

Review

Pedestrians as an Innovation Key for Urban Research: A Bibliometric Network Analysis and Literature Review

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Abstract

The role of pedestrian movement in urban environments is often overlooked, despite its critical importance in supporting effective city functioning and long-term sustainability. While there has been growing scholarly interest in this area, research on pedestrian mobility remains fragmented across various disciplines and lacks a unified framework. For urban planners and designers to collaborate more effectively, a clearer understanding of the key themes shaping pedestrian mobility is needed. This paper addresses that gap by organizing and analysing existing research through a bibliometric review of 1934 articles published between 1994 and 2023 in the Web of Science database. This article explores the evolution of pedestrian mobility research between 1994 and 2023, highlighting key topics and potential future directions. The bibliometric analysis draws on a range of indicators, including published papers, citation data, journal impact factors, h-index scores, top-cited authors and papers, and regional trends in research output. Most importantly, science mapping was conducted using the SciMAT software, with co-occurrence networks helping to reveal how research themes have evolved over time. The extensive body of work on pedestrian mobility made it possible to develop a conceptual map that traces the field’s intellectual development. From this analysis, five key thematic areas were identified: health, methods, environmental–social, city, and mobility.

Keywords: walkability; bibliometric analysis; mapping scientific literature; citations; keyword co-occurrence; research trends



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1. Introduction

Social, economic and environmental concerns for the sustainability of urban areas have an impact on urban design, particularly on the layout of public spaces. In response to emerging societal expectations, urban researchers and planners have increasingly incorporated pedestrian mobility into their urban analyses [1,2], recognizing it as a key component of quality of life, social cohesion, and urban sustainability.

Pedestrian mobility has seen notable growth in academic interest in recent years, with a rising number of studies exploring the topic. Since the late twentieth century, growing interest in this field has been linked to efforts toward building more sustainable cities, supported by policies and initiatives in areas such as public transportation, green spaces, and community infrastructure aimed at addressing social, environmental, and economic

challenges through urban planning and management [3–6]. These interventions have contributed to strengthening urban resilience and to a rethinking of the role of pedestrians in public space.

The notion of pedestrian mobility has gained increasing academic attention since [7] introduced the term walkability [8]. Since then, research has addressed multiple dimensions associated with walking in urban environments [9], including health, the built environment, social equity, safety, and urban design.

Bibliometric analysis has shown to be a useful approach for reviewing large bodies of literature and has been applied in many academic fields [10]. It helps to examine and interpret research output related to pedestrian mobility at the level of countries, institutions, and journals, and facilitates the identification of patterns, trends, and research gaps [11,12]. This method was selected due to its advantages over other review techniques. Compared to traditional approaches like content analysis, bibliometric methods are capable of handling a significant number of publications while also uncovering connections among articles, citations, co-citations, and keywords, offering a detailed overview of the research field [13].

Recently, bibliometrics has been used to assess the evolution of walkability measures over time [14–17]. However, to date there have only been partial approaches in the field of walkability, and they were focused on analysing no more than 200 articles. A structured and comprehensive review of the literature on pedestrian mobility is essential to better understand the current state of the field, trace its development over time, and guide future research efforts (see Tables A1 and A2 in Appendix A).

Unlike earlier bibliometric studies on pedestrian mobility, which primarily relied on tools such as SPSS [15] or VOSviewer [14,17], this study employs SciMAT (Scientific Mapping Analysis Software Tool) [18,19]. Although a variety of bibliometric tools are available, SciMAT offers several advantages that make it particularly suitable for this study [20]. It enables scientific mapping over time by dividing the overall study period into sub-periods allowing for a comparative analysis of how research topics have developed [21]. In addition, SciMAT includes robust data pre-processing functions, including an advanced de-duplication phase that ensures the quality and reliability of the dataset. The software also enhances result interpretation by incorporating multiple impact metrics such as total, maximum, minimum, and average citation counts alongside advanced bibliometric indices like the h-index, G-index, HG-index, and q2-index. These features help identify which research topics have had the greatest academic influence and productivity over time.

The main objective of this article is to analyse the evolution of research on pedestrian mobility between 1994 and 2023, identifying the main research themes and their relationship with urban design. More specifically, the study pursues the following objectives:

- To analyse the growth and distribution of scientific production on pedestrian mobility in terms of publications, citations, journals, authors, and institutions.
- To identify the main thematic areas that have structured pedestrian mobility research over time.
- To examine the conceptual evolution of these thematic areas and changes in research priorities.
- To explore the role of urban design within the field of pedestrian mobility and its integration with other approaches related to sustainability, health, and urban planning.

Based on these objectives, the study is guided by the following research questions:

- How has research on pedestrian mobility evolved over the past three decades?
- What are the main themes and approaches that have dominated this field of study?
- In what ways has urban design been incorporated into pedestrian mobility research?
- What emerging trends may inform future lines of research in this field?

In addition, a science mapping analysis based on co-word networks is carried out to explore the main research themes in pedestrian mobility and how these themes have evolved over time. By combining both performance and science mapping techniques, this study contributes to the existing literature by offering a more detailed understanding of current research priorities and by proposing directions for future investigation.

This article is structured as follows: Section 2 presents the methodology and dataset used; Section 3 presents the performance analysis; Section 4 discusses the results of the science mapping; Section 5 interprets the key findings; and Section 6 concludes the study.

2. Materials and Methods

To study how research on pedestrian mobility has evolved over time, this study applies the SciMAT software v.1.1.06 [21] which enables the construction of keyword networks over distinct time intervals. This process makes it possible to recognize recurring themes, trace their development, and identify how different areas of research are connected. The method follows four main steps, based on [22,23] studies:

- 1- **Identifying research themes:** Keywords are taken from publications in each period and used to create a network depending on how frequently they co-occur. Each node in the network corresponds to a keyword, and when two appear together often, a connection is formed. A clustering algorithm [24,25] is applied to group related keywords into thematic clusters.
- 2- **Visualizing themes:** Once the themes are identified, they are displayed through strategic diagrams and thematic networks. Each theme is assessed using two indicators: centrality, which reflects how strongly a theme is connected to others, and density, which indicates the internal strength and development of the theme. These visualisations categorize the themes into four types based on their position within the diagram (Figure 1a):
 - a. **Motor themes:** well-developed and important to the structure of the field;
 - b. **Basic and transversal themes:** relevant but still developing;
 - c. **Emerging or declining themes:** less developed or losing relevance;
 - d. **Highly developed and isolated themes:** mature but weakly connected to other areas.

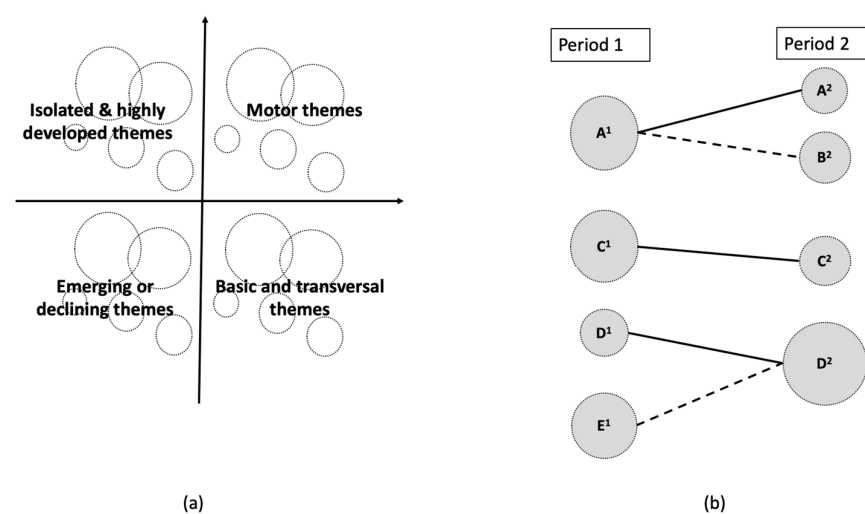


Figure 1. Strategic diagram (a) and thematic evolution (b), adapted from [18].

The size of each sphere in the diagram reflects the number of related publications, and citation counts are shown in parentheses.

- 3- **Thematic evolution:** This step looks at how themes change across time, showing which topics continue, disappear, or evolve into new areas. It also helps identify broader thematic areas and how they are linked as shown in (Figure 1b).
- 4- **Evaluating performance:** For each theme, bibliometric indicators are used to measure productivity and impact. These include publication and citation counts, as well as more advanced metrics such as the h-index, G-index, HG-index, and q2-index.

To conduct this analysis, relevant publications were collected from the Web of Science (WoS) Core Collection database. WoS was selected for its comprehensive coverage and detailed bibliometric metadata. The search was performed in February 2024 using the keywords walkability, walking, city, and pedestrian mobility in the subject field. The advanced search query used was:

TS = ("walkability") OR ("walking" AND "city") OR ("pedestrian mobility"), which initially retrieved 6258 publications.

To refine the dataset, several criteria were applied: only documents published between 1990 and 2023 were retained, and only specific document types (articles, review articles, and proceedings papers) were included. Additionally, research not directly related to operations management was excluded. After filtering, the final dataset comprised 1934 publications. These records were exported from WoS with full metadata (authors, titles, abstracts, keywords, affiliations, citations, etc.) and imported into SciMAT. To improve data quality, a pre-processing phase was carried out, including a deduplication process to group similar words and concepts. Terms with overly broad meanings, such as methodology, were excluded to preserve thematic clarity. The final unit of analysis was based on author keywords and ISI Plus keywords, capitalized for readability. In total, 5323 unique keywords were used for the science mapping analysis [26].

The research methodology applied in this study is based on visual bibliometric techniques, as illustrated in Figure 2.

