



Women's safety in Public Transportation: A case study of Jaipur city, India

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Abstract

Women's safety in public transportation is a major point of concern for transport planners worldwide, including India. Perceptions regarding safety can significantly influence commuters' mode choice decisions. This study aims to quantify the psychological factors that can impact women's perception of safety while traveling on public transportation in Jaipur, India. To conduct this study, we collected data from female commuters through a questionnaire, which included questions related to the respondents' socio-economic characteristics, safety perceptions while using buses, bus preferences among different types of buses, satisfaction with various attributes of public bus services, and Likert-scale responses regarding women's safety when using public buses. We obtained a total of 439 valid responses, which were used for analysis. The factor analysis technique was employed to analyze the responses, revealing that *Infrastructure and operations of public buses*, *Safety concerns related to boarding/alighting*, *Information accessibility*, and *Positive sentiments towards bus stops* are the major factors affecting safety. The results of this study will assist policymakers and transport planners in creating safe infrastructures for women to ensure their safety during public transportation commutes. Furthermore, it will contribute to an increased mode choice share of women in public transportation.

Keywords: Women safety; Public Transportation; Psychological factors; Factor analysis.

1. Introduction

In emerging economies such as India, women empowerment and their active participation in the country's development activities are crucial. To ensure their involvement, it is essential to provide a safe and secure environment for women in public places. The mode of transportation chosen by women for commuting is influenced by their sense of safety while traveling (Verma et al., 2017). To promote the use of public transportation and empower women in developing countries like India, authorities must prioritize women's safety in public transportation services such as buses and trains. Safety is a significant factor that contributes to the overall satisfaction with the quality of services

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provided by public transportation. Moreover, it also influences the well-being of commuters (Solanki et al., 2022). Based on recent statistical research reports on women's participation in economic activities, it has been observed that the rate of female labor force participation has increased by 0.6% since 2021, indicating a clear rise in women's active involvement in activities related to economic development (Statista, 2021). The country's largest statistical report also confirms commendable growth in the workforce participation rate of females, which is expected to further increase with the rise in literacy rates (Census of India, 2011). The significant contribution of women to the country's economic growth necessitates a safe and secure environment for their commute from home to the workplace. In contrast to the past few decades, when women's participation was mainly concentrated in the agriculture sector (Sivasankar, 2019), there has been a notable increase in their involvement due to advancements in literacy rates and women's empowerment reforms, as evidenced by the appointment of two female presidents in India over the last few decades. Emerging economies have witnessed a substantial transformation in the role of women within the country. With the growing population and increasing road congestion leading to greater reliance on public buses, including by women, it is crucial for authorities to ensure essential safety measures to facilitate their convenient transportation.

The main objective of this study is to analyze the sense of safety among female commuters using public buses in metropolitan cities like Jaipur. As the capital of Rajasthan, Jaipur is home to numerous educational institutions, industries, and workplaces where women workers rely on public buses for daily commuting. Therefore, it is crucial to comprehend and assess the feeling of safety in public transportation for these women. Additionally, this study aims to identify the factors that contribute to a sense of safety or the lack thereof.

The next section of the article discusses the previous studies conducted in the relevant area, followed by an explanation of the methodology adopted for this study. Subsequently, the section presents the results of the data analysis, followed by a discussion of the policy implications. Finally, the article concludes with a summary of the findings.

2. Literature Review

In today's era of technological advancement, commuters have a multitude of transportation options at their disposal. However, if they do not feel safe and satisfied with one mode of transportation, they are likely to switch from public to private modes. A recent study conducted in the rapidly growing cities of Ahmedabad and Bangalore revealed that higher education plays a significant role in shaping the perception of safety when using public buses. Additionally, a positive travel experience and well-developed public transportation infrastructure have a substantial impact on women's perception of safety while using public buses (Verma et al., 2020). Public transportation services, in line with the model of sustainable development, contribute significantly to energy savings, cost reduction, and emissions reduction compared to private vehicles (Verma et al., 2014).

