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Designing inclusive cities: A framework for gender and age-responsive urban mobility

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Abstract

Mobility plays a crucial role in ensuring social inclusion, economic participation, and overall quality of life. However, urban mobility systems often fail to address the needs of vulnerable populations, particularly women and the elderly. This study conducts a systematic literature review to identify urban design interventions that promote gender- and age-inclusive mobility. Initially, 80 peer-reviewed papers were selected from Scopus, Web of Science, and ScienceDirect, the most relevant databases for urban studies and mobility research. Through keyword frequency analysis, the selection was refined to 30 key studies for in-depth review. The study explores inclusive mobility principles, identifying key urban design strategies such as universal accessibility, pedestrian-friendly infrastructure, gender-sensitive planning, and technology integration. It also examines barriers to inclusive mobility, including safety concerns, inadequate public transport access, and poor last-mile connectivity. The research further categorizes gender- and age-specific urban mobility challenges and proposes critical parameters and indicators for intervention. A significant outcome of this study is the proposal of the Pink Map, a data-driven urban planning tool that maps safe and accessible urban spaces for women and the elderly. By leveraging GIS mapping, community participation, and real-time feedback, the Pink Map serves as a decision-making tool for policymakers and a reporting platform for citizens. Findings indicate that a multi-scalar approach integrating policy reforms, urban design strategies, and participatory planning is essential to achieving inclusive mobility. The study emphasizes the need for data-driven decision-making, technology-enabled safety solutions, and gender- and age-sensitive urban transport policies to ensure equitable access to mobility for all.

Keywords: Inclusive Mobility; Gender-Sensitive Urban Design; Age-Friendly Cities; Pedestrian Infrastructure; Transport Accessibility; Urban Planning; Universal Accessibility

1. Introduction

Mobility is a fundamental right that influences social inclusion, economic participation, and overall quality of life [1]. The ability to move freely and safely within urban environments enables individuals to access employment, education, healthcare, and social opportunities, thereby enhancing overall well-being and economic productivity. However, urban mobility systems are often designed with a one-size-fits-all approach, overlooking the diverse needs of different demographic groups, particularly vulnerable populations such as women, children, and the elderly [2], [3]. Women often experience mobility constraints due to safety concerns, caregiving responsibilities, and gendered travel patterns, leading to restricted access to economic and social opportunities [4], [5]. Similarly, older adults face challenges related to physical accessibility, digital exclusion, and the lack of age-friendly infrastructure. These mobility barriers contribute to social exclusion and limit the participation of these groups in urban life. As cities continue to grow and evolve, the need for inclusive urban mobility systems becomes increasingly critical. This research aims to propose a comprehensive framework for urban design interventions that address the specific needs of gender and age groups, fostering a more

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inclusive and equitable urban mobility paradigm. By identifying key barriers, analyzing best practices, and defining actionable urban design strategies, this study seeks to contribute to the ongoing discourse on equitable urban development and sustainable mobility solutions.

1.1. Objectives

- To explore how inclusive mobility can be created through urban design and identify design criteria supporting inclusive mobility.
- To examine gender- and age-specific mobility barriers commonly encountered in urban environments.
- To identify parameters and indicators that can be intervened in to create gender- and age-inclusive mobility solutions.

1.2. Methodology

This study follows a systematic literature review approach to analyze urban design interventions for gender- and age-inclusive mobility. Research articles were sourced from Scopus, Web of Science, and ScienceDirect, selected for their extensive collection of peer-reviewed studies in urban planning, mobility, and transport equity. An initial screening identified 80 relevant papers, which were then refined through keyword frequency analysis, reducing the selection to 30 key studies for in-depth examination. Keywords such as "inclusive mobility," "gender-sensitive urban planning," "elderly-friendly transport," and "universal accessibility" were analyzed to identify thematic trends and categorize studies based on urban design interventions, mobility barriers, policy recommendations, and case study evaluations. The extracted data were synthesized to develop a parameter-indicator framework, outlining measurable criteria for inclusive mobility interventions. By employing this structured approach, the study ensures a comprehensive and evidence-based understanding of the urban design strategies necessary to create inclusive mobility systems.