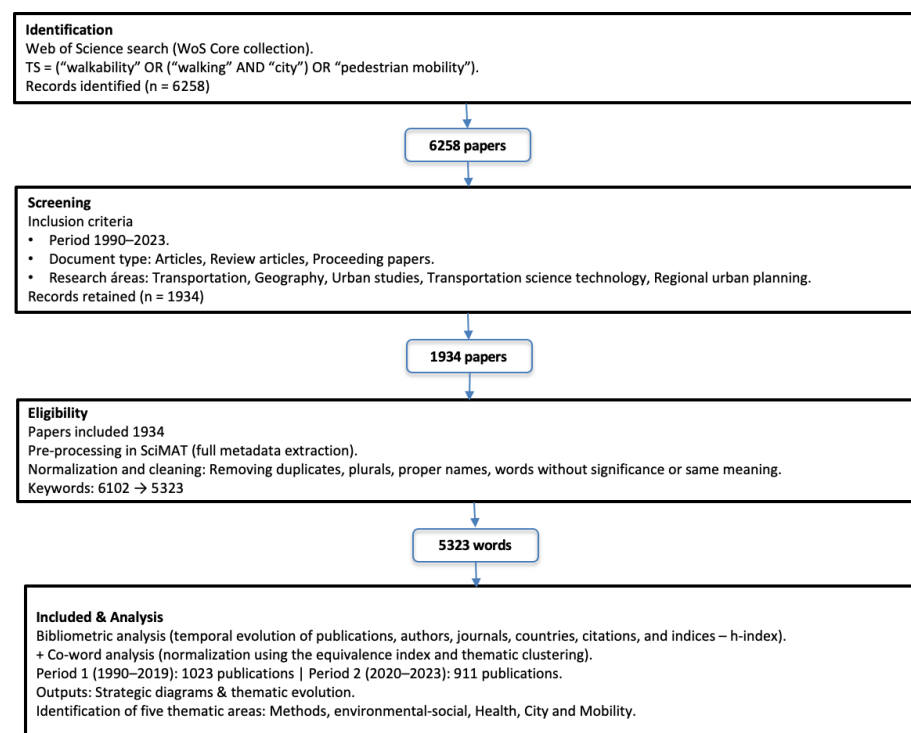


Figure 2. Methodological framework of the bibliometric review integrating a PRISMA-based selection process with SciMAT science mapping analysis.

3. Bibliometric Analysis of Pedestrian Mobility

The evolution of research on pedestrian mobility is assessed through a range of bibliometric indicators, including the number of publications, citations received, journal impact factors, h-index values, geographical distribution of publications, and the most cited articles and authors. The analysis is structured in two parts: (1) total output and citation impact of the documents, and (2) the contribution and influence of authors, journals, countries, and research areas.

The number of publications increased steadily until 2019, reaching a total of 1023 articles. Between 2020 and 2023, the field experienced a notable surge in output, though the pattern was less consistent, with 911 articles published during that time. The time periods used in the analysis are unequal, but this choice was made to allow for a clearer comparison of research trends and better identification of major thematic developments. While both periods include a similar volume of publications, the first reflects the early stages of the field, whereas the second shows more dispersed and irregular growth, as illustrated in Figure 3.

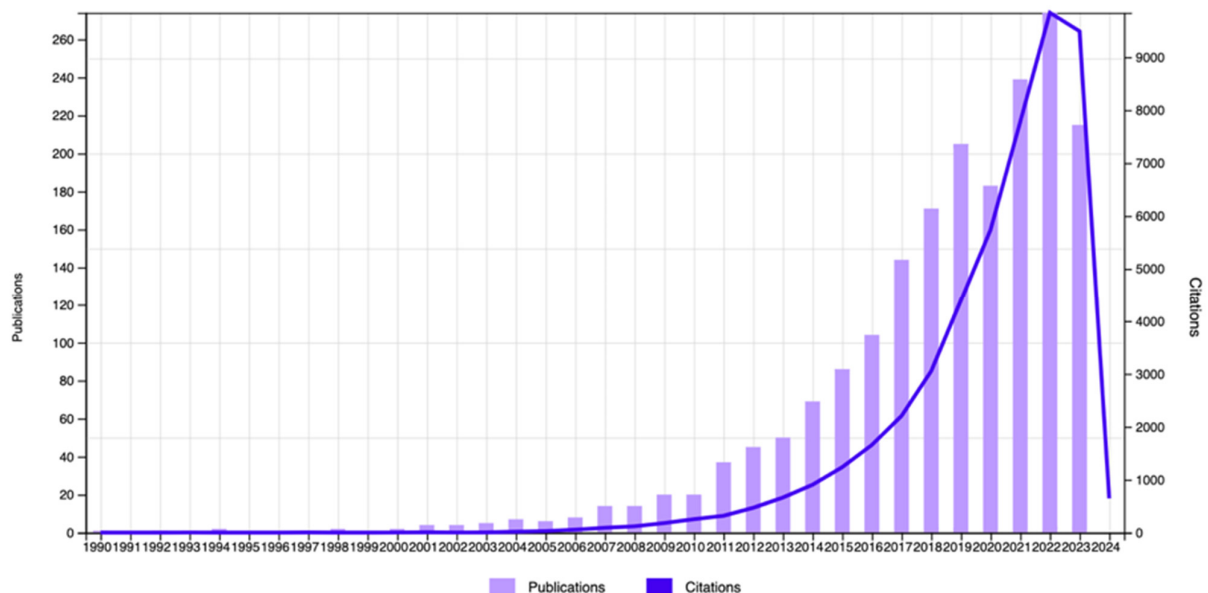


Figure 3. Evolution of frequency of publications related to pedestrian mobility and citations collected.

3.1. Publications and Citations

The slope of the graph and the number of citations (see Figure 3) show that interest in pedestrian mobility has grown over time and suggest that this area of research may continue to develop in the future. Since the data was collected in February 2024, publications from that year are not included in the analysis. In total, the 1934 publications gathered from 1990 to 2023 received 49,148 citations, with an average of 25.41 citations per article.

3.2. Authors, Journals, Countries, and Research Areas

Understanding who contributes most actively to the field whether through publications, citations, or journal output helps clarify the current structure and dynamics of pedestrian mobility research. Examining the geographical spread of publications and the associated research areas also helps identify regional research strengths and disciplinary priorities within the field.

Table 1 lists the most productive and most cited authors between 1990 and 2023. The first column shows author names, followed by the number of publications and total citations in the second and third columns, respectively. When two or more authors have

the same publication count, they are listed in alphabetical order. Lu Yi's 17 publications on pedestrian mobility grant this author the first position, followed by Miralles-Guasch, with 13. These results show that no author has mastered the field so far.

Table 1. Most prolific authors on pedestrian mobility and citations received (1990–2023).

Authors	Publications	Cites Received	Years, Cites Received
Lu, Yi	17	681	2019, 2020, 2021, 2022, 2023, 2024
Miralles-Guasch, Carme	13	343	2015, 2016, 2017, 2019, 2022, 2023, 2024
Giles-Corti, Billie	12	532	2013, 2014, 2015, 2016, 2017, 2018, 2019, 2022, 2023
Soria-Lara, Julio A.	11	223	2015, 2017, 2019, 2021, 2022
Cerin, Ester	11	582	2007, 2011, 2016, 2017, 2019, 2020, 2022, 2023
Sun, Guibo	10	269	2017, 2018, 2019, 2021, 2022, 2024
Hamidi, Shima	10	294	2016, 2017, 2018, 2019, 2020, 2021
Ewing, Reid	10	443	2014, 2016, 2017, 2019, 2020, 2022
Lee, Chanam	10	417	2006, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2023

Table 2 shows the journals that have published the largest volume of research related to pedestrian mobility. The information is divided into two main sections. The first section, shown in the first two columns, lists the number of articles published on pedestrian mobility in each journal. The second section, shown in the remaining six columns, provides general information about the journals themselves.

Table 2. Top journals publishing on pedestrian mobility (1990–2023).

Journals	Publications on Pedestrian Mobility	Citations of Articles on Pedestrian Mobility	5 Year Impact Factor	Journal Citations 2022	Impact Factor (JIF 2022)	Journal Citation Indicator (JCI)	Article Citation Median	Issues/Year
Journal of transport & health	171	3.598	3.6	3766	3.2	0.87	2	4
Journal of transport geography	163	5.069	6.2	14,188	5.7	1.76	4	8
Transportation research record	119	2.023	1.9	30,482	1.6	0.36	1	
Cities	110	2.736	6.8	19,532	6	2.02	4	12
Landscape and urban planning	78	3.337	8.7	28,158	7.9	2.37	5	20
Transportation research Part-A Policy and practice	72	2.790	6.9	20,629	6.3	1.69	4	12
Transportation research Part-D Transport and environment	65	2.530	7.8	20,643	7.3	1.63	5	6
Journal of urban planning and development	56	1.165	2.1	2116	1.7	0.52	1	4
Urban forestry & urban greening	56	2.385	6.4	15,848	6	1.76	4	8

Table 3 identifies the countries with the highest research on pedestrian mobility between 1990 and 2023. The classification is based on the authors' affiliations, as listed in the

articles compiled, following the approach established in earlier studies [27,28]. A country was counted if at least one co-author in a publication was affiliated with an institution in that country. Because some authors are affiliated with institutions in multiple countries, a single paper may be attributed to more than one country. As a result, the total number of publications by country exceeds the total number of unique documents analysed (1934). The United States ranks first with 604 publications, followed by China with 299.

Table 3. Countries with the highest number of publications on pedestrian mobility (1990–2023).

Country	Publications
US	604
China	299
UK	204
Australia	195
Canada	177

Table 4 highlights the main Web of Science research areas and categories linked to pedestrian mobility during 1990–2023. The findings show that this topic has been studied not only within business and management fields, but also in engineering-related areas. Notably, there is growing interest in the environmental and technological aspects of pedestrian mobility, reflected in the number of publications associated with these areas.

Table 4. Most Web of Science research areas and categories (1990–2023).

WoS Research Areas	Publications	WoS Categories	Publications
Engineering	261	Management	236
Business economics	253	Engineering—industrial	165
Operations research management science	143	Engineering—manufacturing	152
Environmental sciences ecology	45	Operations research management science	143
Science technology other topics	42	Business	62

4. Science Mapping Analysis of Pedestrian Mobility

The following section presents an overview of the scientific mapping analysis, focusing on the relationships between keywords and terms in the main research areas related to pedestrian mobility. It includes two connected components: a keyword co-occurrence analysis and a thematic evolution map. The co-occurrence analysis identifies the main topics discussed in the literature during each of the two time periods, while the evolution map traces how these topics have developed and how they are connected throughout the entire study period.

4.1. Article Content Analysis

Figure 4 presents two strategic diagrams that highlight the main research topics in pedestrian mobility from 1990 to 2023. Each topic is represented by a sphere, with its size corresponding to the number of citations it received. These diagrams reflect two related analyses: a clustering of research themes and a thematic evolution map. The clustering reveals the central topics in each time period, while the evolution map shows

how these themes have developed and how they relate to one another throughout the entire study period.