Over the years, there have been numerous incidents of sexual harassment against women in public transportation. A report based on data collected from Delhi University students revealed that approximately 89% of female students have experienced sexual harassment while using public transport. While the provision of free public transportation services for females by the Delhi government can increase the number of female riders in

public buses, it can also lead to an increase in harassment incidents due to backlash from some men (The IGC report, 2020). Regrettably, policymakers have not focused enough on understanding the travel patterns of women commuters. It is observed that women often use public transport for shopping trips during off-peak hours, in addition to their regular commutes. These short trips, known as trip chaining, result in women paying more in fares, which is referred to as the "pink tax" in urban areas. With the increasing participation of women in the workforce, policymakers are now also addressing the issue of women's safety during travel. However, it is essential for policymakers to move beyond conducting safety audits and take concrete actions to ensure women's safety in urban spaces (Nikore, 2022).

According to a report on urban mobility in India, the results indicate that only 9% of women feel that public transport is safe, and a significant portion of respondents perceive urban mobility as unsafe during night time. Approximately 80% of women who use public transport find it safe during daylight hours but not after dark. While there are numerous advantages to using public transportation, such as its range, accessibility, comfort, and affordability, many female commuters have expressed the need for improved last-mile connectivity, particularly during night time. On the other hand, women have also highlighted issues such as inadequate lighting along roads and broken footpaths, which pose obstacles to safe travel (OMI survey, 2019).

There is a notable dearth of studies focusing specifically on the safety perception and concerns of women while traveling in public buses. Many researchers and policymakers tend to prioritize women's safety in general, rather than within the context of urban mobility, which plays a significant role in their daily lives. Therefore, the primary objective of this study is to identify and shed light on the challenges faced by female commuters while traveling on buses, including issues related to the bus environment and bus stops.

3. Study Area and Methodology

3.1 Study Area

To study women's safety in urban mobility, data was collected from Jaipur, the capital city of Rajasthan, India. Jaipur is the largest city in the state and is often referred to as the "Pink City." It is nestled amidst the Aravalli hills and has a population of approximately 3.073 million, predominantly comprising urban residents, according to the 2011 census. Jaipur is situated in a semi-arid region with high temperatures during summer, limited rainfall in the rainy season, and mild winters. The city serves as a commercial hub in Rajasthan, resulting in significant traffic congestion and rapid urbanization. It enjoys good connectivity with major cities in India through road and air transport. Being a metropolitan city, Jaipur hosts numerous events and festivals throughout the year. However, the city experiences scorching heat for most of the year, except during the winter season. With a thriving economy, there is substantial female participation in the workforce, necessitating reliable transportation services for their daily commutes. Due to the increasing incidents of sexual harassment faced by women in public buses, our aim is to understand the factors that contribute to their feeling of unsafety and shed light on these areas to policymakers.

3.2 Study Methodology

Jaipur was selected as the study location due to its high urban population, making it the most populous city in Rajasthan. According to the census data from the past decade, the city's population was over 3 million, and it is likely to have increased since then. A questionnaire was designed to gather responses from female commuters on buses. The questionnaire covered various aspects, including the socio-economic characteristics of the commuters, satisfaction with bus services, perception of safety while using public bus infrastructure, and responses on a five-point Likert scale regarding statements related to women's safety during bus travel.

The data collection process was well-structured to accurately identify and assess the issues affecting the safety of female commuters. It encompassed factors such as staff behaviour, condition of bus stops, and safety during travel. Out of the 450 respondents, some responses were incomplete or recorded incorrectly. After excluding these flawed responses, 439 surveys were deemed suitable for analysis. The questionnaire was divided into four sets of questions. The first set focused on the socio-economic characteristics of the respondents, including age, education qualifications, income, marital status, and more. The second set explored satisfaction with public bus services, encompassing punctuality, frequency of buses, cost of travel, travel time, safety during travel, and bus schedules. The third set assessed the perception of safety while boarding and alighting from public buses. Lastly, the fourth set comprised statements related to the perception of safety based on the respondents' experiences with public bus infrastructure, staff behaviour, amenities at bus stops, and measures taken by bus operators to ensure women's safety.

Once the responses from female commuters were collected, factor analysis was performed to extract underlying factors influencing women's safety. To ensure the reliability of the data, Cronbach's alpha was calculated, followed by the Kaiser-Meyer-Olkin Measure of Sampling Adequacy.

4. Analysis and Results

4.1 Descriptive Analysis

Women engage in multiple short trips throughout the day, which necessitates policymakers' attention to make urban mobility more comfortable and affordable for them (World Bank blogs, 2022). However, the rising crime rates and issues of sexual harassment in urban areas have resulted in a potential shift from public transport to private vehicles. Fear and discomfort further discourage women from actively participating in the country's development. The socio-economic characteristics of the respondents are presented in Table 1 below.

