HIGH VOLUME TRANSPORT APPLIED RESEARCH

THE URBAN CATALYSTS


# Safe and Secure Public Transport in Delhi

## Project Completion Report

September 2024

HVT055 – LC023

DT Global

UK International Development

Partnership | Progress | Prosperity

**This research was funded by UKAID through the UK Foreign, Commonwealth & Development Office under the High Volume Transport Applied Research Programme, managed by DT Global.**

**The views expressed in this report do not necessarily reflect the UK government's official policies.**

| | |
|---|---|
| Reference No. | HVT055 – LC023 |
| Lead Organisation/ Consultant | The Urban Catalysts |
| Partner Organisation(s)/ Consultant(s) | NA |
| Title | Safe and Secure Public Transport in Delhi |
| Type of document | Project Report |
| Theme | Technology and Innovation |
| Sub-theme | The digitalisation of transport |
| Author(s) | Sonal Shah, Manisha Sharma, Shradha Gupta, Abhijeet Sengupta, Sujata Savant |
| Lead contact | Sonal Shah, The Urban Catalysts |
| Geographical Location(s) | Delhi, India |


| Abstract |
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| There is an increasing recognition for gender mainstreaming in urban transport, globally. However, gender inclusive public transport operations is hindered by the lack of regular and consistent gender (age and ability) disaggregated data and an analytical framework that provides details on how men, women and other genders use public transport, and how it can be used to prioritize safety and security in public transport. This project proposes a research-to-implementation initiative, along with a process centered technology innovation in digitalization of public transport ticketing systems and its application to improve safety and security in e-bus transport.<br><br>The project will be piloted along one e-bus route in the city in partnership with the Delhi Transport Corporation, whose lessons will be scaled up to other routes across the city. This process will also provide lessons for bus transport agencies in low-and-middle income countries. |



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|---|---|
| Keywords | Safe, bus, public transport, digitalization |
| Funding | UK Aid, FCDO |
| Acknowledgements | We are very appreciative of the Delhi Transport Department and the Delhi Transport Corporation for their support throughout the project. Specifically, we are grateful to:<br>• Shri Ashish Kundra (IAS), Principal Secretary to Lieutenant Governor, Government of the National Capital Territory of Delhi (GNCTD).<br>• Shri Prashant Goyal (IAS), Principal Secretary and Transport Commissioner, Government of the National Capital Territory of Delhi (GNCTD).<br>• Smt Shilpa Shinde (IAS), Managing Director, Delhi Transport Corporation. |

We are grateful to the DT Global team for project management support: Neil Ebenezer (Team Leader), Samuel Fookes and Jeff Turner for his technical reviews.

There are multiple stakeholders who collaborated with us in this project. We appreciate the support by Indraprastha Institute of Information Technology, Tummoc, Delhi Integrated Multi-Modal Transit System Limited, Azad Foundation, Martha Farrell Foundation, Delhi Skill and Entrepreneurship University, Janki Devi Memorial College, TN College of Competitions and Kasturba Institute of Technology.

| Issue | Status | Author(s) | Reviewed By | Approved By | Issue Date |
|---|---|---|---|---|---|
| 1 | Skeleton Report | Sonal Shah, Manisha Sharma, Shradha Gupta, Abhijeet Sengupta, Sujata Savant | Jeff Turner | Jeff Turner | |
| 2 | Gendered travel & rapid analysis report | Sonal Shah, Manisha Sharma, Shradha Gupta, Abhijeet Sengupta, Sujata Savant | Jeff Turner | Jeff Turner | |
| 3 | Endline Assessment Report | Sonal Shah, Manisha Sharma, Shradha Gupta, Abhijeet Sengupta, Sujata Savant | Jeff Turner | Jeff Turner | |
| 4 | Project Completion Report | Sonal Shah, Manisha Sharma, Shradha Gupta, Abhijeet Sengupta, Sujata Savant | Jeff Turner | Jeff Turner | |

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# Abbreviations/Acronyms

| | |
|---|---|
| AFC | Automatic Fare Collection |
| API | Application Programming Interface |
| AVL | Automatic Vehicle Location |
| CCC | Command-and-Control Centre |
| CCTV | Closed-Circuit Television |
| CDV | Civil Défense Volunteers |
| CNG | Compressed Natural Gas |
| CRUT | Capital Region Urban Transport |
| DIMTS | Delhi Integrated Multi-Modal Transit System |
| DTC | Delhi Transport Corporation |
| ETM | Electronic Ticketing Machine |
| FCDO | Foreign, Commonwealth & Development Office |
| FGD | Focus group Discussion |
| GNCTD | Government of National Capital Territory of Delhi |
| GST | Gender Sensitisation Training |
| HPCRW | Household Purchases and Care-related Work |
| HVT | High Volume Transport |
| LFPR | Labor Force Participation Rate |
| LMIC | Low- and middle-income countries |
| MBTA | Massachusetts Bay Transport Authority |
| MCD | Municipal Corporation of Delhi |
| MTR | Metropolitan Transport Authority |
| NCMC | National Common Mobility Card |
| O-D | Origin Destination |
| ODA | One Delhi Application |
| OMNY | One Metro New York |

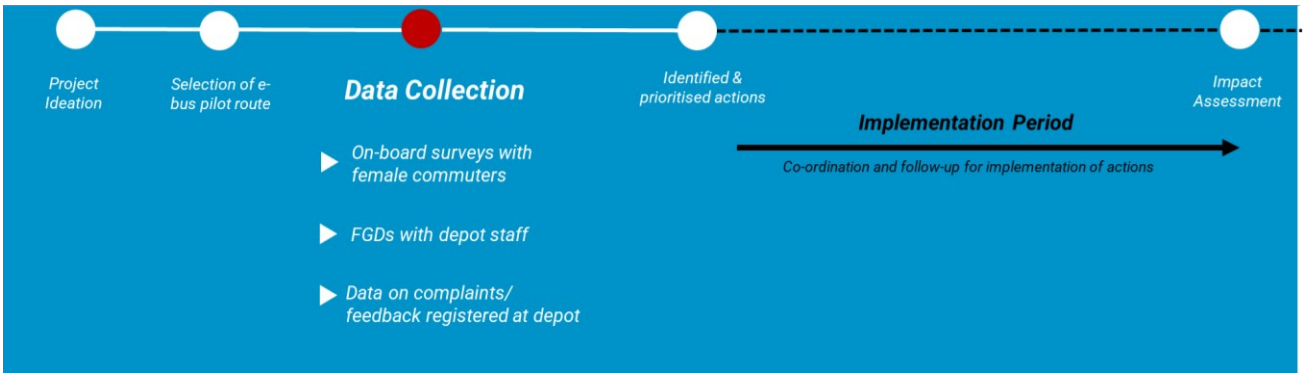
| | |
|---|---|
| PIS | Passenger Information System |
| PT | Public Transport |
| PWD | Public Works Department |
| PwD | Persons with Disability |
| QR | Quick Response |
| SAM | Secure Access Module |
| SSIs | Semi-structured Interviews |
| TfL | Transport for London |
| WMATC | Washington Metropolitan Area Transit Authority |

# Executive Summary

Despite growing recognition of the need for gender mainstreaming in urban transport, there remains a significant gap in creating gender equitable public transport systems. This gap largely results from public transport authorities' reliance on gender-blind data, which excludes insights into women and girls' travel behaviour from effective planning and service provision. Traditional data sources, such as household surveys and census data, often fail to capture the dynamic nature of public transport usage.