2. Literature Review

2.1. Inclusive Mobility: Definition and Urban Design Principles

Inclusive mobility refers to the ability of all individuals, regardless of gender, age, or physical ability, to access and navigate urban spaces safely, comfortably, and affordably. It ensures that mobility infrastructure, public spaces, and transport systems cater to the diverse needs of society, enabling all individuals to participate fully in economic, social, and cultural activities [6]. Creating inclusive mobility is essential for fostering equity in cities and ensuring sustainable urban development.

2.1.1. Key Urban Design Principles Supporting Inclusive Mobility

Achieving inclusive mobility requires strategic urban design interventions that prioritize accessibility, safety, and connectivity. The following key principles form the foundation of inclusive mobility:

Universal Accessibility (Barrier-Free Design)

- Ensures that urban spaces and transportation systems are accessible to people of all abilities, including those with disabilities, the elderly, and caregivers with young children [6].
- Incorporates features such as step-free access, tactile paving for the visually impaired, wheelchair-friendly sidewalks, and auditory signals at pedestrian crossings.
- Uses ramps, elevators, low-floor public transport vehicles, and accessible restrooms to facilitate seamless mobility [7].

Mixed-Use Development

- Encourages diverse land-use patterns that integrate residential, commercial, institutional, and recreational spaces within walkable distances.
- Reduces dependency on private vehicles by ensuring that essential services, employment opportunities, and public transport hubs are easily accessible [8].
- Enhances walkability and promotes vibrant street life, benefiting pedestrians and non-motorized transport users.

Safe Pedestrian Infrastructure

- Ensures the development of well-maintained sidewalks, pedestrian-friendly crossings, and dedicated pedestrian zones.
- Introduces speed-reducing measures such as speed bumps, raised crosswalks, and pedestrian signals to enhance road safety.
- Implements adequate lighting and surveillance to improve safety, particularly for women, children, and elderly pedestrians [9].

Well-Connected Public Transport Systems

- Provides an efficient and affordable public transportation network that connects key urban centers and residential neighborhoods.
- Introduces integrated multimodal transport options, including buses, metro systems, cycling lanes, and pedestrian pathways.
- Improves last-mile connectivity by incorporating feeder services, shared mobility solutions, and bicycle-friendly infrastructure [10].

Gender-Sensitive and Age-Responsive Infrastructure

- Designs urban mobility systems that cater to the specific needs of women, children, and the elderly.
- Incorporates gender-sensitive safety measures such as well-lit transit stops, women-only transport options, and community monitoring systems.
- Provides amenities like seating areas, shaded pathways, and age-friendly transport options to support older adults and individuals with reduced mobility.

2.1.2. Barriers to Inclusive Mobility

Despite the established principles of inclusive mobility, several challenges persist in urban environments that limit the mobility of marginalized and vulnerable groups. The most common barriers include:

Lack of Pedestrian-Friendly Infrastructure

- Many urban areas lack well-maintained sidewalks, pedestrian crossings, and designated pedestrian zones, making walking difficult and unsafe.
- Encroachments, illegal parking, and street vending often obstruct pathways, further restricting mobility.
- Poorly designed intersections and insufficient pedestrian signals increase accident risks for vulnerable road users.

Inadequate Public Transport Access

- Public transport services in many cities do not adequately cater to people with disabilities, the elderly, and women.
- Issues such as overcrowding, lack of priority seating, high fares, and limited-service hours disproportionately affect vulnerable populations.
- Absence of transport options in peri-urban and low-income areas exacerbates mobility inequalities [11].

Safety Concerns, Especially for Women and Elderly Populations

- Women frequently experience harassment in public transport and transit hubs, leading to restricted mobility and economic participation.
- Poorly lit streets, lack of security personnel, and absence of surveillance in transit areas contribute to safety concerns.
- Elderly individuals face risks of accidents due to inadequate pedestrian infrastructure and lack of assistive facilities in public spaces [9].

Poor Last-Mile Connectivity

- Many urban transit systems lack reliable last-mile solutions, making it difficult for users to reach public transport hubs from their homes or workplaces [10].
- The absence of safe walking and cycling infrastructure discourages active transportation modes and increases reliance on private vehicles.

- Lack of investment in paratransit options and on-demand mobility services further limits accessibility for individuals with special mobility needs.

