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Women's Safety in Urban Transportation Network in PMC Area: Perception, Challenges, and Policy Intervention

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Abstract: *The issue of woman safety in urban transit remains a critical problem and it has a direct impact on their mobility and socio-economic involvement, along with access to key opportunities. This study reviews the perceptions of women, experiences in commuting to the city and their safety in the urban transport system of the Patna Municipal Corporation (PMC). The study employed a combined research approach in which primary data were collected from a sample of one hundred female commuters across four representative wards through structured questionnaires, supported by GIS-based mapping of routes and major transport hotspots. The results highlights suggest that most women feel that the use of public transport is unsafe, which is explained by the fact that they consider it to be overcrowded, harassed, insufficiently lit, poorly surveilled, ineffective connectivity during the first and the last mile and inadequate patrol of the police. Chi-Square tests prove the presence of statistically significant interaction between the perception of safety and the type of transport and the access to women-only services. Regardless of the presence of the national and state-level programs, such as the Nirbhaya Fund, ERSS-112, Pink Buses and CCTV programs, they are not followed in practice consistently. Thus, the main purpose of the study is to assess women's perceptions regarding safety in the PMC urban transportation network, to identify key challenges and risk factors women face while commuting in the PMC Area, to evaluate the effectiveness of existing policy interventions aimed at promoting women's safety and to recommend policy measures and interventions for improving women's safety in the urban transportation system in the PMC Area based on findings.*

Keywords*: Women's safety, Urban transport, Patna Municipal Corporation (PMC), Public transport security, GIS mapping, Gender-sensitive mobility.*

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Introduction:

Women's safety in urban transportation is an important issue because it affects their mobility, independence and access to education, work and healthcare. Most of the women commute to the city to work, study and even do their day-to-day chores and most of them rely on buses, autos and other modes of transport. Nevertheless, the transport system remains not quite female-friendly and secure in some of the developing cities. This paper concentrates on the Patna Municipal Corporation (PMC) which is the location in which many women use the transport means daily. Some of the problems women are forced to deal with are harassments, overcrowding, poor lighting, lack of surveillance and poor facilities. Social pressures and fear limit their movement too. The

paper attempts to understand how these issues are being raised and ways in which they can be addressed to enhance the safety and accessibility of transport. Research that has been done in most countries shows that a large percentage of women are bullied verbally or physically, upon using the public transport. This is typical even in India and a high amount of such cases is not reported due to fear or social pressure. These experiences generate fear and compel women to avoid certain transportations, even when the latter is cheap and needed. In Patna, access to opportunities is directly influenced by safety issues on the part of women. Consequently, it is noteworthy that learning about the emotions of women and defining the key issues will help to make vehicles safer and develop a more accommodating system.

Literature Review:

Even research concerning safety in urban transport systems indicates that the mobility of women is impacted by male-oriented design, infrastructure and socio-cultural factors that make them vulnerable to risks on a daily basis. Findings from research carried out in India indicate that a lack of lighting, safety in accessing bus stops and inadequate last-mile connectivity are contributing factors to reduced perceptions of safety of women score, thus discouraging the use of public transportation after darkest hours (Meena, Solanki, & Suthar, 2024). Findings from research carried out in Chennai indicate that verbal, physical and psychological abuse occurs on a regular basis when accessing, traveling or waiting in remote areas (Govindaraj et al., 2024). General research in urban setting identifies how a male-oriented design of urban space hampers the safety of women while accessing transport infrastructure (Tiwari & Vyas, 2024). Findings from research in Kolkata indicate how degraded infrastructure, isolated streets, particularly at night, increase the perceived safety risks of women (Kerketta& Maiti, 2023).

Objectives:

The study is based on the following objectives.

1. To assess women's perceptions regarding safety in the PMC urban transportation network.
2. To identify key challenges and risk factors women face while commuting in the PMC Area.
3. To evaluate the effectiveness of existing policy interventions aimed at promoting women's safety.
4. To recommend policy measures and interventions for improving women's safety in the urban transportation system in the PMC Area.

Hypotheses:

The study is based on the following hypotheses.

1. Women in the PMC area perceive public transportation as less safe compared to private modes due to infrastructural and operational shortcomings.
2. Enhanced surveillance and women-specific services can significantly improve women's perception and experience of safety.

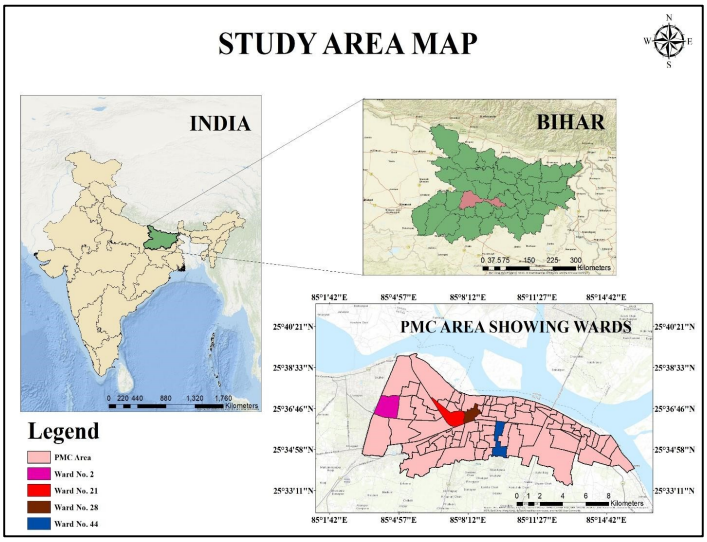
Methodology:

The methodology of this study involves conceptual and applied research techniques and the research work is done in three stages. The pre-field stage comprises a study of related literature, collection of study materials, data, maps and visiting libraries and reliable websites for background information. In the field survey stage, a structured questionnaire is prepared and a scheduled survey of 100 women commuters aged above 18 across different age groups in the Patna Municipal Area is conducted through a random sampling technique in order to collect primary data. In the post-field stage, secondary data is analyzed and primary data are compiled, tabulated and presented through graphical presentation methods. The hypotheses are tested with the Chi-Square method, and GIS mapping is done to ascertain the reported hotspots or unsafe areas. Finally, all findings are organized to prepare the research paper.

