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Elements of Pedestrian Pathways and Their Influence on Pedestrian Comfort: A Literature Review

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Abstract
Introduction: *Pedestrian pathways are an essential element of urban transportation systems that support active mobility and environmental sustainability. However, the quality of pedestrian pathways in many urban areas has not fully addressed pedestrian comfort, both in terms of environmental and physical aspects.* ***Objective:*** *This article aims to review pedestrian pathway elements and their influence on pedestrian comfort in urban environments.* ***Method:*** *This study employs a literature review method using a thematic analysis approach of national and international scientific articles published between 2020 and 2025.* ***Results and Discussion:*** *The review findings indicate that environmental elements, particularly vegetation and microclimatic conditions, are the most dominant factors influencing pedestrian comfort. In addition, physical characteristics of pedestrian pathways, safety aspects, and psychological comfort also play important roles in shaping walking experiences.* ***Conclusion:*** *Pedestrian comfort is multidimensional and influenced by interactions among environmental, physical, and perceptual elements. Therefore, integrated pedestrian pathway planning that emphasizes environmental quality is required to enhance pedestrian comfort and support urban sustainability.*

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Introduction

Rapid urban development has created various challenges in the provision of high-quality and sustainable public spaces. One of the main challenges is how to create urban environments that support active mobility, particularly walking, as part of an environmentally friendly transportation system. Walking not only contributes to the reduction of emissions and energy consumption but also plays an important role in improving physical health, mental well-being, and the quality of social interactions in urban areas (Giles-Corti et al., 2021).

Pedestrian pathways have become an essential element of urban spatial structure. The effectiveness of pedestrian pathways is not determined solely by their availability, but also by the level of comfort experienced by users. According to Arellana et al. (2020), pedestrian comfort is a key factor influencing individuals' decisions to walk and to use public spaces sustainably. Pedestrian pathways that are uncomfortable, even when physically available, tend to be underutilized by the public.

Pedestrian comfort is a complex and multidimensional concept. Several studies indicate that comfort is not only related to the physical characteristics of pedestrian pathways but is also influenced by environmental conditions and user perceptions. According to Liao et al. (2021), environmental factors such as air temperature, exposure to solar radiation, and the quality of green spaces have a significant impact on walking experiences. Unsupportive environmental conditions, particularly in high-density urban areas, may reduce pedestrian comfort and tolerance toward walking activities.

The physical characteristics of pedestrian pathways also play an important role in shaping comfort. Pathway width, surface quality, continuity, and accessibility are considered fundamental elements affecting pedestrian comfort and safety. Research by van der Spek et al. (2022) suggests that pedestrian pathways with well-designed physical characteristics tend to enhance perceived safety and encourage more intensive walking activities in urban areas.

Perceptual and psychological aspects have also received increasing attention in studies on pedestrian comfort. Perceptions of safety, visual quality of the environment, and the overall atmosphere of walking spaces contribute to the overall walking experience. According to Alfonzo and Guo (2023), pedestrian comfort is strongly influenced by emotional responses to walking environments, including feelings of safety, calmness, and visual attractiveness of pedestrian spaces.

In the context of Indonesian cities, pedestrian comfort faces additional challenges related to tropical climate conditions and urban infrastructure limitations. High temperatures, intense solar radiation, and limited shading can reduce thermal comfort and discourage walking activities. In addition, pedestrian pathways in many Indonesian urban areas are often fragmented, obstructed by illegal parking, street vendors, or motorcycle encroachment, and lack adequate drainage systems, resulting in flooding during rainfall. Accessibility barriers, such as uneven surfaces, lack of ramps, and inadequate facilities for persons with disabilities, further limit inclusive pedestrian mobility. These conditions highlight the importance of understanding pedestrian comfort within the specific environmental and infrastructural context of Indonesian cities, where improving pedestrian pathways can contribute not only to sustainable mobility but also to urban livability and social equity.

Although research on pedestrian comfort has expanded in recent years, existing studies remain fragmented and often focus on specific elements in isolation. This has resulted in a fragmented understanding of the factors influencing pedestrian comfort.

Therefore, a literature review that synthesizes recent research findings is needed to identify the main pedestrian pathway elements contributing to pedestrian comfort in urban environments. This review is expected to provide a conceptual basis for pedestrian pathway planning that emphasizes environmental quality and urban sustainability.

Method

This study adopts a literature review approach to examine and synthesize scientific findings related to pedestrian pathway elements and pedestrian comfort in urban environments. The literature review approach was selected because it enables the integration of findings from previous studies and the identification of general patterns and trends within a specific field of research (Aghamolaei et al., 2023).

