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Perception of Safety in Public Space: A Bibliometric and Network Analysis from 1978–2023

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ABSTRACT

The discussions about the POS in public spaces have gained momentum during post-pandemic in cities across the globe. The wide scope of the subject and the fact that it is studied in other fields of social and human science other than spatial planning and design offers a very broad perspective. In this context, two research questions emerged (1) what are the prevailing themes related to the POS in public spaces and (2) how did these themes come together? This study conducts a comprehensive bibliometric review to explore the perception of safety (POS) within the domain of public safety (PS) by utilising VOS Viewer and R software. Utilizing a systematic literature search in the SCOPUS database from 1978 to 2023, 528 articles were selected for analysis based on inclusion and exclusion criteria focused on specific disciplines and languages. Data cleaning and extraction were performed to ensure the integrity of the dataset. Employing descriptive bibliometric analysis techniques, insights were gleaned into major publishing journals, prolific authors, temporal production trends, and geographical contributions. Six emerging thematic clusters were identified: the concept of perception of safety, built environment, surveillance, public spaces, urban green spaces, and correlation between age and gender. The uniqueness of this paper depends on the fact that the combined use of the two methods enabled the classification of some useful themes of POS, which may facilitate the betterment of public space. This may assist future studies since it provides a theoretical basis for the field.

1. INTRODUCTION

Open Public Spaces are vital for social interaction, community engagement, and individual well-being within urban environments. These spaces, which include parks, streets, plazas, and green spaces, are essential for fostering social cohesion and providing areas for recreation, relaxation, and cultural activities. The design and quality of public spaces significantly impact their usage and the perceptions of safety (POS) among users. Morphological characteristics, such as spatial structure and infrastructure quality, play crucial roles in enhancing the attractiveness and usability of these spaces. Studies have shown that well-designed public spaces can improve physical activity levels, promote mental health, and support social interactions, thereby contributing to overall urban livability. Moreover, public spaces are dynamic entities that reflect broader societal trends and issues, such as the need for social distancing during the COVID-19 pandemic or the growing emphasis on nature-based solutions for urban resilience. Understanding the diverse factors that influence public space usage and perception helps urban planners and policymakers create environments that are inclusive, safe, and beneficial for all community members.

POS is a multifaceted construct that encapsulates how individuals perceive their risk of harm within various environments. POS is influenced by a myriad of factors, including physical characteristics of the environment, such as lighting, presence of escape routes, and signs of disorder, as well as personal factors like gender, psychological state, and past experiences. Theories like the "broken window theory" suggest that visible signs of the disorder can exacerbate feelings of insecurity and potentially foster further crime and antisocial behaviour. The wide scope of the subject and the fact that it is studied in social and human science fields other than spatial planning and design offers a comprehensive perspective. The main objective of this paper is to provide a broad overview of more than forty-five years of literature on POS in PS by using a bibliometric literature review. In this context, two main research questions emerged (1) what are the prevailing themes related to the thematic evolution POS in PS and (2) how did these themes come together? While answering these two research questions it also helps in identifying seminal authors, sources, countries and methodological approaches in this field. Mainly studies in this domain have used systematic review to understand aspects of POS and PS. The analysis and results from this study can be used for various purposes. They can be used by interested target groups to better understand existing tools, methods, and approaches for assessing POS and its implication for PS; they can inform interested researchers of key tools, journals, and publications

that can serve as points of reference for a better understanding of the field; and they can also be used to understand key areas that need to be explored further in the coming years. While 'safety' research has been rapidly increasing over the past decades, there is still a lack of studies that provide a complete overview of the 'perception of safety' and its interplay in PS of the field.

Research indicates that POS is also shaped by broader social dynamics and environmental satisfaction, highlighting the interplay between individual perceptions and the social and physical context. This study taps into the complex interplay that necessitates a comprehensive understanding of POS to enhance safety measures and improve overall well-being in different environments.

2. MATERIALS AND METHODS

The following steps were used to generate the data set:

2.1 Study search

To achieve the study's objectives, acknowledging the major themes and sub-themes of POS is important; thus, the literature search was started using the terms: "Perception of Safety" and "Open Public Spaces" within the titles, keywords, abstracts in the SCOPUS database on May 3, 2024. This step was taken to analyse how people perceive safety in PSs thoroughly. The SCOPUS database was chosen to select articles. According to the Elsevier website, the database boasts nearly 25,000 journals and hosts over 75 million articles, which have garnered 1.4 billion citations. High-quality research is typically indexed in reputable databases, but this approach has limitations. Valuable studies may not be included if they are not indexed and are part of the grey literature.

2.2 Inclusion and exclusion criteria

Research on the POS in PSs started from 1978 onwards, this study has taken 1st January 1978 to 31st December 2023 as the tenure for the selection of the articles. As shown in Figure 1, the first search resulted in 1031 articles of which 538 were selected after incorporating inclusion and exclusion criteria. To align with the theme of this study, articles belonging to the following disciplines the subject area were limited to social science; environmental science; Arts and humanities and psychology. Non–English articles were omitted.

2.3 Data cleaning, extraction, and analysis

Data cleaning was done in Scopus comma-separated values (.cvs) format file. Certain incomplete records and duplication errors were identified and subsequently removed. Articles in non-English language were excluded. Some papers were excluded as they were unrelated to the theme of POS in PS. After a thorough analysis, a total of 528 studies have been chosen for the final assessment. Besides, the study examined the citation report from 1978 – 2023 (Figure 1) and found citations with an average citation per article (Figure 2).

This study underscores the importance of bibliometric analysis as a powerful tool for understanding the evolving landscape of knowledge within public safety perception. By synthesizing a large body of literature, it provides a comprehensive overview of the current state and trends in POS research. Bibliometric analysis has become an essential tool across diverse professional fields for visualizing the status, characteristics, evolution, and development trends of knowledge [1, 2]. Bibliometric analysis is categorized into two types: descriptive and evaluative [3]. In this study, descriptive bibliometric analysis was used. Under this, performance as well as network analysis was carried out. For performance analysis, we utilized the statistical capabilities and control of the R environment [4]. "R" was used to extract information related to the major POS in PS publishing journal, POS in PS authors, production over time, key articles, top contributing countries and top contributing organisations.

After that a network analysis was done and VOS Viewer was used for conducting study the study. 'Visualisation of similarities' also known as VOS Viewer maps based on similarity, to create a two – dimensional bibliographic network [5]. The type of analysis used was 'bibliographic coupling' and the unit was 'documents' using a fractional counting method. Since the number of documents was large, 538, a threshold value of 40 was chosen, which resulted in 107 articles for cluster analysis. A total of thirteen clusters were formed. Out of these five themes emerged clearly. Out of the remaining eight clusters were analyzed in detail and one common theme emerged from them. The remaining seven themes did not seem to form any particular theme and they were rejected.