Study Area:

The capital of Bihar is the city of Patna which is one of the fastest-growing urban centres in eastern India. It is in the southern bank of the river Ganga, at 25°36′45.6372″N latitude and 85°9′31.500″E longitude and an important administrative and educational centre. It is located on the southern bank of the river Ganga, and it is an important administrative and educational centre. This research paper will target the Patna Municipal Corporation (PMC) area, which is the largest urban local government with civic governance.

The 2011 Census showed that PMC has a population of 1,684, 297 people with a total of 109.218 sq. km and 75 wards that are distributed into six administration circles. The study focuses on Wards 21 and 28 in New Capital Circle, Ward 02 in Patliputra Circle and Ward 44 in Kankarbagh Circle. The chosen wards are the representatives of various urban environments, which contribute to the creation of all-encompassing information on the safety and transportation issues of women in the PMC area.



Map 1. Study Area Map

Result and Discussions:

Demographic Composition : The study includes 35 percent of young respondents in the age group of 15–24 years and 30 percent in the age group of 25–34 years. The outcome is that students and early-career women have to travel frequently. However, middle-aged women are 20 percent, and those above 45 years are 15 percent; 50 percent of the respondents are graduates and 17 percent are postgraduates. This reflects considerable awareness regarding safety issues. Professionally, 36 percent of them are in the informal sector, 23 percent are students, 20 percent employed formally and 19 percent are homemakers. The income levels show that 53 percent of the population earn less than 10000. This demonstrates the fact that most women in PMC require safe and affordable means of transport.

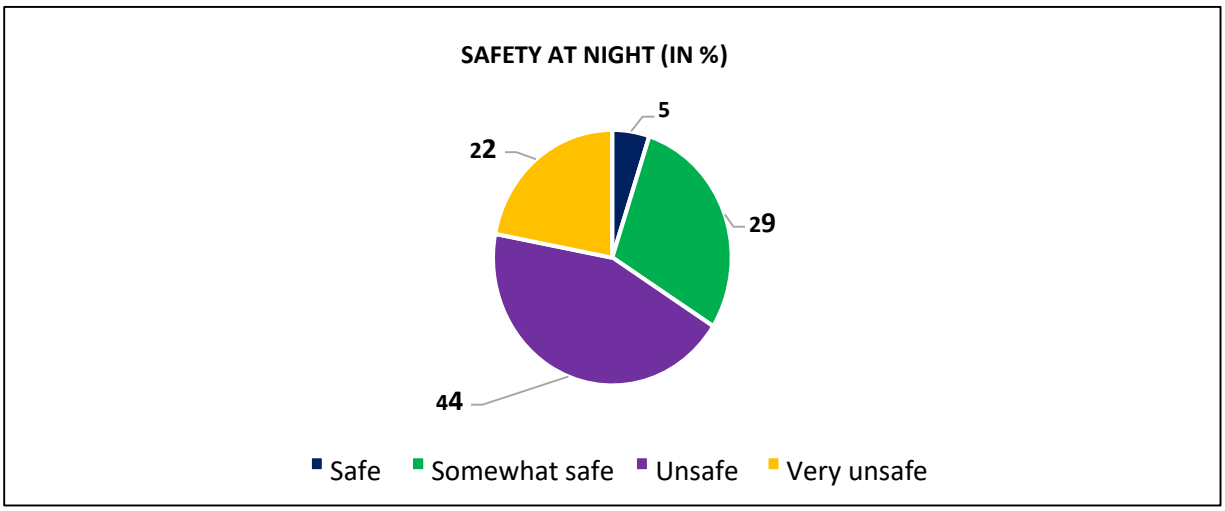
Women's Perception of Safety in PMC Transport system: Safety in urban transportation for women can make all the difference in their mobility, independence and access to education, work and other essential services. In the case of PMC, it is very relevant to understand how women view personal safety within the public transportation system. Their experiences can often highlight bigger issues related to infrastructure, monitoring, and overall service quality.

Table 1. Public Transport Safety

Public transport safety	No. of respondents	Percentage share
Always	11	11
Sometimes	57	57
Rarely	18	18
Never	14	14
Total	100	100

Source: Primary Survey 2025.

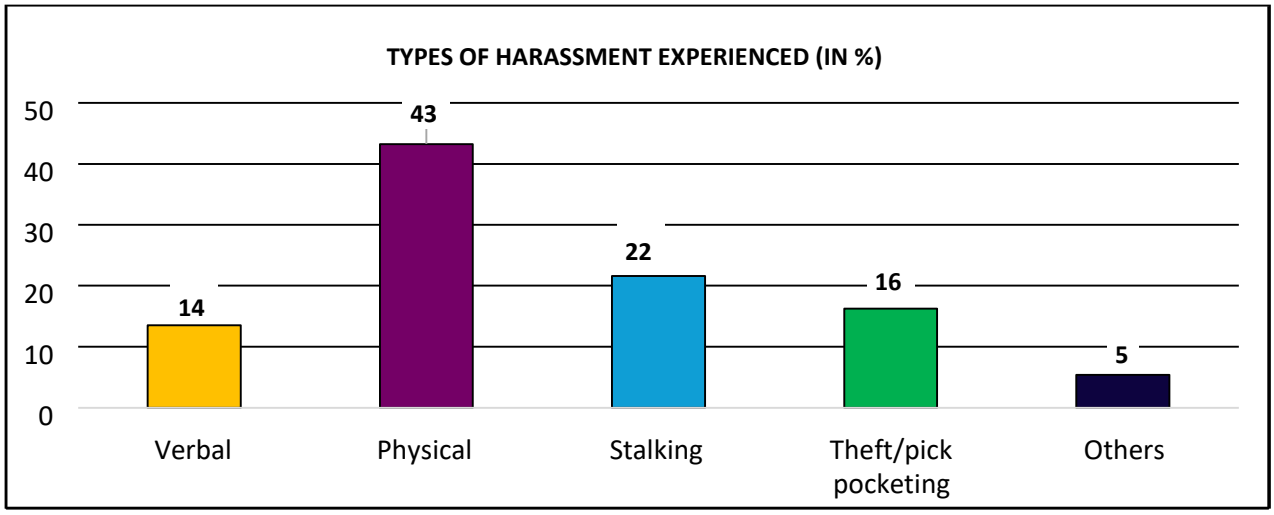
As indicated in Table 1, women who are commuting in the PMC, suffer a lot of uncertainties and inconveniences during their commute. Only 11 percent of them indicated that they are always safe, but most of them are safe sometimes. The high level of insecurity, unusual or absent, indicates severe problems of harassment, overcrowding and lack of supervision and this increases the need to improve safety.



