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Public transport systems and safety of female commuters in low-and-middle-income countries: a systematic scoping review

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Abstract

Background This scoping review systematically maps and summarises research evidence concerning the safety of female commuters in public transport systems across Low- and Middle-Income Countries (LMICs). Given the essential role of public transport in LMICs, particularly for women in both formal and informal sectors, understanding the safety challenges they face is crucial.

Methods We followed the Arksey and O'Malley methodological framework to structure this scoping review. The Population (Females), Concept (safety in public transport/transit), and Context (LMICs) framework guided our eligibility criteria. We searched for original research articles in PubMed, EBSCOhost (CINAHL, PsycInfo, and Health Source: Nursing/Academic Edition), SCOPUS, and Web of Science published between 2012 and 2023, and updated in February 2025. We additionally searched Google Scholar platform, and the reference list of included studies to uncover any additional relevant literature. The study selection and data extraction were performed by two reviewers using pilot-tested forms. Thematic analysis was used to organise the data into themes and a narrative summary of the findings is presented.

Results Of the total 114 articles obtained from the database searches, 26 studies published in 14 countries met the inclusion criteria. The review identified a paucity of research in this area, with an average of three relevant papers published per year. The existing literature is geographically imbalanced, with a predominant focus on South Africa, India, and Malaysia, leaving many LMICs underrepresented. Most (11 out of 26) studies employed quantitative methods, leaving a need for more diverse research methodologies. Widespread concerns, fear of assault and harassment among women commuters across various countries; underreporting of sexual harassment, prevalence of violence against women in public transport systems with its psychological, economic, health, and social consequences; and transit sexual assault were among the themes identified.

Conclusion This scoping review reveals the urgent need for further research on the safety of female commuters in LMICs, especially in underrepresented countries, to provide a more comprehensive understanding of the challenges faced by women in diverse contexts. It advocates for diversified research methods, public awareness campaigns,

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improved reporting mechanisms, policy reforms, infrastructure enhancements, and culturally sensitive initiatives to ensure the safety and well-being of female commuters in public transport systems across LMICs.

Background

Public transport systems play a pivotal role in facilitating access to essential services, employment, and social activities for urban populations worldwide, particularly in low- and middle-income countries (LMICs) where these systems are often the primary means of transportation for women in both formal and informal sectors [1, 2]. Despite its significance, the safety of women commuters which encompasses a wide range of issues, including but not limited to, sexual harassment (e.g., inappropriate sexual comments or jokes, unwelcome sexual advances or propositions, sending or displaying sexually explicit materials, and unwanted touching or groping with a sexual intent); and physical harassment or violence (e.g., hitting, pushing, shoving, unwanted touching or grabbing), and severe forms of sexual violence such as sexual assault or rape [3–5] has emerged as a critical concern. For instance, the notion of the “last kilometre home” which refers to the final stage of a woman’s journey typically from a public transport stop to her home, which is often the most dangerous [6]. Research has highlighted how the design and management of public transport, coupled with the surrounding urban environment, fail to account for these risks, leaving female commuters vulnerable to various forms of harassment and violence [7–9].

A global analysis on public transport, reveals alarming rates of harassment and violence faced by women in transit [6, 10]. In particular, several LMICs report significantly higher levels of these incidents, with cities like São Paulo, Lagos, and Mexico City showing especially high prevalence [6, 10]. In South Africa, a study found that nearly 65% of women reported feeling unsafe while using public transport [11]. India also faces high rates of harassment in public transit, where public sexual harassment (often termed “eve teasing”) is rampant [12].

One widely debated intervention is women-only transport options, which have been introduced in several countries as a response to gender-based violence. Feminist advocacy groups have actively campaigned for these services, particularly in light of highly publicised cases of femicide and assault on public transport in countries like Mexico [13]. Women-only carriages and dedicated ride services have increased awareness and provided safer travel alternatives [14]. However, such interventions have received critiques, including concerns that they do not address the root causes of harassment, reinforce gender segregation, and inadvertently shift responsibility for safety away from transport authorities and onto women [14]. Furthermore, these solutions often exclude gender-diverse individuals, whose safety concerns are

equally pressing but less frequently addressed in policy discussions.

Travel safety is generally defined as a state of users feeling safe on a transport and terminal or bus stop without fear of injury or harassment [15, 16]. Safety concerns not only impact the daily lives and mobility choices of women but also have broader societal implications, including restricting their access to education, employment, and healthcare [6, 17]. As a result, women and gender-diverse individuals employ several strategies to protect themselves [18]. These strategies often involves modifying their behaviour to minimise attention or avoid high-risk situations, strategies that reflect both the systemic nature of transit insecurity and the limitations of current interventions [18]. Addressing these safety challenges women and gender-diverse individuals faced is vital not only for ensuring gender equity but also for promoting inclusive urban development [6, 17].

Despite the critical importance of these issues, research on female commuters’ safety in LMICs is still limited, geographically skewed, and methodologically narrow, underscoring the urgent need for comprehensive, context-sensitive studies [6]. A scoping review offers an effective approach to map and describe the research evidence on this topic [19, 20], providing valuable insights into the challenges, factors, and potential interventions related to female’s safety in public transport systems. This scoping review, therefore, aims to fill this critical knowledge gap by systematically examining and summarising existing research on the safety of female commuters in public transport systems across LMICs. By employing a scoping review methodology, we explore the breadth and depth of available literature, identify key themes, and map out the geographic distribution of research efforts. This approach will enable us to provide a comprehensive overview of the existing evidence, identify research gaps, and offer recommendations for future research and policy interventions.

The findings of this scoping review hold the potential to inform policymakers, urban planners, transportation authorities, and advocacy groups about the specific challenges faced by women and gender-diverse individuals’ commuters in LMICs. Furthermore, it will contribute to the development of gender-sensitive policies and interventions that prioritise the safety and well-being of women within public transport systems, ultimately fostering more inclusive and equitable urban environments.

Methods

To fulfil the aim of this systematic scoping review, we employed the methodological framework developed by Arksey and O'Malley [21] as a guiding framework for mapping and exploring the literature relating to the safety of women commuters in public transport systems in LMICs. This Arksey and O'Malley framework encompasses several pivotal stages, which involve identifying the research question, identifying pertinent studies, selecting studies for inclusion, charting and collating data, and ultimately summarising and reporting the findings [19, 20].