2.1.3. Inference: Towards Inclusive Cityscapes

To create truly inclusive urban environments, a multi-scalar approach must be adopted, integrating physical infrastructure, policy frameworks, and community participation. The key strategies to enhance inclusive mobility include:

- Urban Design Reforms: Prioritizing pedestrianization, universal accessibility, and safety enhancements in city planning.
- Policy Interventions: Implementing gender-sensitive and age-inclusive policies to ensure equitable mobility solutions.
- Community Engagement: Encouraging participatory planning that involves local stakeholders, women's groups, elderly communities, and disability rights organizations.
- Technology Integration: Leveraging smart mobility solutions, digital applications, and data-driven approaches to improve transport efficiency and accessibility.
- Cross-Sector Collaboration: Coordinating efforts between urban planners, transport agencies, policymakers, and civil society organizations to implement inclusive mobility frameworks effectively.

By addressing these barriers through targeted urban design and governance interventions, cities can move toward achieving equitable, accessible, and inclusive mobility for all residents. The next sections will further explore gender and age-specific mobility challenges and propose actionable strategies for overcoming them.

2.2. Gender and Urban Mobility: Different Perspectives

Women face distinct mobility challenges that stem from societal roles, economic disparities, and security concerns. Their travel patterns, modal choices, and mobility experiences differ significantly from those of men due to various socio-economic and cultural factors.

2.2.1. Key Issues in Gendered Mobility

(i) Gendered Travel Patterns (Trip-Chaining and Caregiving Responsibilities): Women are more likely to make multiple short trips within a day, often combining work, household errands, and caregiving responsibilities (e.g., dropping children at school, grocery shopping, visiting healthcare facilities) [12]. Public transport systems are traditionally designed to accommodate peak-hour, home-to-work commutes rather than the multi-stop, flexible routes that women frequently require. The absence of well-integrated transport networks and inadequate infrastructure (such as safe pedestrian pathways) further exacerbates mobility challenges for women managing household and professional responsibilities. [13].

(ii) Fear of Harassment and Safety Concern: A major barrier to women's mobility is the risk of harassment, assault, and violence in public spaces and transport systems. Poor lighting, deserted transit stops, lack of security personnel, and overcrowding contribute to unsafe travel environments [9]. Many women resort to altering their travel behavior, such as avoiding nighttime travel, choosing costlier transport modes for safety, or even withdrawing from economic activities due to unsafe commuting options [14].

(iii) Limited Access to Safe Public Transport: In many cities, public transport infrastructure does not cater specifically to women's needs, including insufficient female-friendly facilities such as priority seating, separate compartments, and well-lit waiting areas [15]. Socioeconomic constraints may limit women's access to private transportation, making them heavily dependent on public transit systems that may not be safe or reliable. Inadequate last-mile connectivity further restricts their ability to access work, education, and healthcare services, particularly in urban peripheries.

2.2.2. Case Studies & Policies: Addressing Gendered Mobility Challenges

Several cities and governments have implemented targeted interventions to improve mobility for women and ensure safer, more equitable transportation systems.

Women-Only Transport Services: Countries such as India, Japan, and Mexico have introduced women-only transport services to address safety concerns. Examples include: 'Pink Autos' in India, women-driven auto-rickshaws offering safer commuting options for female passengers; women-only metro compartments and buses, implemented in cities

such as Tokyo, Mexico City, and Cairo to reduce harassment and provide a safer travel experience, while effective in addressing immediate safety concerns, such measures are sometimes criticized for reinforcing segregation rather than addressing the root causes of gender-based violence in public spaces.

Gender-Sensitive Transport Policies in European Cities: Several European cities have adopted gender-responsive mobility policies to ensure transport planning considers the specific needs of women. Examples include: Vienna, Austria, the city has redesigned urban infrastructure based on gender-sensitive mobility studies, introducing wider sidewalks, improved street lighting, and pedestrian-friendly spaces; Sweden's Gender-Equal Transport Strategy which focuses on equitable access to transport services and infrastructure, ensuring that mobility planning addresses women's travel patterns and caregiving roles [16].

Safety Audits and Participatory Mapping Initiatives: Safetipin (India), a mobile app that allows women to report unsafe areas and share real-time safety audits of urban spaces. This data is used by urban planners and policymakers to enhance street lighting, improve surveillance, and address security gaps. Women's Safety Mapping in Latin America which uses participatory projects involving local women to map unsafe locations and advocate for safer public spaces and Bogotá, Colombia has introduced gender-sensitive urban design interventions such as well-lit bus stops, increased police presence, and dedicated women's help desks in transport hubs.