***Source*:** Primary Survey 2025

Fig. 1

As shown in Fig.1, the safety of women in the transport system during evening travels in the city is not safe. It also indicates that only 5 percent of women are completely safe, 29 percent are somewhat safe whereas 44 percent were not safe and 22 percent were very unsafe. All groups of women experience the acuity of feeling vulnerable because of such factors as a lack of sufficient lighting, absence of transport options, risk of harassment, and low level of police presence.



***Source*:** Primary Survey 2025

Fig. 2

Fig. 2 highlights that women encounter various safety threats while using transport in PMC area. A notable 43 percent reported experiencing physical harassment, with stalking, theft, and verbal abuse following closely behind. These challenges stem from overcrowded conditions, insufficient lighting, unsafe routes, and a lack of CCTV or supervision. Overall, the transport environment continues to pose risks, with inadequate protective measures for women commuters.

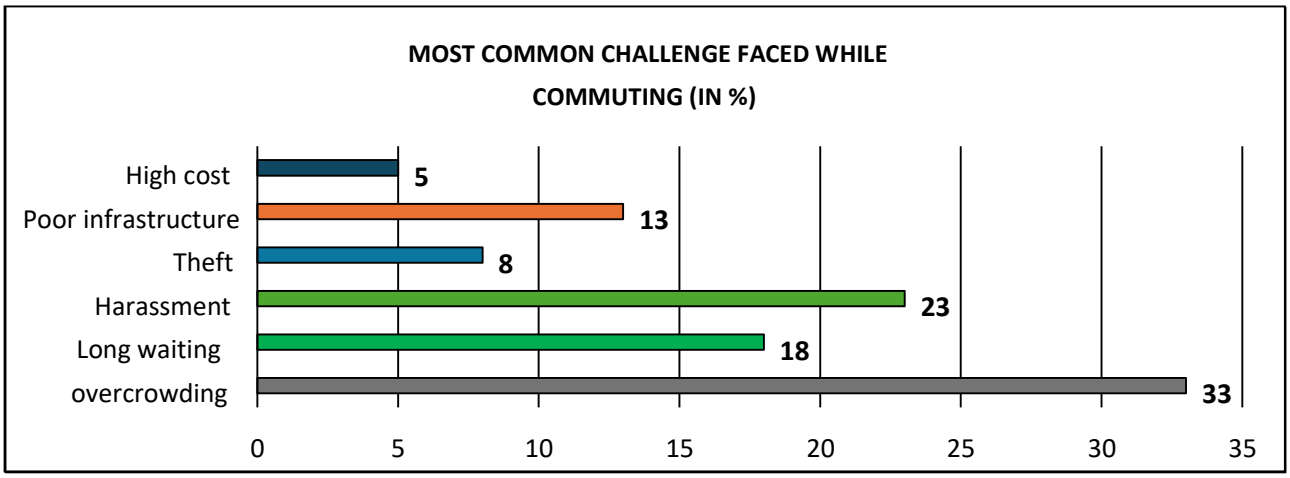
Table 2. Comparative Analysis of Safety Perceptions Among Women Commuters

Safety Perception	Mode of Transportation		Total	Chi-Square	DF	P
	Public	Private				
Always Safe	04	08	12	10.7	3	0.0133
Sometimes Safe	26	15	41			
Rarely Safe	24	05	29			
Never Safe	14	04	18			
Total	68	32	100			

***Source*:** Primary Survey 2025.

Table 2 shows that public transportation is perceived to have a lower level of safety, as evidenced by 26 percent of women who consider it sometimes safe, 24 percent who regard it as rarely safe and 14 percent who believe it is never safe. Conversely, private transportation is viewed as safer, with 8 percent of women feeling always safe and merely 4 percent indicating that it is never safe.

Key Commuting Challenges and Risks for Women: The key challenges and risk factors that women face during commuting are an important part of the overall assessment of the safety and accessibility of the urban transport network at PMC. In addition to the availability of transport services, the daily travel experiences of women are affected by structural, environmental and behavioral factors which impact their sense of security and comfort. Recognizing these challenges provides a clearer picture of the everyday barriers that impact women's mobility.



