





# Characteristics of the built environment associated with the perceived security by the women while walking

 Lara Reis Rodrigues<sup>1</sup> and  Rochele Amorim Ribeiro<sup>2</sup>

<sup>1</sup> Universidade de São Paulo, Escola de Engenharia de São Carlos – EESC-USP / São Carlos, SP – Brazil 

<sup>2</sup> Universidade Federal de São Carlos - UFSCar / São Carlos, SP – Brazil  - [rochele@ufscar.br](mailto:rochele@ufscar.br)

## Authors' notes

The authors have no conflicts of interest to declare.

Corresponding author: Lara Reis Rodrigues - [larareisrodrigues@usp.br](mailto:larareisrodrigues@usp.br)

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## Abstract

**Objective:** To select characteristics of the built environment that affect the perceived security of pedestrians, considering mainly females .

**Methodology:** A Systematic Literature Review (SLR) was conducted from March to August 2022, analyzing national and international publications of a scientific and technical nature, available in virtual databases, in order to establish a synthesis and comparison of results from works related to the topic.

**Originality/Relevance:** Studies have shown that characteristics of the built environment are associated with perceived security when walking and that people's gender also influences this perception in an urban space. Thus, the relevance of this work lies in the search for visibility and improvement of a recurring and underreported issue in the daily lives of female pedestrians.

**Results:** Of the total collected samples, 68,43% were scientific articles, 21,05% were books, 5,26% were theses and 5,26% were technical works, coming from North America, South America, Europe and Oceania and having been published from 1971 to 2022. From these samples, eight measurements were selected, which were grouped into four aspects of urban space, summarizing the main characteristics of the built environment associated with the perception of security: (i) flow of people, (ii) street maintenance, (iii) attractiveness of the urban space and (iv) surveillance.

**Social contributions / for management:** The article offers, as a contribution to management, subsidizing urban planning decision-making, aiming for cities that are noticeably more secure for pedestrians, especially women, highlighting which aspects and measures can be considered to consolidate this intention.

*Keywords:* women's issues in transportation, perceived security, walkability, urban planning

## Resumo

### Características do ambiente construído associadas à segurança percebida pelas mulheres ao caminharem

**Objetivo:** Selecionar características do ambiente construído que interferem na segurança percebida de pedestres, considerando principalmente o gênero feminino.

**Metodologia:** Realizou-se uma Revisão Sistemática de Literatura (RSL), de março a agosto de 2022, analisando publicações nacionais e internacionais, de caráter científico e técnico,



disponíveis em bases de dados virtuais, a fim de estabelecer síntese e comparação de resultados de trabalhos associados ao tema.

**Originalidade/Relevância:** Estudos têm demonstrado que características do ambiente construído estão associadas à segurança percebida ao caminhar e que o gênero das pessoas também interfere em tal percepção no espaço urbano. Assim, a relevância deste trabalho está na busca pela visibilidade e pela melhoria de uma problemática recorrente e subnotificada no cotidiano das mulheres pedestres.

**Resultados:** Do total de amostras coletadas, 68,43% foram artigos científicos, 21,05% livros, 5,26% teses e 5,26% trabalhos técnicos, sendo provenientes da América do Norte, da América do Sul, da Europa e da Oceania e tendo sido publicados no decorrer de 1971 até 2022. A partir de tais amostras, foram selecionadas oito medidas, as quais foram agrupadas em quatro aspectos do espaço urbano, sintetizando as principais características do ambiente construído associadas à percepção de segurança: (i) circulação de pessoas, (ii) manutenção viária, (iii) atratividade do espaço urbano e (iv) fiscalização.

**Contribuições sociais / para a gestão:** O artigo oferece, como contribuição para a gestão, subsídios para a tomada de decisão de planejamento urbano, visando cidades perceptivelmente mais seguras aos pedestres, sobretudo às mulheres, evidenciando quais são os aspectos e medidas que podem ser considerados para consolidar esta intenção.

*Palavras-chave:* desafios das mulheres no transporte, segurança percebida, caminhabilidade, planejamento urbano

## Resumen

### Características del entorno construido asociadas a la seguridad percibida por las mujeres al caminar

**Objetivo:** Seleccionar características del entorno construido que interfieran con la seguridad percibida de los peatones, considerando principalmente el género femenino.

**Metodología:** Se realizó una Revisión Sistemática de Literatura (RSL), de marzo a agosto de 2022, analizando publicaciones nacionales e internacionales de carácter científico y técnico, disponibles en bases de datos virtuales, con el fin de establecer una síntesis y comparación de los resultados de trabajos asociados al tema.

**Originalidad/Relevancia:** Los estudios han demostrado que las características del entorno construido están asociadas con la percepción de seguridad al caminar y que el género de las



personas también influye en esta percepción en el espacio urbano. Así, la relevancia de este trabajo radica en la búsqueda de visibilización y mejora de un problema recurrente y subreportado en la vida cotidiana de las mujeres peatones.