Table 1: Socio-Economic Characteristics of Respondent

Characteristics	Number	Share
Categorical Variables		
<i>Gender</i>		
Female	439	100%
<i>Marital Status</i>		
Single	253	57.63%
Married	159	36.21%
Divorced	7	1.59%
Widowed	20	4.55%
<i>Education</i>		
Illiterate	20	4.55%

Class 10 th	71	16.17%
Class 12 th	90	20.50%
Graduation	191	43.50%
Post-graduation	62	14.12%
Ph.D.	5	1.13%
Employment type		
Student	171	38.95%
Self-employee	40	9.11%
Govt. Employee	30	6.83%
Private Employee	75	17.08%
Housewife	76	17.31%
Retired	1	0.22%
Unemployed	42	9.56%
Others	4	0.91%
Driving License		
No	181	41.23%
Only Two-wheeler Driving license	150	34.16%
Only Four-wheeler driving License	11	2.50%
Both	97	22.09%
Quantitative Variables		
Age of the Respondent		
Less than 18 years	5	1.49%
18-25 years	270	80.59%
26-40 years	46	13.73%
41-60 years	12	3.58%
More than 60 years	2	0.59%
Household Monthly Income (In INR*)		
0-15,000 ₹	61	13.89%
15,000 - 50,000 ₹	110	25.05%
50,000 - 90,000 ₹	157	35.76%
90,000 - 1,50,000 ₹	84	19.13%
More than 1,50,000 ₹	27	6.15%
Number of two-wheelers in Household		
Zero	25	5.69%
One	193	43.96%
Two	179	40.77%
More than two	42	9.56%
Number of four-wheelers in Household		
Zero	164	37.35%
One	211	48.06%
Two	51	11.61%
More than two	13	2.96%
Frequency of using Public Transport Buses		
Daily	81	18.45%
Sometimes	232	52.84%
Once in a while	76	17.31%
Rarely	50	11.38%

*Conversion rate: 1 US Dollars (USD) = 82.50 Indian Rupees (INR).

Based on the collected data from the respondents, it was found that 18.45% of women use public buses on a daily basis, 52.84% use them occasionally, and the remaining use them rarely. In Jaipur, there are various types of buses available, including low-floor AC buses, low-floor non-AC buses, mini pink buses, and private mini buses. These options primarily cater to the busy routes that attract the majority of commuters. While Jaipur also has metro facilities, their limited coverage on key routes makes public

buses a more preferred choice for female commuters. In terms of mode choice, public buses and mini buses offer better last mile connectivity compared to the metro and other transportation modes, and they are available at affordable prices for commuters across the city. Even though auto-rickshaws and cab services provide a high level of comfort, they are not cost-effective for daily commuters and middle-class individuals. Among the respondents, 38.95% are students who rely on public buses to reach their educational institutions, while a significant portion (23.91%) consists of working women employed in government and private sectors. The increase in female literacy rates over the past few decades is evident, with only 4.55% of women reported as illiterate, indicating that the majority are educated enough to actively contribute to the economy's growth. Surprisingly, 58.77% of female respondents possess a driving license but still opt for public buses due to the high congestion in urban areas and the expensive nature of private vehicle travel.

The data reveals that a significant proportion of respondents belong to the youth category, with 80.59% falling in the 18-25 years age bracket and 13.73% in the 26-40 years age group. The ownership of private vehicles for urban mobility is challenging, as indicated by the data on vehicle ownership among the respondents. Only 5.69% of female commuters reported owning a four-wheeler, while the majority (62.65%) owned one or more two-wheelers in their households.

Table 2 shows the feeling of safety in public buses by female commuters and mode choice among different types of buses.

Table 2: Safety experience in buses and choice among different buses

Characteristics	Number	Share
<i>Feeling of safety while travelling in Public buses</i>		
Safe	186	42.36%
Unsafe	253	57.64%
<i>Issues faced in the past while travelling in public buses</i>		
Yes, myself only	73	15.90%
Yes, my relatives or friend	140	30.50%
Both (me and my friends and relatives)	168	36.60%
Never faced	58	12.63%
<i>Type of public bus used for traveling</i>		
Govt. low floor bus	111	24.18%
Private mini bus	41	8.93%
Both	275	59.91%

Looking at the data from Table 2, it becomes apparent that a significant portion of the respondents do not feel safe while traveling on public buses. Only 42.36% of female commuters reported feeling safe, while a mere 12.63% stated that they had not encountered any safety issues. The majority of respondents shared that someone in their vicinity had experienced safety concerns while traveling on public buses. When comparing government and private minibuses, women showed a preference for government low-floor buses. However, due to the limited availability of low-floor buses on all routes, commuters are utilizing both types of public buses, accounting for 59.91% of respondents.