***Source*:** Primary Survey 2025 **Fig. 3**

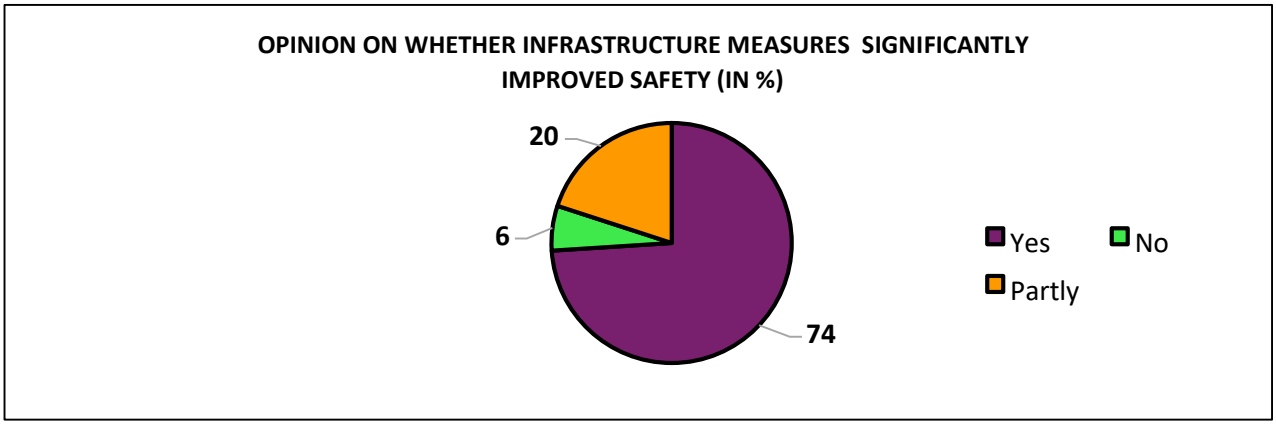
The data given in Fig. 3 shows that the most frequent challenge for women is overcrowding, indicating that public transport is often congested and inconvenient. 23 percent of women have reported that harassment is also a major concern, reflecting persistent safety issues in transport area. 18 percent of the respondents felt that long waiting time is an issue, while 13 percent are affected by poor infrastructure and 8 percent by theft, reveal that the overall commuting environment lacks efficiency and safety. Only 5 percent reported high cost, which shows that financial burden is a lesser but still a challenge. Overall, the pattern suggests that physical congestion and safety risks are the main issues faced by women in commuting.

Table 3. Avoidance of Specific Routes or Timings Due to Safety Concerns

Routes or timings being avoided due to safety concern	No. of respondents	Percentage share
Yes	82	82
No	18	18
Total	100	100

Source: Primary Survey 2025

Table 3 shows, 82 percent of respondents avoid certain routes or timings because of safety concerns. This indicates a significant level of fear and risk perception in daily commuting. Only 18 percent of women do not avoid such routes, which means that unsafe environments heavily dictate the choice of commuting for most women.



***Source*:** Primary Survey 2025 **Fig. 4**

Fig. 4 shows that 74 percent of respondents believed that infrastructure improvements strongly enhance safety. Another 20 percent felt they help partially, while just 6 percent thought they do not help. This highlights the importance of environmental design in shaping women's sense of security better lighting, surveillance, and emergency systems play a crucial preventive and protective role.

Table 4. Availability of Street Lighting

Availability	No. of respondents	Percentage share
Adequate	27	27
Moderate	39	39
Poor	22	22
Not available	12	12
Total	100	100

Source: Primary Survey 2025

Table 4 depicts that street lighting is largely insufficient, with only 27 percent of women considering it sufficient and 39 percent rating it as moderate. On the other hand, 22 percent think it's poor and 12 percent report no lighting at all. This signifies that 34 percent of the streets are poorly lit or completely dark, making one more vulnerable to harassment, especially around bus stops and narrowly used lanes. The situation indicates urgent need for better and more reliable lighting to ensure safer travel for women.

Table 5. Availability of CCTV Surveillance

Availability of CCTV	No. of respondents	Percentage share
Adequate	11	11
Limited	41	41
Not available	48	48
Total	100	100

Source: Primary Survey 2025

Table 5 shows that only 11 percent of the women reported that the transport areas in Patna Municipal Area had adequate CCTV coverage, 41 percent said there was partial coverage and 48 percent said none at all. That means 89 percent of transport spaces have poor monitoring, resulting in harassment and unsafe behaviour to go unnoticed. Poor surveillance around the major bus stops and auto-stands literally discourages reporting and reduces the confidence of women, highlighting the need for improved and widen the scope of CCTV coverage.

Table 6. Condition of First/Last Mile Connectivity

Condition	No. of respondents	Percentage share
Good	20	20
Moderate	50	50
Poor	30	30
Total	100	100

Source: Primary Survey 2025

Table 6 depicts that while 20 percent of women perceive the first/last-mile routes as good, half consider it as moderate and 30 percent feel that it is poor. Only 20 percent have full connectivity, while 80 percent face complications at the start and end of journeys due to vehicular shortages and narrow, ill-maintained roads which add to discomfort and safety risk, especially for working women and students. Thus, the finding shows the urgent requirement of safer walkways and better last-mile planning that can help support women commuters in the PMC area.

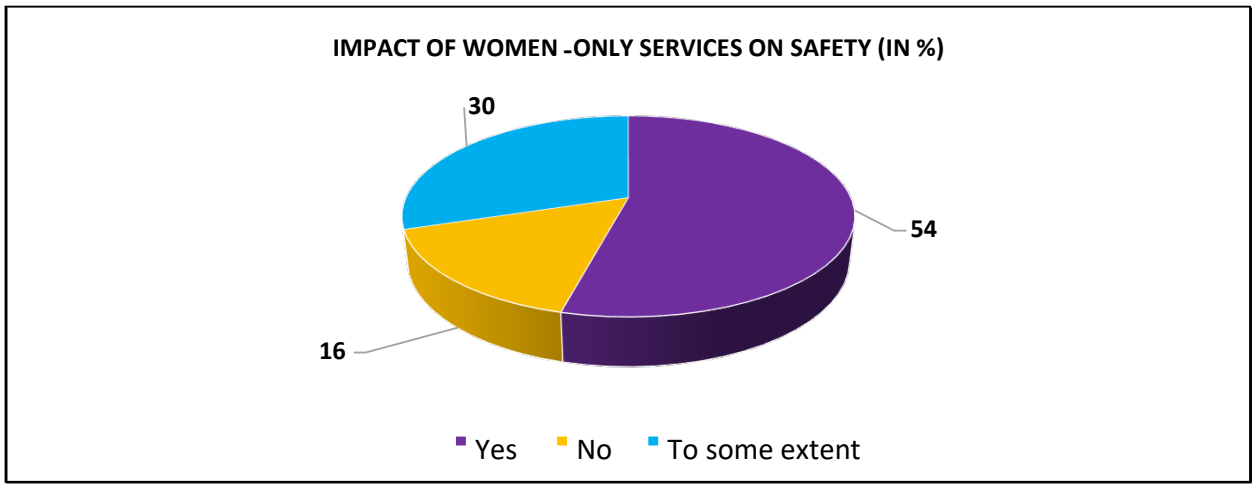
Effectiveness of Policy Interventions on Women's Safety: Effective current policy interventions are essential to understand how well they meet the safety needs of women within the PMC transport system. Although there are many laws, schemes and initiatives aimed at improving women's mobility, their actual effectiveness depends on proper and real-world experiences. By exploring how women perceive these policies, it can help in pinpointing the gaps and gauge their actual effectiveness on the ground.