This project highlights the critical role of data in addressing these service gaps to enhance the safety and reliability of public transport for women and girls. The initiative focuses on electric buses, capitalizing on the ongoing transition of Indian cities toward electric buses.

The project employed a two-pronged approach. The first phase involved identifying gaps through literature reviews, primary surveys with female commuters, and focus group discussions with depot staff. A global review of public transport ticketing data revealed that gender-disaggregated data is either not collected or, if collected, is not effectively used to address service gaps from a gendered perspective. Literature widely supports that a multifaceted approach, similar to the Guardian project in London, is effective in addressing safety concerns. This phase also included analysing the knowledge and behaviour of public transport frontline staff regarding the safety of female commuters. The second phase focused on implementing recommendations based on empirical evidence and evaluating the impact of these interventions.




The baseline assessment indicated that 72% of female commuters on the pilot e-bus route travel for paid work, with 18% traveling for education. The majority (77%) of female commuters on the pilot route are young women aged 18-35. Although 77% of female commuters have access to a smartphone, their digital literacy is low. The Delhi government has implemented various safety initiatives for female commuters, including helpline numbers, panic buttons, and mobile applications for ticketing and feedback. However, awareness of these initiatives among female commuters is limited. Only 2% of female commuters are aware of the One Delhi application, 5% know about the panic buttons, and 10% are familiar with the DTC helpline number.

Female respondents felt less safe while traveling inside the bus (69%) as compared to waiting at bus stops (21%). The key issues highlighted include the lack of real-time bus arrival information at stops, limited awareness of grievance redressal mechanisms, overcrowding during peak hours, and taunting by male passengers regarding the fare-free travel scheme.

The focus group discussions with frontline staff revealed gender-biases, with staff prioritizing paid work travel and perceiving women traveling for household chores or recreational purposes are misusing the fare-free travel scheme. This bias leads to drivers skipping bus stops if they perceived that women are not traveling for significant purposes like paid work. There is also a stark difference between the perceptions of frontline staff regarding women's safety and the actual feelings of female commuters, 69% of whom report feeling unsafe. This suggests that frontline staff may not fully recognize sexual harassment as a critical safety concern.

Both women and frontline staff prefer e-buses over CNG buses due to better air conditioning, regular maintenance, and quieter operations. However, concerns about e-buses include long waiting times, frequent breakdowns, ventilation issues, and malfunctioning Passenger Information Systems (PIS).

Based on survey findings and consultations with government stakeholders, strategies were developed to improve the safety of female commuters on DTC buses. These included integrating e-buses into a mobile application for real-time information, updating latitude and longitude data for accurate bus stop

announcements within e-buses, and enhancing the mobile app's user-friendliness based on female commuters' needs and educational levels. An awareness campaign was also conducted on the pilot route, in colleges, institutes, and with women in membership organizations, as well as on social media. Stickers with helpline numbers and panic button information were displayed on all DTC e-buses. Additional measures included gender sensitization training of depot staff and updating audio announcements to increase awareness of safety initiatives.

The endline assessment revealed increased awareness of DTC helpline number (from 10% to 35%), the One Delhi application (from 2% to 63%), and panic buttons (from 5% to 65%). Secondary data also showed an increase in e-ticket purchases by female commuters using the mobile application and an increase in the number of complaints registered by female commuters is observed during project's implementation phase.

These insights from this pilot study are crucial for scaling up activities within Delhi and can also inform efforts in other Indian cities and LMICs to improve public transport services for female commuters. The project underscores the need for systematic collection and analysis of gender-disaggregated ticketing data to ensure safe and reliable public transport for women and girls. An integrated approach that employs multiple strategies is found to be more effective in addressing women's needs and improving services for all commuters. Targeted awareness campaigns are essential, particularly for resource-poor women who may face barriers to digital access. Based on these findings, a scale-up plan has been developed with stakeholders to extend these initiatives more broadly, enhancing travel safety for women and girls.

# 1. Introduction

There is an increasing recognition for gender mainstreaming in urban transport, globally. Women constitute most public transport passengers in numerous countries in Latin America, the United Kingdom, and Europe (1). According to the data from the Census of India (2011), women workers[1] constituted 24 percent of bus passengers and 16 percent of rail passengers in urban districts across India.

The absence of consistent gender-disaggregated travel and perception data, particularly in low- and middle-income countries (2,3), along with uncertainty about effectively leveraging such collected data (4), obstructs gender equitable public transport operations. This hinders strategic, evidence-based public transport operations, planning, and decision-making for safe and secure commute for women, girls, and other sexual minorities. For example, there is no clear rationale for how many seats should be reserved for women in buses in low-and middle-income countries (LMICs) or consider service augmentation on routes where more women may travel, depute women bus drivers and conductors on such routes or prioritize safe first and last mile connectivity.

This data is currently being filled through numerous surveys undertaken by public transport agencies and civil society organizations. This may be collected (if at all) through surveys like household surveys, travel surveys, boarding & alighting surveys, perception surveys, etc. However, the scope of the data collection is limited to specific routes and not across the entire system. Bus transport agencies in cities in India are moving towards digitalization of their ticketing systems, to provide trip data, reduce revenue leakage, for paperless transactions, and initiate a shift towards a more cash-less digital economy. In Mumbai, BEST (public transit agency) has piloted the use of smart cards and a tap-in and tap-out system on two buses (5). The National Common Mobility Card (NCMC) was launched in India with the tagline of One Nation One Card on March 04, 2019 (6), so that all transit payments are interoperable. It is still in its nascent stages and will depend on multiple transit agencies making it compatible. The Delhi government has the One Delhi Card and application, which can be used across buses and the metro-rail system.

The smart cities approach is driving the transition within transit agencies from traditional mobility to smart mobility through the integration of various technical and digital technologies (7). However, existing literature indicates that these new technological solutions, like bike-sharing programmes, mobile applications for real-time information, and digital ticketing systems, may exclude women with limited access to smartphones (3). These systems require the use of the internet. According to the International Telecommunication Union, the worldwide Internet penetration rate in 2017 stood at 45% for women, in comparison to 51% for men. This disparity is more pronounced in developing countries, where it reaches 17%, as opposed to developed countries, where it is less than 5% (8). According to the findings of the National Family Health Survey-5, 69% of women in urban India have a mobile phone; however, 52% of them utilize mobile internet services (66% of men), and a mere 30.9% of this subset have reported employing it for financial transactions (9). Also, the ownership of mobile phones and the ability to use them are influenced by the income strata. This connection is exemplified by our study conducted in 2020 with 800 resource-poor women in Delhi, where only 10% of the surveyed women had access to a personal or shared smartphone and only 2% of them knew how to make digital payments. This indicates a substantial impediment in improving resource poor women's access to public transport where smartphone-based real-time information and digital ticketing are being initiated. There is a need to enable inclusive digitalisation of ticketing systems that also capture gender-disaggregated data at the point of sale of a ticket and use that to improve women's safety in public transport.