In the context of feeling unsafe, it is important to address the safety of public infrastructure, such as inadequate lighting at bus stops, inconvenient access to bus stops via footpaths, and insufficient stop times for commuters to board or alight the bus. Ensuring safety at bus stops is crucial since it marks the beginning and end of a trip. The

absence of a sense of safety often leads to a tendency among commuters to switch modes of transportation. In addition to infrastructure issues, women face various challenges while using public transportation, including theft, molestation, and harassment. Instances of inappropriate touching by male passengers and misconduct by conductors during ticket checks and fare collection are unfortunately common. These incidents contribute to the feeling of insecurity among female commuters, who often have no choice but to tolerate and adapt to such conditions. These issues also increase the likelihood of mode switching, with women opting for private transportation, thereby exacerbating emissions and congestion on urban roads.

Policymakers hold the key to effectively address and prevent such incidents by implementing safety measures that can change the perception of safety for women using public transportation services. It is crucial to recognize that public transportation is the most sustainable mode of transportation and should be encouraged for its environmental and social benefits.

Table 3: Perception of safety while using public buses

Characteristics	Number	Share
<i>At the bus stop</i>		
Always feel safe	30	6.83%
Sometimes feel safe	186	42.36%
Rarely feel safe	186	42.36%
Never feel safe	37	8.42%
<i>While travelling inside the bus</i>		
Always feel safe	28	6.37%
Sometimes feel safe	220	50.11%
Rarely feel safe	134	30.52%
Never feel safe	57	12.98%
<i>While boarding and alighting</i>		
Always feel safe	31	7.06%
Sometimes feel safe	194	44.19%
Rarely feel safe	128	29.15%
Never feel safe	86	19.58%

According to the responses from female commuters, there is a significant doubt regarding safety at bus stops, with only 6.83% of women feeling secure in those locations. When it comes to traveling inside the bus, a concerning 12.98% of women reported never feeling safe while commuting on public buses. Moreover, a substantial figure of 19.58% expressed concerns about safety during the boarding and alighting process, highlighting the reckless behaviour of bus drivers and conductors towards commuters. Addressing this issue requires implementing proper training and education to correct their conduct and ensure the safety of female passengers.

Table 4: Average scores of satisfactions with public bus services attributes

Attributes	Average scores
Punctuality	2.535
Frequency	2.628
Cost	3.054
Safety	2.293
Travel time	2.671
Bus schedule	2.589

5- Highly satisfied, 4-Satisfied, 3-Neutral, 2-Unsatisfied, 1-Highly unsatisfied

Table 4 presents the collected data regarding female commuters' satisfaction with various aspects of public bus infrastructure, including services and cost. The highest level of satisfaction was observed in the cost-to-commuter perspective, indicating that the affordability of public buses is quite satisfactory for female commuters. However, the lowest satisfaction was recorded in the safety attribute of the public bus transport infrastructure, which is a major concern for authorities. Despite numerous incidents of sexual harassment, eve teasing, and inappropriate touching against women, the figures regarding women's safety remain disconcerting. Policymakers should take rapid and stringent action to ensure the safety of female commuters, as this is crucial for encouraging women's active participation in developmental activities. Ignoring such facts would either cause women to withdraw or shift to other modes of transportation that are not sustainable in terms of reducing carbon footprints and promoting urban well-being.

4.2 Factor Analysis

Factor analysis is the most suitable method for this study, considering the type of dataset. It is a data reduction technique that condenses the various variables responsible for the outcome into factors based on their factor loadings. In this study, we collected questionnaire responses from the participants, including 31 statements rated on a Likert scale. Therefore, factor analysis is the most appropriate method to extract and identify the factors influencing the feeling of safety on buses. To perform the factor analysis, we used principal component analysis for factor extraction. We assumed that the variables related to the safety of female commuters are independent of each other. For better interpretation, we applied varimax rotation. To assess the adequacy of the sample, we conducted the Kaiser-Meyer-Olkin Measure, which yielded a value of 0.937 for the data listed in Table 5. This indicates that a significant amount of variance exists in the extracted factors. Additionally, we conducted Bartlett's Test of Sphericity with a significance level of 0.000 to validate the extracted factors.