Table 7. Perceived Effectiveness of Existing Policies and Laws

Perceived effectiveness of existing policies/laws	No. of respondents	Percentage share
Yes	18	18
No	32	32
Partly	50	50
Total	100	100

Source: Primary Survey 2025

Table 7 depicts that half of the women's population i.e. 50 percent, feels that policies are partly implemented, while 18 percent believe current policies are effectively implemented, whereas 32 percent say they are not. This indicates that while laws exist on paper, but their on-ground execution is inconsistent which reduces their impact on women's safety and mobility.



Source: Primary Survey 2025 **Fig. 5**

According to the data given in the Fig. 5, more than half of the population 54 percent, believe women-only services enhance safety, while 30 percent think they help only to some extent and 16 percent, reported they do not help. This reveal that women exclusive transportation is widely appreciated by females, however, it is not considered a complete solution to deeper systemic safety issues.

Table 8. Perceived Safety Among Women Using Women-Only Transport Services

Perceived safety level (%)	Use of women-only transport services			Total	Chi-Square	DF	P
	Yes	Partly	No				
Always	17	01	01	19	14.6	6	0.0235
Sometimes	29	18	10	57			
Rarely	05	08	03	16			
Never	03	03	02	08			
Total	54	30	16	100			

Source: Primary Survey 2025

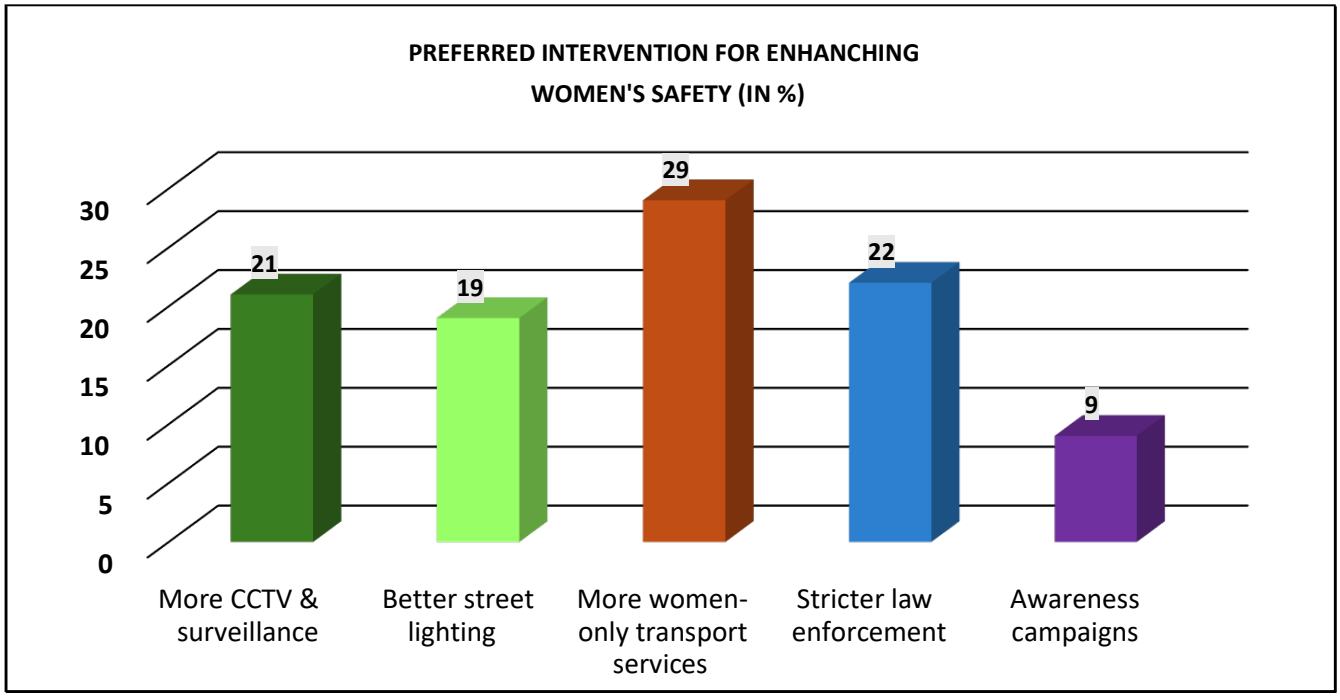
Table 8 suggests that for many women, women-only services do improve their sense of safety. 17 percent felt entirely safe and another 29 percent sometimes safe. For those who reported only sometimes feeling safe, the actual responses vary, reflecting uneven protection. Most of those women who felt unsafe reported very low levels of confidence overall. This suggest that while women-only services do raise the degree of safety for the majority, they by no means eradicate the problem.

Table 9. Adequacy of Police Patrolling in Transport Zones

Adequacy of police patrolling in transport zones	No. of respondents	Percentage share
Yes	38	38
No	62	62
Total	100	100

Source: Primary Survey 2025

Table 9 shows that 62 percent of the total respondents reported police patrolling as inadequate; while remaining 38 percent consider it sufficient. The visibility of security at transports is low and creates fear, harassment and ultimately avoidance of unsafe routes.