**Resultados:** Del total de muestras recolectadas, el 68,43% fueron artículos científicos, el 21,05% libros, el 5,26% tesis y el 5,26% trabajos técnicos, procedentes de América del Norte, América del Sur, Europa y Oceanía y publicados desde 1971 hasta 2022. De estas muestras se seleccionaron ocho medidas, que se agruparon en cuatro aspectos del espacio urbano, resumiendo las principales características del entorno construido asociadas a la percepción de seguridad: (i) circulación de personas, (ii) mantenimiento de carreteras, (iii) atractivo del espacio urbano y (iv) supervisión.

**Contribuciones sociales / para la gestión:** El artículo ofrece, como contribución a la gestión, subsidios para la toma de decisiones de planificación urbana, buscando ciudades notablemente más seguras para los peatones, especialmente las mujeres, destacando qué aspectos y medidas pueden considerarse para consolidar esta intención.

*Palabras clave:* desafíos de las mujeres en el transporte, seguridad percibida, caminabilidad, planificación urbana

## Characteristics of the built environment associated with the perceived security by the women while walking

Walking is the most basic and fundamental way of mobility and is also the mode of transportation with the greatest connectivity and interaction between the individual and the built environment (Hong & Chen, 2014). In this regard, walking allows one to connect with their surroundings and experience the city through all of their personal senses and perceptions.

From this perspective, walkability can be understood as an adjective used to indicate how acceptable or suitable an urban space is for walking, concerning both physical and perceived attributes, thus indicating the quality of the walking environment (Croft, Elazar & Levasseur, 2013). According to this viewpoint, Dovey and Pafka (2020) define walkability the result of interactions between population density, mixed land use, and access networks. Concurrently, Lizárraga, Martín-Blanco, Castillo-Pérez, and Chica-Olmo (2022) describe walkability as a multidimensional concept, which can be defined as the extent to which the built environment is

pedestrian-friendly for walking.

However, perceived (in)security in the built environment, related to crime, is considered one of the main factors influencing the choice to walk in urban spaces as a mode of transportation (Foster, Giles-Corti & Knuiiman, 2014; Lizárraga et al., 2022). According to Silva, security involves preventing risks to personal, physical, and psychological integrity, (2022), and is studied as the state of protection against crimes, attacks, or losses caused by intentional actions by others (Hessami, 2004; Holtrop & Kretz, 2008).

Moreover, according to Lizárraga et al. (2022), it is important to emphasize that gender is one of the most relevant variables when considering the perception of security in urban spaces and its relation to the choice to walk. Their case study research in a Spanish city found that women are about twice as likely as men to choose not to walk.

Ceccato and Loukaitou-Sideris (2022), through case studies in eighteen cities across different countries and continents (including Brazil), have observed that crimes related to sexual victimization impact women's unobstructed mobility, leading to fear and stress in their municipalities' streets. According to empirical research conducted in a medium-sized Brazilian city by Nourani, Antonello, and Govone (2019), women represent about 73% of victims of harassment, abuse, and sexual violence in public spaces. Despite these findings, the high underreporting of sexual crimes against women in public spaces contributes to the invisibility of this problem in the cities (Ceccato & Loukaitou-Sideris, 2022; Loukaitou-Sideris, 2004).

In this context, women generally exhibit a greater perception of insecurity in built environments, which restricts their mobility and affects their choice to walk (Croft et al., 2013; Lizárraga et al., 2022; Loukaitou-Sideris, 2004; Loukaitou-Sideris, 2011; Nourani et al., 2019; Silva, 2022). Quantitative and qualitative research demonstrates that if the environment is perceived as insecure for pedestrians, particularly for women, and considering the higher personal exposure of pedestrians in public spaces, individuals may occasionally opt for the use of a motorized private vehicle if their financial situation allows (Croft et al., 2013; Lizárraga et al., 2022; Loukaitou-Sideris, 2004; Loukaitou-Sideris, 2011; Nourani et al., 2019; Silva, 2022). Rader (2004) refers to such strategies as "restrictive behaviors," which are activated when there is a perception of risk in urban spaces, especially when linked to its emotional dimension, that is, individual fear.

As far back as the 1970s, Newman (1972) developed one of the first and most influential empirical studies on the relationship between crime, perceived security, and the built environment, analyzing how certain characteristics of urban space can affect the occurrence of criminal activities and the perception of security. This type of environment was classified as "defensible



space" (Newman, 1972).

In this regard, characteristics of the built environment and transportation configurations are responsible for increasing levels of fear and subjective insecurity, as well as for higher crime rates, which reduces the likelihood of choosing to walk (Ceccato & Loukaitou-Sideris, 2022; Lizárraga et al., 2022). Urban areas showing signs of poor condition, abandonment, and deterioration typically act as catalysts for crime and insecurity (Loukaitou-Sideris, 2004). Researchers consider such city locations as "hot spots of crime," meaning areas with a concentration or higher likelihood of crime and greater perceived insecurity (Buerger, Cohn & Petrosino, 1995; Sherman, 1995).

It is evident that visible deterioration of the urban environment is directly related to the perception of security, being associated with what Kelling and Coles (1997) call the "broken window syndrome." Darkness, poor surveillance, desolation, lack of maintenance, and signs of physical and/or social disorder in a specific urban area, along with vacant lots and underused buildings in its vicinity, tend to affect pedestrians' perceived security (Ceccato & Loukaitou-Sideris, 2022; Lizárraga et al., 2022). From this perspective, Loukaitou-Sideris (2004) determines that crime increases or decreases depending on whether the opportunities available in the urban environment are greater or fewer, respectively.