The initial stage of the study involved a systematic search for relevant scientific articles. The reviewed articles were limited to publications released between 2020 and 2025 to ensure the currency of information and relevance to contemporary urban issues. Inclusion criteria consisted of studies addressing pedestrian pathways, walking environments, or pedestrian comfort in urban contexts. Articles focusing on motorized transportation or non-urban settings were excluded from the review.

Selected articles were subsequently analyzed using a thematic analysis approach. Thematic analysis was employed to identify recurring themes within the literature, such as environmental elements, microclimatic conditions, physical characteristics of pedestrian pathways, safety aspects, and psychological factors. According to Trop and Shoshany-Tavory (2023), thematic analysis is an effective method for systematically organizing and synthesizing findings from multiple studies in a literature review.

During the analysis process, each article was examined to identify the pedestrian pathway elements studied and the comfort indicators applied. The results of the analysis were then grouped into several thematic categories to facilitate synthesis and interpretation. This approach allows for comparisons across studies without primary data collection while providing a comprehensive overview of research trends in the field (Mandić et al., 2024).

The findings of the literature review were subsequently presented in the form of synthesis tables to summarize key elements and dominant patterns. The use of tables aims to enhance analytical clarity and support narrative discussion. This method is commonly applied in thematic literature reviews to strengthen transparency and traceability in the synthesis process (Sharma & Dehalwar, 2025).

Result and Discussion

This section presents the results of the literature review related to pedestrian pathway elements and pedestrian comfort indicators based on scientific articles published between 2020 and 2025. The findings are organized thematically to identify the main pedestrian pathway elements and the comfort indicators most frequently discussed in the literature. Based on the literature review, various pedestrian pathway elements have been identified as factors influencing pedestrian comfort. These elements are summarized and categorized as presented in Table 1.

Table 1
Elements of Pedestrian Pathways Influencing Pedestrian Comfort

No	Pedestrian Pathway Elements	Sub-elements Discussed	General Description from the Literature
1	Vegetation and Green Spaces	Trees, canopies, small parks	Vegetation plays an important role in improving pedestrians' thermal and psychological comfort through shading and microclimate improvement
2	Environmental Microclimate	Air temperature, solar radiation, humidity	Cooler microclimatic conditions and protection from direct solar radiation enhance walking comfort, especially in dense urban areas
3	Physical Pathway Elements	Sidewalk width, pathway surface, materials	Physically adequate pedestrian pathways enhance users' sense of safety and comfort
4	Surrounding Building Configuration	Building height, spacing between buildings	Building configurations influence airflow patterns and levels of heat exposure along pedestrian pathways
5	Safety and Security	Lighting, visibility, traffic conflicts	Perceived safety is an essential prerequisite for pedestrian comfort
6	Psychological Comfort	Perception, stress, sense of comfort	Visually attractive and non-oppressive environments support positive walking experiences
7	Accessibility and Inclusivity	Disability-friendly pathways, ease of access	Inclusive pedestrian pathways enhance comfort for diverse user groups
8	Social Environmental Activities	Pedestrian density, social interaction	Balanced social activities increase the liveliness and comfort of pedestrian spaces

The pedestrian pathway elements identified in Table 1 are further evaluated through various comfort indicators used in previous studies. These indicators illustrate how pedestrian comfort is measured and assessed across different research contexts, as presented in Table 2.

Table 2
Pedestrian Comfort Indicators Based on the Literature

No	Type of Comfort	Indicators Used	General Description from the Literature
1	Thermal Comfort	Air temperature, solar radiation, PET	Thermal comfort is the most frequently used indicator to assess the quality of pedestrian pathways, particularly in urban environments
2	Physical Comfort	Pathway width, surface quality, slope	Adequate physical conditions of pedestrian pathways enhance walking ease and safety
3	Psychological Comfort	Comfort perception, stress, sense of safety	Psychological factors play an important role in shaping positive walking experiences
4	Visual Comfort	Visual quality, vegetation, aesthetics	Visually attractive environments increase pedestrians' interest and comfort
5	Safety Comfort	Lighting, visibility, traffic conflicts	A sense of safety is a fundamental prerequisite before pedestrians experience comfort
6	Social Comfort	Density, social interaction	Balanced social interactions can enhance the quality of walking experiences
7	Accessibility Comfort	Disability-friendly pathways, ease of access	Good accessibility supports comfort for all user groups

The discussion focuses on synthesizing the main findings from the reviewed studies to identify patterns and trends in the influence of pedestrian pathway elements on pedestrian comfort. The synthesis of these findings is presented in Table 3.