To assess the reliability of the data recorded on the Likert scale, Cronbach's Alpha was performed, yielding results that indicate the data's reliability. For the factor analysis, Table 6 displays the factors extracted using principal component analysis and the cumulative percentage of variance explained by them. After conducting the factor analysis on the 31 exploratory variables in the form of statements, a total of four factors were extracted. During the analysis, any individual variables with factor loadings below 0.3 were excluded, as determined by the statistical tool used. Only factor loadings greater than 0.3 were considered for factor extraction. Among the extracted factors, most of the factor loadings are above 0.5, with only one factor loading below this threshold. Moving forward with the analysis, the factors were named based on the factor loadings of the statements or variables, indicating the clustering of statements under specific factor names.

Table 5: KMO and Bartlett's Test for 31 Items

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.937
Bartlett's Test of Sphericity	Approx. Chi-Square	7976.685
	Df	435
	Sig.	0.000

Table 6: Factor loadings from Principal Component Analysis of 31 items using Varimax with Kaiser Normalization method (N = 439)

Factor Name	Statements	Factor Loading
Factor 1: Infrastructure and Operations of Public Buses Eigen Value: 6.683 % of Variance: 22.277 Cronbach's Alpha Reliability: 0.941	Displaying information about bus timings can reduce waiting time, thereby reducing crime at bus stops.	.772
	The presence of women-only buses does not guarantee the safety of women at bus stops.	.740
	Drivers and conductors tend to be more courteous towards young mothers, the elderly, and physically challenged women.	.684
	I am unsure about the safety of the bus stop where I will be getting down.	.673
	Running special buses for women can help in reducing crimes against women.	.669
	Computerized ticketing system minimizes the possibilities of cheating and bribery.	.640
	Crimes against women are more likely to occur in overloaded buses.	.632
	Reserving a few seats exclusively for young mothers, the elderly, or physically challenged women is preferable to reserving seats for all women.	.625
	Crimes against women are reduced when everyone has a seat on the bus.	.599
	Crimes against women are more likely to occur in empty buses.	.582
	Having special seats for females does not guarantee their safety.	.566
	I am uncertain if I am getting off at the correct bus stop.	.555
	Drivers and conductors are generally courteous.	.552
	The presence of women-only buses does not ensure the safety of women inside the bus.	.469
Factor 2: Boarding/Alighting related safety concern Eigen Value: 5.222 % of Variance: 17.406 Cronbach's Alpha Reliability: 0.897	Boarding a bus can be challenging as buses do not always stop exactly at the bus stop.	.764
	I feel unsafe and worry about being run over by another bus or vehicle if the bus doesn't stop at the bus stop.	.745
	I feel unsafe about my luggage when getting off the bus.	.697
	Many people experience sprains when getting off the bus due to uneven bus stops.	.681
	The bus rarely stops directly at the bus stop, which makes me feel unsafe when getting off the bus.	.667
	I feel unsafe due to my co-passengers.	.640
	I feel very unsafe when moving from my seat to the bus door.	.549
Factor 3: Information accessibility Eigen Value: 4.451 % of Variance: 14.836 Cronbach's Alpha Reliability: 0.853	Bus information is easily accessible through phone calls, SMS, and the Internet.	.765
	Bus stops are conveniently situated.	.761
	Bus schedule and route maps are readily available and reliable.	.749
	Destination display systems are installed inside the bus.	.707
	Bus stops are well-lighted during the night.	.648
	I feel unsafe with the drivers and conductors as well.	.537

Factor 4: Positive sentiments towards bus stops Eigen Value: 2.165 % of Variance: 7.218 Cronbach's Alpha Reliability: 0.769	Bus stops are safe for young mothers and elderly women.	.846
	Bus stops are safe for girl children.	.826
	Bus stops are safe for women.	.787
Total variance explained: 61.737%		
Rotation converged in 6 iterations.		

The analysis of the data collected in this study resulted in the extraction of four factors that are relevant to the safety concerns of female commuters. These factors provide insights into the various aspects of women's safety while using public buses.