Identifying the research question

This scoping review study question is as follows: What research evidence linked to public transport systems and safety of female commuters in LMICs over the past decade does exist? To ascertain the suitability of this scoping review question, we incorporated the Population, Concept, and Context (PCC) framework [22] into the criteria for study eligibility, outlined in Table 1. The exclusion criteria in this scoping review ensured a focused analysis on the safety of female commuters in public transport systems within LMICs. This study planned to exclude male commuters to maintain the focus on gender-specific challenges faced by females, while HICs are excluded to address the unique infrastructural and socio-economic issues in LMICs. This study also planned to exclude secondary sources like other review studies to prioritise original research, and non-peer-reviewed materials are excluded to ensure the reliability and credibility of the findings. Overall, this approach ensured that the review provides relevant, high-quality insights specific to the target population and context.

Literature searches

The objective of our literature search was to identify relevant peer-reviewed articles addressing the research questions outlined in this scoping review. To accomplish this, a thorough exploration was conducted across various electronic databases, including PubMed, EBSCOhost (comprising CINAHL, PsycInfo, and Health Source: Nursing/Academic Edition), SCOPUS, and Web of Science. This search encompassed original articles published between January 2012 and October 2023, and updated in January 2025. Additionally, a search on the Google Scholar platform was performed to uncover any additional relevant literature. For the database searches, a collaborative effort with an information scientist was undertaken to construct an effective search strategy. This search strategy ensured the inclusion of essential keywords such as “female”, “women”, “girl”, “public transport”, “taxi”, “minibus” “bus” and “safety”. Boolean operators (AND/OR) and Medical Subject Heading (MeSH) terms were employed to refine the search query (Supplementary file 1). Syntax adjustments were made to align with the specific requirements of each database. In addition to electronic searches, a manual review of the reference lists of included sources was conducted to identify any additional pertinent literature. During this phase, no search filters based on language or publication type were applied; however, the search results were restricted to publications from 2012 to 2023. Language limitations was removed because the authors planned to employ “Google Translate” to translate non-English publications if any. The transportation systems and social dynamics in LMICs are rapidly evolving. To ensure that the findings and recommendations are relevant and applicable to current contexts, the review includes only publications from the past 10 years. Older studies may not accurately reflect

Table 1 Study eligibility criteria

Eligibility criteria	Inclusion criteria	Exclusion criteria
Population	Female commuters (including gender-diverse individuals who identify as female or woman) of all ages.	Male commuters
Concept	Safety in public transport systems: a state of users feeling safe on a public transport/transit and terminal or bus stop without fear or injury or harassment. So, studies reporting any of these: inappropriate sexual comments or jokes, unwelcome sexual advances or propositions, sending or displaying sexually explicit materials, and unwanted touching or groping with a sexual intent, hitting, pushing, shoving, unwanted touching or grabbing were included	
Context	Low-and-middle-income countries as defined by the World Bank in 2023.	High-income countries
Study designs	Quantitative (observational studies), qualitative and mixed-methods study designs	Review studies such as literature review, rapid review, and expert review
Publication type	Peer reviewed papers	Abstracts only, conference documents, editorials, non-peer-reviewed publication such as reports, theses and dissertations
Language	All publication languages	
Time frame	Publications within 10 years (between 2012 and 2023)	

the current safety conditions or the latest interventions and policies, making them less useful for informing contemporary practices and improvements in public transport safety for female commuters. All search results were imported into an EndNote Library X20 to facilitate efficient citation management.

Articles selection process

A study selection tool was developed using Google Forms based on the items outlined in the inclusion criteria (Table 1) and was subsequently pilot tested with fifty (50) articles by two authors (DK and MK), and the needed amendments made based on the feedback obtained. The EndNote library was then examined for duplicates using the “Find Duplicate” function prior to the actual articles screening. Two authors (DK and MK) independently utilised the study screening tool to categorise titles and abstracts into two groups: “include” and “exclude.” Any discrepancies in their responses during this phase were resolved through discussion and consensus. The full-text articles of all titles and abstracts that met the inclusion criteria during the initial screening phase were obtained from using the Durban University of Technology Library Services, and independently screened by DK and MK following the eligibility criteria as a guide. In cases where there was a lack of consensus between DK and MK, a third author (GM) was consulted to resolve any discrepancies. The PRISMA flow diagram was utilised to document the article selection process, ensuring transparency and accountability.

Quality appraisal

The Mixed Method Quality Appraisal Tool (MMAT) Version 2018 [23] was utilised to assess the methodological quality and potential risk of bias in the included studies. This tool was employed to evaluate the appropriateness of the study's objective, the suitability of the study design, participant recruitment methods, data collection procedures, data analysis techniques, and the presentation of results/findings. To determine the quality of the studies, a quality score based on established criteria was applied, where a score of 50% indicated low quality, 51–75% indicated average quality, and 76–100% indicated high quality. This rigorous assessment is crucial for identifying any research gaps. Two authors (DK and GM) independently conducted the quality appraisal, and any disagreements were resolved by involving a third author (JDP).

Data charting

Data extraction was conducted using a spreadsheet, which underwent a pilot test with 15% (3 studies) of the included evidence sources to ensure its efficacy in capturing all relevant data for addressing the review question. Feedback from the pilot test was carefully considered,

and necessary adjustments were made to the form. Upon a comprehensive examination of the full texts, two independent reviewers (DK and GM) extracted all relevant data from the included studies. The data extraction process employed a hybrid approach, incorporating both inductive and deductive reasoning [24]. The process involved a thorough analysis of the extracted information to identify patterns, themes, and trends in the existing research evidence linked to safety of women commuters on public transport systems in LMICs. Key study characteristics, including author(s), publication year, study title, aim/objective, geographical location (country), study design and study population, and the relevant study findings were extracted.

Collating, summarising, and reporting the results

The results of the data extraction were collated and summarised in a narrative format. Descriptive analysis and narrative synthesis were utilised to present the findings in a comprehensive manner. The study outcomes included a comprehensive overview of the scope of research evidence on safety of women commuters on public transport systems in LMICs. This study was reported in keeping with the Preferred Reporting Items for Systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR) checklist [25].

Results

Study selection

A total of 114 potentially eligible articles across databases were screened and after excluding duplicates and those that did not meet this study's eligibility criteria after full text-article screening, included 26 studies for data extraction and analysis (Fig. 1).

Characteristics and quality appraisal of the included studies

Out of the 26 studies included in this study's analysis, the highest representation ($n=6$ studies, 19%) was from South Africa, followed closely by India and Malaysia, each contributing 4 studies (15%). Several ($n=12$ studies, 46%) additional studies were drawn from 11 other LMICs (Fig. 2). In terms of publication years, the majority of the included studies were published in 2020 and 2022, each accounting for 5 studies (19%) (Fig. 3). Regarding the study designs, cross-sectional studies were the most ($n=9$ studies, 35%) prevalent. Moreover, a substantial portion (17 studies, 65%) involved female participants in general, while the type of public transport was unspecified in most studies (12 studies, 46%). The mean quality score for the 26 included studies was calculated at $85\% \pm 15$ (Table 2).