Achieving gender-inclusive urban mobility requires a holistic approach that integrates gender-sensitive transport planning, participatory decision-making, technological innovations, and policy reforms. Urban transport systems must be redesigned to accommodate women's unique travel patterns, ensuring safe, reliable, and accessible mobility options [4]. Community engagement and participatory planning processes should actively involve women in transport policy decisions, allowing their concerns and needs to shape mobility solutions [17]. Leveraging technology, such as crowd-sourced safety mapping and mobile applications, can enhance security and efficiency in urban transport. Additionally, strong policy frameworks and strict enforcement of safety regulations are crucial in addressing gender-based violence and ensuring equitable access to transport infrastructure. By implementing these measures, cities can foster inclusive urban environments where women can participate fully in economic and social activities, ultimately contributing to broader gender equity and urban sustainability.

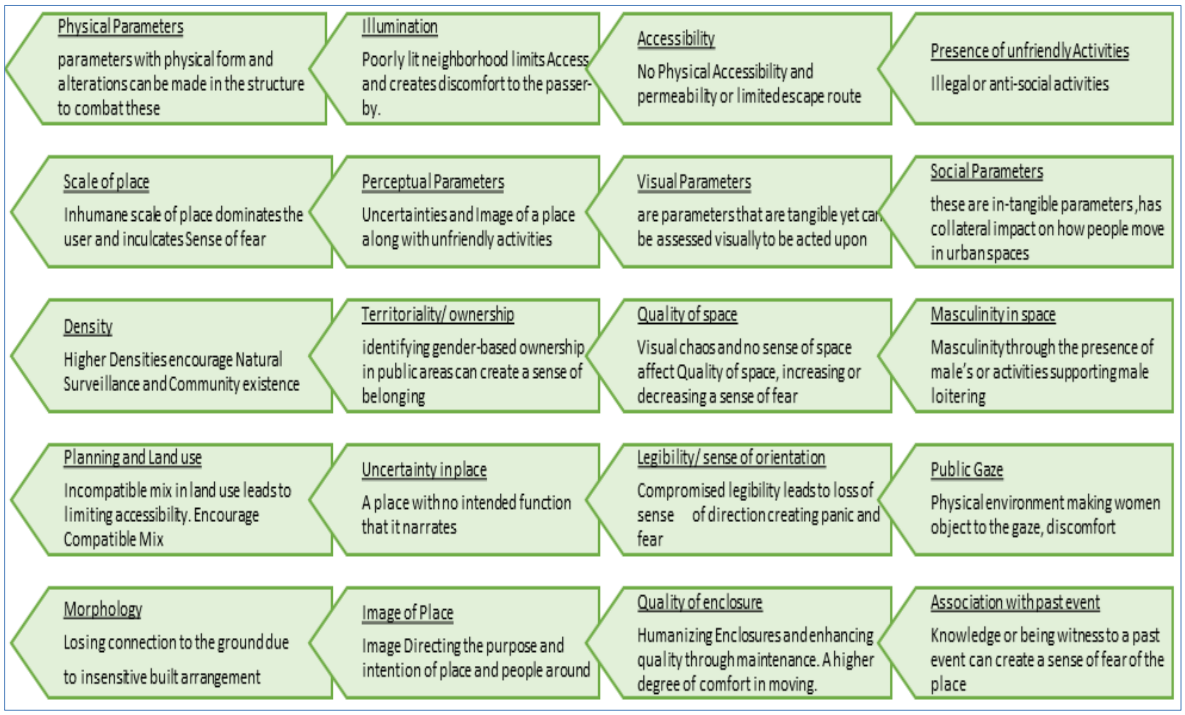

Figure 1 Reviewed literature checklist that helps meet the criteria for inclusive design. (Source: author)

2.3. Old Age and Urban Mobility: Different Perspectives

As urban populations age, ensuring mobility for elderly individuals becomes a critical aspect of inclusive city planning. Older adults often face unique mobility challenges that limit their independence and participation in social and economic activities [18].