## 1.1 Project aim and Objectives

This project centers on technological innovation in the digitisation of public transport ticketing systems, with a primary objective of addressing gender-disaggregated data gaps. The purpose is to provide transport authorities with evidence-based insights, fostering a proactive approach to safety and security in bus-based transportation. The project intends to initiate a pilot implementation of this innovative approach in e-buses, leveraging the ongoing transition of Indian cities toward electric buses.

[1] *Workers here mean other workers. As per Census of India 2011, Other workers are those workers who have been engaged in some economic activity during the last one year, but are not Cultivators or Agricultural Labourers or Workers in Household industry.*

As of June 2023, Delhi had around 300 electric buses or e-buses, making it the city with the highest number of e-buses. It aims to increase its fleet of e-buses to 1,500 by the end of the year 2023. Thus, Delhi is selected for the project.

Specifically, the objectives of the project are to establish a systematic approach for collecting and analysing consistent gender-disaggregated data and identify the gaps in the existing strategies implemented by the Government of National Capital Territory of Delhi (GNCTD) to improve the safety of women, girls, and other gender minorities. Our research aligns with the broader framework of utilising technology to mainstream gender considerations in public transport services.

## 1.2 Beneficiaries and Research Uptake

This project focuses on e-buses in Delhi and aims to extract insights that could be applicable for replication in Indian cities and other LMICs. The initiative provides a pathway for collecting gender-disaggregated data through public transport ticketing system and utilising the data to address service gaps and improve safety of women and girls. The goal is to integrate a gender perspective into the planning and operations of bus-based public transport. The target audience includes transport operators in LMICs, who can apply the insights from this project to integrate a gender perspective into their operations.

# 2. Theoretical Approach & Methodology

The methodology is informed by existing research on sexual harassment in Delhi's public transport and service level gaps perceived by women, girls, and gender minorities in bus-based travel, both day and night. The approach acknowledges the lack of gender-disaggregated data and aims to establish strategies based on evidence to address service gaps and ensure safe and secure travel. The research design recognises the limited experience of bus-based public transport operators in gender mainstreaming in planning and operations, particularly in LMICs, necessitating the need for supportive guidance given the emerging nature of this concept in developing countries.

## 2.1 Theoretical Approach

There is an abundance of literature available that highlights the prevalent issue of sexual harassment in public transport in Indian cities (10). Cities in developing countries like Nepal, Pakistan, Turkey, and Bogota face similar issues (11,12,13). In the landscape of sexual harassment incidents within public transport systems, several factors inhibit the reporting of such incidents. Notably, these deterrents encompass a lack of awareness, the tendency to trivialize sexual harassment as an integral part of the public transport journey, and the belief that such occurrences aren't grave enough to warrant reporting (14). The low reporting rates of sexual crimes against women in public transport stem from the societal norms dictating the behaviours expected of men and women in public spaces. However, there's also an association with the available infrastructure that enables victims to report incidents (15). The perception of lack of support during and after the crime also deter women from involving law enforcement agencies (16,15). In Indian cities, like Delhi where 80% of surveyed women faced sexual harassment but only 1% reported it to the police is a serious issue (17). For instance, another study conducted in Mumbai found only 2% of women commuters who had faced harassment approached the police and none were satisfied with the outcome (16).

The theoretical framework guiding this research is rooted in the Knowledge, Attitude, and Behaviour (KAB) theory. The theory states that people's knowledge about a particular behaviour can affect their attitudes towards that behaviour, and their attitudes can, in turn, affect their behaviour. However, knowledge alone cannot influence the behaviour change (18). These insights stem from the Guardian project of Transport for London where an emphasis on creating a secure environment for women commuters to report incidents resulted in a 20% increase in reported incidents (19). This project focuses on developing the infrastructure system to make the reporting of the crime easier and increase accountability. Adopting the KAB theory, the aim is to utilise primary surveys to identify the knowledge gaps and attitude barriers that may facilitate understanding their actions. This project framework focuses not only on safety but also improving the service quality of bus-based public transport to travel safer and reliable for women and girls.

For public transport system managers aiming to maintain or enhance ridership, it's imperative to comprehend the security requirements of passengers, particularly women. A comprehensive approach to safety, considering the whole-of-journey approach proves valuable in identifying aspects of the transit experience that demand special attention from transportation providers (15). While the whole journey of approach is important, the fragmentation of public transport provision needs to be recognised as a particular hurdle that needs to be addressed.

Furthermore, multiple studies have demonstrated that the perception and experience of safety in public transport have strong intersectional dimensions (20,14,21). In this context, intersectionality pertains to various factors such as age, income, education level, and gender identity. This study also explores some of these intersectional dynamics.

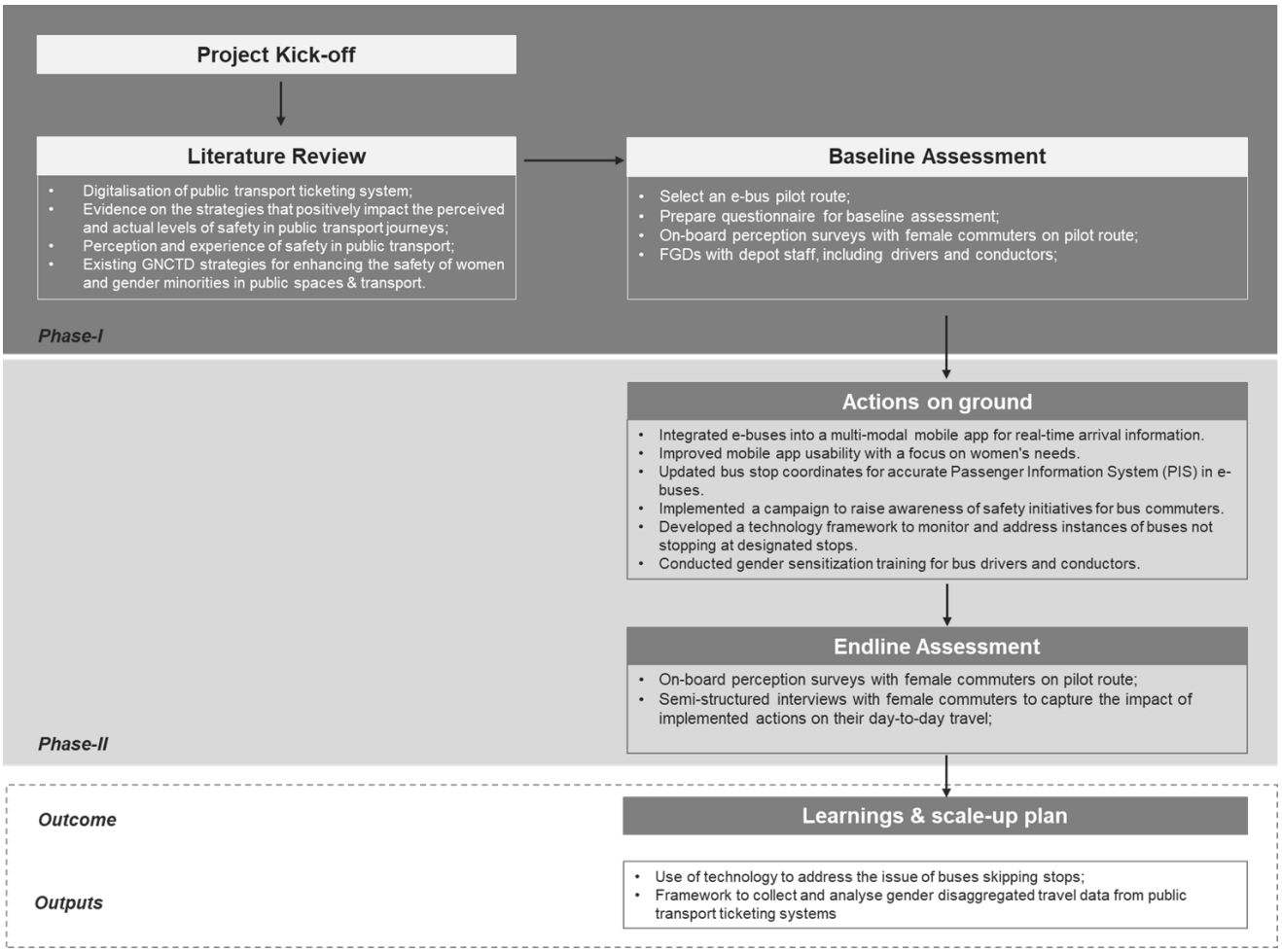
Overcrowded public transportation systems are often identified as the cause of sexual harassment and various forms of sexual abuse. While it is important to note that overcrowding itself does not serve as a direct cause for sexual crimes against women in these environments, it does, however, play a facilitating role by creating opportunities for perpetrators to exploit vulnerable situations. Addressing the predicament of overcrowding often involves the augmentation of buses or trains to mitigate the issue. However, this study takes a distinct approach by focusing on enhancing the management of public transport. However, addressing the underlying social factors that contribute to gender-based violence goes beyond the scope of transport planning and urban design. The physical aspects of urban and transportation structures play a significant role in encouraging or challenging the incidences (20).