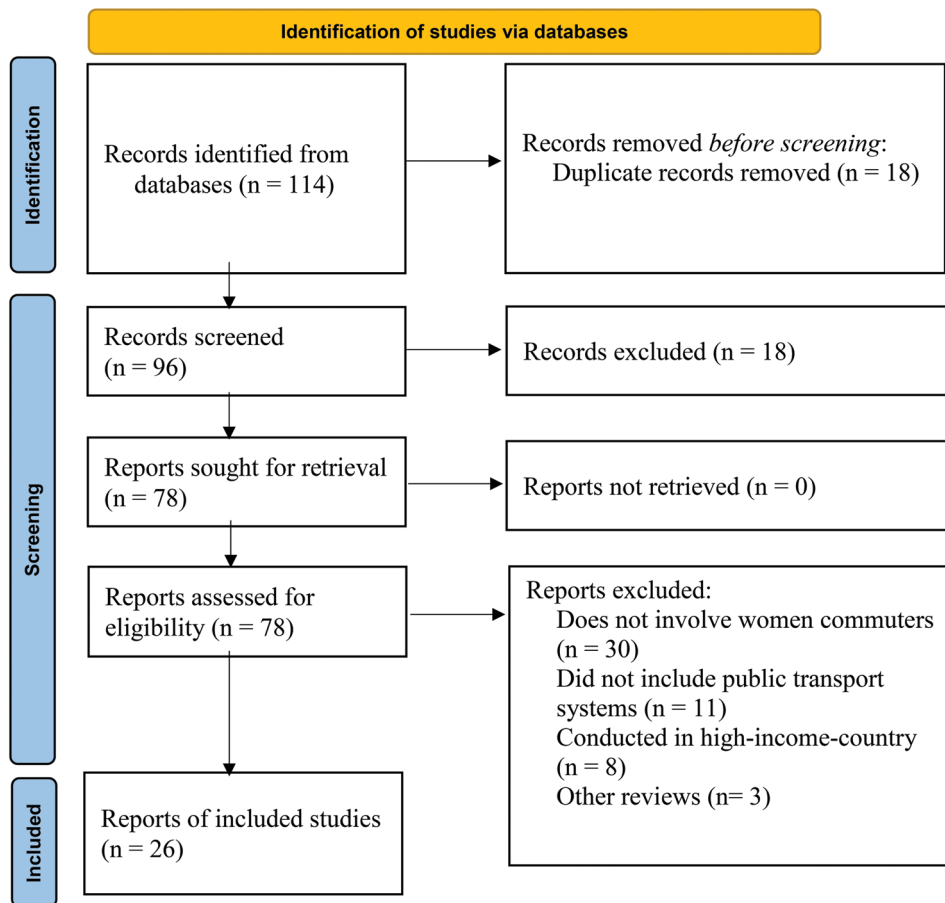


Fig. 1 PRISMA 2020 flow diagram

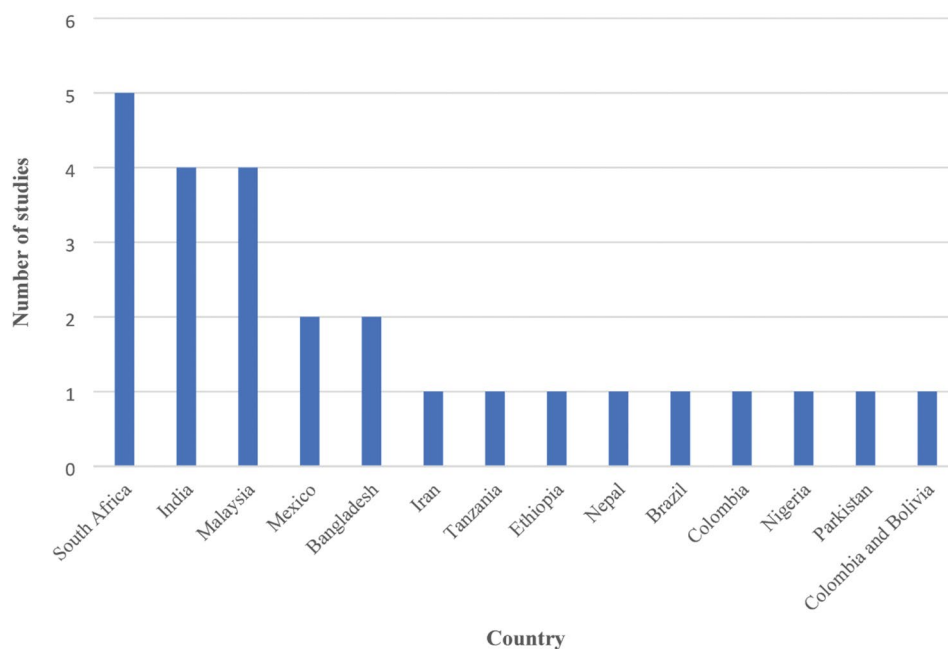


Fig. 2 Distribution of the included studies per country

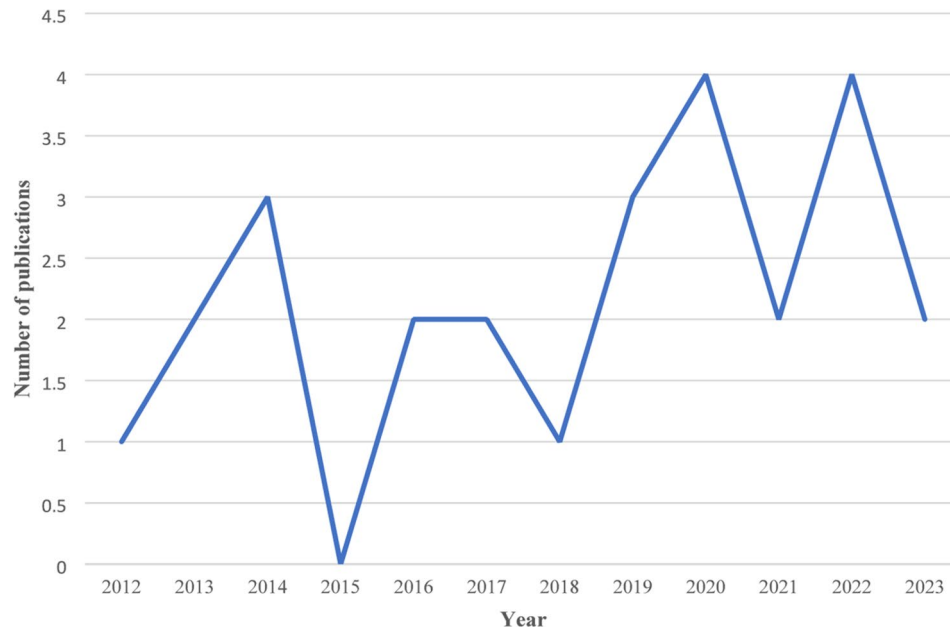


Fig. 3 A line chart displaying the trend of publications over the time (from 2013–2023)