Key barriers include:

- Physical Inaccessibility: Many urban environments lack age-friendly infrastructure, such as ramps, tactile paving, accessible pedestrian crossings, and elevators. Poorly maintained sidewalks, high curbs, and inadequate lighting further hinder safe mobility for elderly individuals.
- Digital Exclusion: The increasing reliance on digital platforms for transport services, including ride-hailing apps, digital payment systems, and real-time transit information, often excludes elderly populations who may not be technologically proficient [19].
- Limited Walkability and Seating Areas: Many cities prioritize vehicular traffic over pedestrian comfort, resulting in long walking distances, inadequate resting areas, and insufficient shade or shelter, which can make urban mobility difficult for older adults [20].

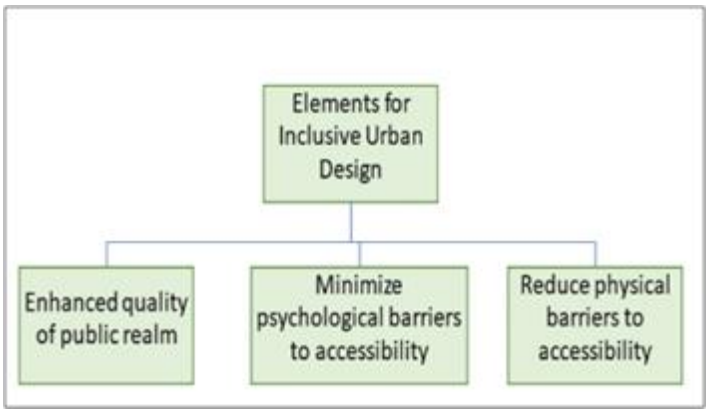

Figure 2 Key aspects for accessible urban design for disabled. (Source: author)

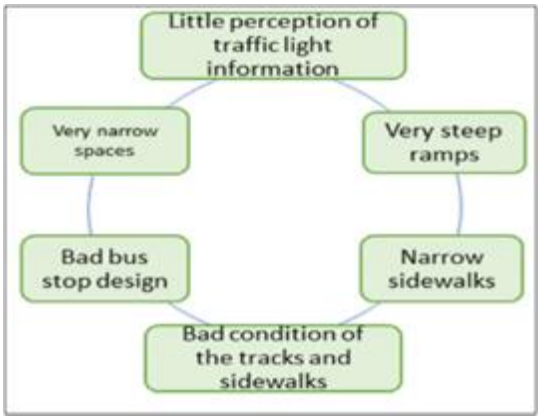

Figure 3 Major barriers for old and disabled, source [7]

3. Case Studies and Best Practices

WHO's Age-Friendly Cities Framework: The World Health Organization (WHO) has developed an Age-Friendly Cities Framework to guide urban areas in making their environments more accessible for elderly populations. This includes improving public spaces, transport systems, and pedestrian infrastructure to ensure safety and comfort.

Public Transport Adaptations in Japan and Scandinavia: Japan and Scandinavian countries have introduced age-inclusive transport policies, such as priority seating, low-floor buses, barrier-free train stations, and real-time transport assistance services. Japan's "Silver Seats" and Scandinavian smart transit systems enable easy navigation for elderly passengers, improving accessibility and independence [21].

To create age-friendly urban mobility, cities must adopt universal design principles that prioritize accessibility, safety, and convenience for older adults. Public transport and pedestrian infrastructure should be barrier-free, with features such as low-floor buses, wide sidewalks, safe crossings, and adequate seating areas. Digital literacy programs and alternative booking/payment options should be introduced to bridge the digital divide. Community engagement is also crucial, as participatory planning allows elderly individuals to voice their concerns and contribute to solutions tailored to their needs. By integrating these strategies, cities can enhance the quality of life for older adults, ensuring their continued independence and active participation in urban life.