This entails framing women's safety within a broader context, as the individual's needs and right to the basic public good. In instances where this fundamental need remains unfulfilled- a reality prevalent in numerous transportation systems across cities in the Global South- improving women's safety in public transport on a short-term basis becomes an intricate challenge.

## 2.2 Methodology

Building on our approach, the research followed a two-phase process. The first phase aimed at understanding the gaps in grey and published literature, aggregating perspectives and awareness level of female commuters, and evaluating the understandings and viewpoint of frontline workers on the specific issues faced by female commuters. This also includes comprehending the knowledge and behaviour of frontline staff members working in public transport concerning the safety of female commuters. Following that, the subsequent phase centered around the implementation of recommendations drawn from empirical evidence, while simultaneously evaluating the resulting impacts of these recommendations. The research methodology is summarised in Figure 1.

Figure 1: Project Methodology




### 2.2.1 Study Methods

The study methodology encompasses a thorough literature review of peer-reviewed research papers, conference proceedings, and grey literature, including reports and publications. A mixed-method approach was adopted for the project, thus both quantitative and qualitative data was collected. Quantitative data was collected through perception/awareness surveys, while qualitative insights ware collected through ethnographic studies utilising focus group discussions and semi-structured interviews. To ensure robustness, triangulation was employed to correlate results from both quantitative and qualitative surveys.

## 2.2.2 Literature review

The literature review is divided into three sections. The first section includes the study on the type of data collected through the digitalisation of public transport ticketing systems and how is it being utilised. This includes case studies from cities such as London, New York, Bhubaneswar, and Delhi that collect or use ticketing data for public transport planning and operations. The research primarily aims to evaluate the collection and use of gender-disaggregated data within bus-based public transport systems, with a particular focus on improving safety for female commuters. Additionally, the study seeks to identify gaps and limitations in the collection and use of this data in Delhi.

The second section of the literature review synthesizes evidence on strategies that positively impact the perceived and actual levels of safety in public transport journeys. This review aims to leverage existing research/experience of other cities to derive evidence-based strategies that could be employed in case city to enhance travel safety for women, girls, and gender minorities.

The third section of the literature review amalgamates findings from various studies to map out the landscape of safety perceptions and experiences, including incidents of sexual harassment in public transport and public spaces in Delhi. It also outlines the initiatives implemented by GNCTD to improve the safety of women, girls, and gender minorities in public transport and public spaces.

## 2.2.3 Data collection strategies

### Perception surveys

A two-tiered methodology was employed to select a pilot e-bus route among all the route operate by the Delhi Transport Corporation (DTC). First, a depot was selected and then the pilot e-bus route. In the first tier, the selection of a depot was based on the lowest headway exhibited by buses across all routes originating from the respective depots.

In the second tier, a framework was established to assign weightage to various routes based on two key parameters: land use mix and e-bus frequency. The inclusion of land use mix was due to its substantial influence on travel behaviour (22). Land use mix is defined as the level of integration among different land use types, such as residential, commercial, institutional, industrial, and green spaces. The assessment of land use mix was conducted using the Entropy Index for land use within 500 meters along the e-bus routes. Both parameters are accorded equal weightage in the evaluation process.

The Entropy Index is commonly used for representing the land use mix (23,24). It measures the number of land uses present in an area with the total number of land uses found in the area. Higher levels of Entropy mean a higher mix level of land uses. However, the spatial interaction of different land uses is not considered in the entropy index (25). Entropy is calculated as:

$$\mathrm{LUM} = -\sum_{i=1}^{k} \frac{P_i \times ln(P_i)}{ln(k)}$$

Where $P_i$ = the proportion of total land area of ith land-use category; and k = total land uses considered in the study area. Proposed land use map of Delhi for 2021 was used for this analysis.