Knowing that women generally experience higher levels of subjective insecurity while walking in public spaces (Carter, 2004; Ceccato & Loukaitou-Sideris, 2022; Hong & Chen, 2014; Clifton & Livi, 2004; Lizárraga et al., 2022; Loukaitou-Sideris, 2004; Nourani et al., 2019), researchers have demonstrated that characteristics of the built environment are particularly associated with women's perception of security (Ceccato & Loukaitou-Sideris, 2022; Loukaitou-Sideris, 2004; Silva, 2022). It is necessary, therefore, to identify these characteristics in order to inform the planning of areas more secure for pedestrian, especially for women.

Thus, the research problem addressed in this article is: which characteristics of the built environment are associated with pedestrians' perception of security, particularly for women?

In light of this, the relevance of this work lies in seeking visibility and improvement of a recurring and underreported issue in the daily lives of female pedestrians, who, according to Ceccato (2017), face fear and perceived insecurity in urban spaces on a daily basis, gradually losing their right to mobility and, consequently, their right to the city, increasingly restricting their walking routes. Moreover, perceived security in urban spaces is one of the most determining and influential factors in the choice of active transportation modes, such as walking, thus contributing to sustainable urban mobility (Silva, 2022; Ceccato & Loukaitou-Sideris, 2022).







## Objective

The objective of this research is to identify characteristics of the built environment that impact pedestrians' perceived security, with a particular focus on women.

## Materials and methods

This study was conducted through a Systematic Literature Review (SLR), involving the synthesis and comparison of results from studies related to the topic. This method entails the systematic, transparent, and reproducible synthesis of research results, including the identification and critical evaluation of relevant studies on the subject, as well as the collection and analysis of data from these studies (Wang & Ke, 2024).

As noted by Tranfield, Denyer and Smart (2003), systematic literature reviews represent a fundamental tool for academic research. They are used to comprehensively manage and analyze the diversity of knowledge in a specific area, in this case, the context of perceived security in urban spaces by pedestrians, with a particular focus on women.

Currently, policymakers and decision-makers increasingly seek evidence-based knowledge to develop solutions for political and social issues. In this regard, systematic reviews stand out as effective tools, providing comprehensive key information (Petticrew & Roberts, 2006; Santos & Cortese, 2022).

Given the gap in the literature regarding which characteristics of the built environment affect pedestrians' perception of (in)security, especially for women, this article employs a qualitative systematic review approach. In this approach, the survey materials are collected through a systematic review process and subsequently analyzed using qualitative methods (Wang & Ke, 2024).

The methodology applied in the research was primarily developed between March and August 2022, facilitated by the analysis of publications collected remotely. The survey materials consisted of national and international scientific and technical publications, such as articles, theses, books, and technical reports, available in databases.

These survey materials were available in databases that compile publications and offer free access to educational and research institutions in Brazil. It should be noted that the collected samples were found based on the results of searches using a specific set of keywords related to the research topic, considering both Portuguese and English languages, as shown in Table 1.



**Table 1***Main set of keywords used in databases*

PORTUGUESE	ENGLISH
<i>Segurança percebida</i>	Perceived security
<i>Desafios das mulheres no transporte</i>	Women's issues in transport
<i>Caminhabilidade</i>	Walkability
<i>Planejamento urbano</i>	Urban planning
<i>Prevenção do crime através do design ambiental</i>	Crime prevention through environmental design
<i>Diferenças de gênero na caminhada</i>	Gender differences in walking
<i>Espaços defensivos</i>	Defensible spaces

*Source:* Own elaboration (2023).

The databases used to obtain the bibliographic survey materials were primarily: (i) the Coordination for the Improvement of Higher Education Personnel (CAPES) Journal Portal, which provides titles to users in alphabetical order, by field of knowledge, and by publisher/supplier, through institutional login, allowing free access; (ii) ScienceDirect, a platform offering a notable variety of publications, also allowing free access through institutional login; and (iii) Google Scholar, a freely accessible virtual search engine that provides a variety of publication formats. The collected survey materials thus provided theoretical grounding on which characteristics of the built environment are associated with perceived security while walking, particularly considering the female gender.

The search terms used are listed in Table 1. However, during the application of the method, combinations of these terms were used: “perceived security” AND “women's issues in transport” OR “gender differences in walking” AND “urban planning” OR “walkability” AND “defensible spaces” OR “Crime Prevention Through Environmental Design (CPTED)”. It should be noted that, as filters, the search was applied to title, abstract, and keywords fields; however, no specific material type, such as “articles only,” was chosen as a criterion, nor was a temporal delimitation established, as there was no methodological need for such specification. It is also important to emphasize that the search did not limit a specific language, although the keywords were used in both Portuguese and English in the search space.

It was observed that these keywords are utilized in the literature on the topic, and thus, with this set of terms and concepts applied, it was possible to accurately select the various materials found that were relevant to the research topic. Nineteen (19) materials were collected



that address at least one characteristic of the urban space affecting pedestrians' perception of security, particularly considering the female gender, and also considering the period during which this bibliographic review was conducted (March to August of 2022).