Table 2 Characteristics and quality appraisal of the included studies ($N = 26$)

Characteristics	<i>n</i> (%)
Study design	
Cross-sectional study (Observational)	9 (34.6)
Mixed-Methods Study	8 (30.8)
Qualitative study	7 (27.0)
Case study	1 (3.8)
Comparative study	1 (3.8)
Study population category	
Passengers/commuters (unspecified)	17 (65.5)
University student	3 (11.6)
Minibus taxi drivers	2 (7.7)
Students and working women	1 (3.8)
Victims of sexual assault and users	1 (3.8)
Female riders of public transportation	1 (3.8)
Adult users	1 (3.8)
Type of transport system/study setting	
Public transport (unspecified)	12 (46.2)
Minibus taxi	4 (15.4)
Bus	3 (11.6)
Multiple (bus, three-wheeler, local train and rickshaw)	2 (7.7)
BRT	2 (7.7)
Shared taxis	1 (3.8)
Women-Only Coach	1 (3.8)
Transit Environments (bus and trains)	1 (3.8)
Quality appraisal score	
≤75%	10 (38.5)
≥75%	16 (61.5)

Findings from the included studies

Table 3 presents summaries of the relevant results/findings of the included studies. The analysis of these results/findings from the included studies yielded eight [8] themes as presented below.

Safety concerns, fear of assault and harassment

Across various LMICs, studies consistently reveal that safety concerns, particularly the fear of assault and harassment, significantly influence the use of public transportation, especially among women. For instance, in South Africa, anxiety about personal safety (including the security of belongings) during public transport commutes was highlighted as a major concern, impacting the work performance of groups disproportionately targeted, including women [11]. Similarly, research in Malaysia showed that women were more likely to be apprehensive about their safety while using public transportation for daily commuting [26]. These concerns are echoed in India, where fear of assault and harassment was frequently cited by women commuters, influencing their travel choices and prompting them to seek safer alternatives [27].

Furthermore, a global study found that cities in Latin America and Africa reported higher rates of harassment and victimisation in public transport, reinforcing the vulnerability faced by women in these regions [6]. In Mexico, the demand for women-only transportation services reflects growing public concern over violence and harassment, underscoring the need for gender-sensitive transport solutions [13]. The issue of public sexual harassment is further compounded by inadequate legal protections in

Table 3 Summaries of findings from the included studies

Author(s)	Objective/aim	Significant findings
Suman et al. 2019 [27]	To compare the existing bus services of Delhi and Mumbai, and identify feasible strategies to improve the bus system in Delhi	<ol style="list-style-type: none"> 1. Women commuters frequently expressed fear of assault and harassment as significant concerns when using public transportation. 2. The fear strongly influenced women's travel choices, leading many to seek safer alternatives. 3. Safety concerns had a significant impact on women's mobility, influencing their choice of transportation modes and travel patterns.
Firoozi Yeganeh et al. 2022 [39]	To explore the factors and motivations affecting women's shared mobility choices, specifically, shared taxis, in a less developed country with specific socio-cultural structures in Iran	<ol style="list-style-type: none"> 1. Women faced direct and indirect restrictions from family and society when it came to their mobility choices. 2. Gender social norms and family expectations, particularly prevalent in traditional and developing societies, often posed challenges to women's everyday mobility. 3. Individual values, beliefs, and personality traits were identified as important factors influencing women's travel behaviour and perception of safety.
Dunckel-Graglia, 2013 [13]	To examine, analyze, and evaluate women-only transportation, focusing on the roles of culture and public opinion (Mexico)	<ol style="list-style-type: none"> 1. Concerns about violence and harassment led to an increased demand for women-only transportation services. 2. Local feminist groups advocated for these services as a means of addressing gender discrimination in public transit
Kash, 2019 [29]	To document the prevalence and effects of transit sexual assault in two Latin American transit systems: Bogotá, Colombia's TransMilenio BRT and informal transit in El Alto, Bolivia	<ol style="list-style-type: none"> 1. Sexual assault was found to be a common problem in public transit systems, with variations in prevalence between different cities. 2. Victims of transit sexual assault often engaged in defensive behaviours such as avoiding travel at certain times, traveling in groups, or selecting defensible positions within carriages. 3. Various initiatives were suggested to enhance safety in public transportation, including crowd reduction, improved reporting mechanisms, bystander intervention, and women-only carriages. 4. Some victims experienced trauma and anxiety as a result of their experiences, which could have long-lasting effects on their freedom of movement.
Soto et al. 2022 [4]	To describe the relationships among sociodemographic features, travel situations, system-design features, and the Fear of Crime at three different locations (buses, bus stops, and stations) of the BRT system of Barranquilla (Colombia)	<ol style="list-style-type: none"> 1. Fear of crime, particularly inside the bus, had a significant negative effect on women's utility and sense of security. 2. Gender (being a female user) was a strong predictor of fear of crime in public transportation.
Mowri et al. 2023 [40]	To examine the lived experiences of 30 female bus commuters in Dhaka	<ol style="list-style-type: none"> 1. Women's agency to act and respond to harassment in public transport was contingent on multi-scalar assemblages comprising socio-technical infrastructures, lifestyles, cultural histories, personal dispositions and situated knowledge.
Hoor-Ul-Ain, 2020 [12]	To expose the perils of public sexual harassment; women encounter on public transport in the megacities–Karachi & London	<ol style="list-style-type: none"> 1. Legal protection and policies for women's safety varied between countries, with some lacking comprehensive safeguards. 2. The prevalence of sexual harassment was found to vary based on cultural, legal, geographical, and economic factors in different contexts.
Jain et al. 2014 [43]	To derive priorities for different criteria for shifting urban commuters to the public transport system based on their opinion (India)	<ol style="list-style-type: none"> 1. Safety was found to be the most important criteria and then reliability, cost and comfort. 2. Installation of surveillance systems (CCTVs) and the establishment of efficient help lines were recommended to ensure passenger safety. 3. Infrastructure improvements, such as well-lit and monitored stations, were seen as essential to preventing harassment.
Sham et al. 2013 [2]	To examine critically the real factors that contribute to travelling safety issues for women while travelling on public transport in Penang Island (Malaysia)	<ol style="list-style-type: none"> 1. Most women feel insecure when the bus is not punctual, service quality is low, and when less information provided regards to the bus service. 2. Least factors that contributed to women fears were infrastructure and comfort.
Bachok et al. 2014 [35]	To assess the commuters' perceptions towards Women-Only Coach services by the KTM Komuter (Malaysia)	<ol style="list-style-type: none"> 1. A significant number of respondents claimed that there was an absence of security personnel at Women- Only Coach to monitor the safety of the coach. 2. More than 50% of these respondents also felt insecure in the presence of male passengers on-board women-only coach.
Meshram et al. 2020 [36]	To examine the safety and comfort perceptions during ridesharing among women residing in India.	<ol style="list-style-type: none"> 1. Young women and unemployed women express lower trust in shared transportation facilities due to fears of victimization, especially when traveling with unknown males or during nighttime