4. Identification of Parameters and Indicators for Intervention

The study identifies critical parameters influencing gender- and age-inclusive mobility:

- **Physical Infrastructure**: Accessible sidewalks, ramps, public seating

- **Safety Measures**: Street lighting, CCTV surveillance, emergency contact points
- **Public Transport Design**: Reserved seating, easy boarding mechanisms
- **Policy Interventions**: Gender-sensitive planning, participatory decision-making
- **Technology Integration**: Digital inclusion, real-time transport tracking

Table 1 Gender-Specific Mobility Parameters and Indicators

Parameter	Indicator	Measurement Unit	Data Collection Method	Evaluation Criteria	Remarks
Pedestrian Infrastructure	Safe and well-lit pedestrian pathways	% of streets with adequate lighting	Field surveys, GIS mapping	≥85% of pedestrian pathways well-lit	Reduces safety concerns at night
	Walkable and active street frontages	% of streets with active facades	Land use mapping, observations	≥50% of pedestrian paths have active frontage	Improves perceived safety for women
Public Spaces	Presence of gender-sensitive public spaces	% of parks with gender-inclusive design	Field surveys, audits	≥70% of public parks have lighting and seating	Encourages women's participation in public life
Safety Measures	Presence of street lighting	% of streets with adequate lighting	Night-time audits, luminance measurement	≥85% of streets well-lit	Reduces fear of harassment in public spaces
	CCTV surveillance at transit hubs	No. of cameras per transit hub	Official records, GIS mapping	100% major transit hubs covered	Enhances safety and deters crime
	Availability of emergency contact points	No. of emergency kiosks per km^2	Field observations, user surveys	≥2 emergency points per km	Quick assistance for women in distress
Public Transport Design	Women-only transport services	Availability of women-only options (Yes/No)	Policy review, transport records	Dedicated services operational	Provides safer mobility options
	Reserved seating for women	% of seats reserved for women	Public transport audits	≥15% of seats per vehicle reserved	Ensures priority seating in transit
	Women-friendly transit hubs	% of transit hubs with separate women's facilities	Transport authority data, audits	≥80% of transit hubs have safe waiting areas	Ensures safer transit experiences
Wayfinding and Signage	Presence of clear, multilingual signage	% of wayfinding signage in local languages	On-site observation, user surveys	≥90% of transit points with multilingual signage	Enhances mobility confidence for all users
Policy & Planning	Gender-sensitive urban planning	Presence of gender-inclusive policies (Yes/No)	Policy review, stakeholder interviews	Strong legal framework	Encourages inclusive urban design
	Women's participation in transport planning	% of women in urban mobility policymaking	Government reports, meeting records	≥30% representation	Ensures women's voices in decision-making

Technology Integration	Crowd-sourced safety mapping	Availability of safety apps (Yes/No)	App store review, user feedback	Active and widely used	Enhances real-time safety awareness for women
Emergency and Surveillance	Presence of CCTV and emergency response points	No. of CCTV cameras per transit hub	Official transport reports, GIS mapping	100% major transit hubs covered	Enhances security in public space

Table 2 Old Age-Specific Mobility Parameters and Indicators

Parameter	**Indicator**	**Measurement Unit**	**Data Collection Method**	**Evaluation Criteria**	**Remarks**
Physical Infrastructure	Accessible sidewalks and ramps	% of streets with barrier-free design	Field surveys, GIS mapping	≥80% of streets with ramps and tactile paving	Ensures ease of movement for elderly users
	Availability of public seating	No. of seating/rest areas per km^2	On-site observations, community feedback	≥5 seating areas per km	Provides rest points for elderly pedestrians
Pedestrian Infrastructure	Accessible sidewalks with ramps and tactile paving	% of sidewalks with universal design	Field surveys, GIS mapping	≥80% of streets with barrier-free sidewalks	Ensures ease of mobility for elderly
	Availability of frequent resting spaces	No. of seating/rest areas per km	On-site surveys, audits	≥5 seating/rest areas per km	Reduces fatigue for elderly pedestrians
Public Transport Design	Reserved seating for elderly	% of seats reserved for elderly	Public transport audits	≥15% of seats per vehicle reserved	Ensures accessibility for elderly passengers
	easy boarding	% of buses/trains with step-free access	Transport authority records	≥70% of fleet accessible	Facilitates easy movement for elderly users
	Low-floor buses	% of buses with low-floor design	Transport authority data	≥70% of public transport accessible	Ensures easy boarding for elderly users
	Audio-visual announcements in transit	% of transit vehicles with AV systems	Transport audits, passenger surveys	≥90% of fleet equipped	Assists elderly individuals with navigation
	Dedicated waiting areas with seating and shelter	% of bus stops with age-friendly design	Site audits, user feedback	≥80% of major transit hubs covered	Enhances comfort while waiting for transport
Crossing and Intersection Design	Signal timing adapted for slower crossing speeds	Time allocated per pedestrian crossing	Traffic signal audits, user feedback	≥30 seconds crossing time at key intersections	Enhances safety for elderly pedestrians