Although dozens of materials on the topic were found, a systematic selection was made, involving reading and understanding these works. It was possible to analyze that, although many others besides these 19 are relevant to the topic, they generally do not provide evidence about the influence of specific urban space characteristics on pedestrians' perceived security concerning crime. Thus, this systematic review process was essential for applying a "filter" to the works found related to the research topic, aiming to select only those that provided concrete evidence regarding such characteristics of the built environment. From this perspective, the following inclusion and exclusion criteria were considered:

a) Inclusion criteria: 1) Scientific or technical works that provide evidence on characteristics of the built environment capable of affecting the perceived security of pedestrians, particularly women, within the period during which the systematic bibliographic review was conducted.

b) Exclusion criteria: 1) Non-scientific or non-technical works; 2) works that address perceived security or the perceived security of pedestrians, including specifically women, but do not provide evidence on which characteristics and aspects of the built environment can actually impact this perception of security; and 3) works related to other fields of knowledge without full relevance to the research topic.

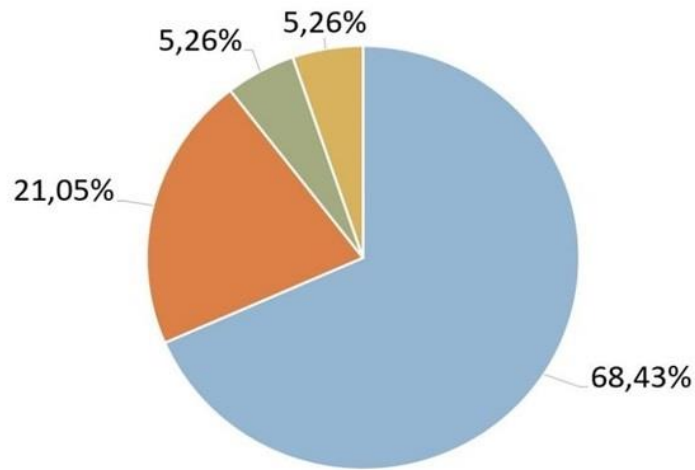
Therefore, based on these inclusion and exclusion criteria, a selected set of the 19 materials was obtained that truly establishes which characteristics of urban space generally impact pedestrians' perception of security, including and particularly focusing on women in their diversity.

## Results and Discussion

Through the bibliographic research conducted, from the total of 19 materials collected, 68,43% were scientific articles (13), 21,05% were books (4), 5,26% were theses (1), and 5,26% were technical reports (1), which related to an existing walkability assessment tool developed by ITDP Brazil (2019). These materials allowed for the selection of characteristics of the built environment that affect pedestrians' perceived security, particularly considering women, with the aim of contributing to urban planning and management decision-making. Figure 1 illustrates a chart of the types of materials collected in the bibliographic research.

**Figure 1**

*Chart of the types of materials collected in the bibliographic research.*



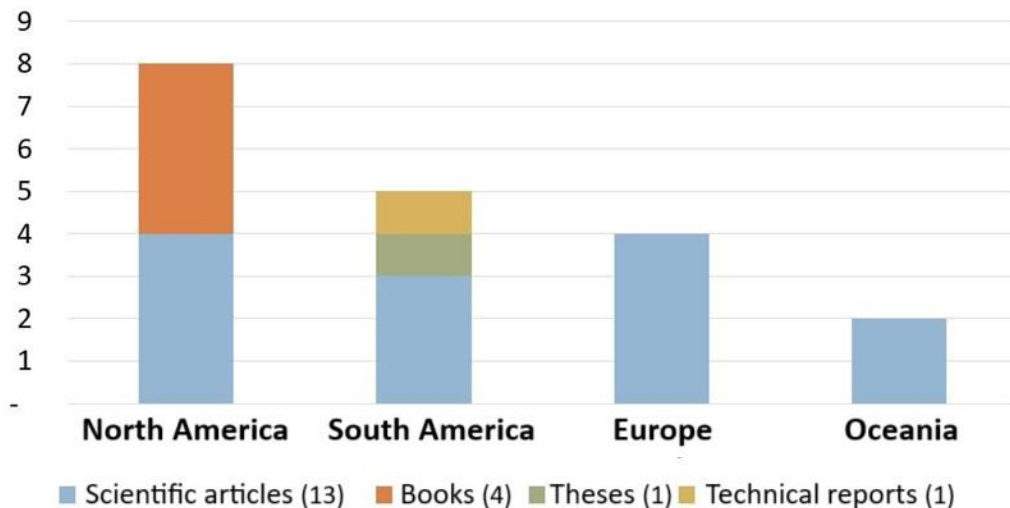
■ Scientific articles ■ Books ■ Theses ■ Technical reports

Source: Own elaboration (2023).

The collected and analyzed materials primarily originate from the United States (North America), Brazil and Colombia (South America), the United Kingdom, Sweden, and Spain (Europe), as well as Australia (Oceania), and were published between 1971 and 2022. Figure 2 below shows the quantity of collected materials by geographic location, considering the mentioned continents.

**Figure 2**

*Chart of the geographic location of the collected materials by continent with quantities*



■ Scientific articles (13) ■ Books (4) ■ Theses (1) ■ Technical reports (1)

Source: Own elaboration (2023).