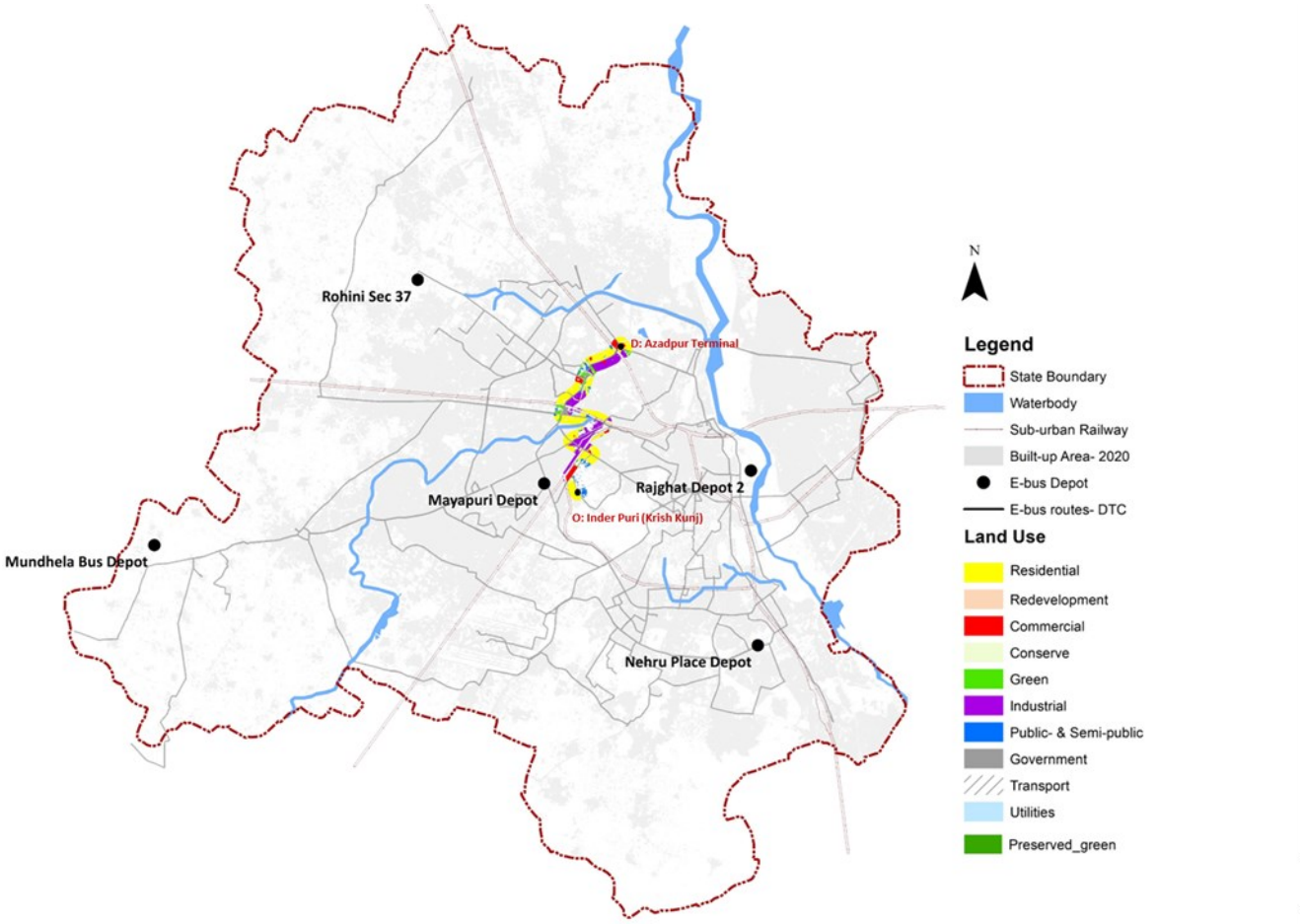
Two potential routes were chosen for on-site verification. Following the ground truthing process, a pilot e-bus route was selected from 39 routes operated by five e-bus depots[2]. The pilot route- R78- spans 15 km running from Inder Puri (Krish Kunj) to Azadpur terminal and had a ridership of 7,652 passengers in at the time of selection (August 2023). Female commuters constituted 51% of the total ridership. This route represents an urban corridor, beginning and ending within the city.

The geographical landscape along this route is primarily characterized by residential areas, including Jughi Jophri (JJ) resettlement colonies such as Budh Nagar, Pandav Nagar, and Baljeet Nagar. Additionally, the route intersects significant industrial areas, including Naraina Vihar, Najafgarh, Moti Nagar, and Wazirpur

[2] At the time of pilot e-bus route selection, there were 5 electric bus depots in Delhi- Mundhela Kalan, Rohini Sec-37, Rajghat Depot-2, Mayapuri, and Nehru Place - which cater to around 500 e-buses (as 200 new e-buses were added in June 2023) (22). E-buses are being incorporated into the DTC fleet during the project period. The methodology includes data up to July 2023. Currently, as of July 2024, DTC has a fleet of 1,970 e-buses (58).

Industrial Area. Furthermore, it incorporates prominent commercial hubs such as Azadpur Mandi and Netaji Subhash Place.

Figure 2: Pilot e-bus route: R78




The perception surveys were conducted with female commuters aged >10 years on the selected e-bus route. The data was collected on weekdays from 07:00 am to 07:00 pm with equal distribution of surveys in both the Up and Down directions of the route. A stratified random sampling method was adopted to collect data. A survey agency was hired to conduct on-board surveys for both baseline and endline surveys.

A draft survey questionnaire was first created and tested amongst the female commuters on 3 routes and subsequently revised. Training is provided to all surveyors and supervisors to ensure their understanding of the questionnaire and survey ethics. Only female surveyors were employed to conduct the survey.

## Baseline Surveys

A baseline study was conducted in September-October 2023 on the selected e-bus pilot route. 296 female commuters were surveyed which accounts to 8% of female ridership on the pilot route. The determined sample size is based on a 90% confidence level and a confidence interval of 5%, taking into account the female e-bus ridership. The survey questionnaire aimed to assess the travel behaviour of women traveling on the selected route, their perception of safety while traveling, awareness of the initiatives implemented by the Delhi government for women's safety, and their perception of e-buses.

## Endline Surveys

The endline assessment with an aim to evaluate the project's impact and to derive lessons that can be utilised to improve the future implementation strategies were conducted in June 2024. For the endline assessment, a similar mixed-method approach was adopted as was used during the baseline assessment. The same questionnaire used for baseline assessment, with some improvements, was utilised to not only measure awareness levels but also to understand the specific features of the existing mobile phone

application, with a focus on One Delhi Application, being used by female commuters. A total of 40 surveys were conducted for comparison with the baseline data.

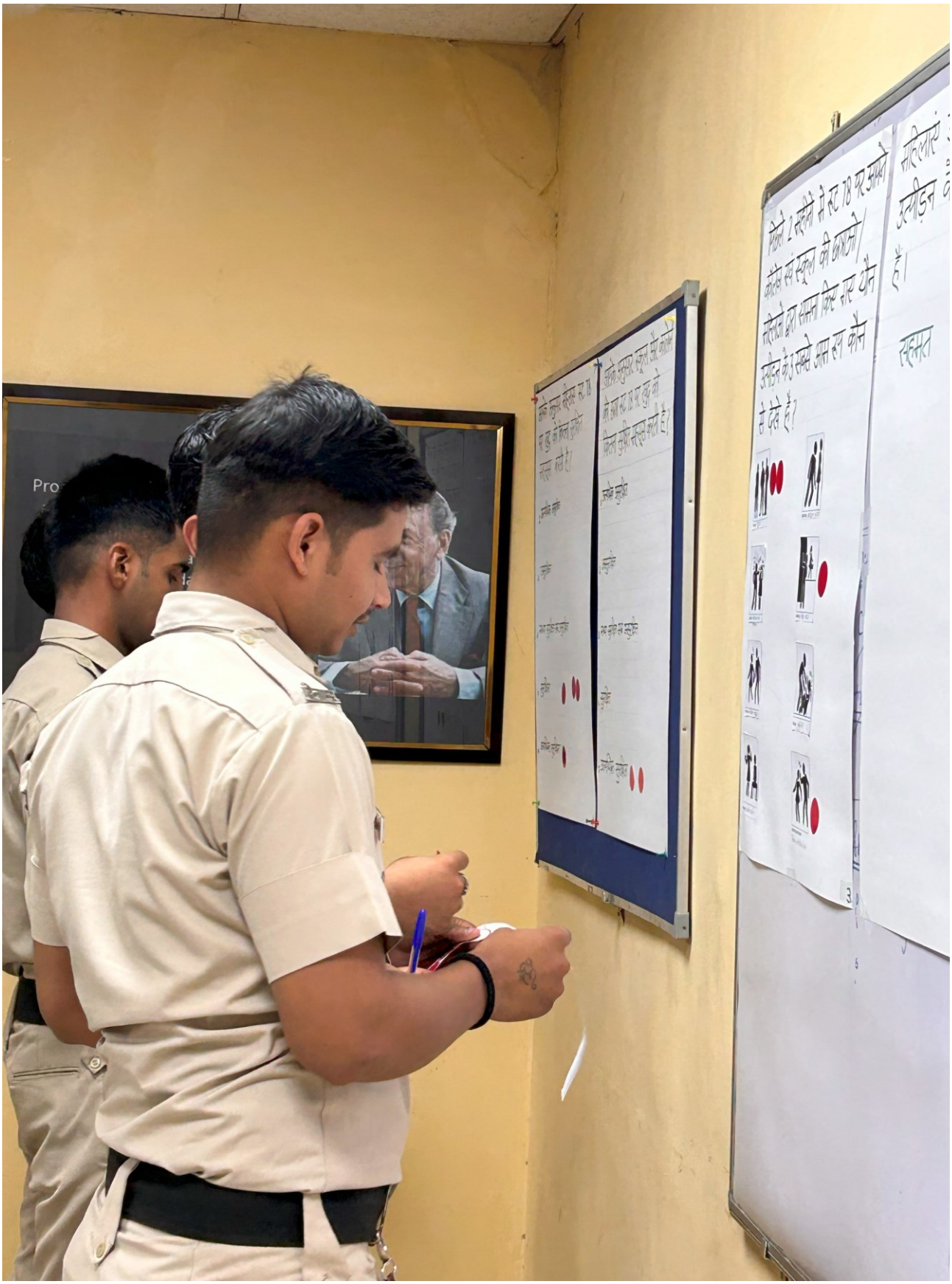
The sample size for the endline assessment was reduced due to the time needed for the implementation of actions on ground. To substantiate findings, semi-structured interviews with female commuters were conducted to understand detailed narratives and qualitatively evaluate the impact of increased awareness on their daily travel experiences. The impact was also measured through secondary data, including metrics such as online tickets purchased by female commuters and feedback submitted via helpline number or mobile phone application.