Table 3 (continued)

Author(s)	Objective/aim	Significant findings
Niboye, 2023 [31]	To establish factors that influence violence against women in public transport spaces in Dar es Salaam City (Tanzania)	<ol style="list-style-type: none"> 1. Women often experience various forms of violence, including physical violence, verbal assault, and sexual assault, while using public transport. 2. The study identified cultural, legal, geographical, and economic factors as influences on violence against women in public transport spaces, with resulting psychological, economic, health, and social effects. 3. Initiatives to address violence against women in public transport encompass legal, behavioral, and infrastructure measures. 4. The establishment of necessary legal and policy frameworks, along with conducive physical infrastructure at bus stations and inside public buses, is recommended to prevent violence against women.
Nayak et al. 2017 [38]	To observe the victimization of women commuters in public transports in Malviya Nagar New Delhi, India	<ol style="list-style-type: none"> 1. Many (64%) women reported feeling unsafe while using public transport, particularly in situations of overcrowding or during the night.
Gobind, 2018 [44]	To examine whether the anxiety associated with public transport results in poor work performance (South Africa).	<ol style="list-style-type: none"> 1. Vulnerable groups, particularly women, express concerns about their safety and the security of their belongings when using public transport apart from the expected pushing and shoving.
Borhan et al. 2019 [26]	To investigate the constraints that limit the use of public bus by people commuting to work in Putrajaya, Malaysia	<ol style="list-style-type: none"> 1. Female respondents, in particular, are more concerned about their safety while using public transport.
Azizan et al. 2016 [45]	To identify the factor influencing the crime occurrence in KTM Komuter station, investigating the facilities and commuters' perception at the station while bringing into new perspective in enhancing the element or features of the facilities (Malaysia).	<ol style="list-style-type: none"> 1. Closed-Circuit Television (CCTV) systems, passengers traveling alone, and the presence of inadequate security personnel at stations were identified as significant contributors to higher crime rates among women passengers
Kebede, 2020 [46]	To assess the women's and girls' safety and security in public transport services and to identify factors that contribute to violence against women and girls (Ethiopia).	<ol style="list-style-type: none"> 1. The major finding of the study shows that about 51% of women and girls have experienced at least one type of violence while using public transport. 2. Gender-sensitive public transport service plans and policies are essential to meet the specific needs of women and girls in transportation systems
Ceccato et al. 2022 [6]	To assess the variation of these students' safety perceptions, examining how they differ because of their individual characteristics, transit mode, and city-country contexts (multi-country including Nigeria).	<ol style="list-style-type: none"> 1. The prevalence of sexual harassment and violence across different cities and regions, with Latin American and African cities reporting higher levels of victimization 2. Cultural norms and societal contexts played a significant role in shaping the experiences of women in public transit. 3. Students from city samples characterized by higher levels of sexual harassment, such as Mexico City, Sao Paulo, or Lagos, also reported, <i>ceteris paribus</i>, feeling less safe. 4. Overall women respondents reported feeling always or often safe more at the train station or bus stop than on the way walking to/from them.
Martin et al. 2022 [33]	To explore how women who use minibus taxis as part of their everyday commuting experience the threat of sexual violence within these spaces (South Africa).	<ol style="list-style-type: none"> 1. The study revealed the ways in which women articulated the threat of sexual violence in minibus taxis was co-produced through shifting taxi↔commuters↔bodies assemblages which not only informed how the threat of sexual violence was experienced, but, also, how their own bodies, men's bodies, and everyday commuting were negotiated.
Yasir et al. 2022 [46]	To understand the perception of different demographic cohorts on women's mobility, public transportation experience, and desirable safety precautions (Bangladesh).	<ol style="list-style-type: none"> 1. The study suggested that women in smaller towns may be more susceptible to harassment, possibly due to underreporting of incidents compared to larger cities. 2. Recommendations include providing female-only rides, especially at night, and planning business activities around transit stops to improve safety and reduce harassment risks for women
Dunckel, 2016 [14]	To investigate how women pursue mobility despite hostile and violent conditions that immobilise them (Mexico).	<ol style="list-style-type: none"> 1. Gender-based violence in Mexico City's public transportation limited women's mobility and reinforces gender inequality. 2. Women-only transportation was identified as a catalyst for challenging traditional gender norms and promoting women's rights in some cities. 3. Women-only provided a platform for women to assert their right to safe urban mobility.

Table 3 (continued)

Author(s)	Objective/aim	Significant findings
Ceccato et al. 2017 [10]	To investigate all types of crimes, but devotes special attention to the nature and spatio-temporal dynamics of sexual crimes against women while in transit (Brazil)	1. Sexual violence tends to be concentrated at busy central stations, with a higher likelihood of occurrences during morning and afternoon rush hours.
Neupane et al. 2014 [7]	To explore sexual harassment and assault in public transport in Kathmandu, Nepal	1. The study found that sexual harassment and sexual assault are ubiquitous on public transport with younger women particular targets of this assault. 2. Underreporting of sexual harassment and assaults (irrespective of the seriousness of some of these assaults and comments), with victims often reluctant to file complaints with authorities (bus companies or the police).
Mchunu et al. 2020 [41]	To explore condom use and condom negotiation strategies among taxi drivers and taxi queens in Kwa- Zulu-Natal	1. The study revealed that condom use and negotiation are sources of conflict for women participating in taxi driver-passenger relationships. 2. Strategies employed by participants to ensure condom usage were found to be inconsistent and potentially problematic due to various complex factors.
Eagle and Kwele, 2021 [32]	What is the psychological impact of this exposure? What coping mechanisms are employed to manage in this environment? (South Africa).	1. Interviewees commonly reported exposure to various forms of violence during minibus taxi commuting, including accident risk, dangerous driving, assault, aggression between drivers, street crime, sexual harassment, and violation. 2. The impact of these experiences resulted in anxiety, fear, "thought blocking," and resignation, consistent with continuous traumatic stress. 3. Coping mechanisms employed by women included both emotion-focused coping, such as prayer, and problem-focused coping, involving considered choices about their behavior within the commuting space.
Potgieter et al. 2012 [42]	To provide some preliminary findings on taxi drivers' attitudes and beliefs about taxi queens and their relationships with taxi drivers (South Africa)	1. Taxi drivers largely perceived their relationships with young women passengers (taxi queens) as mutually beneficial, providing status for both parties. 2. However, the study highlighted the stigmatization faced by young women who chose to ride with taxi drivers. 3. Taxi drivers demonstrated knowledge and awareness of the risks associated with unsafe sex and generally supported condom use.

some LMICs, as evidenced in India, where studies have shown that current safety policies fall short of addressing the challenges faced by women commuters [12].