In the sequence, there is a theoretical framework regarding the discussion of the literature found from the database searches, providing general information on the effects of urban space on pedestrians' perception of security, especially for women. Following this, based on the samples outlined in the theoretical framework, the characteristics of the built environment that impact pedestrians' perceived security, particularly focusing on women, are presented.

### Theoretical Framework

In association with the concept of “defensible space”, by Newman (1972), which examines how urban space characteristics influence perceived security and even the actual occurrence of criminal activities, is the concept of “Crime Prevention Through Environmental Design” (CPTED). CPTED aims to prevent and reduce criminal occurrences, mitigate the perception of insecurity in the built environment, encourage natural surveillance, promote territoriality, and reduce conflict areas through urban planning principles and design characteristics (Crowe, 2000). The idea of CPTED is to deter potential offenders by creating urban spaces that increase opportunities for surveillance and present a “positive image” (Foster, Giles-Corti & Knuiman, 2011; Brown, Perkins & Brown, 2004; Cozens, Saville & Hillier, 2005).

Deserted areas, facades lacking visual permeability, poor maintenance of streets, signs of vandalism, graffiti, and litter are generally environmental factors that most contribute to pedestrians' perception of insecurity, especially for women (Ceccato, Näsman & Langefors, 2021; Foster et al., 2011; Foster, Giles-Corti & Knuiman, 2014; Kelling & Coles, 1997; Loukaitou-Sideris, 2004; Lucchesi, Larranaga, Ochoa, Samios & Cybi, 2021; Silva, 2022; Skogan, 1992; Wilson & Kelling, 1982).

Moreover, street lighting has also received considerable attention among the physical characteristics of urban space that affect perceived security for women (Ceccato & Loukaitou-Sideris, 2022; Ceccato et al., 2021; Foster et al., 2011; Foster et al., 2014; ITDP Brazil, 2019; Harris, 1971; Lizárraga et al., 2022; Loukaitou-Sideris, 2004; Loukaitou-Sideris, 2011; Loukaitou-Sideris, 2012; Lucchesi et al., 2021; Nourani et al., 2019; Painter, 1996). Lizárraga et al. (2022) recognize these urban elements as environmental markers that affect women's likelihood of choosing to walk.

According to Lizárraga et al. (2022) and Loukaitou-Sideris (2004), there are two general categories of public spaces that most activate women's perception insecurity regarding to the possibility of sexual victimization while walking: (i) enclosed spaces with limited or distant escape routes, such as subway stations, underground passages in tunnels, and dead-end streets; and (ii) deserted open spaces, such as remote public transport stops, empty public parks, and streets



with a significant number of abandoned or underutilized buildings and vacant lots.

Given this context, recognizing that gender is the most significant variable in terms of perceived insecurity in public spaces, there is a need to consider urban alternatives and interventions that can make the built environment more friendly to women (Lizárraga et al., 2022).

Visually active and physically permeable facades are significant indicators of the “Walkability Index (iCam)” developed by the Institute for Transportation and Development Policy (ITDP) Brazil (2019), as well as its evaluative criteria within the public security category, such as lighting and pedestrian flow during the day and night. The latter is associated with monitoring the movement of people in urban spaces.

Among the possible urban management and planning suggestions to reduce the perceived insecurity of women walking in public spaces, some strategies and recommendations studied by Loukaitou-Sideris (2004) stand out, though they are situational and need to be adapted to the specifics of each environment.

In general, the first recommendation involves addressing Kelling and Coles’s (1997) “broken windows” theory, which includes improvements to building facades and streets, ensuring proper lighting, maintenance, and cleaning of public spaces. Poor street maintenance, with signs of deterioration such as graffiti and litter, has a direct impact not only on perceived security but also on local crime rates, as it indicates a lack of social control in the area (Loukaitou-Sideris, 2004; Skogan, 1992; Wilson & Kelling, 1982).

The second suggestion proposed by Loukaitou-Sideris (2004) is to enhance visibility in public streets by placing public transportation facilities in locations that can be monitored by neighbors, pedestrians, and local businesses, away from “deserted” areas or places with low pedestrian traffic; replacing tunnels and pedestrian walkways with secure ground-level passages; and reducing dead-end streets and empty alleys that obstruct visibility.

Lucchesi et al. (2021) also emphasize that special attention should be given to security at public transport stops to reduce the perception of insecurity in these high-risk crime environments. Public transportation facilities should be located in areas that can be monitored, at least most of the day, by neighbors, pedestrians, and local businesses, meaning they should be situated in areas with higher pedestrian traffic and mixed land use (Lucchesi et al., 2021).

In addition, natural surveillance and the assurance of continuous visibility through mixed land use contribute to mitigating perceived insecurity and even to the potential prevention of crime occurrences in public spaces (Carbonari & Lima, 2016; Foster et al., 2011).

As early as the 1960s, Jacobs (2011) highlighted that natural surveillance is crucial for ensuring urban spaces more secure. These actions are essential because empty streets and



desolate public spaces not only heighten the perception of insecurity but also evoke a sense of fear, particularly among women, as they present greater opportunities for criminal acts (Loukaitou-Sideris, 2004).

The third proposal suggested by Loukaitou-Sideris (2004) pertains to street lighting. It argues that dark areas generally activate perceptions of insecurity and fear; thus, improving street lighting is one of the primary measures to address this issue.