Table 3
Synthesis of Literature Findings

Main Elements	Impact on Pedestrian Comfort	Patterns Identified in the Literature
Vegetation and Green Spaces	Enhance thermal and psychological comfort	Almost all studies emphasize the role of vegetation as the most dominant element in improving pedestrian comfort
Environmental Microclimate	Reduce heat stress while walking	Studies indicate that cooler microclimatic conditions consistently enhance comfort, especially in dense urban areas
Physical Pathway Elements	Increase safety perception and walking convenience	The literature agrees that physical pathway quality is a basic prerequisite for comfort
Surrounding Building Configuration	Influence airflow and heat exposure	The impact of building configuration is contextual and depends on urban density
Safety and Security	Determine pedestrians' willingness to use pathways	Safety is considered a minimum requirement before comfort can be perceived
Psychological Comfort	Enhance walking experiences	Studies emphasize the importance of perception and subjective experience in comfort
Accessibility and Inclusivity	Extend comfort to all users	Recent literature highlights the importance of inclusive pedestrian pathways
Social Environmental Activities	Shape the quality of pedestrian spaces	Balanced social activities strengthen comfort without causing excessive crowding

The results of the literature review on pedestrian pathway elements and pedestrian comfort indicators are based on scientific articles published between 2020 and 2025. The findings are organized thematically to illustrate research trends, dominant elements examined, and the comfort indicators most frequently used across studies.

The review results indicate that the pedestrian pathway elements most frequently discussed in the literature include vegetation and green spaces, environmental microclimate conditions, physical characteristics of pedestrian pathways, surrounding building configurations, and safety and security aspects. These elements consistently appear across various research contexts, including empirical studies, microclimate simulations, and systematic literature reviews.

Environmental Elements of Pedestrian Pathways

Vegetation and green spaces are the most dominant elements in the literature related to pedestrian comfort. Several studies indicate that the presence of trees, vegetation canopies, and linear green spaces along pedestrian pathways can enhance thermal comfort through shading and the reduction of air temperature at the pedestrian level. According to Teshnehdel et al. (2020), adequate tree cover can reduce air temperature and Physiologically Equivalent Temperature (PET) values, thereby creating more comfortable walking conditions. This finding is consistent with Fahed et al. (2020), who stated that green spaces and water elements significantly contribute to reducing heat stress along pedestrian pathways in dense urban areas.

Detommaso et al. (2021) further argued that urban greening strategies are the most effective approach to improving pedestrian thermal comfort compared to surface material–based strategies. Similarly, Pattnaik et al. (2025) reported that layered vegetation structures and compositions have a greater influence on thermal comfort than vegetation with a single structural form.

Environmental Microclimatic Conditions

Environmental microclimatic conditions, such as air temperature, solar radiation, and airflow, have become a primary focus in many studies. The literature indicates that pedestrian pathways directly exposed to solar radiation tend to exhibit lower levels of comfort, particularly in hot-climate regions. Fahed et al. (2020) noted that increases in surface temperature and solar radiation are directly associated with reduced walking comfort.

Silva et al. (2024) emphasized the importance of micro-scale microclimatic analysis for understanding pedestrians' thermophysiological comfort. Their study demonstrated that microclimatic variations over relatively short distances can result in significant differences in comfort levels, suggesting that pedestrian pathway design should consider environmental conditions in a specific and contextual manner.

Physical Elements of Pedestrian Pathways

Physical elements of pedestrian pathways, such as sidewalk width, surface quality, and pathway materials, are also widely discussed in the literature. The review findings indicate that pedestrian pathways with adequate dimensions and well-maintained surfaces contribute to physical comfort and a sense of safety for pedestrians. Distefano and Leonardi (2023) stated that the quality of pedestrian infrastructure has a direct influence on user satisfaction and the willingness of people to walk as a mode of transportation.

Several studies emphasize that physical pathway elements serve as basic prerequisites before other comfort factors can be experienced. Narrow, damaged, or uneven pathways may reduce comfort even when environmental elements have been well designed.

Safety, Psychological Comfort, and Accessibility

Safety and security aspects also emerge as important elements in the literature. Adequate lighting, good visibility, and minimal conflicts with vehicular traffic are considered fundamental factors influencing pedestrian comfort. Sundling and Jakobsson (2023) stated that perceived safety is one of the main determinants of positive walking experiences.

Recent literature also highlights the importance of psychological comfort and accessibility. Comfort is not only understood as a physical condition but also as a subjective experience influenced by perception, stress, and mental well-being. Pedestrian pathways that are inclusive and friendly to diverse user groups, including older adults and persons with disabilities, are considered capable of enhancing the overall quality of walking experiences (Distefano & Leonardi, 2023).