Underreporting of harassment and trauma

Underreporting of harassment in public transportation remains a significant barrier to addressing the issue, with victims often reluctant to come forward due to fear, stigma, or a lack of confidence in authorities. Studies across different LMICs show that this underreporting not only conceals the true scale of harassment but also exacerbates its impact, particularly on women. In Nepal, for instance, a study highlighted that victims of sexual harassment and assault in public transport rarely report incidents to authorities, driven by fear of retaliation or societal judgment [7]. This pattern of underreporting contributes to continued harassment, as perpetrators remain unpunished.

Furthermore, the psychological toll of unreported incidents is evident, with victims often experiencing trauma and anxiety that can restrict their freedom of movement. A study covering Colombia and Bolivia found that sexual assault victims frequently reported feelings of trauma, leading to long-term anxiety that affected their ability to travel freely [28]. Similarly, research in Bangladesh suggested that women in smaller towns might be more vulnerable to harassment, not necessarily because the

incidents are more frequent, but because underreporting is more prevalent in these areas compared to larger cities [29]. This suggests a complex relationship between underreporting and women's overall mobility in different demographic settings.

Violence against women commuters in public transport systems

Violence against women in public transport systems is a pervasive issue, influenced by a range of cultural, legal, geographical, and economic factors. Studies across different LMICs underscore the various forms of violence—physical, verbal, and sexual—that women endure during their commutes. In Tanzania, research revealed that women in Dar es Salaam City frequently experience multiple forms of violence (including physical violence, verbal assault, and sexual assault) while using public transport, resulting in psychological, economic, health, and social consequences [30]. These findings align with evidence from South Africa, where women commuting via minibus taxis face polyvictimisation, encompassing dangerous driving, driver aggression, street crime, and sexual harassment [31]. This exposure to violence has profound psychological effects, including heightened anxiety, fear, and a sense of resignation or powerlessness [31].

What emerges from both settings (Tanzania and South Africa) is the heavy psychological burden on women commuters, which leads to emotional responses like fear and strategies to manage their environments. In South Africa, participants reported employing coping mechanisms such as “thought blocking,” where the constant threat of violence overwhelms their ability to think clearly, as well as emotion-focused coping, like prayer, and problem-focused coping, such as making careful decisions about their behaviour during commutes [31]. These findings highlight the broader emotional and mental health impacts of violence in public transportation systems, emphasising the urgent need for systemic interventions to address perpetration and create safer transit environments.

Transit sexual assault

Sexual assault in public transportation systems is a widespread issue, with patterns of occurrence and response strategies varying across regions. Studies consistently show that women face significant risks while using public transit, prompting them to adopt defensive strategies. For instance, research in Colombia and Bolivia documented the pervasive nature of transit sexual assault, revealing that many women avoid traveling at certain times or prefer to travel in groups as a means of self-protection [28]. Similarly, in Brazil, sexual violence was found to be concentrated in central transit hubs, particularly during rush hours, illustrating the spatial and temporal dynamics that increase women’s vulnerability [10].

Across different contexts, the prevalence of sexual harassment is shaped by cultural, legal, and economic factors. In India, for example, women in Karachi face significant public sexual harassment, reflecting how such incidents are influenced by societal norms and protections [12]. This trend is echoed in Nigeria, where a multi-continental study revealed that over 70% of female students in Lagos reported experiencing sexual harassment in transit, comparable to high-risk cities like Mexico City and São Paulo [6].

In South Africa, the complex perception of sexual violence within minibus taxis further illustrates how women’s responses to the threat of assault are influenced by their environment. The study found that interactions between the physical space of the taxi, the commuters, and the behaviour of drivers shaped women’s perceptions of safety and impacted their commuting experiences [32]. This dynamic interaction underscores the multifaceted nature of sexual assault in transit, where external factors continuously shape both the risk and women’s coping mechanisms [32].

Location-based fear of crime

Fear of crime in public transportation systems significantly affects the mobility and sense of security of female commuters. Research shows that women, in particular, experience heightened fear due to various sociodemographic and system-design factors. In Colombia, for instance, a study examining the Bus Rapid Transit (BRT) system found that women’s fear of crime, especially inside buses, had a pronounced negative impact on their overall transit experience and utility [33]. The study identified gender as a strong predictor of fear, with female users feeling more vulnerable to crime in public transport environments [33].

This finding aligns with broader patterns observed in public transit systems worldwide, where fear of crime is often exacerbated by the design and operation of transport systems, particularly in enclosed or crowded spaces. The fear of victimisation not only affects women’s daily commuting decisions but also highlights the need for gender-sensitive transportation planning to create safer and more secure environments for all commuters.

Factors influencing women’s safety

Women’s safety on public transportation is shaped by multiple factors that impact their sense of security during travel. Studies reveal that both the quality of transport services and the presence (or lack) of safety measures contribute significantly to women’s perceptions of safety. In Malaysia, research highlighted that factors such as punctuality, service quality, and the availability of information about bus services play a crucial role in determining women’s feelings of security while commuting [2]. Additionally, another Malaysian study focusing on women-only coach services found that the absence of security personnel, coupled with concerns about male passengers boarding these coaches, exacerbated women’s sense of insecurity [34].

This concern is echoed in India, where a study on ride-sharing revealed that young and unemployed women expressed lower levels of trust in shared transportation due to fears of victimisation [35]. Furthermore, the importance of surveillance systems, such as Closed-Circuit Television (CCTV), was underscored in another Malaysian study, which found that the presence of such systems significantly enhanced women’s feelings of safety [36]. Inadequate security personnel at stations and the vulnerability of passengers traveling alone, especially at night, were also identified as key contributors to the heightened risk of crime among women commuters [36].