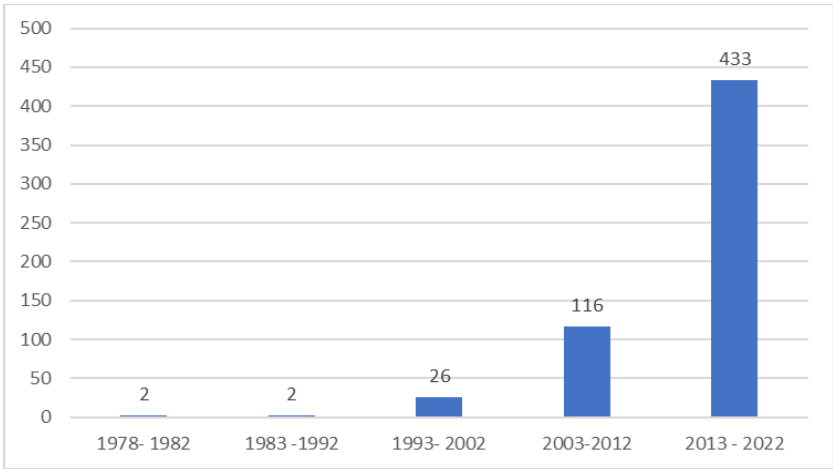

Figure 1. Total articles after inclusion and exclusion criteria from 1973 to 2022

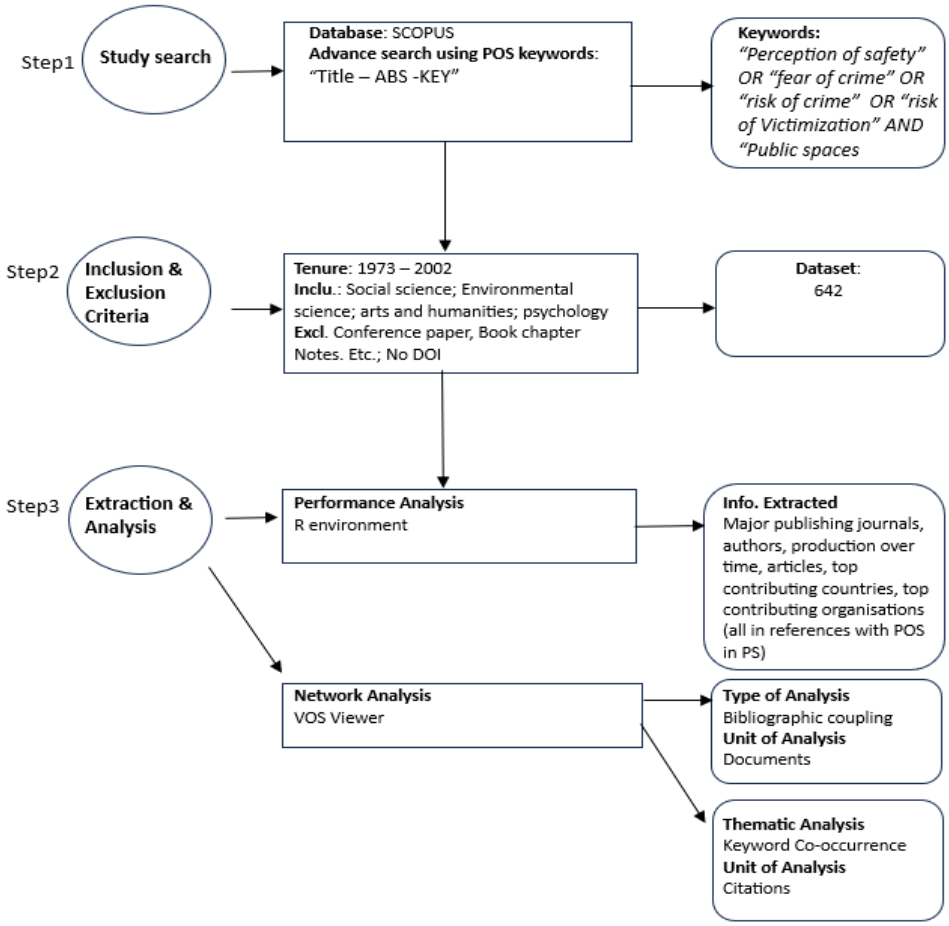

Figure 2. Methodology adopted for selection of articles for this study

3. RESULTS

3.1 Major POS in PSs – publishing journals

Table 1. Top 10 contributing journals

Source	Articles	Source	Citation (Global)
International Journal of Environmental and Public Health	16	PLoS ONE	184362
Urban Forestry and Urban Greening	14	International Journal of Environmental Research and Public Health	130872
Landscape and Urban Planning	11	Sustainability Switzerland	130265
Sustainability Switzerland	9	Social Science and Medicine	117748
BMC Public Health	8	BMC Public Health	28137
PLoS ONE	6	Landscape and Urban Planning	26862
Frontiers in Public Health	5	Frontier in Public Health	18706
Gender Place and Culture	5	Urban Forestry and Urban Greening	12189
Urban Studies	4	Urban Studies	14628
Social Science and Medicine	4	Gender Place and Culture	2972

Source: Scopus Database (May 2024)

Table 1 shows the top ten contributing journals in the domain. The analysis reveals the International Journal of Environmental and Public Health with 16 articles and citations 130872 is one of the most prominent journals. Followed by Urban Forestry Urban Greening, and Landscape and Urban Planning. Corresponding in terms of citation score, PLoS ONE is the number one contributor with 184362 citations followed closely by Sustainability Switzerland with 130265 citations.

3.2 Authors productivity over time

Table 2 shows the top 10 principal authors in the domain. The table shows several articles and articles fractionalised by each author. The author fractionalised refers to an author's output divided by the square root of several co-authors. The results indicate that Valentine and McKendrck [6] has three articles, but an article fractionalised of 600.5. The study conducted by her [6] explores the differing perspectives between children and their parents regarding the children's ability to navigate PSs safely. While children often feel capable, parents tend to be more protective and skeptical of their children's abilities to manage potential dangers in PSs. The study delves into this dichotomy and examines its implications on children's independence and experiences in public environments. The study conducted by Valentine [7], intends to investigate the impact of parental perceptions of safety and changes in childhood on children's outdoor play patterns in North-West England. The second highest contributor, Prof. DA. Cohen started working in the domain in 2013 and has 3 contributions to this theme. The themes are the

importance of POS to park use; and the use of neighbourhood parks concerning socio-economic status.