Factor 1. Infrastructure and Operations of Public Buses: This factor comprises statements related to the infrastructure of public bus services, such as the availability of real-time bus status at bus stops, which helps reduce waiting time and crime incidents. It also includes statements about the provision of special seats for women in buses and the implementation of computerized ticketing systems. Additionally, this factor addresses the operation aspects of buses, such as the introduction of all-women buses to ensure the safety of female commuters, the importance of courteous behaviour from bus operations staff towards young mothers and elderly female commuters, and the correlation between crime rates and overloaded or empty buses with few female passengers. Among all the factors, this factor exhibits the highest factor loadings for the included statements.

Factor 2. Boarding/Alighting related safety concern: This factor encompasses statements that address the safety challenges experienced by female commuters at bus stops and during boarding and alighting from the bus. The statements shed light on concerns related to inadequate stop time and the absence of proper facilities for getting off the bus. It highlights the difficulties faced when carrying luggage and the struggle to reach the exit in overcrowded buses, particularly when accompanied by luggage or children. The factor emphasizes the potential for physical harm caused by alighting on uneven surfaces or being struck by adjacent moving vehicles. These safety concerns arise due to the fear of encountering inappropriate behaviour from fellow passengers.

Factor 3. Information accessibility: This factor consists of statements that pertain to user-oriented or user-friendly bus services. It focuses on the strategic placement of bus stops in areas with high trip production and attraction, ensuring accessibility to a maximum number of commuters. Enhancing the user-friendliness of public bus services involves providing real-time information about buses through digital platforms, calls, and SMS, thereby offering greater convenience to female commuters. Additionally, ensuring sufficient lighting at bus stops and inside buses creates a sense of safety for women and helps prevent untoward incidents.

Factor 4. Positive sentiments towards bus stops: This factor consists of statements that highlight the safety concerns of women at different stages of their lives. It addresses the specific needs of young mothers, who require extra attention in terms of seat availability and courteous behaviour from bus staff. Furthermore, it focuses on the safety concerns of elderly ladies who rely on buses, emphasizing the importance of a smooth ride and seamless boarding and alighting processes. A significant safety concern in today's society revolves around working women and female students who commute daily via public buses and face issues such as eve-teasing and sexual harassment from fellow passengers, both on the buses and at bus stops.

These factors provide a comprehensive understanding of the multifaceted aspects of women's safety while using public buses. By considering these factors, policymakers and transportation authorities can implement measures to enhance safety, improve infrastructure, and create a more inclusive and secure environment for female commuters.

5. Planning and Policy Recommendation

In order to enhance public transportation services, valuable insights can be drawn from the analysis of the data collected in this study, which will have significant implications for improving bus services for female commuters. Given that India is a rapidly growing economy with an increasing contribution from women in developmental activities, it is crucial to create a convenient environment for women to actively participate in the country's progress. To achieve this, authorities must prioritize the safety of women who travel using public buses. Policymakers should establish strict rules and regulations regarding the safety of female commuters, which must be followed by the staff of public transportation services. It is essential to provide ample real-time information to commuters through various platforms, reducing waiting times and enhancing convenience and accessibility to public transportation services.

Based on the data collected from female commuters, there should be an option for women-only buses in key working hubs and routes with a significant number of female travellers. This would ensure more secure and worry-free journeys for women. Additionally, bus stops require stringent regulations, including designated stoppage times to enhance safety during boarding and alighting. Drivers and conductors should receive adequate training to understand passenger behaviour and be courteous enough to create a comfortable environment for female commuters. Bus stops are equally important as buses in the public transportation infrastructure. Thus, proper lighting, availability of security alarms for emergencies, and levelled surfaces should be provided to ensure safety during boarding and alighting. According to the questionnaire responses, 75.82% of women also utilize private minibuses when government buses are unavailable on certain routes. Therefore, policymakers should also prioritize the safety of women traveling in private minibuses.

Promoting sustainable transportation options is a key concern for authorities to control emissions. To achieve this, they must provide safer public transportation services to discourage commuters from switching to alternative modes of transportation. Overall, by implementing these measures, the authorities can create a safer and more inclusive public transportation system that encourages women's active participation and contributes to the country's sustainable development.