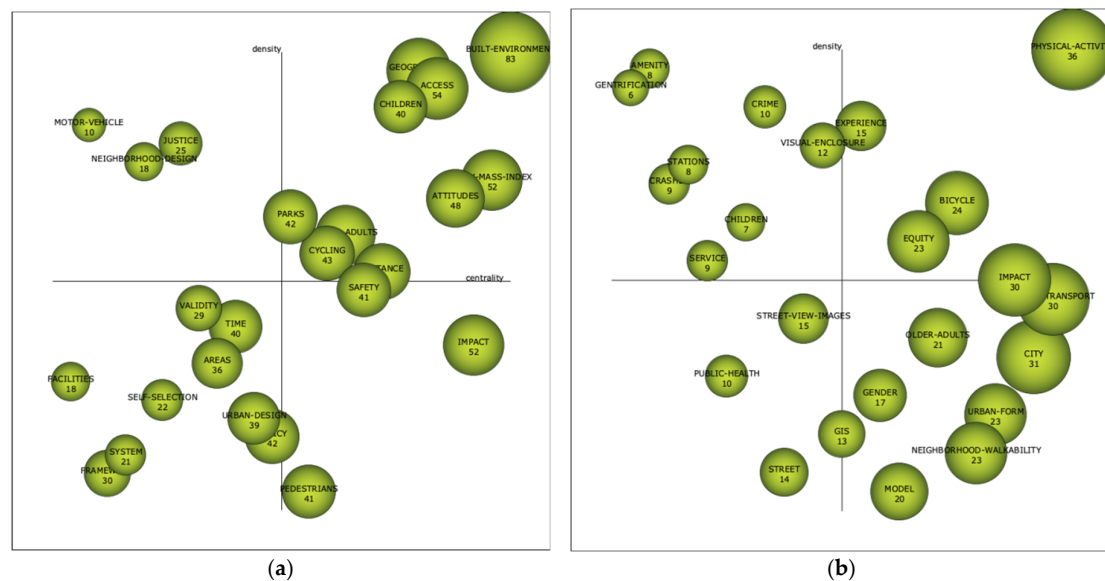


Figure 4. Strategic diagrams: (a) Period 1990–2019; (b) Period 2020–2023.

4.1.1.1. First Period (1990–2019)

The strategic diagram in Figure 4a shows that pedestrian mobility comprises twenty-five research topics during this period, thirteen of which are considered fundamental (motor and core themes) for their constructive contribution to the growth of the field. The remaining twelve include isolated themes with specific contributions and others which can be regarded as either emerging or disappearing.

Table 5 presents the performance indicators for the main topics in the first period, including the number of publications, their share of the total, total citations, and h-index values. Based on citation counts and h-index scores, the topics that played a key role in shaping pedestrian mobility research during this initial period are outlined below:

BUILT-ENVIRONMENT was the most prominent research topic during this period, with the highest number of publications, citations, and the strongest h-index. Its leading position reflects the central importance of the built environment in studies on pedestrian mobility. This theme includes research on walking behaviour and its measurement, walkability, and related topics such as health, obesity, and physical activity, the latter becoming a separate cluster in the second period. This cluster also incorporates ideas related to transportation and travel and its performance, together with other city features such as land use, neighbourhoods or urban form which also evolves into a cluster in the second period. GEOGRAPHIES covers a group of articles which study issues related to mobility and city again; these will become a cluster in period 2. Other prominent aspects are space, place or landscape and sense, ethnography, encounter or assemblage, all with the key factor identity. The ACCESS motor theme links healthcare with accessibility, spatial accessibility, spatial equity and unemployment, as well as geo-positioning systems, which will evolve into a cluster in the second period, and environmental justice, public parks, transit and public transportation. It is also a period 2 cluster. The ATTITUDES motor refers to articles based on citizens' appreciation of mobility, where personal choices such as mode, residence, habits, mode of transport, risk perception when travelling by car or even by bicycle will become a cluster in the second period. The CHILDREN motor is a prominent cluster when studying pedestrian mobility; it is stable all through the second period, although it evolves towards quadrant 2 (basic and transversal) as an isolated, developed theme. This research

topic includes other groups, such as adolescents and young people and their relationship with school.

Table 5. Results of bibliometric analysis for the period 1990–2019 (sorted by number of publications).

Theme (Quadrant)		Publications	% of Total	Citations	h Index
BUILT ENVIRONMENT	Q1	740	0.7407	31,576	83
GEOGRAPHIES	Q1	296	0.2963	11,166	57
IMPACT	Q4	250	0.2503	9624	52
ACCESS	Q1	232	0.2322	1048	54
BODY-MASS-INDEX	Q1	218	0.2182	10,044	52
ATTITUDES	Q1	201	0.2012	6977	48
OLDER-ADULTS	Q1	168	0.1682	8253	50
DISTANCE	Q1–Q4	167	0.1672	7105	45
POLICY	Q3–Q4	159	0.1592	6551	42
PEDESTRIANS	Q4	143	0.1431	5377	41
SAFETY	Q1–Q4	138	0.1381	6307	41
PARKS	Q1–Q2	128	0.1281	6087	42
TIME	Q3	122	0.1221	5528	40
CHILDREN	Q1	121	0.1211	5451	40
CYCLING	Q1	117	0.1171	5442	43
URBAN-DESIGN	Q3	116	0.1161	4518	39
AREAS	Q3	83	0.0831	3639	36
FRAMEWORK	Q3	62	0.0621	2335	30
VALIDITY	Q3	56	0.0561	2093	29
JUSTICE	Q2	41	0.0410	1873	25
SYSTEM	Q3	40	0.0400	1567	21
SELF-SELECTION	Q3	39	0.0390	1217	22
FACILITIES	Q3	33	0.0330	836	18
NEIGHBORHOOD-DESIGN	Q2	27	0.0270	876	18
MOTOR-VEHICLE	Q2	13	0.0130	366	10
		999			

BODY-MASS-INDEX is a motor theme dealing mainly with aspects of people's mobility environment, walkability, active travel and distance measurement. It also incorporates issues of cardiovascular health, overweight and others, such as air pollution. The OLDER-ADULTS motor theme includes studies targeting this group of citizens from various perspectives and is composed of papers focused on quality of life, health, urban performance, barriers, the disabled and walking activities. The CYCLING motor theme is very much oriented towards transportation sustainability, its interference with car dependency, road-related injuries and their severity, urban mobility, travel lanes, route safety and health benefits. The DISTANCE theme, classified as a basic and transversal motor theme, is closely related to pedestrian mobility performance, where distance is viewed as a key factor in improving accessibility and movement. This cluster includes several important elements to consider when analysing distance in mobility studies, such as school locations, travel

demand, environmental factors, residential patterns, trip possibilities, population density, and stop locations.

SAFETY, which is a basic transversal motor, covers such things as traffic accidents, child pedestrians, gender aspects, mortality and tools contributing to safety, such as spatial design or human sensations.

The IMPACT theme reflects a methodological approach to pedestrian mobility research. It brings together concepts such as risk processes, values, climate, transit-oriented-development (TOD), modelling, and behaviour, which have been commonly applied in studies related to pedestrian mobility risk management. The final basic transversal theme is PEDESTRIANS, which relates to the conditions and possibilities of movement. This theme includes aspects like centrality, liveability, urban planning, and path choice, all of which support a clearer understanding of how mobility functions in urban settings. POLICY refers to diversity, poverty, sustainability, climate change, urban transport, urban growth and its patterns, determinants and congestion. JUSTICE refers to equity (evolving into a cluster in period 2), inequality, profit and gentrification (also evolving into a cluster in period 2). VALIDITY refers to trust, valuation, vehicles and quality. SYSTEM refers to agent-based modelling, optimization and challenges. MOTOR-VEHICLE refers to traffic safety and collisions. SELF-SELECTION refers to ownership valuation and preferences. FACILITIES refers to mixed-model network. AREAS refers to space syntax, movements, social exclusion, exposure and commuters, and NEIGHBORHOOD-DESIGN refers to urban sprawl, pedestrian environment and land use. MOTOR-VEHICLE refers to traffic safety and collisions. URBAN DESIGN refers to compact development, connectivity, pedestrian level, attributes, public spaces, socioeconomic status, transit accessibility, prevalence, seniors and evaluation. PARKS refers to proximity, crime, urban planning, green spaces and urban green spaces, tools, street, spatial configuration, questionnaires, recreation and people. TIME refers to opportunities, experience, car, body, history, work, decisions, travel behaviour, simulation model, service and population. FRAMEWORK refers to indicators and urban.

4.1.2. Second Period (2020–2023)

As shown in Figure 4b, the second period includes twenty-four research topics related to pedestrian mobility. Fifteen of these are key topics, either motor themes or basic transversal ones, while the rest are more specific or appear as isolated or emerging areas. When comparing both periods, motor themes and basic or isolated themes have not evolved in the same manner; while the area of knowledge in the second period is much more concentrated when it comes to motor themes, moving from eleven in the first period to six, there is an increase in basic themes—now we have nine basic themes instead of four—and isolated themes—eight instead of four.

The performance data in Table 6 shows that PHYSICAL-ACTIVITY, is the most important topic in this period. It has the highest number of documents, citations, and the strongest h-index. Three other topics—city, public transport, and impact—also show strong research activity and influence in the field.

PHYSICAL-ACTIVITY was already present in the first period as part of the built-environment cluster but now appears as a separate theme. Environment has gained more importance, supported by high citations and a solid h-index. The theme of equity seems to have developed from the earlier access topic, showing how certain research areas have evolved and become more defined over time.

Therefore, these findings suggest that the recent literature has approached pedestrian mobility primarily from an internal perspective, which is often a necessary foundation for a broader analysis of urban and transport systems.

Table 6. Performance of themes during 2020–2023.