Impact of safety concerns on mobility

Safety concerns have a profound impact on women’s mobility, shaping their transportation choices and travel behaviours across different contexts. In India, for

instance, safety concerns significantly influence women's preferences for transportation modes, often leading them to avoid buses during overcrowded or nighttime travel [27]. This sense of insecurity was reinforced by another study in India, which revealed that many women feel vulnerable while using public transportation, particularly in situations where overcrowding or poor lighting exacerbates their fears [37].

Similarly, in Iran, societal and familial influences play a major role in limiting women's mobility, especially in shared transportation settings like taxis. Gender-based social norms and family expectations, often deeply rooted in traditional and resource-limited contexts, restrict women's ability to move freely, affecting both their mode of transport and their perception of safety [38]. Individual factors, such as personal values, beliefs, and personality traits, further shape women's travel behaviour and responses to perceived threats [38].

In Bangladesh, research focusing on female bus commuters in Dhaka highlighted that women's ability to navigate harassment is closely linked to their personal dispositions and experiences. Women with greater knowledge and confidence were better equipped to handle these challenges, illustrating the complex relationship between safety concerns and women's mobility [39].

Conflict around condom use

Condom use and negotiation within transactional relationships (having personal or intimate relationships' or 'engaging in relationships) between taxi drivers and "taxi queens" in South Africa highlight complex power dynamics and vulnerabilities. These relationships, often involving young women (girls or teenagers) who receive gifts or favours (money, and/ or free rides) in exchange for companionship or sexual services, raise significant concerns about exploitation and health risks. Research reveals that condom use is frequently a source of conflict, with women often struggling to negotiate safer sex practices due to power imbalances [40]. One study showed that while strategies to ensure condom use exist, they are not always sustainable, as various social and economic factors complicate their consistent application [40].

Another study examining the attitudes of taxi drivers toward these relationships underscored the transactional nature of the connections, which confer a sense of status for both the women and the drivers [41]. However, this dynamic also leads to the stigmatisation of women involved, particularly younger women [41]. While many drivers expressed support for condom use and acknowledged the risks of unsafe sex, there remained a degree of uncertainty and confusion about the likelihood of HIV infection, reflecting gaps in understanding and consistent safe practices [41].

Table 4 An overview of various initiatives aimed at improving safety of women in public transportation, along with their descriptions and respective sources

Initiative	Description	Source
Preventing crowding	Strategies such as crowd reduction have been suggested as a means of improving safety for passengers	Kash, 2019[29]
Enhanced reporting	Improved reporting mechanisms are essential to facilitate the reporting of incidents and ensure that appropriate actions are taken	Kash, 2019[29]
Community involvement	Encouraging bystander intervention can create a safer environment by involving the community in addressing issues of harassment	Kash, 2019[29]
Specialised services	The concept of women-only carriages has been proposed as a way to provide a safe and comfortable space for women during their commute	Kash, 2019[29]
Surveillance and communication	Installing surveillance systems (CCTVs) and establishing efficient help lines have been recommended to enhance passenger safety and provide a means of seeking assistance when needed	Jain et al. 2014[43]
Multifaceted approach	Initiatives to address violence against women in public transport encompassing legal, behavioural, and infrastructure measures.	Niboye, 2023[31]
Legal and policy frameworks	Establishing necessary legal and policy frameworks, along with creating conducive physical infrastructure at bus stations and inside public buses, is recommended to prevent violence against women	Niboye, 2023[31]
Gender-sensitive plans	Gender-sensitive public transport service plans and policies are deemed essential to cater to the specific needs of women and girls in transportation systems	Kebede, 2020[46]
Infrastructure enhancements	Infrastructure improvements, such as well-lit and monitored stations, are seen as fundamental in preventing harassment and enhancing overall safety	Jain et al. 2014[43]
Promoting women's rights	Women-only transportation has emerged as a catalyst for challenging traditional gender norms and promoting women's rights in some cities	Dunckel, 2016[14]
Nighttime safety	Recommendations include providing female-only rides, especially at night, to ensure safer commuting experiences.	Yasir et al. 2022[30]
Feminist advocacy	Local feminist groups have actively advocated for women-only transportation services as a means of addressing gender discrimination in public transit	Dunckel-Graglia, 2013[13]

Initiatives and solutions

To improve the safety of women in public transportation, various initiatives have been proposed, ranging from practical infrastructure changes to policy reforms (Table 4). These efforts aim to address the safety concerns highlighted in multiple studies, showing a broad

recognition of the issue. A common theme across the studies is the importance of a multifaceted approach that combines legal, infrastructural, and social interventions.

Preventing overcrowding, for instance, has been suggested as a way to enhance passenger safety, especially for women, by reducing the conditions that often lead to harassment [28]. Enhanced reporting mechanisms are equally crucial, as streamlined processes for reporting incidents can ensure timely action and accountability [28]. Involving the community, particularly through bystander intervention programmes, is another strategy aimed at creating a safer environment for women by fostering collective responsibility [28].

Specialised services, such as women-only carriages or rides, have emerged as another critical initiative. These services provide women with a safer space during their commutes, addressing both the psychological and physical safety concerns of female passengers [28]. However, women-only carriages have faced critiques, including concerns that they do not address the root causes of harassment, reinforce gender segregation, and exclude gender-diverse individuals. Some scholars argue that these interventions place the responsibility for safety on women rather than addressing systemic issues related to perpetration and enforcement [14]. Surveillance systems, including CCTV installations and emergency help lines, have been recommended to further bolster security and provide immediate assistance in threatening situations [42]. However, CCTV has also faced significant critiques, particularly regarding its effectiveness in preventing harassment and its potential for misuse. Studies have shown that CCTV surveillance can lead to troubling racial profiling and discriminatory policing, disproportionately targeting racial minorities while failing to adequately address safety concerns for women [45]. This raises questions about the ethical and practical implications of surveillance-based safety interventions in public transportation.

A more comprehensive approach to addressing violence against women in public transportation includes a combination of legal frameworks, behaviour change programs, and infrastructure improvements. This multifaceted strategy seeks to ensure both preventive measures and adequate responses when incidents occur [30]. Legal and policy frameworks, particularly those that create safer physical environments in transit spaces like bus stations, are seen as crucial to fostering a safer public transport system for women [30]. Gender-sensitive transportation plans and policies further highlight the need to design services with women's specific needs in mind, ensuring safer and more inclusive transit experiences [45].

Infrastructure improvements, such as ensuring that stations are well-lit and monitored, are also vital in

preventing harassment and violence, as they create safer environments for women, especially at night [42]. Additionally, women-only transportation has emerged in some cities as a tool for challenging traditional gender norms and promoting women's rights, supported by feminist advocacy groups working to address gender discrimination in public transport [13, 14].

By integrating these various strategies—ranging from legal reforms and infrastructure enhancements to specialised services and community involvement—public transportation systems potentially can become safer and more supportive environments for women.