Table 2. Top 10 principal authors

Paper	Nos. of Articles	Article Fractionalised
[8]	4	235.3
[9]	4	9.5
[10]	4	34.3
[11]	3	9.5
[6]	3	706.9
[12]	3	70.1
[13]	3	93.7
[14]	3	77.9
[15]	4	39.9

Source: Scopus Database (May 2024)

3.3 Key articles on POS in PS

Table 3 represents the most influential SOP in PS articles. The table shows that the studies [6, 7] both were written in the same year and had a combined citation of 781 and a total citation per year of 30 topping the list with publications from study of Wendel et al. [16] with the second-highest total citation of 361 and 32.8 Total Citations per year; the study of Groenewegen et al. [17] with a total citation of 348 and TC per year of 20.4 which is close to 20.7 TC per year of Cushman et al.'s study [18].

Table 3. The most influential POS in PS articles

Seminal Research Papers	Total Citations (Global)	TC per Year
[7]	781	30.0
[16]	361	32.8
[17]	348	20.4
[18]	270	20.7
[19]	264	18.8
[20]	231	21
[21]	179	19.8
[22]	152	16.8
[23]	152	11.6

Source: Scopus Database (May 2024)

3.4 Contributing countries

Based on the document count, Table 4 shows the top 15 contributing countries in the domain. The United States has contributed the most with 106 documents receiving 3752 citations. More than 50 percent of the citations have come in the last three years. Followed by the United Kingdom with 68 and followed by China with 36 documents respectively. India stands at the twenty-fifth position which is not shown in Table 4 with 7 articles and 80 citations.

The data (Table 5) highlights research contributions and impact among the top contributing countries. The United States and the United Kingdom are clear leaders, not just in the number of documents but also in the influence of their research as reflected in citation counts. European countries like the Netherlands, Germany, and Spain show a strong presence in terms of impact relative to their output, whereas countries like China demonstrate higher output but lower citation impact, indicating potential differences in research visibility or recognition. This distribution underscores the concentration of influential research in a few leading countries while also showing a global spread of contributions from diverse regions including Europe, Asia, and Latin America, albeit with varying levels of impact. This can guide strategic collaborations and highlight the importance of enhancing the visibility and quality of research in lower-impact countries.

Table 4. Top 15 contributing countries based on document count

Country	Documents	Citations (Based on Global Citation Index)
United States	165	6338
UK	111	3788
China	46	282
Australia	41	969
Canada	39	1064
Spain	37	500
Brazil	26	197
Netherlands	24	912
South Korea	19	225
Chile	18	340
Sweden	18	333
Germany	17	442
Italy	16	270
South Africa	16	122
Mexico	15	125

Source: Scopus Database (May 2024)

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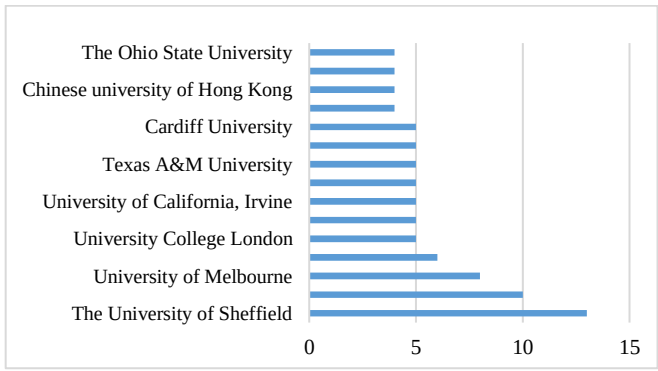

Figure 3. Top 15 contributing institutions based on the number of documents contributed
Source: Scopus Database (May 2024)

Figure 3 provides insights into the distribution of research outputs among the listed universities. The University of Sheffield, Pontificia Universidad Catolica de Chile, and the

University of Melbourne are the leading contributors, which might reflect their strong research capabilities, prioritization of this field, or higher productivity levels. The variation in document counts among the universities indicates differences in research focus, resources, or institutional priorities. This information can be useful for identifying key academic players and understanding the landscape of contributions within the analyzed field.

3.5 Bibliometric coupling analysis

VOSviewer was used for visualisation, representing authors' bibliometric coupling, and showing how their research outputs are connected through shared references for this a threshold size of 25 was chosen. The network (Figure 4) is divided into several three colour-coded clusters, each representing a thematic grouping of authors whose work overlaps. The green cluster includes authors such as Cohen, Lapham, and Evenson, possibly indicating a focus on public health, physical activity, or active transportation research. In contrast, the purple cluster, featuring Boschmann and Cubbon, is related to mobility studies or GIS-based urban research. Meanwhile, the red cluster, with Valentine as a central figure, suggests themes surrounding urban sociology, social interactions, or children's geography. The size of the nodes reflects the bibliometric impact of each author, where larger nodes Valentine G., whose multiple works from different years (1997, 2001) are positioned centrally, indicating her significant influence across various research areas and indicate higher levels of citation or coupling strength. Similarly, Groenewegen P.P. and Van den Berg A.E. appear with large nodes, hinting at their impactful contributions to environmental psychology or urban studies. The connections between nodes are represented by lines, where thicker lines indicate stronger bibliometric relationships, meaning these authors share more references. Authors positioned closer together are thematically aligned. For example, Cutts, Darby, and Boone seem to collaborate or work within overlapping fields, possibly related to sustainability or environmental planning. Likewise, Dempsey and Bramley are tightly linked, suggesting their focus on urban planning or housing/neighbourhood studies. Some authors serve as bridging figures between different clusters, showing cross-disciplinary relevance. For example, Nassauer J.I. and Wright Wendel H. are positioned between multiple clusters, indicating that their research spans environmental design, public space studies, and potentially other fields highlighting the interdisciplinary nature of their work, making them important figures for researchers interested in connecting different thematic areas. Notably, older works like Valentine's publications from 1997 remain relevant, indicating their lasting influence across time.

To quantify different keyword clusters and their importance, bibliographic measures that were citation-based were used. A threshold of 5 citations was chosen to study the evolution of the keywords in the last forty-five years. The network map of keywords (Figure 5), reveals thematic relationships and clustering patterns in research literature. Each color of the cluster represents a group of closely related topics that frequently co-occur in research, highlighting thematic overlaps and research trends. The red cluster focuses on public space, perception, and safety, with keywords such as crime, violence, and urban planning closely connected thus reflecting research on how people perceive safety in public spaces and the role of urban design in mitigating risks, aligning with themes of social well-being and security.