## Focus group Discussions (FGDs) and Semi-structured Interviews (SSIs)

Along with the baseline survey, focus group discussions were conducted with 39 frontline staff, including bus marshals, conductors, and drivers, all of whom have worked on the pilot e-bus route in the past two months[3]. These sessions were conducted separately for both male and female workforce. The purpose of these FGDs was to delve into the underlying perceptions of women's safety in buses, assess their knowledge of roles and responsibilities, and explore the potential role they can play in creating a safe travel environment for women and girls. Each FGD lasted for around 1-1.5 hours.

A semi-structured interview was also conducted with depot staff, including drivers, conductors, and bus marshals, to assess the guiding behaviour of frontline personnel. These interviews focused on understanding the existing grievance redressal mechanism, standard operating procedures for frontline staff, existing incentive mechanisms (if any), and potential strategies to enhance the safety of women and girls traveling on DTC e-buses.

[3] In the context of the DTC, frontline workers are subject to a rotational duty schedule where they are reassigned to a new route every two months.



# 3. Literature Review

This study provides a synthesized comprehensive literature review focused on the digitalisation of ticketing systems in bus-based public transport. It examines how these systems use data (gender-disaggregated) to incorporate gender considerations into the planning and operation of public transport, aiming to improve safety and security for women during travel.

While an extensive body of literature exists regarding strategies for ensuring safe travel for women, there remains a scarcity of empirical studies that offer conclusive evidence regarding the efficacy of these strategies for transport operators and professionals. This study aims to fill the gaps by collecting evidence on the effectiveness of the strategies implemented by public transport authorities to improve safety in public transport, with a focus on LMICs.

## 3.1 Digitalisation of bus-based public transport ticketing system

A rapid literature review is conducted to understand the utilisation of ticketing data to provide equitable and safe public transport services and the following are the key findings:

- Research on the utilisation of electronic ticketing machine (ETM) data is scarce and mainly focuses on developing countries;
- Published research using ticketing data is focused on understanding passenger travel patterns and behaviour analysis, service improvement in terms of route rationalisation, or increase in frequency with little or no focus on gender differences in travel (26). All the studies which focused on gendered travel behaviour relied on primary data collection methods (27,28,29) or either used existing census data (30);
- Transit agencies, even in high-income countries (HIC), do not collect gender-disaggregated data from their Automatic Fare Collection (AFC) system. Transport for London (TfL) conducts a "*Travel Demand Survey*" every year to collect sex-disaggregated travel data (31). New York's OMNY system does indeed incorporate gender-disaggregated data collection. However, the OMNY's data policy explicitly states that the purpose of collecting gender-disaggregated data is to facilitate responsive customer care services in the event of grievances. Even though, the gender-disaggregated data is collected via technologically advanced fare collection systems (like New York), there is limited focus on integrating a gender lens as a recurring aspect of service improvement using the data;
- The analysis of smart card data to improve public transport services is predominantly conducted for developed countries (32). The prevailing body of literature concerning the utilisation of smart card data primarily focuses on urban rail networks (33). In the majority of cities where contactless smart cards or bank cards serve as the primary fare media, they are employed across multiple modes of transportation. This emphasis stems from the presence of both entry and exit points in AFCS transactions within rail networks, rendering the tracking of travel flow notably straightforward. Buses require one tap of smart card at the time of boarding (as present in London). However, there is a subset of literature available that employs different techniques to estimate the alighting location of bus trips by establishing connections with Automatic Vehicle Location (AVL) data or by establishing a correlation with the boarding locations of subsequent trips (34);
- The representation of other sexual minorities appears to be lacking in the landscape of studies using ticketing data or focused on understanding gendered travel behaviour.

The Automatic Fare Collection (AFC) system is more mature and well-established in developed countries and is being adopted by developing nations in a gradual manner (35). In light of this context and the emerging nature of gender-specific data collection, this review comprehensively incorporates pertinent information from both developing and developed countries. A literature review was conducted using the Google search engine and Google Scholar, encompassing published works and grey literature. The aim was to gather insights on gender-specific data collected by AFC system.

AFC system or Electronic Fare Payment systems, leverage electronic communication, data processing, and data storage techniques to streamline and automate the traditional manual fare collection process.