6. Summary and Conclusion

In this study, we aimed to assess the level of safety experienced by female commuters while traveling on public buses in Jaipur, the capital of Rajasthan state in India. To conduct this study, we collected data from female commuters through a questionnaire that included questions related to their socio-economic characteristics, perceptions of safety while using buses, bus preferences, satisfaction with various aspects of public bus services, and their responses were recorded on a Likert scale. Factor analysis was employed to analyze the responses pertaining to women's safety. This technique helped reduce the dimensionality of the data and identify four factors that address the safety concerns highlighted by the female respondents. A similar study was conducted in Bangalore, a city in southern India, which yielded different results. In that study,

respondents' education level emerged as a key factor influencing their perception of safety when using public buses, along with age and employment status (Verma et al., 2017). However, due to the differences in demography and socio-economic characteristics of the respondents, our study produced distinct findings. The key findings of our study are as follows:

1. Daily female commuters who strive to maintain a work-life balance require real-time and accurate information about bus schedules to reduce waiting time and make informed decisions about using public buses for their commute.
2. In areas where there is a high incidence of reported cases of sexual harassment and inappropriate behaviour towards women passengers, the provision of all-women buses can serve as a preventive measure against such social ills and promote the use of public buses.
3. It is crucial to implement training and development programs for the staff operating public buses, with a focus on improving their behaviour and fostering a more courteous approach towards commuters.
4. To ensure the safety of women while boarding and alighting from public buses, clear provisions should be made regarding the duration of stops, allowing passengers to comfortably exit the bus while carrying their luggage.
5. Addressing the issue of inappropriate physical contact in overcrowded buses requires an increase in the number of buses on busy routes during peak hours.
6. Bus stops, often overlooked by policymakers, play a crucial role in ensuring the safety of women. Adequate lighting should be provided at bus stops, and level surfaces should be maintained to prevent injuries while approaching the bus.

These findings provide valuable insights for policymakers and stakeholders in improving public transportation services and enhancing the safety and comfort of female commuters. By addressing these key factors, we can create a more inclusive and secure public transportation system that encourages the use of buses by women and contributes to their overall well-being.

References

- Verma, Meghna, M. Manoj, Nikhita Rodeja, and Ashish Verma. 2017. "Service Gap Analysis of Public Buses in Bangalore with Respect to Women Safety." *Transportation Research Procedia* 25: 4322–29. doi:10.1016/j.trpro.2017.05.283.
- SOLANKI, Sachin, Sanu MEENA, and Umesh KUMAR. 2022. "Development of the Travel Satisfaction Scale (TSS) for the Assessment of Commuters' Satisfaction in Public Transport: Evidence from Delhi Metro (India)." *Scientific Journal of Silesian University of Technology. Series Transport* 117: 233–45. doi:10.20858/sjsutst.2022.117.16.
- Rathore, Manyu. 2023. "India: Female Labor Force Participation Rate." *Statista*. January 30. <https://www.statista.com/statistics/983020/female-labor-force-participation-rate-india>.
- Sivasankar, V. 2019. "Status of Women Workers in India." *Health, Safety and Well-Being of Workers in the Informal Sector in India*, 77–92. doi:10.1007/978-981-13-8421-9_7.
- Verma, Meghna, Nikhita Rodeja, M. Manoj, and Ashish Verma. 2020. "Young Women's Perception of Safety in Public Buses: A Study of Two Indian Cities (Ahmedabad and Bangalore)." *Transportation Research Procedia* 48: 3254–63. doi:10.1016/j.trpro.2020.08.151.

- Verma, Meghna, Ashish Verma, Puthuparambil Madhavan Ajith and Sateesh Sindhe. 2014. "Urban bus transport service quality and sustainable development: understanding the service gaps." *Indian Journal of Transport Management*, 98-112.
- Researchers Dev Patel , Researchers, and Dev Patel Researcher. 2019. "Safety in Numbers? Free Public Transportation for Women and Women's Safety." *International Growth Centre*. October 1. <https://www.theigc.org/project/safety-in-numbers-free-public-transportation-for-women-and-womens-safety/>.
- "India: Making Public Transport More Women-Friendly." 2023. *World Bank Blogs*. Accessed February 22. <https://blogs.worldbank.org/endpovertyinsouthasia/india-making-public-transport-more-women-friendly>.
- Mahale, Ajeet. 2019. "9% Of Urban Indian Women Feel Safe in Public Transport: Study." *The Hindu*. March 12. <https://www.thehindu.com/news/cities/mumbai/9-of-urban-indian-women-feel-safe-in-public-transport-study/article26515429.ece>.
- "Census Data | Government of India." 2023. Accessed February 22. <https://censusindia.gov.in/census.website/data/>.