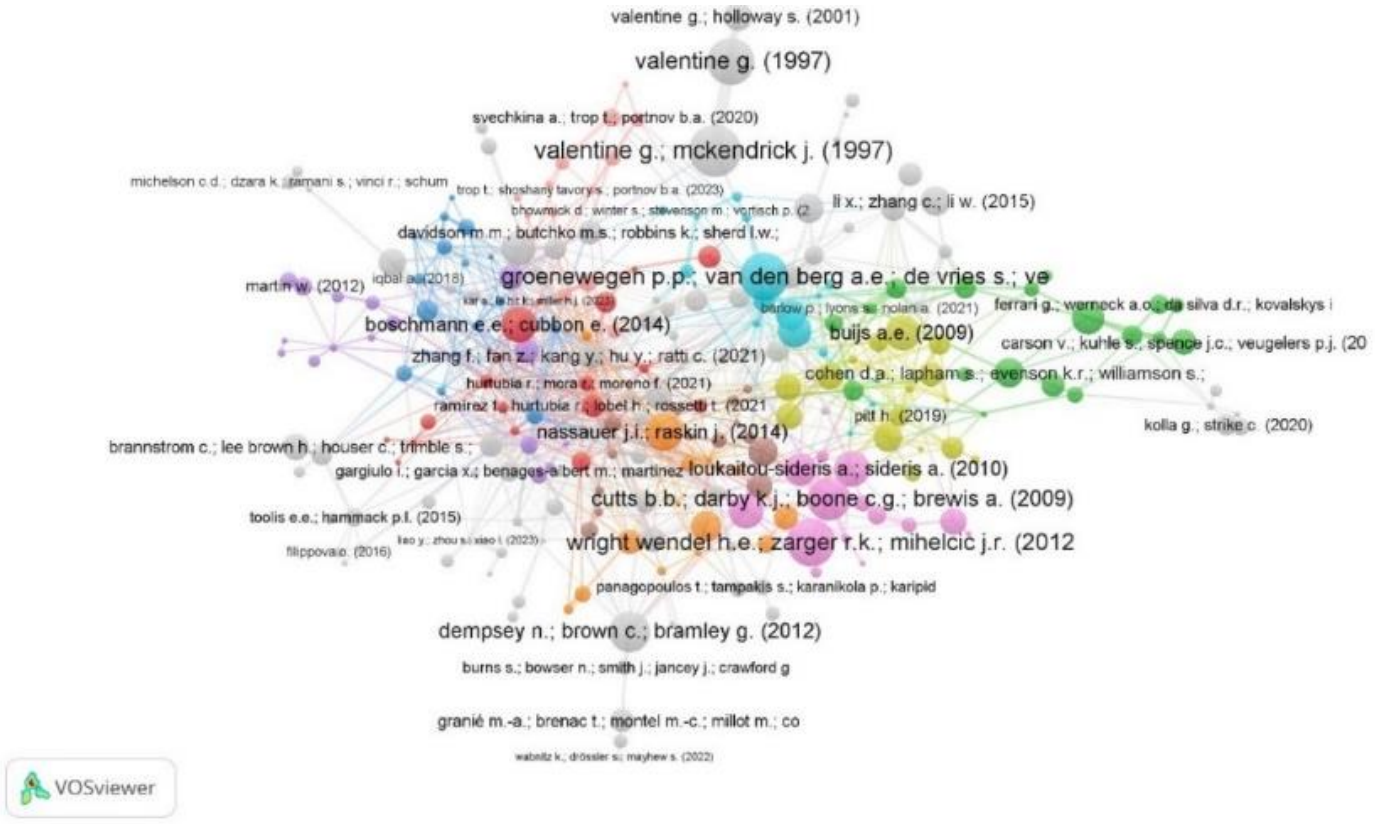

Figure 4. Key co-occurrence analysis

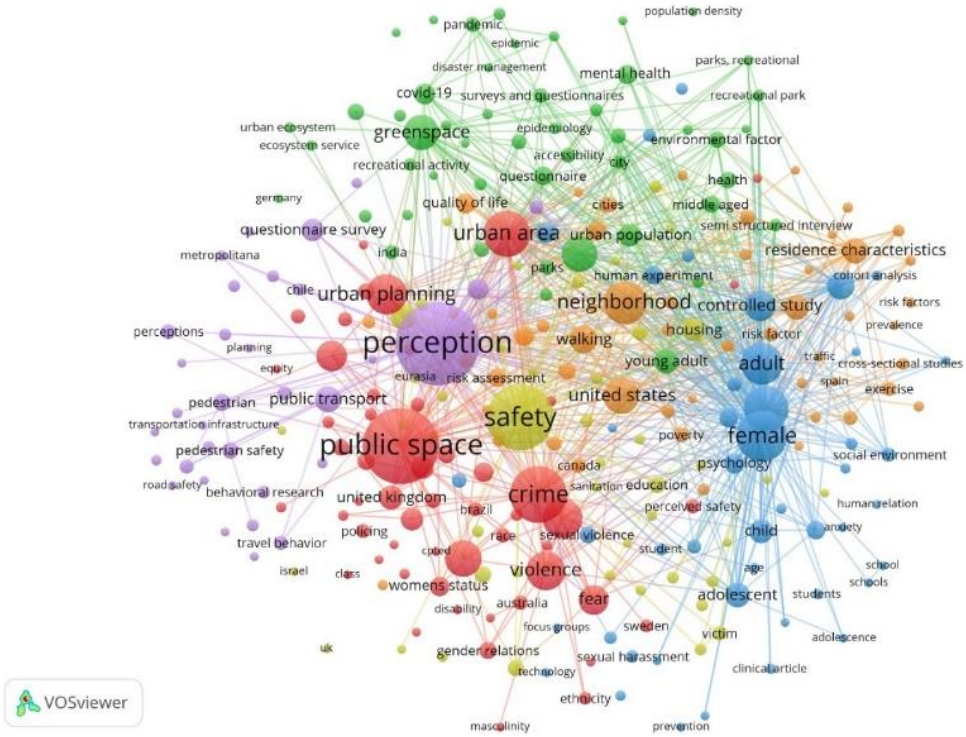

Figure 5. Network map of keywords

In the blue cluster, keywords like female, adolescent, and adult are dominant, indicating a focus on gender and age-related studies that emphasizes research on the varying experiences of safety and public space across gender and age categories. Topics such as neighborhood characteristics, social environment, and residence also appear in this group, suggesting an interest in how individual and community attributes shape public space usage. The green cluster centers around greenspace, mental health, and parks, reflecting research on the health benefits of natural environments and highlighting the importance of urban parks and recreational spaces in promoting mental well-being, linking environmental factors to public health outcomes. Additionally, keywords related to COVID-19 appear, indicating the recent attention towards how access to greenspace became critical during the pandemic. The yellow cluster focuses on topics such as housing, neighborhoods, and controlled studies, suggesting an emphasis on socio-economic conditions and urban infrastructure thus reflecting research that examines how built environments, neighborhood composition, and social factors interact with public space use and well-being. The node size corresponds to the frequency of keyword usage, with larger nodes representing more prominent research themes for example, keywords such as public space, perception, safety, and crime appear larger, indicating their centrality and frequent usage in the literature. Lines between nodes represent the strength of co-occurrence relationships which suggests that topics such as public space and safety, or crime and perception, are closely related and commonly studied together.