Theme (Quadrant)		Publications	% of Total	Citations	h Index
CRIME	Q2	25	0.0278	254	10
AMENITY	Q2	22	0.0245	223	8
GENTRIFICATION	Q2	15	0.0167	142	6
VISUAL-ENCLOSURE	Q2	39	0.0434	476	12
STATIONS	Q2	18	0.0200	218	8
CRASHES	Q2	27	0.0300	252	9
CHILDREN	Q2	28	0.0311	222	7
SERVICE	Q2	45	0.0501	317	9
PHYSICAL-ACTIVITY	Q1	686	0.7631	6.930	36
EXPERIENCE	Q1	70	0.0779	702	15
BYCICLE	Q1	176	0.1958	1917	24
EQUITY	Q1	163	0.1813	1881	23
PUBLIC-TRANSPORT	Q1–Q4	355	0.3949	3601	30
IMPACT	Q1–Q4	322	0.3582	3853	30
OLDER-ADULTS	Q4	145	0.1613	1564	21
CITY	Q4	368	0.4093	3776	31
URBAN-FORM	Q4	208	0.2314	2152	23
GENDER	Q4	82	0.0912	841	17
NEIGHBORHOOD-WALKABILITY	Q4	193	0.2147	1818	23
MODEL	Q4	148	0.1646	1331	20
GIS	Q3–Q4	72	0.0801	612	13
STREET-VIEW-IMAGES	Q3	43	0.0478	690	15
PUBLIC-HEALTH	Q3	33	0.0367	272	10
STREET	Q3	57	0.0634	558	14
		899			

The BYCICLE theme covers twelve topics, among which the relationship between planning-policy and human factors can be highlighted, as well as the relationship between human factors and pedestrians. In this theme, cycling and pedestrians must also be given due relevance. The IMPACT theme, again appearing as a transversal motor theme, continues to reflect a diverse range of factors, as seen in the previous period. However, it now places stronger emphasis on the connection between urban vitality and walking activity. During this time, the role of environment and behaviour becomes increasingly important in measuring impact, alongside considerations such as urban density and the built environment. The theme of EQUITY emerges as a distinct branch of the justice theme from the broader justice cluster seen in the first period. This seems to indicate that the social approach has undergone an efficient integration into pedestrian mobility in recent years. Urban planning, urban parks, environmental justice and the differentiation of pedestrian mobility are aspects of particular interest in this research topic. The EXPERIENCE theme focuses on how benefits, biodiversity and residents' perceptions contribute to shaping the city. It highlights the lived dimensions of pedestrian mobility and its role in differentiating urban spaces. OLDER-ADULTS becomes a well-established transversal theme in this

period. While the health focus remains central, other dimensions such as active travel, quality of life, loneliness, and depression gain prominence in the research. The basic transversal theme CITY progresses from the motor theme GEOGRAPHIES of the previous period to encompass different geographical aspects such as space, green spaces, inequalities, growth, policies and sustainability. This shift reflects how early interest in environmental strategies has developed into a more integrated perspective that also includes economic and social factors. In this period, the PUBLIC-TRANSPORT theme includes various other approaches, such as accessibility, travel behaviour, choice of mode of transport, sustainable mobility, travel time, car use and multimodality. The basic and transversal theme URBAN-FORM incorporates important aspects, such as distance, community or attributes, as well as travel, its results and its forms. Special mention should be made, because of their uniqueness, to aspects such as polycentric and science-based urban design. The theme of GENDER emerges in this period. GENDER connects not only studies of women and work but also time and fear. The basic transversal theme NEIGHBORHOOD-WALKABILITY incorporates studies of urban design, walk score, body mass index, Google street view, pedestrian networks and semantic segmentation. Another basic transversal theme, MODEL, has security, facilities, allocation, standards, network and level as strategic themes. The emerging basic transversal theme GIS deals with indexes and indicators, trips and spatial syntax. Another theme appears, and it has a notable presence: the theme STREET-VIEW-IMAGES brings together studies that apply machine learning, deep learning, and big data to the analysis of urban environments. This line of research explores various visual and spatial factors that influence pedestrian mobility. The impact of the COVID-19 pandemic has also played a significant role in shaping urban research during this period, particularly in contexts marked by uncertainty and rapid change.

The emerging theme PUBLIC-HEALTH collects studies on social inequalities and recreation. The emerging theme STREET incorporates strategic issues of connectivity and public space. CRIME is essentially a reference to violence in the city and the perception of security. VISUAL-ENCLOSURE refers to the perception of seeing and mental health. GIS refers to index, indicators, travel, space syntax and provision. SERVICE refers to strategies, taxi and demand. AMENITY refers to values, house price and geographical regressions. GENTRIFICATION refers to changes in the neighbourhood and displacements. CHILDREN refers to young people and adolescents. STATIONS refers to light rail and speed of traffic. CRASHES refers to safety of pedestrians, drivers and vehicles.

4.2. Conceptual Evolution Map

The second phase of the analysis examines how key research topics have evolved over time, based on the results of the content analysis from both periods. Using SciMAT, the topics identified in each subperiod are analysed through their associated keywords and how these have changed or persisted across years. This approach helps to trace the main thematic areas that have shaped the development of pedestrian mobility research.

Thematic connections between the clusters of the two time periods were identified and are illustrated in Figure A1 in Appendix B. Continuous lines represent direct connections between topics that share the same name or where one topic's name is contained within the other. Discontinuous lines indicate links based on shared keywords, even if the topic names differ. In the conceptual evolution map, the thickness of each line reflects the inclusion index, while the size of each sphere corresponds to the number of documents published on that topic.

Topics were grouped into broader thematic areas based on their connections, both continuous and discontinuous lines and the strength of those connections, as indicated by line thickness. When multiple themes were primarily connected through continuous lines,

they were considered part of the same thematic area. After identifying these connections, the researchers used their knowledge of urban mobility to label each area accordingly. As a result, five main thematic areas were defined: methods, environmental–social, health, city, and mobility. The conceptual evolution and these thematic areas are illustrated in Figure 5.

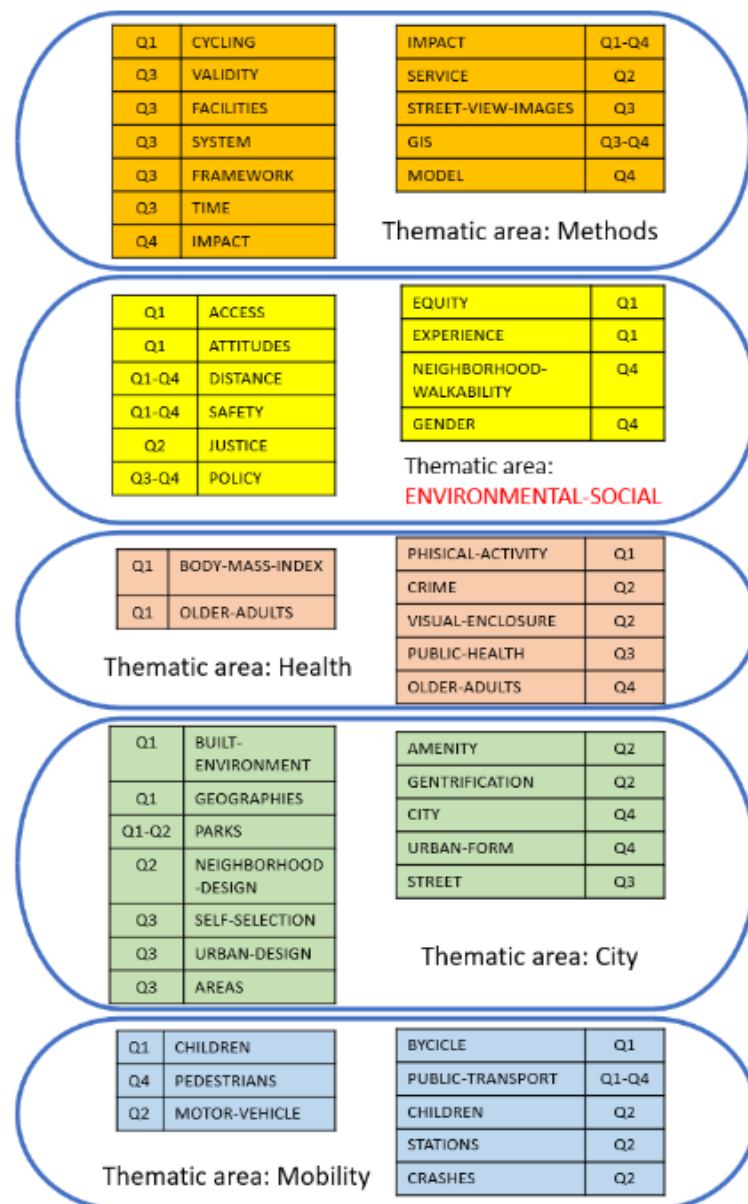


Figure 5. Thematic areas in the field of pedestrian mobility.

4.2.1. Structural Development of Pedestrian Mobility Research

The results of the research carried out on pedestrian mobility (Figure 4) are highly consistent, as revealed by the fact that most of the research topics of the two periods defined can be grouped into thematic areas, which incorporate the evolution of the research topics starting from the previous period. Below, the key thematic areas and their structural progression are summarized.

The **thematic area methods** (Figure A2 in Appendix B) includes a range of methodological and theoretical approaches used in pedestrian mobility research. Across both periods, the field has been explored from multiple angles, with particular attention to geographic and systemic frameworks, as well as the growing use of visual tools and imagery. Within this context, “pedestrian mobility” is often used to describe the applied dimension of these

frameworks. Some studies in this area have also focused on improving mobility through decision-making tools, such as impact assessments and validation methods.

The **thematic area environmental–social** (Figure A3 in Appendix B) focuses on core aspects linked to a strategic understanding of pedestrian mobility, and how specific planning approaches can offer advantages for cities. In pedestrian mobility, the consideration of environmental or social aspects in urban design strategy is crucial to achieving successful results, and that is the reason why it incorporates ACCESS, DISTANCE, EQUITY or NEIGHBORHOOD-WALKABILITY studies.

The **thematic area health** (Figure A4 in Appendix B) covers the different aspects studied in citizens' behaviour from the point of view of their health, with the focus on those groups most concerned by the study, namely the elderly. In the first period, the thematic area health dealt with such varied topics as BODY MASS INDEX and OLDER ADULTS, moving in the second period towards CRIME and PHYSICAL ACTIVITY as motor themes, together with CRIME, PUBLIC HEALTH and VISUAL ENCLOSURE.

In the first period, the key **thematic area city** (Figure A5 in Appendix B) contains essential themes, such as BUILT ENVIRONMENT, PARKS, NEIGHBORHOOD DESIGN, URBAN DESIGN, GEOGRAPHIES or AREAS, all located in three of the quadrants. In the second period, it focuses on CITY, URBAN FORM or STREET, and incorporates the study of AMENITY and GENTRIFICATION of the urban area.

The thematic area mobility (Figure A6 in Appendix B) includes topics related to different user groups, CHILDREN and PEDESTRIANS, as well as MOTOR-VEHICLE in the first period. In the second period, it deals with the user group CHILDREN and incorporates BICYCLE, PUBLIC TRANSPORT, STATIONS and CRASHES, among others.