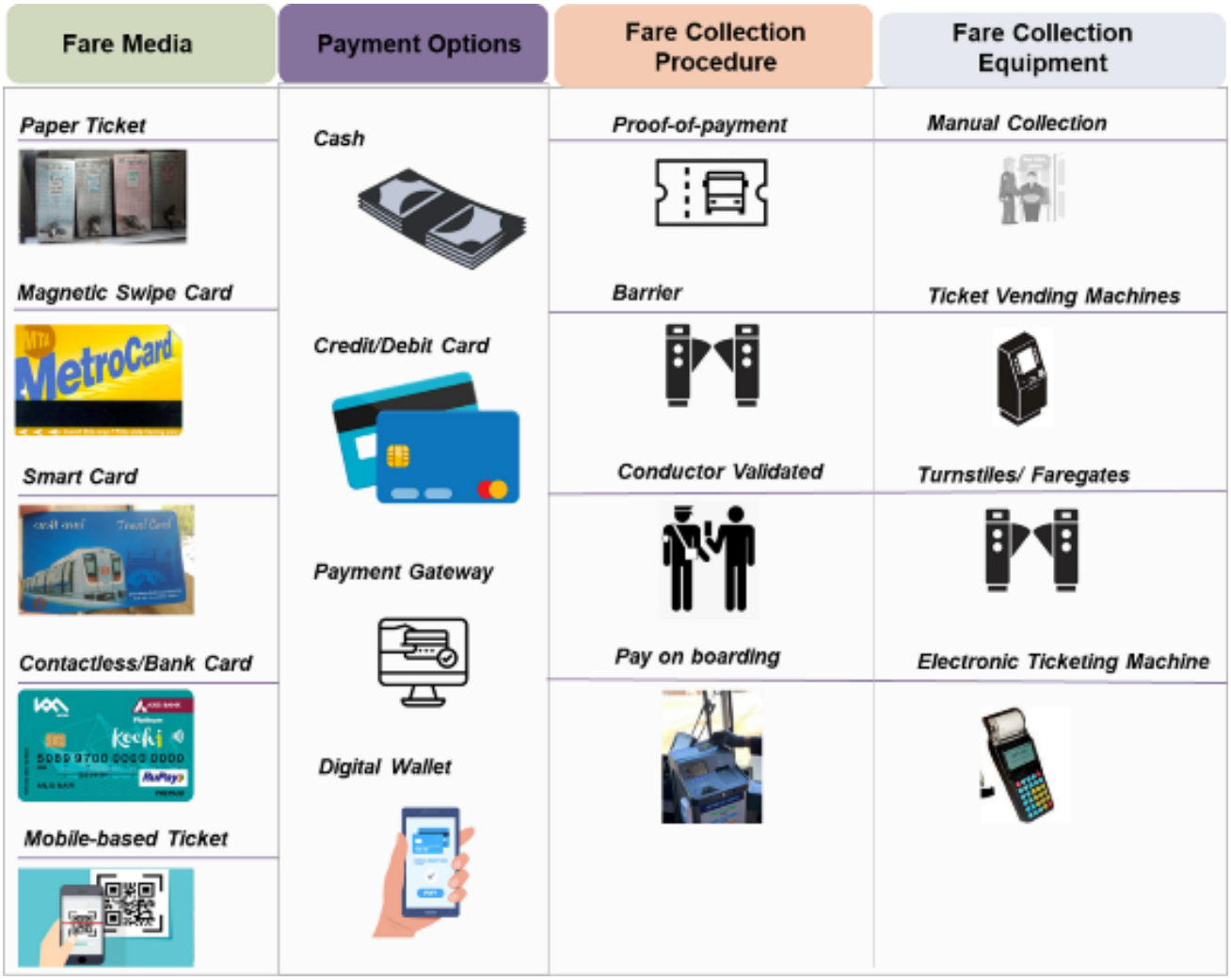
This allows to speed up passenger flows, reduce the cost of fare collection and provide a better service to passengers by analysing the existing travel pattern (36). Based on the literature (37,38) , the following are the four main components of a fare collection system:

(i) **Fare media**, encompass payment mediums like paper tickets, magnetic cards, smart cards such as the metro rail cards;
(ii) **Payment options** facilitate transactions through various means including cash, credit/debit cards, digital wallets like Amazon Pay, Airtel Thanks, and United Payments Interface-based platforms such as Google Pay, Phone Pay, and Paytm;
(iii) **Fare collection procedures**, which include barrier-tap on entry/exit, on board payments, proof-of-payment, and conductor validation; and
(iv) **Fare collection equipment/technology**, includes turnstiles, fare gates, devices for reading magnetic stripes, smart cards, bank cards, and ETM.

Typically, user data is stored in fare media, while mobility data is captured through the fare collection equipment/technology, and this boundary is blurring.

Public transport ticketing systems have evolved from manually issued pre-printed paper-based tickets to smart phone enabled QR code-based tickets. The type of data collected- user and mobility data- varies based on the fare media used in the AFC system. The following figure illustrates the technological advancement in fare media (from top to bottom):

Figure 3: Components of fare collection system




*Source: The Urban Catalysts*

Passenger demographic and travel data can be collected with magnetic swipe cards, smart cards, bank cards, and application-based tickets as well as with electronic ticket vending machines. Passenger data

can include age, gender, disability, senior citizens, and students. Mobility-related information includes origin and destination locations and times, fares. The following table illustrates the international examples of data collected while using different ticket media:

Table 1: Data collected by different ticket media

| Fare Media | Primary Fare Technology | Examples of cities with this system | Data Collected |
|---|---|---|---|
| Pre-printed | Manually issued | Kathmandu, Nepal<br>Beijing, China<br>Delhi, India | **Travel and user details**: Total number of passengers and by route;<br><br>In Delhi, pink tickets issued to women can provide data on daily ridership. |
| Electronic tickets | Issued through ETMs, (multimodal) ticketing applications such as One Delhi Application and Chalo in India | ***Multiple PT modes:*** Dublin, Ireland,<br><br>***Only Buses:*** Ahmedabad (Bus Rapid Transit System) | **Travel details:** Origin and destination stops, fare stage, time stamp, vehicle number, trip direction (up or down);<br><br>**User details** collected through the ETMs or ticketing applications: Gender of the commuter, type of use like a student, elderly, person with disability.<br><br>*Source:* (39) |
| Magnetic card (Swipe) | | ***Multiple PT modes****:* New York (MetroCard) | **Travel details:** Origin and destination stops, time stamp, bus number;<br><br>**User details:** Card identification number;<br><br>*Source:* (40) |
| Contactless transit card/Smart Card | Radio Frequency Identification (RFID) or Near Field Communications (NFC) technology | ***Multiple PT modes:***<br><br>London (Oyster card), New York (SmartLink) Boston (Charlie card), Beijing (Yikatong), and Hong Kong (Octopus card) Barcelona (T-mobilitat)<br><br>***Only metro-rai in Indian cities, including but not limited to****:* Delhi Mumbai Bengaluru Chennai | ***Data collected by Oyster Card: Personal Information***[45]<br>• Title *(Gender-disaggregated data is derived from the title)*, name, address, email address, phone number<br>• Customer ID<br>• Oyster card number<br>• Password/memorable information/telephone PIN<br>• Mobile device number (unique code used to identify), IP address, International Mobile Equipment Identity number<br>• Payment card information (including the 16-digit PAN, expiry date, and CVV number) or bank account and sort code numbers (masked)<br>• Enquiries, complaints, or other correspondence from you |

4 Prominent in bus-based transport

5 Personal information is only collected if a user registers for an Oyster card which refunds money if the card is lost, allows users to see travel history and provides discounts.

| | | | |
|---|---|---|---|
| | | Ahmedabad | ***Travel information***<br>• Journey history<br>• Boarding and alighting time<br>• Boarding & alighting location<br>• Fare amount<br>• History of locations where the card is recharged<br><br>*Source:* (41) |
| Bank cards | NFC Technology | ***Multiple PT modes:*** New York, London, Hong Kong, Chicago, Singapore, Tokyo, New York,<br><br>*Only Buses:* Barcelona<br><br>***Only Metro-rail****:* Kochi | ***Data collected by One Metro New York (OMNY):***<br><br>***Personal data (Collected when an OMNY account is being created by the user):***<br>• Name, gender, age, photograph, email address, date of birth, and password;<br>• Email address, phone number, mailing address like postcode;<br>• Payment information and identity verification information, such as credit card or other payment card information, and the last four digits of your Social Security number;<br>• Any disabilities that may qualify you for a special program;<br>• Geolocation information; device identifiers, device information like IP address, the type and version of your web browser, and referrer addresses that can function to identify a user device;<br><br>***Mobility data:***<br>• Journey history<br>• Boarding and alighting time<br>• Boarding and alighting location<br>• Fare amount<br><br>*Source:* (42) |