In terms of research implications, this network provides insights to highlight the presence of clusters bridging environmental, social, and gendered aspects demonstrating the complexity of public space research. For example, the close connections between safety, public space, and gender reflect growing concerns about inclusivity and accessibility. The clusters also highlight evolving research topics, such as the impact of the pandemic on greenspace use, suggesting new directions for future studies.

3.6 Theme 1: "PS Perception" (PPS)

Theme 1, titled "PS Perception' Consists of nineteen articles. Three articles were not considered as they deviated from the theme and two had nominal reference to PPS. The remaining fourteen articles show a clear linkage to PPS. In this cluster, the article with the highest [15] total link strength (TLS) is 18. This theme explores and understands human perceptions [15], experiences, and interactions within PSs. Topics range from Morphological characteristics [24] and attractiveness in enhancing PSs [25]. Additionally, some studies address specific contexts such as children's experiences [26] or nighttime liveability, while others consider broader factors like pandemic-related concerns and social distancing [27]. Overall, these inquiries aim to uncover the multifaceted aspects of PS perception and use, shedding light on the complexities of urban environments and their impact on people's lives. The literature on urbanism elucidates critical themes concerning gender, FOC [28], and the POS in PSs. Central to this discourse is the "broken window theory," studies [29, 30] demonstrate that broken window theory has been used to understand how visible signs of disorder could foster further crime and antisocial behaviour? Additionally, the impact of physical features, such as lighting, prospects and opportunity to escape alongside personal factors like psychological gender (masculinity and femineity) and biological sex [24], were studied to understand their influence on safety perceptions. our understanding of insecurity and FOC are identified through several latent factors: (a) personal safety, (b) perception of personal [31] and social control [31], (c) the presence of threats, (d) identity and space appropriation, (e) environmental satisfaction, and (f) environmental [31-33] and space usage. From the existing literature, it can be concluded that crime and fear are socio [34] - spatial phenomena [35].

3.7 Theme 2: "POS and Built Environment"

Theme POS and Built environment consists of 17 articles out of which three articles were omitted as they had weak TLS with the main theme. The remaining fourteen articles were analysed. The common theme among these statements is the examination of the relationship between various aspects of the built environment.

Table 6 outlines the key themes emerging from the analysis of literature on the perception of safety (POS) in the built environment. The table categorizes research into themes such as the influence of parks, walking environments, and neighborhood characteristics on human behavior and perceived safety. It highlights studies that examine physical activity, mobility patterns, health impacts, well-being, and quality of life within these environments. The role of perceived environmental factors, safety concerns, and parental perceptions in shaping the use and attitudes towards these spaces is also covered. Additionally, it delves into methodological approaches like GIS mapping, deep learning algorithms, and qualitative research methods used to study these themes.

Table 7 categorizes various aspects of neighbourhood characteristics that influence POS. Architectural, and design factors underline the impact of architectural design and crime prevention strategies on residents' experiences. The role of risk factors, neighbourhood attachment, and observation scales in shaping safety perceptions are emphasized in neighbourhood characteristics. Further, the types of neighbourhoods category examines how different neighbourhood environments, such as multicultural, deprived, urban, and suburban housing, impact residents' safety perceptions and social interactions.

Table 8 focuses on different types of public spaces and their effect on POS. It includes college campuses and gated communities are analyzed for their unique community dynamics and safety aspects. Streets and pedestrian zones cover the influence of streetscape design, harassment, and pedestrian safety, including the role of pedestrian systems. Lastly, various urban spaces like urban stream corridors, transit systems, and hospitals are examined for their impact on perceived safety, reflecting the diverse contexts in which safety perceptions are studied. Ongoing research continues to investigate the multifaceted relationship between POS, the built environment, and diverse characteristics of safety and well-being.

Table 6. Built environment and human behavior

Category	Aspect	Reference	Key Insights
Physical Activity and Mobility	Parks	[13]	Relationship between parks and physical activity.
	Walking Environments	[32, 36]	Impact on mobility patterns and physical activity.
	Neighborhood Characteristics	[33, 37]	Influence on physical activity, well-being, and social interactions.
	Physical Activity and Mobility	[38-40]	Impact on physical activity and mobility patterns.
Health and Wellbeing	Health and Wellbeing	[41, 42]	Perceived health impacts and overall well-being.
	Quality of Life and Aging	[43-46]	Effect on quality of life and engagement with built environments, particularly in older adults.
Safety Perceptions	Environmental and Safety Factors	[47-51]	Role of environmental factors and safety concerns in shaping attitudes and behavior.
	Parental Perceptions	[50, 51]	Safety concerns and parental perceptions shaping individuals' use of public spaces.
Technological Approaches	Technology in Analysis	[15, 22, 52, 53]	Use of GIS, deep learning, immersive media, and machine learning in studying public spaces.
Comfort and Nature-based Solutions.	Comfort in Public Spaces	[54]	Assessment of elements contributing to comfort in public spaces.
	Nature-based Solutions	[14]	Effectiveness of nature-based solutions for increasing perceived safety.

Table 7. Impact of neighborhood characteristics on perceived safety

Category	Aspect	References	Key Insights
Architectural and Design Factors	Architectural Design and Crime	[55, 56]	Social and psychological impacts on residents' experiences of crime and fear.
	Crime Prevention	[57, 58]	Critical review of crime prevention strategies.
Neighbourhood Characteristics	Risk Factors	[59]	Risk factors and citizens' apprehension of becoming victims.
	Neighbourhood Attachment	[60, 61]	Relationship between attachment, collective efficacy, open space quality, and fear of crime (FOC).
	Neighbourhood Observation Scale	[62]	Development and validation of a scale focusing on exploratory and confirmatory factors.
Type of Neighbourhoods	Multicultural Neighbourhoods	[63, 64]	Impact on social interactions and safety perceptions.
	Deprived Neighbourhoods	[65, 66]	Safety perceptions in deprived neighbourhoods.
	Urban and Suburban Housing	[33, 67-69]	Variations in safety perceptions across different housing developments.