4.2.2. Performance Analysis of the Evolution of the Pedestrian Mobility Field

The performance indicators in Table 7 show that city is the most prominent thematic area in the conceptual evolution map, with a total of 2099 publications and 65,930 citations. This area also demonstrates strong momentum, recording the highest impact score during the second period. Three other thematic areas show similar performance levels: health, with 1314 publications and 27,793 citations; methods, with 1310 publications and 34,228 citations; and environmental–social, 1446 publications and 35,103 citations. The performance indicators of the thematic area mobility are 881 publications and 17,404 citations.

Table 7. Thematic areas performance (1990–2023).

Thematic Area	Publications	Citations
Health	1314	27,793
Methods	1310	34,228
Environmental-social	1446	35,103
City	2099	65,930
Mobility	881	17,404

5. Discussion

The analysis of how pedestrian mobility research has evolved over time reveals five main thematic areas: health, methods, environmental–social, city and mobility. By examining the keywords and associated publications within each area, it is possible to track the specific topics addressed during each period and how they have developed. The key terms linked to each thematic area across the two periods are illustrated in Figures A2–A6 in Appendix B.

The methods thematic area (see Figure A2 in Appendix B) includes numerous studies that explore scenario modelling to enhance the planning and performance of pedestrian mobility systems. From a methodological point of view, the literature reviews are commonly applied to structure existing findings and examine various aspects of pedestrian mobility research. STREET-VIEW-IMAGES has become a useful tool for analysing various pedestrian scenarios and for improving management processes, particularly in contexts marked by uncertainty and risk. This area also includes studies that explore how information supports decision making in urban planning, using tools like Transit-Oriented Development (TOD). The goal is to improve how people perceive and interact with the urban environment.

The thematic area environmental–social (see Figure A4 in Appendix B) focuses on the sustainability aspects of pedestrian mobility. The first studies in this area explored ACCESS and ATTITUDES, seen as necessary conditions for evaluating the benefits of different mobility options. Over time, the literature has also explored how environmental and social factors influence the adoption and implementation of pedestrian mobility policies. Sustainability, both environmental and social, is viewed as essential for creating a resilient city, especially in settings marked by uncertainty and the growing risk of climate-related disruptions. Therefore, it is necessary to address the relationships between different interest groups, since pedestrians play such an important role in the city.

The thematic area health (Figure A4 in Appendix B) refers to a set of studies focused on health and related to pedestrian mobility and the interaction that occurs in the physical exercise required for this type of mobility. This area of research has been part of pedestrian mobility studies since their beginning and reflects a shift in urban planning from a vehicle-oriented model to one centred on the needs of people.

The thematic area city (Figure A5 in Appendix B) addresses the urban form, i.e., the built environment. In addition to the components using urban planning, urban-parks or urban green space, the literature has also addressed URBAN DESIGN through a holistic approach, as they share some aspects. The city is composed of two main spatial domains: public space and private space. These domains are distinct, but complementary. Public space includes linear elements such as streets and pathways, as well as surface elements like squares and green areas; their form and importance vary, but all of them belong to the community. Public space is a shared environment where social life happens. It plays a central role in the city and is accessible to everyone, though certain rules usually set by local authorities. One of the key functions of public space is to support movement of both people and goods. Since the arrival of the automobile, cities have assigned different areas for motor vehicles and pedestrians. As cities have grown and become more complex, new forms of mobility have been added to this space like bicycles (traditional and electric), skateboards, delivery tricycles, and maintenance vehicles. This thematic area reflects how pedestrian environment has changed over time, and how cities are increasingly trying to integrate walking with other mobility strategies to improve performance. Public space only works because people use it. As they move through the city, they walk, talk, shop, work, play, rest, and interact. These activities should be encouraged by making sure public spaces are designed to support them [29].

The thematic area mobility (Figure A6 in Appendix B) focuses on pedestrian mobility performance from the perspective of both the user and the transport method. The performance of user groups is considered a key part of the competitive strategy for sustainable urban mobility.

Throughout the 20th century, motorized traffic increasingly dominated public space, primarily for driving and parking. Today, nearly 70% of public space is occupied by motorized vehicles, either directly or through infrastructure that supports them. Additionally, 64% of the distance travelled by these vehicles occurs within urban areas [30]. In the first

period, urban practice prioritized motorized mobility, focusing on speed and efficiency. As a result, pedestrians were confined to narrow sidewalks along the edges of street spaces often too limited to support other urban activities. In the second period, however, there was a shift toward alternative planning strategies that emphasized sustainability and have greater weight to pedestrian mobility within urban design. In this context, walkability was increasingly recognized as a planning tool to enhance the quality and performance of urban environments. This thematic area illustrates a transition from a vehicle-oriented model to one that gives greater importance to pedestrians, driven by a growing awareness of sustainability in urban planning. In recent years, urban planners and decision makers have come to see that considering social, economic, and environmental factors is important for creating cities that are stronger and work better.

Information technologies now play a key role not only in improving transportation systems, but also in supporting sustainability goals. Technological advances have helped cities manage environmental challenges more effectively by reducing pollution, lowering energy use, and promoting more sustainable practices. Adopting pedestrian mobility through a resource-based perspective along with tools like walkability assessments supports the social, environmental, and economic sustainability of urban public spaces.

6. Conclusions

This study examined the development of pedestrian mobility research from 1990 to 2023. Its main objective was to identify the key topics in the field and provide a clear overview of how research in this area has evolved, particularly in relation to urban design. A total of 1934 research articles were analysed using SciMAT. To understand how the field evolved, the study period was divided into two subperiods: 1990–2019 and 2020–2023. Although the time spans are unequal, both periods contain a similar number of publications. This highlights the rise in research activity in recent years, with nearly as many studies published in the last four years as in the previous thirty. The first period covers both early and more established work, while the second reflects recent priorities and emerging directions in pedestrian mobility research.

In recent years, interest in pedestrian mobility research has grown significantly. The increasing number of publications and citations reflects the continued relevance of the topic. Among the researchers with the highest contributions in this field are Lu Y., Miralles-Guasch C. and Giles-Corti B (Table A1 in Appendix A), who have played an important role in shaping the direction of the research.

Journals have also had major influence on how knowledge in this area is shared. The most prominent ones include Journal of Transport and Health, Journal of Transport Geography, Transportation Research Record, and Cities. Another interesting finding is the growing participation from researchers in emerging countries, pointing to a more global engagement with the topic. The field brings together several academic disciplines, with major contributions coming from transportation, geography, urban studies, and technology applied to transport and regional urban planning.

In terms of the scientific mapping, this study presents a visual representation of the development and structure of research on pedestrian mobility over the past 33 years (1990–2023). The analysis identifies five main thematic areas that constitute the core of knowledge in this field: (1) methods, which examines the methodological tools and approaches used to study pedestrian mobility; (2) environmental–social, which addresses sustainability in urban design and the potential strategic benefits it offers cities; (3) health, which studies pedestrian mobility from an internal perspective; (4) city, which involves design and organisational issues; and (5) mobility, which refers to the interaction of different user groups with the city. These thematic areas allow us to visualize how pedestrian

mobility covers a wide variety of urban themes, from operational performance to long-term competitiveness. Furthermore, the conceptual evolution map shows that these themes are interconnected, either directly through shared topics or indirectly through thematic links (see Figure A1 in Appendix B).

Among the key contributions are the identification of major research topics in pedestrian mobility and how they have developed over time. The analysis also offers a clearer view of the field's structure, its main shifts, and the methods most often applied. In addition, it points to future thematic areas that appear especially relevant and worth further exploration.

6.1. Theoretical Contributions and Practical Implications

By tracing the development of pedestrian mobility research from its origins to the present, this work offers a useful reference for both researchers and practitioners. The longitudinal analysis of the literature allows understanding the foundations of the field, how its focus has shifted over time, and which emerging trends are likely to shape future research. It also allows for meaningful comparisons between earlier studies and more recent work, highlighting changes in priorities, methods, and theoretical perspectives.

For researchers aiming to expand on this work, this paper helps to identify the best journals to refer to. It also identifies gaps in the existing literature, offering a broader view of the field and pointing to areas that remain underexplored.

The thematic area methods will especially be useful for researchers interested in the theoretical and practical tools applied in pedestrian mobility studies. Literature reviews are frequently used to analyse user preferences, assess impacts, and support validation. Other approaches such as street-view-images or visual-enclosure are used to study mobility in real settings and contribute to improving urban design without ignoring cycling or positioning (GIS).

The thematic area environmental–social highlights the key sustainability-related topics addressed in pedestrian mobility research. The motors focused on access and distance for pedestrians, safety and gender incorporation. This is the result which equity considers in the vision of urban public space and walkability in the neighbourhood. Identifying these elements provides researchers with a clear foundation to engage with current debates, respond to emerging trends, and address existing gaps in the literature.

In particular, the thematic area health features the elderly as one of its standing clusters, with body mass index and motor vehicle evolving to more specific themes, such as crimes and visual enclosure, which lays before researchers the origins and foundations of the relationship with pedestrian mobility. The most recent research incorporates both aspects of physical activity and public health into patterns of behaviour.

The thematic area city is especially useful for researchers, as it focuses on key drivers such as the built environment and geography, with parks, neighbourhood design and urban design. It incorporates policies in urban development and its facilities to achieve the study of amenities designed for the citizen.

The thematic area mobility exposes the importance given to the study and analysis of different types of transportation, such as cycling, public transport and stations or stops. By studying large user groups, such as children or pedestrians, which are persistent components in both periods, researchers can explore how transport systems and user needs evolve to enhance the effectiveness of pedestrian mobility in all its aspects.

This work is relevant for both decision makers and specialists, as it identifies key research themes and highlights leading authors and institutions in the field, which facilitates the search for academic support and the formation of partnerships to address the practical implications of pedestrian mobility. Our findings also highlight strategies and actions

that can inform urban development processes and help bridge the gap between academic research and real-world application.

Although the thematic area methods is valuable for researchers, it is less useful for professionals as it mainly addresses methodological matters in research literature.

The contribution of the thematic area environmental–social is also useful for practitioners because of its managerial implications. The identification and exploration of sustainability factors, drivers and barriers to pedestrian mobility can be beneficial for a friendlier urban development, as well as the recommendations generally proposed in the literature. Our study shows that the engagement of certain stakeholders is imperative for all other factors to have a strong impact on the process of implementing a citizen-oriented urban design. The commitment of the municipality is often required to carry forward pedestrian mobility initiatives, and the support of other stakeholders at the highest level is of vital importance.

The thematic area health is valuable for both researchers and health professionals as it addresses the interaction between these professions.