This discussion aims to interpret the main findings of the literature review and relate them to the context of pedestrian pathway planning and urban environmental quality. Based on the synthesis of the reviewed studies, pedestrian comfort is not determined by a single factor but rather results from complex interactions among environmental, physical, and psychological elements.

The Dominant Role of Vegetation and Microclimate

One of the most consistent findings in the literature is the dominant role of vegetation and microclimatic conditions in shaping pedestrian comfort. Vegetation does not only function as an aesthetic element but also as an environmental component that actively modifies thermal conditions along pedestrian pathways. According to Teshnehdel et al. (2020) and Fahed et al. (2020), the presence of trees and green spaces can reduce air temperature and solar radiation, thereby alleviating the heat stress experienced by pedestrians.

Detommaso et al. (2021) stated that urban greening strategies represent the most effective approach to improving thermal comfort compared to strategies based on high-albedo surface materials. This is consistent with the findings of Pattnaik et al. (2025), who reported that layered vegetation structures have a more significant influence on thermal comfort than vegetation with simpler configurations. Therefore, vegetation can be understood as a key element in creating comfortable and sustainable pedestrian pathways.

Physical Pathway Elements as Prerequisites for Comfort

Physical elements of pedestrian pathways continue to play a fundamental role in determining pedestrian comfort. Adequate sidewalk width, surface quality, and appropriate materials contribute to physical comfort and users' sense of safety. Distefano and Leonardi (2023) stated that the quality of pedestrian infrastructure has a direct relationship with user satisfaction and people's willingness to walk.

Physical pathway elements can be regarded as basic prerequisites before other comfort factors can be optimally experienced. Pedestrian pathways with poor physical conditions may reduce comfort even when supported by well-designed environmental elements. Therefore, improvements to the physical quality of pedestrian pathways remain an important initial step in planning walkable environments.

Safety, Psychological Factors, and Walking Experience

Safety and security aspects also emerge as important factors in the literature. Perceived safety, influenced by lighting, visibility, and minimal conflicts with vehicular traffic, is a prerequisite for pedestrians to use pedestrian pathways on a sustained basis. Sundling and Jakobsson (2023) stated that safe and psychologically comfortable walking environments contribute to improved mental well-being and positive walking experiences.

Psychological comfort has received increasing attention in recent research. Comfort is not only understood as a physical condition but also as a subjective experience influenced by perception, stress, and mental well-being. Pedestrian environments that are visually attractive, support balanced social activities, and are designed to be inclusive are considered capable of enhancing the overall quality of walking experiences (Distefano & Leonardi, 2023).

Implications for Pedestrian Pathway Planning

This discussion indicates that pedestrian pathway planning oriented toward pedestrian comfort should be carried out in an integrated manner. Approaches that focus solely on improving physical pathway conditions without considering environmental and psychological aspects may result in suboptimal pedestrian spaces. In contrast, the integration of vegetation, microclimate-responsive design, physical pathway quality, and

safety and inclusivity aspects is considered more effective in enhancing comfort and overall urban environmental quality. These findings underscore the importance of positioning pedestrian comfort as a key indicator in sustainable pedestrian pathway planning, in line with efforts to improve quality of life and reduce dependence on motorized vehicles in urban areas.

Conclusion

This literature review demonstrates that pedestrian comfort on pedestrian pathways is a multidimensional concept influenced by interactions among environmental, physical, and psychological elements. Based on the synthesis of studies published between 2020 and 2025, environmental elements particularly vegetation and microclimatic conditions emerge as the most dominant factors affecting pedestrian comfort in urban areas. The presence of vegetation has been shown to enhance thermal and psychological comfort through shading mechanisms and improvements in the walking environment.

The physical quality of pedestrian pathways, such as pathway width, surface condition, continuity, and accessibility, also constitutes a fundamental prerequisite for comfort. Pedestrian pathways with good physical quality not only improve walking comfort but also support perceived safety and ease of mobility for diverse user groups. Safety aspects, perceived security, and psychological comfort further strengthen walking experiences and influence people's willingness to use pedestrian pathways on a sustained basis.

The findings of this review emphasize that improving pedestrian comfort cannot be achieved through a single approach, but instead requires integrated pedestrian pathway planning oriented toward environmental quality. The integration of urban greening, microclimate management, physical pathway improvements, and enhanced safety and inclusivity is key to creating comfortable and sustainable walking environments. This review is expected to serve as a conceptual foundation for planners and policymakers in designing pedestrian pathways that support active mobility and urban quality of life.

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