Table 8. Impact of other public spaces on safety perception

Category	Aspect	Reference	Key Insights
College Campuses	Safety Perception	[70-73]	Safety perceptions and issues in college campuses.
Gated Communities	Community Dynamics and Safety	[74-76]	Safety and community dynamics in gated communities.
Streets and Pedestrian Zones	Safety Concerns and Design	[77-84]	Influence of streetscape design on safety and preferences.
	Street Harassment and Pedestrian Safety	[85-87]	Safety concerns related to street harassment and pedestrian safety.
Urban Spaces	Safety Perception in Various Urban Spaces	[88-98]	Perceived safety in various urban spaces like streams, transit etc.

3.8 Theme 3: "Urban Green Space Perceptions" UGSP

Theme – UGSP, consists of sixteen articles, out of which three articles were not related and thus were omitted. The remaining thirteen articles reveal that they all have UGSP as a common theme. This theme explores perceptions and usage patterns (Table 9) of urban green spaces [99] in various cities worldwide.

This table summarizes the various factors that influence perceived safety in urban green spaces, including design and infrastructure, demographics and social factors, environmental quality, usage patterns, and community engagement. Key insights highlight the importance of infrastructure, socio-economic factors, and emotional attachment to green spaces in enhancing safety perceptions.

Table 10 outlines urban green spaces' health and well-being benefits, focusing on physical activity, psychological well-being, and subjective well-being. Additionally, it emphasizes the role of urban design in promoting equal access and the significance of green spaces in disadvantaged communities.

Table 11 details the various technological and methodological approaches used in the study of urban green spaces, including GIS mapping, deep learning algorithms, qualitative research, and surveys. These approaches help in understanding user patterns, preferences, and perceptions, and in enhancing the management and accessibility of green spaces.

The present trend in the study of UGS and POS is multifaceted, with a strong focus on safety, equitable access, health and well-being, and advanced technologies for investigation and improvement. Researchers are progressively considering the diverse requirements of different populations and the role of green spaces in promoting social equity and reducing inequalities. There is also a noteworthy interest in the design and environmental factors that enhance the efficiency and safety of these spaces.

Table 9. Factors influencing perceived safety in urban green spaces

Category	Sub-Category	Reference	Key Insights
Design and Infrastructure	Spatial Structure	[100]	Crime risk is stronger at the local level of urban structure.
	Infrastructure and Quality	[101-104]	Infrastructure, quality, and maintenance of green spaces influence safety perceptions.
	Density and Size	[105, 106]	The density, adequacy, and size of green spaces are crucial for perceived safety.
Demographics and Social Factors	Gender-Specific Preferences	[107, 108]	Women's landscape preferences and the impact of gender-specific park designs.
	Socio-Economic Factors	[109, 110]	Socio-economic inequalities affect safety perceptions and usage of green spaces.
Environmental Quality	Neighbourhood Greenness	[111]	The greenness of neighbourhoods positively influences perceived safety.
Usage Patterns	Physical Activity and Well-Being	[111, 112]	Green spaces support physical activity and psychological well-being, enhancing safety perception.
	Seasonal and Crisis Impacts	[110, 113]	Usage patterns during summer heat and crises like the COVID-19 pandemic.
Community Engagement	Attachment to Green Spaces	[61]	Emotional attachment to green spaces reduces fear of crime and enhances safety perception.
	Safety Management Tools	[114]	Tools for park safety management based on user feedback.

Table 10. Benefits of UGS

Category	Sub-Category	Reference	Key Insights
Health and Well-Being	Physical Activity	[112, 115]	Green spaces encourage physical activity, contributing to better health and well-being.
	Psychological Well-Being	[111]	Psychological benefits from spending time in urban green spaces.
	Subjective Well-Being	[116, 117]	Overall subjective well-being is enhanced by access to green spaces.
Environmental and Social Equality	Urban Design and Equal Access	[16, 118]	Designing green spaces to serve as equalizers in urban areas with social and spatial inequalities.
	Perception in Disadvantaged Communities	[66, 119]	Focus on promoting equitable access to green spaces in disadvantaged communities.

Table 11. Technological and methodological approaches

Category	Sub-Category	Reference	Key Insights
Methodologies	GIS Mapping	[22]	Use of GIS mapping to analyze spatial distribution and accessibility of green spaces.
	Deep Learning Algorithms	[95]	Application of deep learning algorithms to enhance understanding of user patterns and preferences.
	Qualitative Research	Various Studies	In-depth qualitative research to gather user perceptions and experiences.
	Quantitative (Surveys and Observations)	Various Studies	Use of surveys and observational studies to collect data on usage patterns and safety perceptions.

3.9 Theme 4: COVID-19 and PS

This theme consists of 15 articles out of which 5 articles were omitted as they do not relate to the theme directly. Other ten articles were analysed. These theme studies collectively explore the intricate effects and importance of the COVID-19 pandemic on urban PSs [120, 121]. They investigate the role of green spaces in promoting health and well-being [17, 122-124] shifts in attitudes towards urban PSs [125] choice of urban spaces; Spatial constructions of safety [126] and adaptive strategies in PS design [127]. Additionally, perceptions and utilization of hospital outdoor spaces during the pandemic [128] are examined, along with older adults [45] and gendered perspectives on safety [122, 125] and inclusivity in urban environments. Investigations into security measures in urban parks amid virus transmission concerns further contribute to understanding the evolving dynamics of PSs during the pandemic.

3.10 Theme 5: Gender and age in public open spaces (POS)

This theme consists of twenty-five articles, out of which three articles were not directly related and the other four had low TLS and thus were omitted. In total eighteen articles were considered. The studies examine the nuanced relationship between gender [8, 129] and perceptions of safety in diverse urban settings worldwide. In a seminal paper by Day [8], the idea of utilizing "feminist theory" to elucidate the experiences of women in PSs was introduced. This concept was further expounded upon, delving into the ethic of care in the context of environmental behaviour research on women and PSs. Table 12 below represents an overall correlation between how age and gender transverse to impact POS and concerns in POS. Data has been categorized into distinct age groups and it underlines key concerns, referencing seminal studies and summing up critical insights.