	Presence of mid-block pedestrian crossings	No. of crossings per km	Urban mobility audits	≥3 crossings per km	Reduces long walking distances for elderly
Wayfinding and Information	Large, high-contrast signage for readability	% of transit hubs with elderly-friendly signage	On-site observation, audits	≥90% of signage readable from 3m distance	Improves ease of navigation for elderly
Safety and Comfort	Shaded walkways and pedestrian zones	% of footpaths with shade cover	Urban canopy mapping, surveys	≥50% of pedestrian areas with shaded paths	Prevents heat-related discomfort
	Well-maintained footpaths and step-free crossings	% of walkways in good condition	Infrastructure audits, community feedback	≥80% of sidewalks in usable condition	Prevents falls and injuries
Policy & Planning	Age-friendly city planning	Presence of elderly-inclusive policies (Yes/No)	Policy review, stakeholder interviews	Strong legal framework	Supports elderly-friendly mobility
	Senior citizen transport subsidies	% of public transport offering discounted fares	Policy review, transport authority records	Widely available	Encourages mobility for elderly populations
Technology Integration	Digital literacy programs for elderly	% of elderly comfortable with digital ticketing	User experience testing, interviews	≥75% of elderly users proficient	Reduces digital exclusion for senior citizens

Gender-specific urban design prioritizes safety, visibility, and accessibility to create secure and user-friendly public spaces and transport hubs for women. This includes well-lit pedestrian pathways, active street frontages, gender-sensitive public seating, and dedicated spaces in transit systems to enhance comfort and security. On the other hand, old age-specific urban design emphasizes universal accessibility, comfort, and wayfinding to ensure ease of movement for elderly users. Key interventions include barrier-free sidewalks with ramps and tactile paving, frequent resting spaces, extended pedestrian signal timings, and high-contrast signage for improved navigation. By integrating these design principles, cities can create inclusive urban environments that cater to the mobility needs of both women and the elderly, promoting equity and social participation.

5. Findings

Inclusive mobility is multidimensional and requires a holistic urban planning approach that integrates physical infrastructure, policy frameworks, and community participation.

Gender- and age-responsive design should be embedded within transport planning to ensure that mobility systems cater to diverse user needs.

Safety, accessibility, comfort, and ease of navigation are critical factors in designing inclusive urban spaces.

Community engagement and participatory mapping help identify real-world mobility challenges and develop effective, user-centric solutions.

International best practices provide valuable insights, but successful implementation requires contextual adaptation to local socio-economic and cultural conditions.

6. Discussion

The study emphasizes that inclusive mobility is not just about infrastructure but also about policies and user engagement. While well-designed pedestrian pathways, accessible transit systems, and safety features are crucial, they must be supported by policy interventions and enforcement mechanisms to ensure long-term impact. A gender-sensitive approach to urban mobility recognizes the unique challenges faced by women, such as safety concerns and trip-chaining due to caregiving responsibilities. Dedicated transit facilities, improved street lighting, and active street frontages can significantly enhance women's mobility. Similarly, an age-responsive design focuses on barrier-free sidewalks, frequent resting areas, and step-free access to ensure elderly users can navigate urban spaces comfortably. Moreover, the role of community engagement cannot be overlooked. Participatory planning methods, such as safety audits, user surveys, and interactive mapping tools, allow cities to tailor mobility solutions to actual needs. While international case studies demonstrate effective strategies, direct replication is not always feasible. Instead, adapting these best practices to local contexts—considering economic constraints, cultural factors, and governance structures—is essential for successful implementation. Ultimately, achieving inclusive mobility requires an integrated approach combining infrastructure, digital innovation, policy reforms, and active community involvement. By embedding these principles into urban planning, cities can foster equitable mobility systems that empower all users, regardless of gender or age.

7. Recommendations

Achieving gender- and age-inclusive mobility requires an integrated approach that combines policy reforms, urban design interventions, technological innovations, and community participation. The following recommendations outline strategic measures to enhance mobility for vulnerable groups:

7.1. Policy Measures

- Formulate gender-sensitive urban transport policies that address women's safety concerns, caregiving-related travel patterns, and last-mile connectivity.
- Develop age-inclusive urban design guidelines ensuring that mobility systems cater to the needs of elderly populations by incorporating accessibility standards.
- Strengthen legal frameworks and enforcement mechanisms to combat gender-based harassment in public transport and urban spaces.