Source: Primary Survey 2025 **Fig. 6**

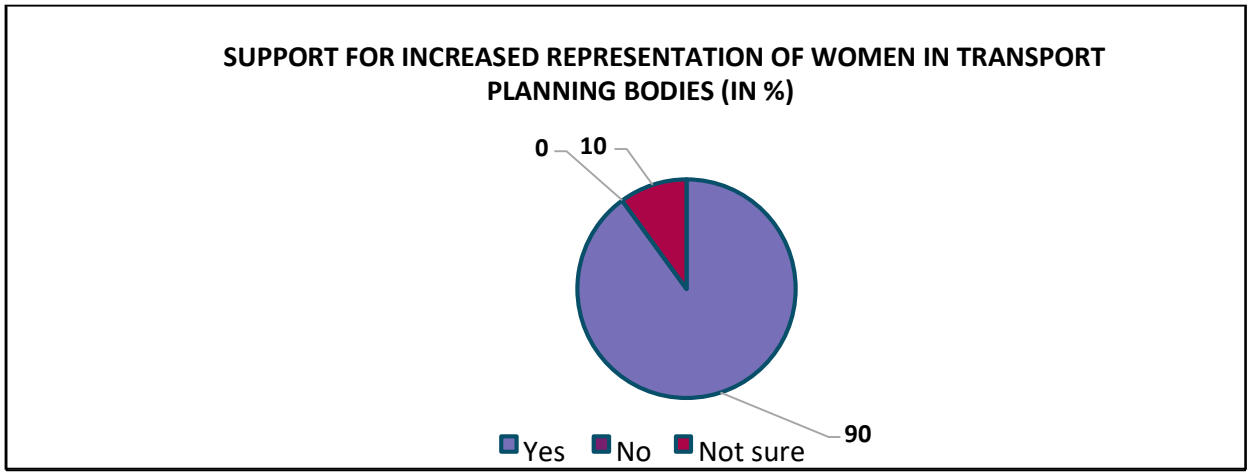
Fig. 6 presents that 29 percent of respondents emphasized on more women-only transport services, showing strong demand for gender-segregated safety solutions. This is followed by stricter law enforcement reported by 22 percent, 21 percent said for more CCTV and surveillance and 19 percent voted for better street lighting. Awareness campaigns, 9 percent rank lowest, suggesting women prefer direct and tangible safety measures over educational ones.

Table 10. Preference for App-Based Reporting and Complaint Mechanisms

Preference for app-based reporting mechanisms	No. of respondents	Percentage Share
Yes	80	80
No	08	08
May be	12	12
Total	100	100

***Source*:** Primary Survey 2025

Table 10 shows a large majority i.e. 80 percent prefer app-based reporting systems, indicating trust in digital tools for quick, discreet complaint registration. 12 percent were uncertain, while only 8 percent were not in favor. This reflects growing digital literacy and the expectation that technology can fill gaps left by slower, traditional reporting processes.

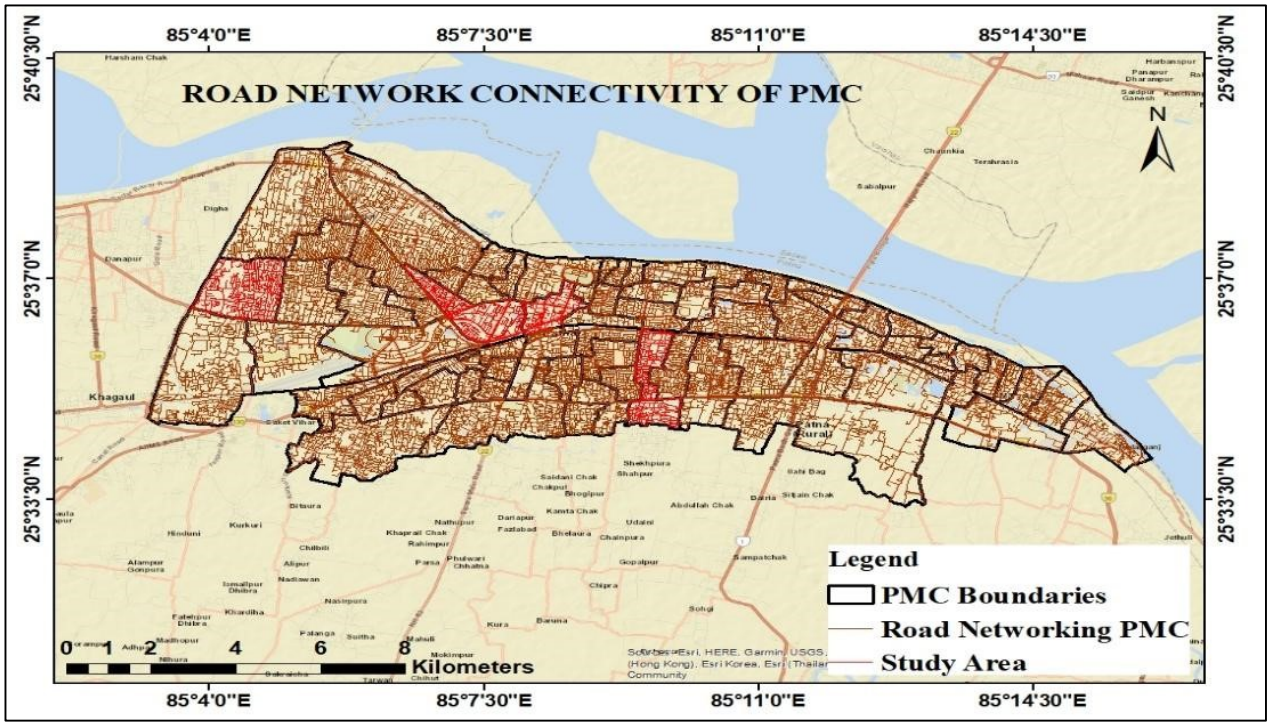


***Source*:** Primary Survey 2025 **Fig. 7**

From Fig 7, a striking 90 percent believed women should have greater representation in planning and policy-making for transportation. This overwhelming support indicates that women felt their experiences and safety concerns were not adequately reflected in current transport decisions. Only 10 percent were unsure, and none oppose the idea.