Table 12. Gender and age in public open spaces (POS)

Age Group	Gender	Key Concerns	Key Studies	Insights/Findings
Children & Adolescents	B/G	Distinct fears, safe play spaces, street safety	[130-134]	Children and teenagers have unique fears; the importance of safe play spaces and street safety.
Young Adults	M/W	Nightlife safety, risk management	[135-138]	Young women have specific nightlife safety concerns; employ strategies to manage risks.
Adults & Middle-Aged Individuals	M/W	Gender norms, societal expectations, specific groups (e.g., sex workers, Muslim women, homeless women)	[139-141]	Adult women face unique challenges influenced by societal norms; specific groups have additional concerns.
Older Adults	M/W	Elderly victimization, age-friendly design	[12, 142, 143]	Older adults have distinct safety needs; the importance of age-friendly PSs.
General Findings	M/W, LGBTQ	Higher fear among women, sexual harm, safety concerns in PSs	[144-147]	Women experience higher levels of fear due to gender-based violence threats; LGBTQ individuals face heightened safety concerns in PSs.
Specific Contexts	V	Safety in women-only parks, gender-based violence at festivals, negotiating safety amidst the male gaze	[107, 148, 149]	Women-only parks improve safety perceptions; gender-based violence at festivals; women in Kolkata negotiate safety amidst the male gaze.
Coping Mechanisms	W	Strategies to avoid violence, coping mechanisms in specific regions (e.g., Mexico)	[150, 151]	Women employ various strategies to evade sexual violence; coping mechanisms in Mexico.
Spatial Dimensions	V	Safe pathways, gendered mobility patterns, perceptions of safety in different cities	[121, 148, 152-154]	Constructing safe pathways; gendered mobility patterns in different cities; insecurity among students.

*B=Boy, G=Girl, W=Women, M=Men, V=Various, LGBTQ= lesbian, gay, bisexual, transgender and Queer

3.11 Theme 6: Surveillance and POS

It was noted that themes like “video surveillance in PSs” emerged in 2002 [155]. Exploring the role of CCTV in urban surveillance [156, 157]. Surveillance through Mobile phones [158], CCTV [159-161]; robots [162] and natural surveillance methods [163, 164] were examined, showcasing their positive impact on improving security in PS [165]. Firmino et al. [166] studied the increasing demand for CCTV about the growing interest in technology for risk management. It is argued CCTV [35, 167] has no impact at all on POS, but rather that it is not necessarily the major factor it is thought to be, and seemingly not a measure to enhance feelings of safety in PSs. A study conducted in public spaces with respect to surveillance [168] adds that urban surveillance technologies alone do not deter unwanted behaviours without the physical presence of policing [169] and surveillance [157].

4. DISCUSSION

Theme 1 explores human interactions, POS, and fear of

crime in public spaces through a comprehensive review of fourteen key articles. It highlights the impact of physical features, personal factors, and socio-spatial phenomena on people's sense of security and urban experience. Theme 2, "POS and Built Environment," the intricate relationship between urban design elements and human behaviour is illuminated through examinations of parks, walking environments, and neighbourhood characteristics, revealing how the built environment influences physical activity, mobility patterns, and overall well-being. The trend in this research domain is going towards a holistic understanding that binds environmental design, socio-psychological, and technological methodologies to better POS in diverse PS. Also, it is noted that advanced tools are being used to address complex multifaceted safety dynamics in an array of urban environments. Theme 3, "Urban Green Space Perceptions," sheds light on the role of green spaces in promoting equity and well-being, particularly in urban areas characterized by social and spatial inequalities, emphasizing the importance of understanding how people perceive and utilize urban green spaces, especially during crises like the COVID-19 pandemic. In Theme 4, "COVID-19 and PS," researchers explore how the pandemic has reshaped attitudes towards urban spaces, leading to adaptive strategies in PS design and highlighting the importance of outdoor environments for health and well-being. Theme 5 delves into the nuanced relationship between gender, age, and perceptions of safety in public open spaces, emphasizing tailored strategies for creating inclusive and secure urban environments that address the unique safety concerns of different demographic groups. Finally, Theme 6 examines the role of surveillance technologies in enhancing security in PSs, acknowledging their potential benefits while also recognizing the need for a balanced approach that considers physical policing and the limitations of technological interventions.

This bibliometric analysis reveals the intricate and evolving scholarly landscape surrounding the Perception of Safety (POS) in Public Spaces (PS) from 1978 to 2023. The findings underscore the critical role of well-designed public spaces in promoting community well-being and urban livability. Public spaces such as parks, plazas, and green areas serve not only as physical environments but also as vital arenas for social interaction and mental health enhancement. The morphological characteristics, including spatial structure and infrastructure quality, significantly contribute to the attractiveness and usability of these spaces, corroborating existing research on their impact on physical activity and social cohesion.

The perception of safety in public spaces emerges as a complex construct influenced by a multitude of factors. Environmental attributes like lighting, visibility, and signs of disorder interact with personal factors such as gender, psychological state, and past experiences to shape individuals' sense of security. This multifaceted nature of POS necessitates a holistic approach to designing and managing public spaces to enhance safety effectively. Theories like the "broken window theory" illustrate the impact of environmental cues on feelings of insecurity and the potential for crime and antisocial behavior. The analysis indicates a growing scholarly interest in POS, marked by an increase in publications over the years and contributions from diverse disciplines including social sciences, environmental science, psychology, and urban studies. Influential works and authors, such as G. Valentine and D.A. Cohen, have significantly shaped the discourse, while key journals like the International Journal of Environmental and Public Health and Urban Forestry and Urban Greening serve as critical platforms for dissemination.

Geographically, the majority of research contributions originate from the United States, followed by the United Kingdom and China, reflecting regional priorities and funding availability. Leading academic institutions play a crucial role in advancing the field, highlighting the importance of concentrated research efforts. The network analysis reveals thematic clusters focused on specific areas such as urban green spaces and the built environment, demonstrating the interconnectedness of various research themes. These findings offer actionable insights for urban planners and policymakers to design public spaces that are inclusive, safe, and beneficial for all community members. Recognizing the evolving nature of public spaces in response to societal trends, such as social distancing during the COVID-19 pandemic, underscores the need for adaptive urban design. While comprehensive, this analysis is not without limitations. The reliance on the SCOPUS database may exclude valuable studies not indexed in this repository. Future research should incorporate additional databases and grey literature to capture a broader spectrum of scholarly work and explore the impact of emerging technologies on the perception of safety in public spaces.

This study highlights the complex interplay of factors influencing the perception of safety in public spaces and provides a foundation for future research and practical interventions aimed at enhancing the quality and safety of these vital urban areas.