7.2. Urban Design Guidelines

- Mandate barrier-free infrastructure, including step-free access, tactile paving, accessible pedestrian crossings, and universally designed transit facilities.
- Implement pedestrian-oriented city planning, ensuring well-connected sidewalks, dedicated crossings, and traffic-calmed zones to promote walkability.
- Integrate well-lit and inclusive public spaces, providing safe waiting areas, adequate street lighting, and visibility-enhancing design interventions.

7.3. Technology and Innovation

- Develop digital solutions, such as mobile applications for real-time transit tracking, emergency response alerts, and route optimization for vulnerable groups.
- Utilize crowdsourced safety mapping tools, allowing users to mark unsafe areas and accessibility barriers for urban planners to address.
- Implement smart infrastructure solutions, including sensor-based pedestrian crossings, wayfinding aids for elderly users, and interactive urban mobility systems.

7.4. Community-Based Approaches

- Encourage participatory planning through safety audits, public consultations, and stakeholder engagement sessions focused on mobility challenges.
- Establish citizen-driven feedback loops, enabling residents to report urban mobility concerns and propose location-specific improvements.
- Promote awareness campaigns and behavioral interventions, educating the public on inclusive mobility practices and accessibility rights.

7.5. Creation of the Pink Map as a Visualization Tool for Inclusive Mobility

7.5.1. Concept of the Pink Map

The Pink Map is a proposed urban mobility visualization tool that identifies gender- and age-inclusive spaces within cities. By mapping key mobility parameters and real-time user feedback, it serves as a decision-making aid for policymakers and a resource for citizens to navigate cities safely and efficiently.

7.5.2. Functions of the Pink Map

- Geospatial Representation of Safe and Accessible Routes: Highlights streets, transit hubs, and public spaces designed with gender- and age-inclusive principles.
- Decision-Making Tool for Policymakers: Assists urban planners in prioritizing interventions based on mobility data and community feedback.
- Citizen Feedback Mechanism: Provides an interactive platform for residents to report mobility barriers, unsafe areas, and accessibility challenges, facilitating continuous improvements.

7.5.3. Implementation Strategy

- Data Collection: Leverage GIS mapping, mobility surveys, and community-generated data to populate the map with real-world accessibility indicators.
- Public Participation: Engage citizens in mapping exercises, encouraging them to contribute real-time insights on urban mobility challenges.
- Policy Integration: Ensure the Pink Map is incorporated into urban transport planning, infrastructure development, and safety audits for effective long-term impact.

By positioning the Pink Map as both a research-driven tool and an urban planning resource, cities can make evidence-based decisions that foster safer, more inclusive mobility for all.

8. Conclusion

Inclusive mobility is fundamental to creating equitable and accessible cities. However, urban environments often fail to address the diverse mobility needs of women, the elderly, and other vulnerable groups. This study highlights the importance of gender- and age-responsive urban design, emphasizing the role of barrier-free infrastructure, safety measures, and participatory planning in fostering inclusive mobility.

Key findings reveal that women face safety concerns, trip-chaining constraints, and limited access to secure public transport, while elderly populations struggle with physical inaccessibility, digital exclusion, and poor pedestrian infrastructure. Addressing these challenges requires a multi-scalar approach integrating policy measures, urban design interventions, technological solutions, and community engagement.

A key contribution of this research is the proposal of the Pink Map, a data-driven urban mobility tool that maps safe and accessible spaces while serving as both a decision-making aid for policymakers and a real-time feedback mechanism for citizens. By leveraging GIS technology, participatory mapping, and policy integration, the Pink Map can help cities identify critical gaps and implement effective urban design solutions.

Moving forward, the adoption of gender-sensitive transport planning, universal accessibility standards, and digital innovation will be crucial in shaping inclusive, safe, and equitable urban mobility systems. Through holistic planning, interdisciplinary collaboration, and continuous public engagement, cities can ensure that mobility is a right, not a privilege, for all individuals, regardless of gender or age.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. There is no conflict of interest in any manner which shall withholds this submission.

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