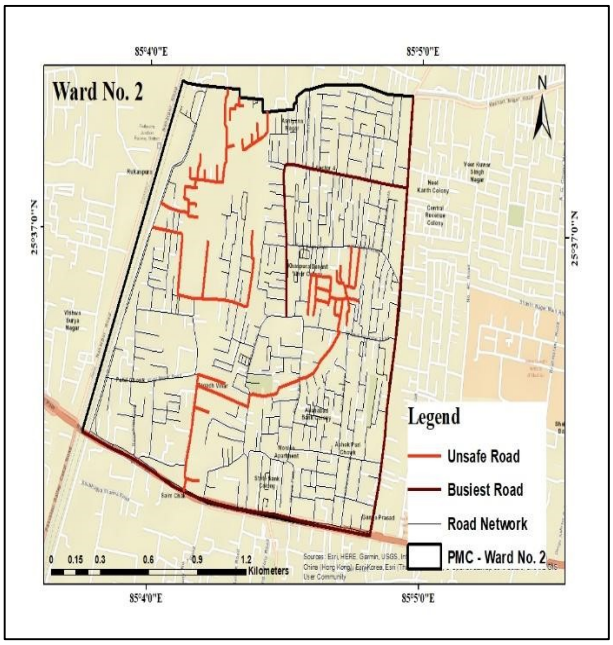
Mapping of Road Network Connectivity and Unsafe Roads

Map 2 is the Patna Municipal Corporation area with detailed major–minor streets and selected wards to understand women's mobility patterns. Maps 3–6 highlight busy and unsafe routes for women: Bailey Road, Ashiyana–Digha Road, Boring Road, Atal Path, Fraser Road, Bypass Road, 90 Feet Road, and Kankarbagh Main Road represent the major unsafe streets, and poor lighting, low surveillance, and reduced pedestrian movement are present in Vijay Nagar Main Road, Patliputra Station Road, Rajesh Kumar Path, New Market Station Road, Chatur Nagar Road, and Adarsh Colony Road.