In this context, Painter (1996) conducted studies and proposed improvements to public lighting on three urban streets with similar characteristics, which were considered poorly frequented during nighttime and prone to perceptions of insecurity and even crime.

The research of Painter (1996) yielded convincing results that adequate lighting leads to a reduction in perceived insecurity and even the risk of crime occurrences, increasing pedestrian use of streets after dark. Factors such as the type, level, and uniformity of public lighting contribute to the potential reduction or increase in perceived security and can even affect the actual risk of crime (Painter, 1996).

Subsequently, Loukaitou-Sideris's (2004) fourth suggestion for reducing perceived insecurity among women walking in public spaces involves eliminating "bad neighbors," in other words, removing certain land uses that give an area a bad reputation and increase crime. Examples include specific bars and clubs, as well as other private addresses or public spaces like urban squares and parks that are associated with illegal activities or conditions contributing to insecurity, such as drug trafficking and pornography. These factors directly influence the perception of insecurity among women walking near such locations (Loukaitou-Sideris, 2004).

Continuing, another strategy proposed by Loukaitou-Sideris (2004) involves creating secure territories through collaboration among neighborhood residents, promoting peaceful coexistence among everyone. Similarly, Jacobs (2011) also emphasizes the importance of interaction between the community and the built environment, fostering a form of surveillance among inhabitants of the same urban area.

In addition to these actions, Loukaitou-Sideris (2004) and Lucchesi et al. (2021) also suggest complementary strategies to urban planning measures, which should involve intrapersonal, interpersonal, institutional, and community approaches, addressing individual, environmental, and social factors. Among these complementary measures are public safety policing and the indication of neighborhood surveillance (Loukaitou-Sideris, 2004; Lucchesi et al., 2021), as well as the creation of educational programs and campaigns by public authorities (Loukaitou-Sideris, 2004).

Additionally, according to Lucchesi et al. (2021), for urban spaces to be more secure





perceptibly and to have high walkability, they should exhibit certain characteristics, such as: high levels of road connectivity, which relates to urban design; presence of shops and services, which pertains to mixed land use; attractive aesthetic features, such as active facades and buildings free from signs of deterioration, underutilization, or abandonment; and high density.

Building on this, Painter (1996) suggests that there are three indicators of potential risk in urban spaces that increase the perception of insecurity: darkness, disorder, and being alone. Therefore, generally, measures related to street lighting, urban design, visibility, access conditions, presence or absence of vandalism, presence of people, policing, and surveillance should be considered (Lucchesi et al., 2021).

In this sense, the urban planning strategies related to security studied and proposed by the researchers and organizations presented here have significant potential for analyzing urban areas to identify locations with higher or lower possibilities of perceived insecurity by pedestrians, especially women.

Thus, the suggestions and ideas presented guide the study of public spaces that are more secure perceptibly and more attractive not only for women but for all pedestrians. They also aim to encourage walking and physical activity, reduce restrictive behaviors, decrease motorized trips, and mitigate environmental impacts.

### **Selected Built Environment Characteristics**

In general, based on the collected sample, characteristics of the built environment related to the perception of (in)security were identified. From this sample, four aspects of the urban space that affect pedestrian perceived security, especially for women, were selected: (i) flow of people, (ii) street maintenance, (iii) attractiveness of the urban space and (iv) surveillance, each comprising two specific measures. Table 2 summarizes the urban space aspects and selected measures with their respective descriptions, related to scenarios that can make the urban environment perceptibly more secure for walking, along with references.



**Table 2**

*Summary of the selected urban space aspects and measures*

Urban space aspects	Measures	Description	References
Flow of people	Urban mobility infrastructure in areas with high flow of people	Bus stops and/or bike racks near commercial and service areas.	Carbonari and Lima (2016), ITDP Brazil (2019), Jacobs (2011), Loukaitou-Sideris (2004), Lucchesi et al. (2021).
	Sidewalks and crossings that promote flow of people	Improvement of sidewalks in areas under viaducts, tunnels, and around vacant lots, green spaces, and abandoned buildings; avoidance of dead-end streets; at-grade crossings instead of elevated walkways.	Carbonari and Lima (2016), ITDP Brasil (2019), Harris (1971), Loukaitou-Sideris (2004), Loukaitou-Sideris (2012), Lucchesi et al. (2021), Silva (2022).
Street maintenance	Adequate lighting	Proper street lighting for pedestrians, without interference from existing vegetation.	Ceccato and Loukaitou-Sideris (2022), Ceccato, Näsman and Langefors (2021), Foster, Giles-Corti and Knuiman (2011), Foster, Giles-Corti and Knuiman (2014), ITDP Brasil (2019), Harris (1971), Lizárraga et al. (2022), Loukaitou-Sideris (2004), Loukaitou-Sideris (2011), Loukaitou-Sideris (2012), Lucchesi et al. (2021), Nourani, Antonello and Govone (2019), Painter (1996).
	Clean and well-maintained streets	Absence of litter and signs of vandalism, such as broken or tampered windows and doors, and graffiti on walls and buildings.	Ceccato, Näsman and Langefors (2021), Foster, Giles-Corti and Knuiman (2011), Foster, Giles-Corti and Knuiman (2014), Kelling and Coles (1997), Loukaitou-Sideris (2004), Lucchesi et al. (2021), Silva (2022), Skogan (1992), Wilson and Kelling (1982).
Attractiveness of the urban space	Active facades	Presence of active facades that allow interaction between the building and the sidewalk. Examples: commercial storefronts, residences without fences or with permeable fences such as grills.	ITDP Brazil (2019), Harris (1971), Loukaitou-Sideris (2004), Lucchesi et al. (2021), Silva (2022).
	Areas free from illegal activities	Areas free from drug trafficking and prostitution.	Loukaitou-Sideris (2004).
Surveillance	Neighborhood surveillance signage	Presence of signage by residents indicating neighborhood watch activities in public spaces.	Jacobs (2011), Loukaitou-Sideris (2004).
	Policing and surveillance by municipal guards and watchmen	Policing in the neighborhood by municipal guards or watchmen and/or security services.	Loukaitou-Sideris (2004), Lucchesi et al. (2021).