Information in the thematic areas city and environment–urban is especially useful for city managers and urban planners. Prior research shows that pedestrian mobility plays an important role in shaping city dynamics and provides several real-world examples of effective applications. The literature covering performance related urban environments is diverse. When effectively integrated into urban design, pedestrian mobility can enhance public space planning and contribute to more efficient outcomes. It is important to consider pedestrians not only within localized zones but across the full extent of public space.

In the mobility thematic area, research has addressed several key aspects of pedestrian mobility performance, including access, safety, stations, accidents, and public transport. These topics suggest that both financial and non-financial indicators should be considered when assessing performance, including how investments relate to the overall value created for the city. The strong emphasis on sustainability also points to where future management efforts should focus, especially as interest grows in how users interact with transport systems. In addition, recent studies highlight the increasing role of information technologies in improving the efficiency of urban design. Ignoring these elements may limit a city's ability to achieve effective and well-performing urban spaces.

6.2. Future Lines of Research and Limitations of the Study

Despite the growing interest in pedestrian mobility, several areas remain insufficiently explored. One of these is the role of urban design as a fundamental component influencing pedestrian movement. Although frequently acknowledged, it has not been treated as a central variable in much of the existing literature. Future research should engage more directly with the spatial and design related dimensions of cities to better understand their impact on pedestrian behaviour and mobility outcomes. In addition, although numerous studies examine the interactions between pedestrians and other urban users such as cyclists and motor vehicles there is a notable lack of research addressing broader themes like resilience, which remains underrepresented in the literature. It is therefore important to look more closely at how pedestrian mobility can be combined with other urban strategies. There is still very little research that focuses on environmental and social aspects, as most studies have concentrated on performance and efficiency. Future work should give more attention to social factors, especially how pedestrian mobility is related to inequality and inclusion in cities.

The growing use of advanced data processing tools such as machine learning, deep learning, and big data, has become increasingly evident in pedestrian mobility research.

The application of big data should be further extended to explore connectivity in public space, among other urban contexts.

Finally, a few limitations of this work should be mentioned. This study used only one database Web of Science which affected the articles included. Using other databases like Scopus or ABI could lead to different results. Another limitation is the exclusion criteria, which were based on factors such as publication year, document type, research domain, and language. Different inclusion and exclusion criteria could lead to a more comprehensive review of the field. As for SciMAT, familiarity with the tool made it possible to configure the settings effectively and select parameters that reduced the risk of generating overly complex strategic diagrams.

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Data Availability Statement: No new data were created or analysed in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Comparison Between Papers

Table A1. Most cited articles (1990–2023), with the corresponding keywords for each of them.

Title	Authors	Year	Citations	Summary	Keywords
Many pathways from land use to health—Associations between neighbourhood walkability and active transportation, body mass index, and air quality [30]	Frank, LD, Sallis, JF, Conway, TL, Chapman, JE, Saelens, BE, Bachman, W	2006	850	This study examines the relationship between urban walkability and health, active travel, and air pollution outcomes. Using a composite walkability index, the authors demonstrate that higher levels of walkability are associated with increased physically active travel, lower body mass index, and reduced vehicle emissions. The paper establishes a clear link between urban form, mobility behaviour, and public health outcomes.	Built environment, Walking, Communities, Public-health, Urban-form, Obesity, Overweight, Physical-activity-questionnaire, Mortality, Pollution
Parks and People: An Environmental Justice Inquiry in Baltimore, Maryland [31]	Boone, CG, Buckley, GL, Grove, JM, Sister, C	2009	500	This article investigates the spatial distribution of urban parks from an environmental justice perspective in Baltimore. While African American residents tend to live closer to parks, they have access to smaller park areas and experience higher levels of congestion. The study highlights how historical processes of urban segregation have produced enduring inequities in access to green space.	Parks, Neighbourhoods, Health, Hazardous-waste, Equity, Environmental justice, Accessibility

Table A1. Cont.

Title	Authors	Year	Citations	Summary	Keywords
Designing the walkable city [32]	Southworth, M	2005	467	This paper proposes a conceptual and design-oriented framework for walkable cities in response to the lack of established theory in pedestrian planning. It identifies six key criteria—connectivity, modal integration, land-use patterns, safety, path quality, and path context—that influence walking behaviour. The study is a foundational reference for integrating walkability into urban design practice.	Promoting-safe-walking, Physical-activity, Obesity, Lessons, Environment
Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies [33]	Buehler, R, Pucher, J, Seinen, M	2011	429	This study reviews long-term trends in cycling levels, safety, and policies in the United States and Canada. It identifies an overall increase in cycling, accompanied by improved safety outcomes, although significant spatial and socioeconomic inequalities persist. The paper emphasizes the role of comprehensive policy packages and presents transferable lessons for cities seeking to promote active transportation.	Work, Walking, Urban-transport-policy, Transportation, Safety, Perceptions, Lessons, Journey, Infrastructure, Determinants, Cycling, Climate, Bike-infrastructure, Access
Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study [34]	Ugolini, F, Massetti, L, Calaza-Martínez, P, Cariñanos, P, Dobbs, C, Ostoic, SK, Marin, AM, Pearlmutter, D, Saaroni, H, Sauliene, I, Simoneti, M, Verlic, A, Vuletic, D, Sanesi, G	2020	322	This international study examines how the COVID-19 pandemic affected the use and perception of urban green spaces. Findings indicate increased appreciation for nearby green spaces and shifts toward local, walkable environments. The study underscores the importance of urban green infrastructure as a critical resource for health and well-being during periods of social crisis.	Physical-isolation, Green-areas, Environments, Ecosystem-services, Citizen-perceptions, Quarantine
Impact of proximity to light rail rapid transit on station-area property values in Buffalo, New York [35]	Hess, DB, Almeida, TM	2007	317	This article assesses the effects of proximity to light rail transit stations on residential property values in Buffalo, New York. Results show that closer proximity generally increases housing values, though effects vary by neighbourhood socioeconomic context. The study also highlights the importance of walkable network distance relative to perceived straight-line proximity.	Prices, Neighbourhoods, Housing-market, Externalities, Determinants, Demand Access

Table A1. Cont.

Title	Authors	Year	Citations	Summary	Keywords
Urban form and travel behaviour: Micro-level household attributes and residential context [36]	Dijst, M, Dieleman, FM, Burghouwt, G	2002	288	This study explores the influence of urban form and individual socioeconomic characteristics on travel behaviour. Using national travel survey data from the Netherlands, the authors demonstrate that both residential context and personal attributes significantly shape modal choice and travel distances. The findings support integrated policy approaches that combine land-use planning with social considerations	Work, Land-use, Journey, Energy, Density, City
Testing the claims of new urbanism—Local access, pedestrian travel, and neighbouring behaviours [37]	Lund, H	2003	262	This paper empirically tests New Urbanist claims regarding the effects of local access to amenities on pedestrian travel and social interaction. While the results provide partial support for the influence of physical design, the study also highlights the strong role of personal attitudes and perceptions. The findings caution against purely deterministic interpretations of urban form.	Town, Streets, Community
The 3Ds+R: Quantifying land use and urban form correlates of walking [38]	Lee, C, Moudon, AV	2006	257	This study introduces an operational framework for measuring walkability based on four core dimensions: destinations, distance, density, and route. The results show that simple distance-based measures to daily destinations can perform as effectively as complex composite indices. The paper has become a key methodological reference for walkability assessment.	Measurement, Environment, Density
The happy commuter: A comparison of commuter satisfaction across modes [39]	Manauagh, K, El-Geneidy, A, van Lierop, D, St-Louis, E	2014	247	This study compares commuter satisfaction across different transport modes. The findings indicate that pedestrians and cyclists report significantly higher satisfaction levels than car users and public transport users. The paper emphasizes the importance of subjective and perceptual factors in understanding mobility experiences and informing transport policy.	Work, Walking, Travel-survey, Social-factors, Public-transportation, Personal-preferences, Mode-comparison, Mobility, Geographies, Commuter-satisfaction, City, Car, Behaviour

Table A2. Comparison of previously published studies on walkability.

Title	Authors	Year	Summary
Neighbourhood walkability: a review and bibliometric analysis [11]	Wang H, Yang Y	2019	This paper provides a critical review of the literature on neighbourhood- and community-level walkability using Geographic Information Systems (GIS). Based on a bibliometric and thematic analysis of 136 studies published between 2008 and 2018, the article examines walkability measurement methods, the relationships between the built environment and health, and the practical applications of walkability research. The study identifies emerging trends and proposes future research directions aimed at improving data quality, expanding geographical coverage, and deepening the application of walkability concepts.
Exploring the trend of walkability measures by applying hierarchical clustering technique [12]	Hasan M Scintigraphy, Oh J-S, Kwigizile V	2021	This study systematically reviews the evolution of walkability measures over the past two decades by analysing 75 articles published in 40 journals and conference proceedings. Using hierarchical clustering techniques and meta-analysis, the paper identifies trends related to scale of analysis, measurement approaches, and data collection tools. The results indicate a growing emphasis on street-level analyses and the increasing use of automated and image-based tools, particularly in recent studies, highlighting new opportunities for large-scale walkability assessment.
Determinants and effects of perceived walkability: a literature review, conceptual model and research agenda [13]	Vos J D, Lättman K, Vlugt A L V D, Welsch J, Otsuka N.	2022	This article reviews existing research on perceived walkability, focusing on how individuals experience the walk-friendliness of their environment. The study emphasizes that perceived walkability may be a stronger predictor of travel behaviour than traditional objective measures. Based on the literature review, the authors propose a conceptual model linking perceived walkability with its determinants and outcomes, and outline future research directions, including the development of a short-perceived walkability scale.
Walkability: bibliometric analysis and review [14]	Singla T, Karki T, Mishra V	2024	This paper presents an extensive review of 200 studies published between 1975 and 2022 on pedestrian-friendly and walkable urban environments. Through bibliometric analysis using VOSviewer, the study identifies and hierarchically structures the key factors influencing walkability. The article also discusses the practical applicability of walkability research and proposes a conceptual framework to guide future studies, emphasizing the roles of urban design, sustainability, and social dimensions in promoting walkable environments.