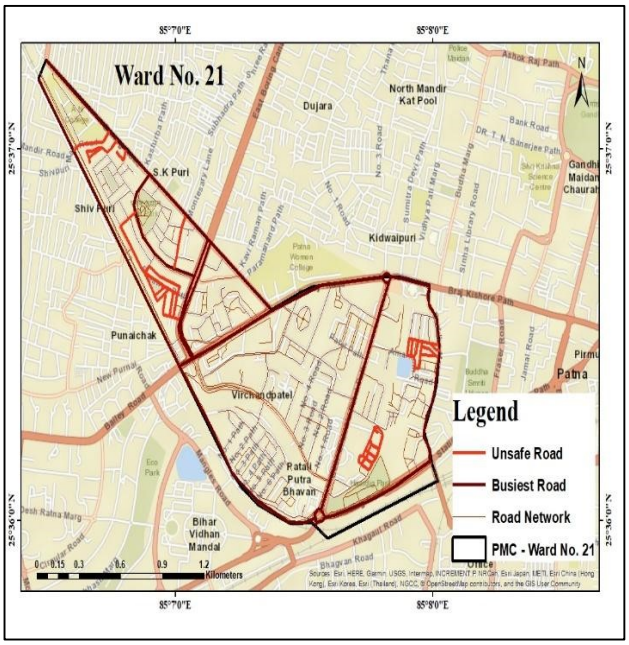
***Source*:** BB Bike.org

Map 2. Road Network Connectivity of PMC



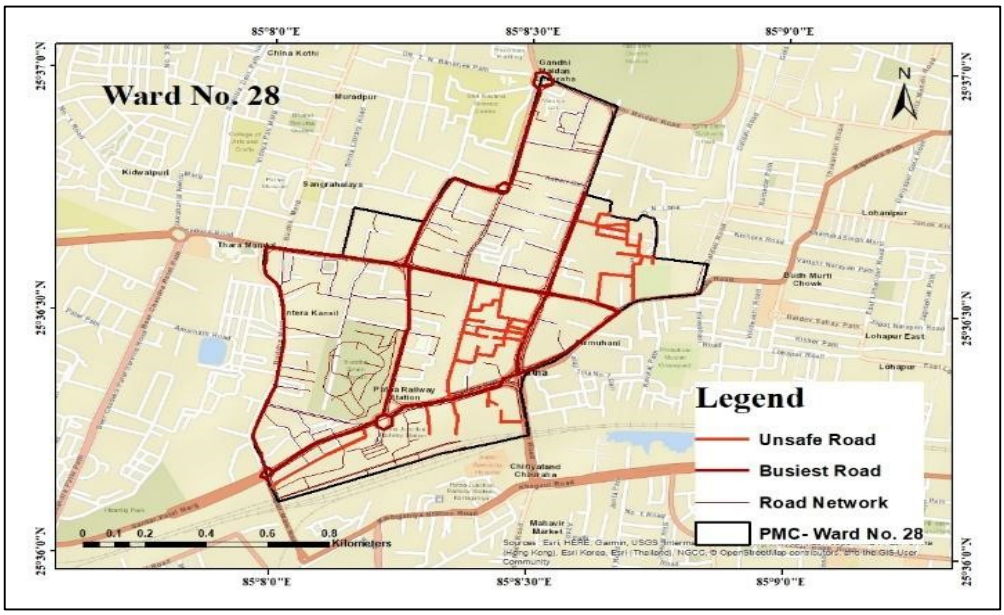
Map 3. Ward No. 2

***Source*:** Primary Survey 2025

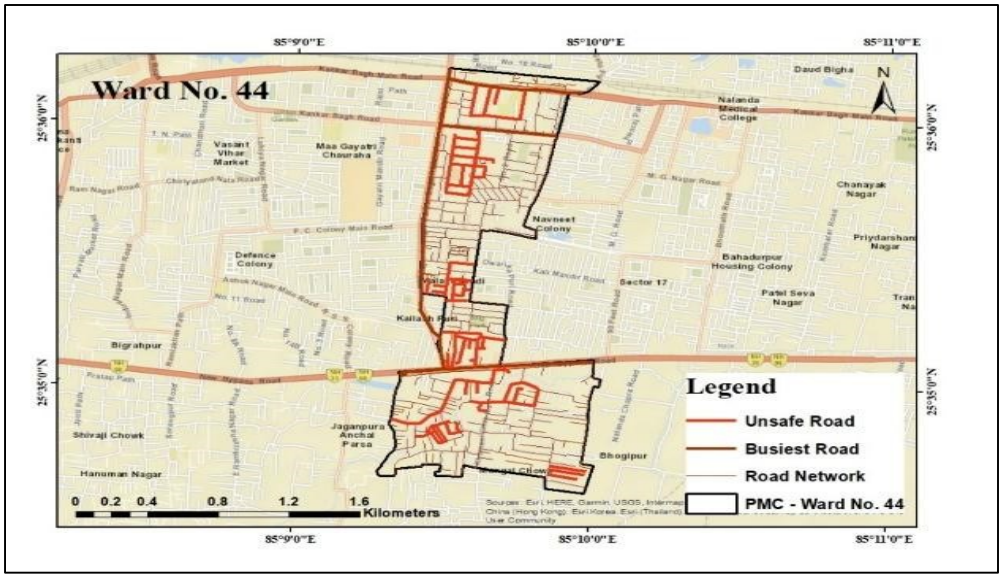


Map 4. Ward No.21

***Source*:** Primary Survey 2025



***Source*:** Primary Survey 2025 **Map 5. Ward No. 28**



***Source*:** Primary Survey 2025 **Map 6. Ward No. 44**

Government Initiatives : The government programs on women safety in city transport involve both national and state measures. The Nirbhaya Fund (2013), National Urban Transport Policy (2014), Safe City Project (2018), and ERSS 112 (2019) together with the GPS–Panic Button requirement (2019) are national policies that would help increase secure mobility. In support, Bihar has provided additional measures: the 181 Women Helpline, 2016; Nirbhaya Project Fund (Bihar) , 2021; GPS tracking of women's travel, 2024; and Pink Bus Service, 2025.The presence of key infrastructure interventions such as CCTV cover, better lighting, safer public transport infrastructure, enhanced road and stop infrastructure and One Stop Centers is another way of improving the safety of women in the PMC area.

Validation of Hypotheses: The first hypothesis says, "Women in the PMC area perceive public transportation as less safe compared to private modes due to infrastructural and operational shortcomings". A Chi-Square Test was conducted using the mode of transport and the perceived safety levels as presented in Table 2. The observed frequencies (n = 100)

formed the basis of the analysis. The value of ChiSquare is 10.71735, with degrees of freedom 3, while the p-value obtained was 0.013357. As the p-value is less than the 0.05 significance level, there is a significant statistical relationship between mode of transport and perceived safety.

The second hypothesis says “Enhanced surveillance and women-specific services can significantly improve women’s perception and experience of safety”. A Chi-Square Test was conducted using Table 8 that shows Perceived safety among women using women-only transport services. The observed frequencies (n = 100) formed the basis of the analysis. The value of Chi-Square is 14.6081, with degrees of freedom 6, while the p-value obtained was 0.023534. Since p-value is below the 0.05 significance level, the association of women-only service with perceived safety is statistically significant.

Future Prospects :

The future prospects for enhancing women's safety in Patna's urban transport system is rooted in smart, inclusive and technology-driven mobility planning. Expanding AI-enabled CCTV networks, introducing women-only transport corridors and improving bus stops with better lighting and internal surveillance can significantly minimize risks. Integrated safety apps with live tracking and SOS features will be further empowered by GPS-based panic systems installed on public vehicles. Long-term accountability will be achieved through the implementation of Crime

Prevention Through Environmental Design (CPTED) principles and establishment of a dedicated PMC Women Safety Cell. Together, these measures can eventually transform Patna into a safer, more equitable and women- focused transport environment.

Suggestions and Conclusion:

The paper has identified some of the most important steps towards making the PMC transport network safe for women. The number of unsafe areas surrounding transit points can be minimized through increasing the amount of light in the streets, getting rid of encroachment in the footpath and creating well-guarded waiting areas. Mandatory GPS and panic buttons in shared autos and taxis can enhance the emergency response. Harassment risks can be mitigated by gendersensitising transport staff, increasing the frequency of buses after 9 PM and increasing visible patrol of police and in particular, women personnel.The police should strictly check cars with dark windows and take action against people hanging around at bus stops. Lastly, a fast online complaint center may make women report those cases without any hesitation.

The security of women in the transport system of Patna Municipal Corporation (PMC) remains in the list of significant problems that impact their movement, access to education, job and the general social involvement. Although there is an increased presence of women in the open areas; they still face challenges in form of poor lighting, poor surveillance, congestion in cars, insecure waiting areas and unreliable transport service among other factors, which restrict their freedom of movement. The study indicates that women under the age of 40 and educated individuals, mainly students, professionals in their early careers and unorganised sector workers rely on transport modes that are cheap such as shared cars, e-rickshaws, buses, and walking, making them more vulnerable especially in early morning and late evenings. Other factors that are hindering the mobility of the elderly women, women with disabilities and other women charged with the care giving duties only increase the gender gap in the day-to-day mobility. Though they initiated such programs as women-only buses, emergency helplines, CCTV cameras and Nirbhaya-funded programs, they are not implemented consistently. To establish a safer, inclusive, gender-sensitive urban transport environment in Patna, there is a need to have more light, surveillance, pedestrian infrastructure and law-enforcement.

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