Source: Own elaboration (2023).



### **Flow of people: urban mobility infrastructure in areas with high flow of people and Sidewalks and crossings that promote flow of people**

The first aspect discussed about urban spaces, "flow of people," refers to the presence of individuals and visibility in the built environment, aiming to prevent "deserted areas," as noted by Loukaitou-Sideris (2004). This aspect is directly related to land use and zoning processes in cities, as neighborhoods with more mixed land use, featuring a higher concentration of businesses and services, typically exhibit higher walkability and greater pedestrian movement throughout most times of the day. Consequently, increased pedestrian activity in streets makes pedestrians, including women, feel more secure in the urban space.

The concept of mixed land use is intrinsically linked to the aspect of pedestrian flow, making it highly relevant when considering walkability and security. Dovey and Pafka (2020) refer to mixed land use as one of the three components of "urban DMA" (Density, Mix of Land Use, and Accessibility), which influences walkability, alongside density and accessibility, all acting together in complex synergies and interdependencies.

Based on this understanding, the aspect of pedestrian flow is composed of two measures. The first, "Urban Mobility Infrastructure in Areas with Pedestrian Traffic," involves analyzing the locations of bus stops, metro access points, and other public transportation facilities. This measure focuses on public transportation, aiming to verify whether these facilities or stops are situated in areas with frequent pedestrian traffic throughout most times of the day, meaning locations close to commercial and service establishments where there is higher visibility and pedestrian presence. This is considered an ideal analysis for this measure (Carbonari & Lima, 2016; ITDP Brasil, 2019; Jacobs, 2011; Loukaitou-Sideris, 2004; Lucchesi et al., 2021).

The second specific measure of the pedestrian flow aspect, "Sidewalks and Crossings that Promote Pedestrian Movement," addresses certain areas of urban space that negatively affect pedestrian flow and contribute to a perception of insecurity, according to the literature (Carbonari & Lima, 2016; ITDP Brazil, 2019; Harris, 1971; Loukaitou-Sideris, 2004; Loukaitou-Sideris, 2012; Lucchesi et al., 2021; Silva, 2022). Such locations are exemplified by Loukaitou-Sideris (2004) as dead-end streets, areas directly facing vacant lots, abandoned or underutilized buildings, spaces under viaducts or elevated walkways, and pedestrian bridges (elevated pathways for pedestrians).

These examples, according to Loukaitou-Sideris's research (2004), contribute a negative aspect to the built environment, leading to reduced pedestrian movement near these elements, which increases the perception of insecurity, especially when combined with other issues such as poor lighting, lack of street maintenance, and inadequate surveillance.

Thus, this measure aims to identify these "negative urban characteristics" in the studied public spaces, associated with urban design, alongside commercial and service points. The analysis intends to show that the mentioned unappealing areas, which result in sparse pedestrian flow nearby, can be improved and neutralized through the presence of mixed land use in their surroundings, with commercial and service establishments, to encourage pedestrian movement even near these "negative characteristics" present in Brazilian cities.

In this sense, mixed land use can mitigate such urban design and planning issues related to perceived security and increased walkability, including for women. A clear example illustrating this situation is the issue of dead-end streets, which create a sense of insecurity for pedestrians (Loukaitou-Sideris, 2004) due to being closed at one end. However, if a dead-end street is enhanced with mixed land use along its length, featuring commercial and service points, it will show increased pedestrian movement and, consequently, a greater sense of security.

### **Street maintenance: Adequate lighting and Clean and well-maintained streets**

The second general aspect of urban space related to mitigating pedestrian insecurity is "street maintenance." This aspect includes two crucial measures, based on the reviewed literature: "adequate lighting" and "clean and well-maintained streets." Among the eight measures listed, lighting was the most frequently cited in the literature concerning its impact on pedestrian-perceived security (Ceccato & Loukaitou-Sideris, 2022; Ceccato et al., 2021; Foster et al., 2011; Foster et al., 2014; ITDP Brasil, 2019; Harris, 1971; Lizárraga et al., 2022; Loukaitou-Sideris, 2004; Loukaitou-Sideris, 2011; Loukaitou-Sideris, 2012; Lucchesi et al., 2021; Nourani et al., 2019; Painter, 1996).