Appendix B. SciMAT Results

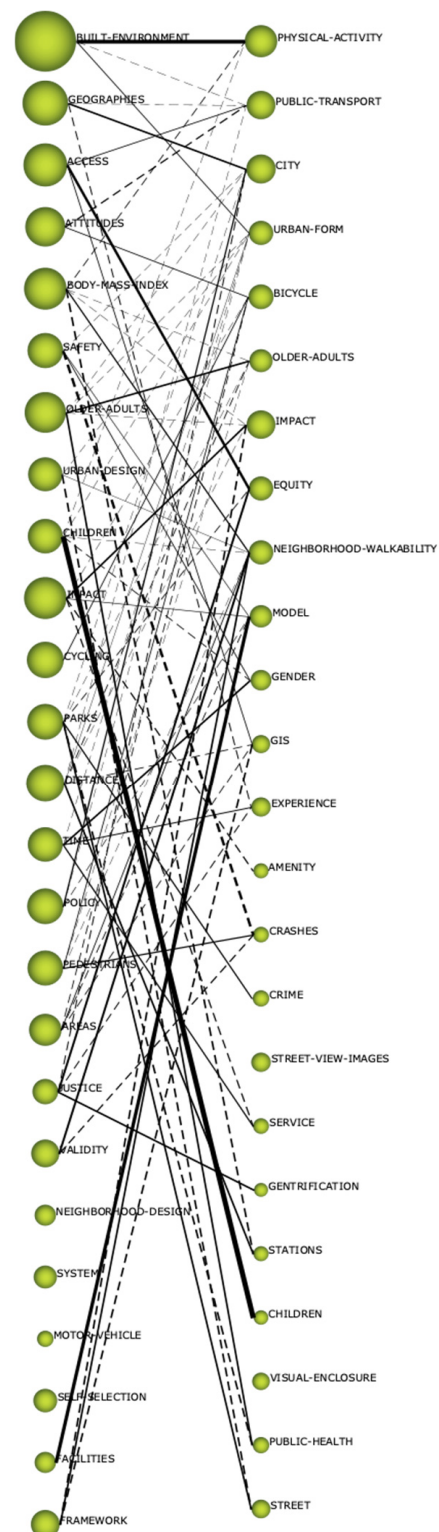


Figure A1. Linear analysis of pedestrian mobility evolution.

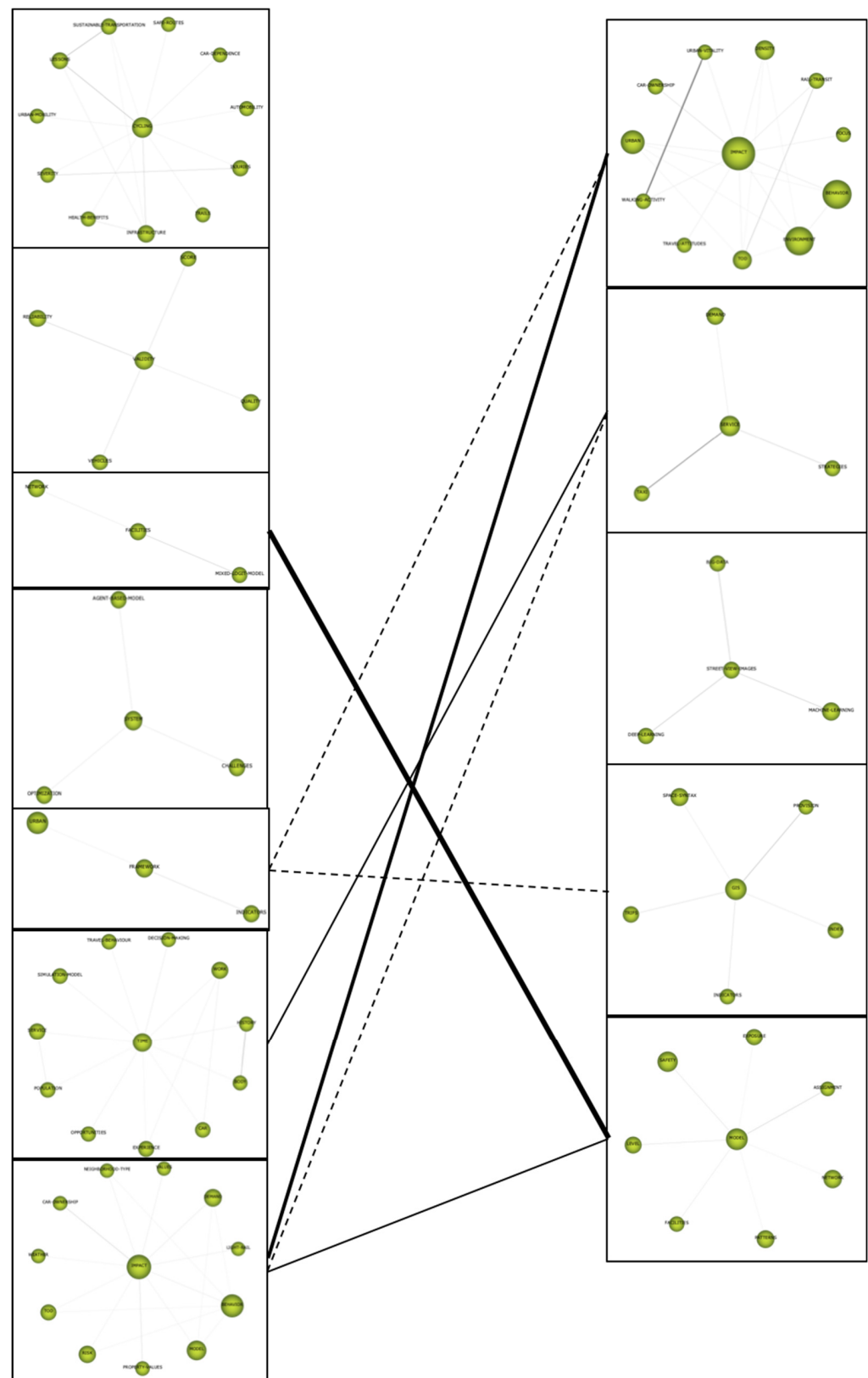


Figure A2. Thematic area methods.

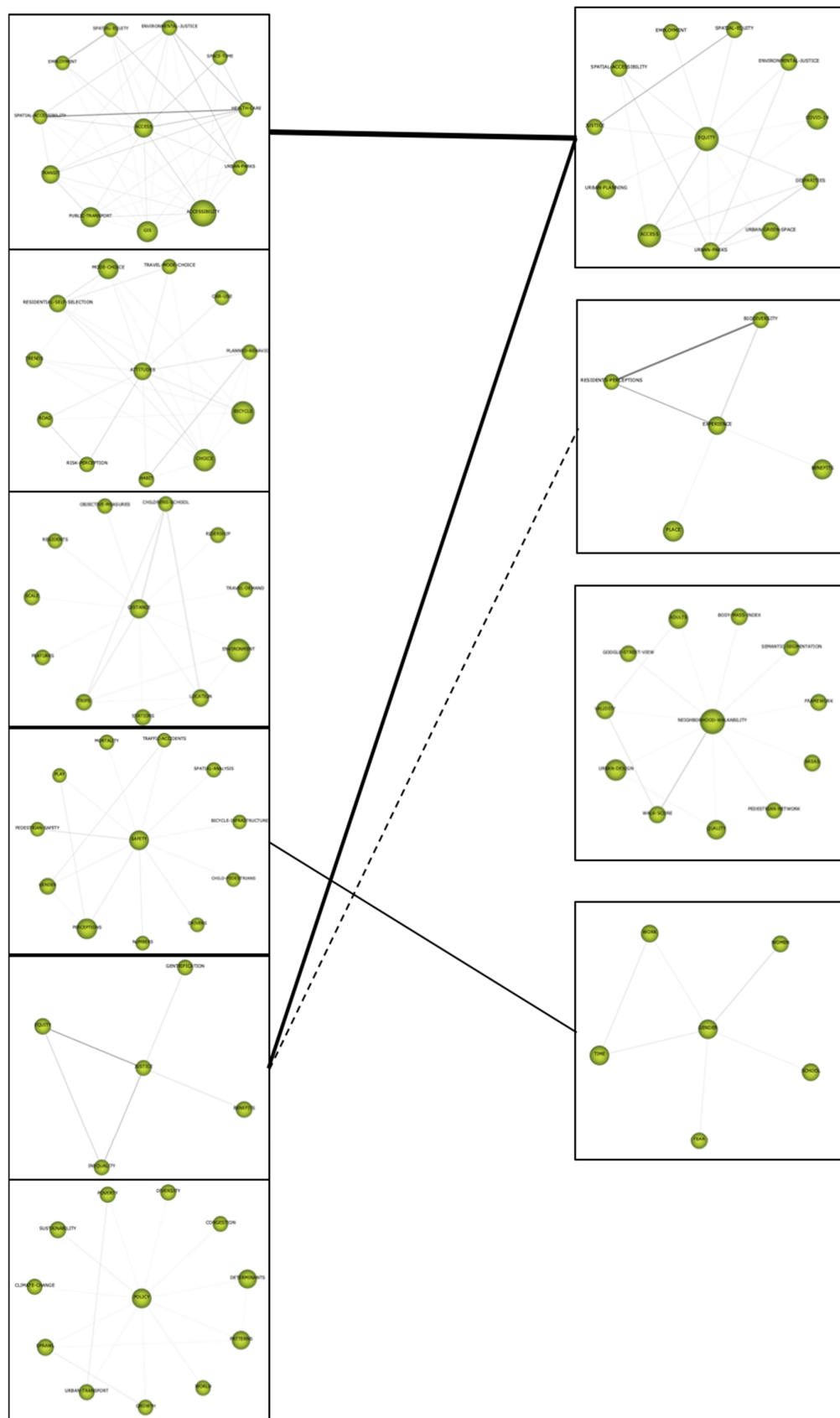


Figure A3. Thematic area environmental–social.

