, and aesthetics.
2	Humpel ^[18]	Review	Accessibility of facilities, opportunities for activity, weather, safety, and aesthetic attributes.
3	Tsukaguchi ^[23]	Survey	The number and level of services provided by pedestrian infrastructure
4	Gallin ^[24]	The pedestrian level of service approach	Walking conditions on a route, path, or facility, which is linked directly to factors that affect mobility, comfort, and safety.
5	Kelly ^[19]	Stated preference surveys; on-the-street survey; on-the-move survey	The risk of accidents, bad weather, theft, and other factors cause people to avoid walking long distances. People tend to walk farther and more frequently if high quality sidewalk facilities are provided.
6	Owen, Neville ^[25]	Review	The aesthetic nature of the local environment, the convenience of facilities for walking, accessibility of places to walk to, level of traffic on roads, and composites of environmental attributes.
7	Brownson, Ross C ^[26]	Review	Community environments, parks, and trails, population density, land use mix, access to recreational facilities, and street pattern.
8	Leslie, Eva ^[27]	Neighborhood environment attribute ratings	Attributes of residential density, land use mix (access and diversity) and street connectivity, traffic safety, and safety from crime attributes.
9	Badland, Hannah ^[28]	Review	Population density, subdivision age, street connectivity, and mixed land use
10	Carnegie ^[20]	Population survey	The aesthetics of the environment (such as attractive scenery) and convenience.
11	Giles-Corti ^[16]	Cross-sectional survey	Attractive neighborhood with sidewalks and shops.
12	Jaskiewicz ^[29]	Survey	Dividing fence, road red line width.
13	Ha Eunji ^[30]	Green Score evaluation system	Urban landscape: Incorporating natural elements in the urban landscape promotes interaction and enhances the overall walking experience. Public seating areas can also encourage casual walking.
14	Pratiwi ^[31]	Hierarchical analysis, SEM	Safety, mobility, and convenience: Ensuring safety, mobility, and convenience are crucial aspects of creating pedestrian-friendly environments. This includes measures such as crime prevention, adequate separation of traffic modes, clear traffic signs, and well-maintained roads. Additionally, amenities such as green spaces, appealing views, and easy access to facilities contribute to a positive walking experience.
15	Xu Yiwen ^[32]	Location evaluation system of urban community public service facilities	Spatial environment perception and behavioral perception. The perception of the spatial environment can be understood through visual perception, traffic perception, and psychological perception. Behavioral perception encompasses recommendation behavior and participation behavior, which are influenced by the overall perception of the environment.
16	Jehle ^[33]	Review, survey	Directness, simplicity, traffic safety, security, comfort, and built environment.

2. Objective Influences on Walking Accessibility

Walkability is influenced by various objective factors, mainly divided into dimensions such as the built environment, policy, and socioeconomic attributes. Researchers used estimated least squares regression and geographically weighted

regression models (GWR) to study the relationship between service accessibility and sociodemographic and environmental variables [34][35][36]. Duncan et al. demonstrated that Walk Score effectively estimates neighborhood walkability across multiple geographic locations and spatial scales [37]. Because of its effectiveness and affordability, perhaps not surprisingly, use and acceptance of Walk Score as a means to assess walkability has increased over time. However, Walk Score primarily emphasizes the proximity to amenities while disregarding other crucial facets of pedestrian accessibility. There exist diverse conceptualizations and definitions of walkability, and researchers have examined various factors associated with it. Consequently, most studies refrain from solely relying on Walk Score as the sole measure of walkability. Instead, they incorporate additional indicators to provide a more comprehensive assessment [38]. Wang et al. proposed a spatial probit model of commuters' mode choice (cycling versus noncycling), considering spatial autocorrelation [39]. Scholars have also focused on walkability inequality in urban community living circles and explored its relationship with disadvantaged groups within communities from spatial and statistical perspectives [40]. Xu et al. argued that significant social inequalities in park accessibility exist under public transport, walking, and cycling modes [41]. Imran et al. analyzed three social indicators of health, education, and municipal facilities using global and local Moran indices [42]. The results of their study will aid policy-makers in prioritizing resources to achieve spatial and opportunity equality. ®®®

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