In this context, "adequate lighting" is discussed in the research as one of the primary and most important measures to consider in mitigating pedestrian insecurity, as public lighting can either decrease or increase pedestrian visibility at night, thereby providing better recognition of distances and enhancing the sense of security, according to Painter (1996).

Thus, this measure aims to assess street lighting perceptually, considering factors such as type, level, and uniformity, as well as checking whether existing lighting is obstructed by trees or shrubs, which can affect its coverage.

However, the measure "clean and well-maintained streets," which also falls under the general aspect of road maintenance, pertains to the analysis and correction of "broken windows," as discussed by Kelling and Coles (1997). This measure aims to identify and evaluate the presence of trash and debris, as well as possible signs of vandalism, such as graffiti and broken or violated windows and doors in walls and buildings, even if these are not necessarily abandoned



or underutilized, as these factors can alter the perception of security, according to the reviewed literature (Ceccato et al., 2021; Foster et al., 2011; Foster et al., 2014; Kelling & Coles, 1997; Loukaitou-Sideris, 2004; Lucchesi et al., 2021; Silva, 2022; Skogan, 1992; Wilson & Kelling, 1982).

### **Attractiveness of the urban space: Active facades and Areas free of illegal activities**

The third aspect that was listed about urban spaces is "attractiveness of the urban space", which includes the measures "active facades" and "areas free of illegal activities". The role of the active facades in improving pedestrian security perception has been extensively studied and highlighted by researchers and organizations, making it another significant measure among the discussed ideas (ITDP Brazil, 2019; Harris, 1971; Loukaitou-Sideris, 2004; Lucchesi et al., 2021; Silva, 2022).

The presence of active facades is considered a crucial feature for urban streets, not only for its attractiveness but also for enabling interaction between the building and the sidewalk. This interaction provides visual permeability for pedestrians to the built environment around them, enhancing their sense of security.

The specific measure regarding "areas free of illegal activities" pertains to identifying and analyzing "bad neighbors" in urban areas, as mentioned by Loukaitou-Sideris (2004). This involves checking for the presence of illegal activities that frequently occur in establishments and certain fixed locations in public spaces, such as squares and urban parks.

All the measures listed in the literature contribute to influencing in the security of the pedestrian, but they do not directly impact the actual incidence of crime in urban spaces, as perceived security does not correlate with the real risk of crime occurrence.

In this context, the last measure mentioned contributes to "attractiveness of the urban space" making it more or less inviting and attractive, as well as more or less perceptually secure, depending on whether or not there is common knowledge among the population, through news reports for example, that a particular type of crime frequently occurs in the same area.

### **Surveillance: neighborhood surveillance signage and Policing and surveillance by municipal guards and watchmen**

The fourth and final general aspect considered, "oversight," is composed of the following measures: "neighborhood surveillance signage" and "policing and surveillance by municipal guards and watchmen." The first measure aims to verify the presence of surveillance in the urban area by residents and merchants, with signs or banners indicating neighborhood watch activities.



This, according to Harris (1971), Jacobs (2011), and Loukaitou-Sideris (2004), leads to an increased perception of security.

The last specific measure listed under the oversight aspect refers to complementary practices studied by Loukaitou-Sideris (2004) and Lucchesi et al. (2021) concerning the importance of increased policing and surveillance in public spaces through the presence of police stations, municipal guards, police officers, and night watchmen.

According to the literature reviewed, even though this measure, like its general aspect as a whole, is not directly associated with urban planning, it greatly contributes to pedestrians' sense of security by establishing an awareness of the constant presence of strategic oversight, whether through police officers, guards, or watchmen as suggested by this measure, or through the community itself.

In light of the presented information, the four aspects of urban space and the eight measures aimed to translate and synthesize the ideas and concepts studied in the selected literature into urban planning actions capable of altering pedestrians' sense of security, including that of women, and assisting public space managers in decision-making.

It is important to note that this work considered the female gender in all its diversity, including cisgender and transgender women. Additionally, the consulted literature does not establish differences or specific studies on each of these cases.

### Conclusion

The main theoretical/methodological contribution of the study, through bibliographic analysis, was the selection of a set of aspects and measures that affect pedestrians' perceived safety in urban spaces, with a focus on women, which is crucial for improving walkability. These issues are essential when considering the gap in the literature on this topic and the high rates of women victims of violence, crimes, and harassment in public spaces while walking.

As a contribution to management, the article provides support for urban planning decision-making, aiming for cities that are perceptibly safer and more inviting for pedestrians, especially women, highlighting the aspects and measures that can be considered to achieve this goal. Furthermore, the pursuit of cities that are perceptibly safer for pedestrians also aims to reduce car use, particularly when cars are used solely as a precaution for personal safety against crime in certain situations, which represents an environmental contribution.

Although the identified aspects and measures affect perceived safety and are linked to the concepts of "defensive space" and CPTED, it is important to emphasize that they do not guarantee a reduction in the actual risk of crime in public spaces, as these are tied to complex social issues. To achieve the goal of reducing the real risk of crime in the built environment, it is





necessary to combine these aspects and measures with extensive efforts in public awareness, education, and enforcement by authorities, as well as a broader process aimed at reducing existing social inequalities.

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