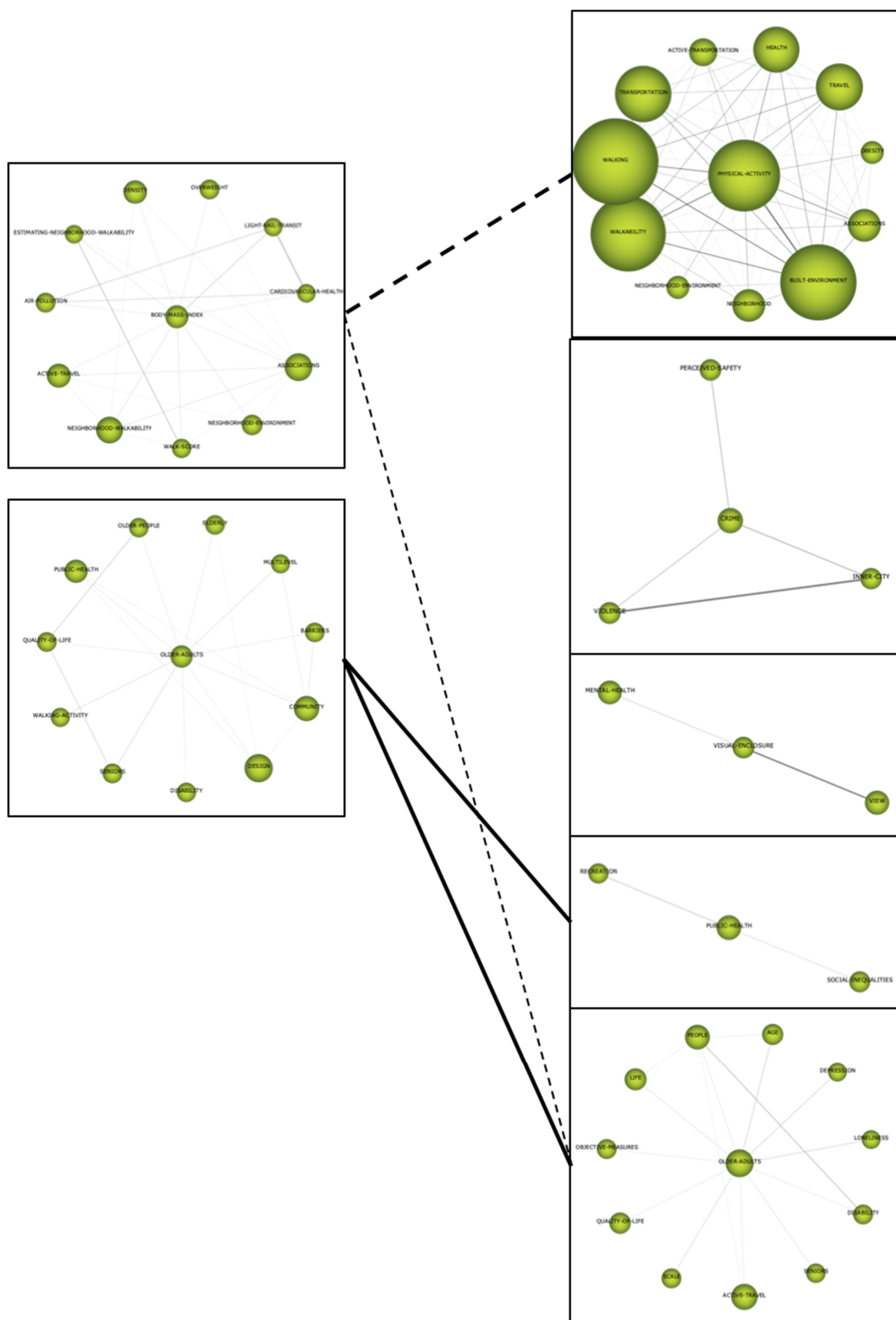


Figure A4. Thematic area health.

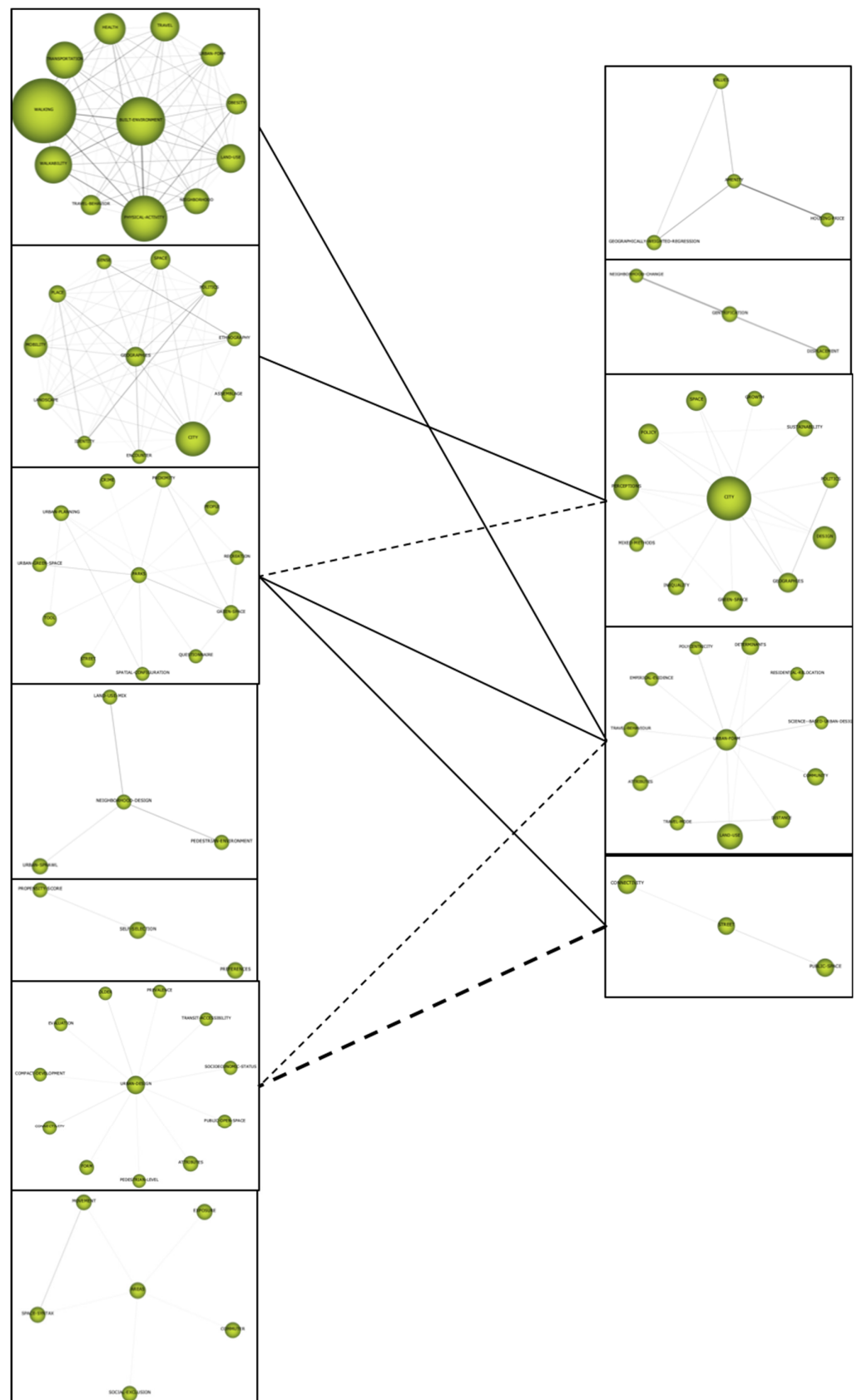


Figure A5. Thematic area city.

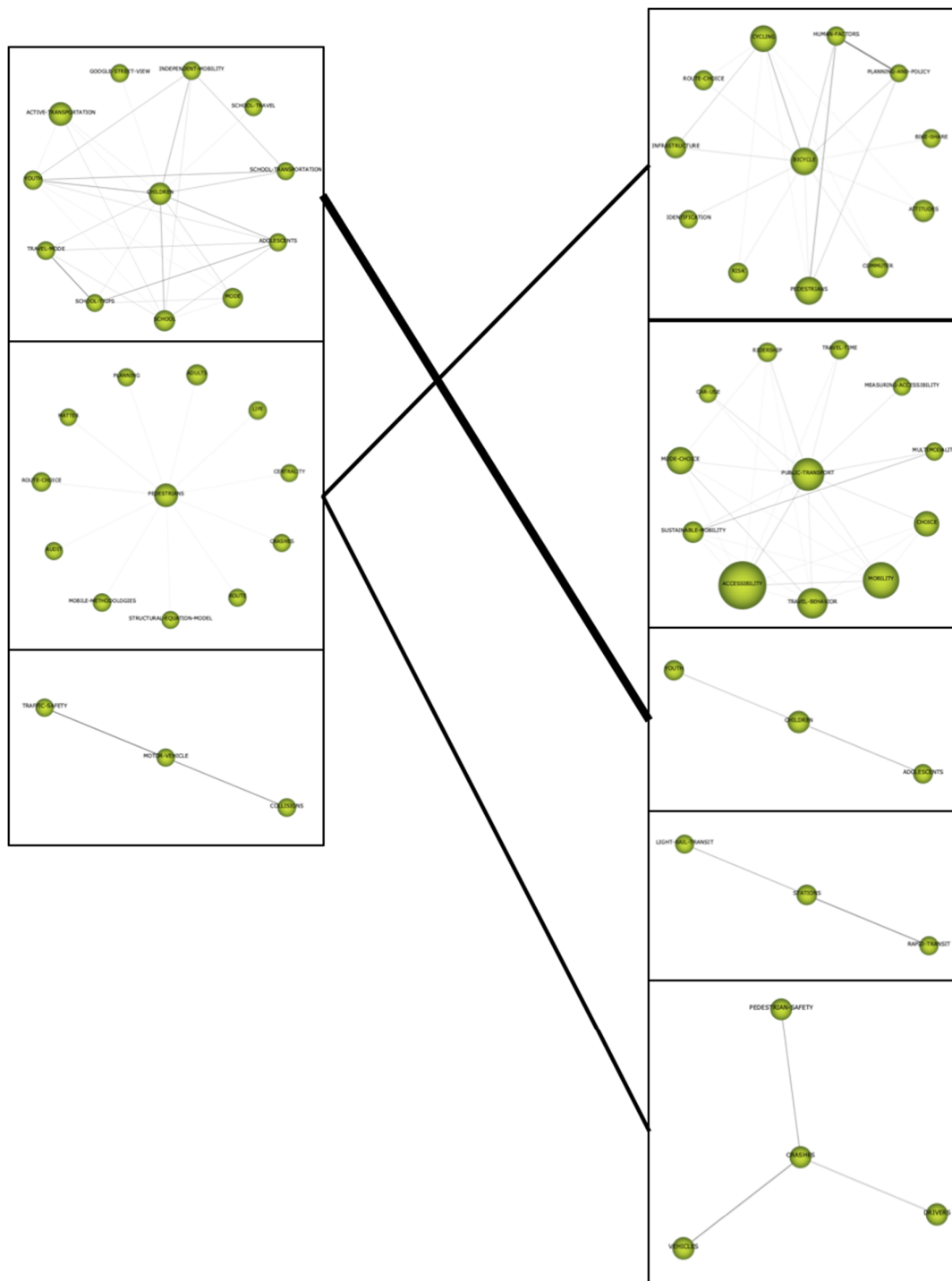


Figure A6. Thematic area mobility.

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