Discussion

This scoping review systematically mapped and summarised research evidence on the safety of female commuters in public transport systems across LMICs, revealing a limited number of published studies despite the high number of female commuters, particularly in informal sectors like minibus taxis. With an average of three papers per year on this topic, this output is inadequate, especially considering the widespread use of public transportation by women in LMICs. Notably, the research is geographically imbalanced, with most studies focusing on South Africa [31, 32, 40, 41, 43], India [12, 27, 35, 37, 42], and Malaysia [2, 26, 34, 36], while countries like Mexico [13, 14], Bangladesh [46], Iran [38], Nigeria [6], Tanzania [30], Ethiopia [45], Brazil [10], Nepal [7], Colombia [33], Pakistan [39], Bolivia [28], and others are underrepresented. The predominance of quantitative methods also highlights a gap in qualitative or mixed-methods approaches, which could provide more nuanced insights into women's experiences.

Nonetheless, this review identified widespread safety concerns, particularly fear of assault and harassment, as significant issues for female commuters across various countries [6, 12, 26, 27]. Studies consistently pointed to the underreporting of harassment, largely due to societal and systemic barriers that discourage women from coming forward [7]. The prevalence of violence against women in public transport systems and its profound psychological, economic, health, and social impacts was also evident [30]. Transit sexual assault emerged as a common issue, with women employing defensive strategies such as avoiding certain times or places when traveling [28]. Fear of crime in specific locations, such as inside buses or at busy stations, was another critical concern raised in multiple studies [33].

Factors influencing women's safety in public transport—such as the presence (or lack) of security measures, overcrowding, and infrastructure—were highlighted as key issues [34]. Additionally, studies have discussed the conflict around condom use in transactional relationships between women and taxi drivers, reflecting the

complexities and power dynamics involved [40]. Finally, various solutions proposed in the literature, including crowd management, improved reporting mechanisms, community involvement, gender-sensitive transport services, and enhanced surveillance, demonstrate a comprehensive approach to improving safety [13, 28–30, 42, 45]. However, there is a need to assess the effectiveness of these interventions in specific contexts before broader adaptation.

Implications for practice and research

The findings of this scoping review underscore the need for a more comprehensive understanding of women's safety in public transportation, particularly in LMICs. The limited number of studies and their geographic concentration indicate a significant research gap, as noted in previous research [12, 27, 30]. Future research should prioritise LMICs and regions that have been underexplored, such as parts of Africa, South America, Pacific, and Southeast Asia, to develop a more complete understanding of the challenges female commuters face.

Moreover, while the majority of studies employed quantitative methods, there is a need for greater methodological diversity. Qualitative and mixed-methods studies, which offer deeper insights into the experiences and perceptions of female commuters, are crucial for capturing the more nuanced aspects of their safety concerns. For example, the studies that used qualitative methods, like those from Iran [38] and Bangladesh [39], provided valuable perspectives on the socio-cultural factors shaping women's experiences. Expanding these approaches will enrich the overall understanding of the issue and help tailor interventions to the specific needs of women.

Public awareness campaigns and advocacy efforts, such as those observed in Mexico and South Africa [13, 14, 41], should be prioritised to address the pervasive concerns around fear of assault and harassment. These campaigns can play a critical role in mobilising communities and stakeholders to take action. Research has shown that community involvement, such as bystander intervention programmes [28], can significantly improve the safety of women in public transportation.

The underreporting of harassment and trauma among female commuters, identified in several studies [7], also demands attention. Initiatives to support victims and encourage reporting must be developed, tested for effectiveness and implemented [31, 32]. Law enforcement and transportation staff should receive training to handle harassment cases with sensitivity, as observed in efforts to create safer public spaces in India and Tanzania [27, 30].

The prevalence of violence against women in public transport highlights the need for strong policy reforms and legislation to protect female commuters. Research

from South Africa and Brazil has shown that legal frameworks and better enforcement mechanisms are critical to addressing this issue [10, 31]. Infrastructure enhancements, such as well-lit stations, surveillance systems, and women-only transportation services, are also essential, as demonstrated in studies from Malaysia and India [34, 42].

Lastly, the role of cultural, legal, and societal factors in shaping women's experiences of safety in public transport cannot be overlooked. For example, the research in Iran and South Africa [38, 41] shows how societal norms influence both the perception and reality of safety. Policies and interventions must therefore be culturally sensitive and inclusive, ensuring that they cater to the unique needs of women in different contexts. It is our opinion that researchers, policymakers, and practitioners should collaborate and engage in knowledge-sharing initiatives to address the complex issues related to women's safety in public transportation. Sharing best practices, research findings, and successful interventions can facilitate evidence-based policy and practice.

Strength and limitations

The strengths of this scoping review include adherence to the Arksey and O'Malley framework, the use of clear inclusion and exclusion criteria with the PCC framework, and a comprehensive search strategy that involved multiple databases and the collaboration of an information scientist. The involvement of two independent reviewers for article screening also ensured reliability, while the use of the MMAT for quality assessment added rigour to the process. Moreover, the review followed the PRISMA-ScR checklist to ensure transparency.

However, there are some limitations. The focus on peer-reviewed papers may have introduced publication bias, as studies with negative results or those published in non-peer-reviewed sources may have been excluded. Additionally, the search may have missed relevant studies from emerging or non-indexed journals. While the search string was inclusive of gender-specific terms, it could have been expanded to include keywords related to specific incidents, such as harassment, assault, theft, crime, and shared ride services for greater exhaustiveness. These limitations should be considered when interpreting the findings of this review. Nonetheless, this scoping review is novel in this field of study and provides essential evidence on the safety of female commuters in public transport systems in LMICs and identifies literature gaps for future research.

Conclusion

This scoping review reveals significant gaps in the literature on the safety of female commuters in LMICs. The limited number of studies, geographic imbalance, and dominance of quantitative methods highlight the

need for more diverse and inclusive research, particularly in underrepresented countries. Advocacy, public awareness campaigns, and support systems are urgently needed to address the concerns around fear of assault and harassment. The underreporting of harassment and trauma must be tackled through better support mechanisms and training for law enforcement. Policy reforms, infrastructure improvements, and cultural sensitivity are key to ensuring the safety of women during public transportation. Finally, collaboration among researchers, policymakers, and practitioners is essential to creating evidence-based policies and practices that address the complex issues surrounding women's safety in public transport.

Supplementary Information

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Supplementary Material 1: Supplementary file 1: Updated electronic literature searches

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GM, BN, SD, CI, and DK conceptualised the study. GM and DK curated the data and wrote the manuscript. All authors reviewed the manuscript and approved it.

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Competing interests

The authors declare no competing interests.

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