4.1 Understanding the interplay of themes in public space perception

The intricate relationship and interplay between public space perception, the built environment, and urban green spaces form the crux of contemporary urban studies. Various public settings are captured in a comprehensive analysis of various themes that explore how safety, comfort, and behaviour manifest in different public settings and this study examines these themes, to gain a deeper understanding of the factors influencing urban life, as well as the research gaps and future avenues for exploration.

POS encompasses the subjective feelings of safety and FOC experienced by individuals in public spaces and is the common theme that links with all domains, which further builds on its universal relevance. Research indicates that safety perceptions significantly influence public behaviour, as people are often deterred from using spaces they perceive as unsafe thus, highlighting the need for urban planners to consider safety as a primary factor in public space design. Studies have shown that well-designed environments can foster feelings of security and encourage public engagement.

The overlap of POS and the built environment demonstrates that while safety is paramount, the aesthetic and functional aspects of the built environment also play a crucial role. The Psychological Well-being & Safety theme introduces another layer of complexity, demonstrating how emotional factors, such as neighbourhood attachment and the psychological benefits derived from nature, influence POS. The research indicates that parks and green spaces can significantly enhance psychological well-being and quality of life, making it essential to form emotional attachments while underscoring the unique contributions of urban green spaces, particularly in

fostering a sense of community and belonging, moreover, themes such as Mobility Patterns & Physical Activity and Nature-based Solutions for Safety introduce contemporary methodologies that focus on the interaction between the built environment and public health Crime Prevention Strategies emerge prominently in the context of safety perception, with established theories like the Broken Windows Theory; Crime prevention through environmental design; and socio-ecological theory guiding discussions on effective design strategies for mitigating crime. However, this theme has less representation in the urban green space discourse, concerning cities in the global south, indicating a potential gap in research. Understanding how crime prevention strategies can be integrated with green space design could pave the way for more holistic urban safety solutions that are context specific. The analysis of Gender & Safety Perceptions reveals how gender roles significantly affect perceptions of safety, and research indicates that women may experience public spaces differently than men. This insight calls for a more nuanced approach to urban design that considers diverse perspectives, thereby ensuring inclusivity in public space development. Parental Perceptions & Safety further highlights the role of caregivers in shaping the usage of public spaces and stresses the importance of family dynamics in designing safe and accessible environments for children. Similarly, the impact of the Pandemic on Public Spaces has reshaped perceptions and behaviors, illustrating how crises can alter public space usage and necessitate adaptability in urban design, however, the post-pandemic change in POS in PS has not been studied much and thus underscores a research gap and themes that future studies can build on.

In conclusion, this analysis reveals the multifaceted nature of POS in PS, establishing the interconnectedness of safety, the built environment, psychological well-being, and social dynamics. Identifying overlaps and unique aspects among themes not only highlights existing research gaps but also opens pathways for future studies aimed at creating safer, more inclusive, and psychologically enriching urban environments.

5. CONCLUSIONS

The study highlights and provides a comprehensive study of the evolving landscape of research in POS in PS. This study also helps to navigate through the vast array of studies conducted on POS in PS and filter the critical themes and trends that impact our understanding of safety in urban environments. PS such as parks, streets, plazas, and green areas, act as an anchor in urban life, providing venues for social interaction, recreation, and cultural activities. The morphological characteristics of PS, including their spatial structure and infrastructure quality, drastically impact their attractiveness and usability, thus influencing users' POS [170]. The findings reinforce the importance of well-designed public spaces in promoting physical activity, mental health, and social cohesion, thereby enhancing overall urban livability. In the last decade, the literature on safety in public spaces has grown multifold because of the focus on its alignment with sustainable development goals and new urban agenda which highlights safety and inclusivity in public spaces. The most favoured studied public space has been urban public parks, however, there is a lack of quantitative studies on the assessment of the Perception of safety in these public spaces, especially in the context of the global south. This research gap was one of the major research insights that appeared from the in-depth study.

POS is a complex construct influenced by a myriad of factors, both physical and personal. Environmental features such as lighting, cleanliness, and the presence of escape routes, alongside social dynamics and individual psychological states, contribute to how safe people feel in public spaces. This study underscores the relevance of theories like the "broken window theory," which posits that visible signs of the disorder can heighten feelings of insecurity and potentially lead to increased crime and antisocial behaviour. The bibliometric analysis revealed that research on POS in public spaces has been growing, with significant contributions from diverse fields including social sciences, environmental sciences, and psychology. Key journals like the International Journal of Environmental and Public Health, and authors such as G. Valentine and D.A. Cohen, have made substantial contributions to this body of knowledge. The analysis also highlighted the leading countries and institutions in this domain, with the United States, the United Kingdom, and China being top contributors. Network analysis using tools like VOS Viewer provided insights into the interconnectedness of research themes and the most influential articles in this field. Themes such as "PS Perception," "POS and Built Environment," and "Urban Green Space Perceptions" emerged as pivotal areas of focus. These themes explore various dimensions of safety perception, including the impact of physical design, environmental quality, and socio-economic factors on how safe individuals feel in public spaces. This study underscores the multifaceted nature of POS in public spaces and the importance of a holistic approach in urban planning and policymaking. By integrating insights from diverse disciplines and employing robust bibliometric techniques, this research provides a valuable framework for understanding and enhancing safety perceptions in public spaces.

Bibliometric analysis is a valuable approach for organizing and summarizing literature, but it does have limitations. When conducting co-word analysis, it is important for researchers to carefully review bibliometric information obtained from scientific databases to identify any duplicated or incorrect words. Furthermore, bibliometric analyses offer short-term or retrospective insights into the research field. Therefore, researchers shouldn't make long-term predictions about their subjects [171]. Despite these constraints, bibliometric analyses can assist in organizing scientific knowledge, particularly when examining comprehensive topics [172]. VOSviewer proved to be an impactful tool for studying the landscape of the thematic evolution of POS in PS. In the last decade, substantial research has been done regarding Safety in PS, this fast pace of research and publication has led to a massive database, outpacing the capacity to frequently undertake extensive systematic evaluations, such tools thus are vital for tracking the progress of research and new trends. The use of only the Scopus database is one of the limitations of the study and future studies could consider using data from Web of Science and include other broader databases and languages to make the data pool more comprehensive and robust. One of the challenges with using VOSViewer is that, for example, the term co-occurrence clusters are produced purely based on the number of times two words co-occurred and do not give any information on the nature of the interactions between those two terms. Future research should continue to explore the

dynamic interplay between environmental design, social factors, and individual perceptions to create inclusive, safe, and vibrant urban environments.

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