*Source: The Urban Catalysts*

## 3.1.1 Case Studies

### London

TfL is considered a “data-driven organisation” which uses data to improve its public transport services. TfL started the digitalisation of its fare collection system in 2003 by introducing the Oyster Card in all modes of public transport **(43)**. For buses, one has to tap the Oyster Card at the boarding station **(44)**. Therefore, the Oyster Card doesn't record data about when passengers exit buses. This is addressed by either associating the card's usage with the next station on the bus or rail route or by connecting the data about bus locations to the card usage data **(45)**. Table 1 highlights the data collected by Oyster Card. The smart card only collects personal data if the user registers the Oyster card or creates an online account. Though registering the Oyster card is optional, it allows users to see their travel

history, apply for refunds, top-up facility and get refunds, which is not available if the card is not registered to an online account **(44)**.

Though gender-disaggregated data is collected through Oyster card via title. However, there is no information available on what all title options are available and how this information is utilised. TfL employs ticketing data to enhance existing transport services, offer reroute information in case of emergency to targeted end-users **(46)**, and avoid overcrowding at stations **(47)**. However, there is currently a lack of substantial or comprehensive information supporting the utilisation of this data to incorporate a gender lens in transportation planning and decision-making processes. Annually, TfL undertakes a travel demand survey aimed at gathering gender-related data, including trip rate and mode choice (TfL, 2023). The online platform which presents the findings of the ticketing system only presents trips by travel mode and by station types which is extracted through ticketing data (TfL, 2023).

In 2022, nearly half of the women (48%) surveyed by London Travel Watch reported that they had refrained from traveling at specific times due to safety concerns **(48)**. However, TfL currently lacks supported data to identify the specific stations that might be perceived as unsafe. Presently, safety-related initiatives undertaken by TfL rely on the conclusions drawn from a primary survey conducted in 2017 **(49)**.

The Octopus card in Hong Kong collects similar information (Table 1) and does not collect any gender-related information. However, one can get a personalised Octopus card in Hong Kong for which gender-disaggregated data, including name, Hong Kong identity card, date of birth, email address, marital status, education level, occupation, monthly personal and household income is collected as mandatory information during the registration. This information is only collected to facilitate courteous customer contact **(50)**.

## New York

New York is shifting from magnetic stripe cards- MetroCard- to contactless bank cards- One Metro New York (OMNY)- where one can use their debit/ credit card to pay for public transport.

The MetroCard system in New York City operates on an entry-only basis, where users swipe their cards at entry gates, capturing transaction details only when passengers board public transportation. Therefore, it requires the Metropolitan Transport Authority (MTR)- a public transport agency- to identify the ways to identify O-D patterns. It doesn't collect any user's details. There is limited information available online on how MTR is utilising this data. The existing data indicated that ticketing data is used to report ridership in all modes of public transport in New York (51). The are numerous academic studies that leverage MTR's ticketing data to discern passenger demand patterns by analysing the Origin-Destination (O-D) information, which is only available for rail network.

Metropolitan Transport Authority- the transit agency of New York- introduced OMNY in 2019. OMNY allows transit users to pay through debit card, credit card, or mobile. It collects the personal information of the users; however, gender-disaggregated data is not collected.

## Bhubaneshwar

In 2018, the Government of Odisha revived the bus services for Bhubaneshwar and adjoining cities of Puri and Cuttack with new bus services called Mo Bus (52). This service is operated by a special purpose vehicle named Capital Region Urban Transport (CRUT) under a gross-cost contract model. CRUT has incorporated gender tagging into its ETMs, enabling the collection of gender and age data, encompassing adults, senior citizens, and children. Additionally, the system gathers route names, boarding-alighting patterns, and travel demand on specific routes (53), allowing the transit agency to capture route-wise ridership, and O-D information. However, there is no information available online on how this data is being utilised to provide safe and secure mobility for women.

## Delhi- Case City

Delhi, also known as the National Capital Territory of Delhi, has an urban population of 16 million as per the Census 2011. The public transport in Delhi comprises a network of metro-rail, ring-rail, and bus services. Bus services in Delhi are managed by the DTC and Delhi Integrated Multi-Modal Transit System Limited (DIMTS). DTC was set up in 1971 under section 22 of the Road Transport Corporation Act, 1950, and functions under the administrative control of the GNCTD (54). It operates red (air conditioned) and green coloured (non-AC) buses. DIMTS is an equal equity joint venture company of the Government of National Capital Territory of Delhi (GNCTD). It manages orange-coloured buses under the Scheme for Corporatization of Private Stage Carriage Services in Delhi since 2007 (55). Delhi also has a metro-rail system with 300+ km of extensive network which catered to 4.6 million passengers[6] daily in 2022-23 (56).

DTC is operating and overseeing a fleet of 4,346 buses[7] (including 1,231 AC CNG buses, 1,960 non-AC CNG buses, and 1,155 AC low-floor e-buses[8]), while DIMTS functions as the nodal agency tasked with the management of a fleet comprising 2,841 buses (including 94 e-buses) under the cluster scheme (57). In 2022-23, the average daily ridership of DTC was around 2.5 million (56). DTC is transitioning its fleet to electric vehicles. As of July 2024, the number of e-buses has increased to 1,970 (58).

## Data collection for operations and planning of public transport

The Delhi government with an aim to provide safe public transport equip its buses with features such as CCTV cameras, panic buttons, Automatic Vehicle Location (AVL) tracking system, and handheld ETMs. The incorporation of these equipment began in 2010 on certain buses and has been incrementally extended to include the entire fleet operated by both DTC and DIMTS (59,60). However, Currently, DTC buses utilise pre-printed tickets for fare collection, as the ETMs previously employed on these buses in 2016 (Banerjee, 2016) have phased out in September 2022 (61). They were either not working or required an upgrade. However, all the cluster buses operated by DIMTS are equipped with CCTV cameras and handheld ETMs (60). DTC has been collecting gender-disaggregated data since the implementation of the free travel scheme in buses in 2019. Paper-based pre-rinted pink tickets, priced at Rs 10, are issued to female commuters.

In 2018, it was announced that the Delhi Metro card could be used to pay fares on both buses and the metro (62). Though the metro card provides a discount for Delhi metro usage, the bus fare remained the same for metro card users. During this period, the ETMs in DTC buses underwent upgrades with the addition of a Secure Access Module (SAM) chip, enabling the use of the metro card as a payment method in buses. However, the current lack of ETM machines in DTC buses poses a challenge for implementing this system now.

In 2019, Delhi Transport Department launched '***One Delhi'*** mobile phone application, with features such as a journey planner, travel details, including metro routes, fares, and journey durations (63). The digitalisation of the ticketing system in buses gained momentum during and after the COVID-19. In 2022, an updated version of the One Delhi app (ODA) was introduced, incorporating additional functionalities like real-time information of next bus arrival at the bus stops, bus routes and stop information, online ticket purchase through QR code available within buses or using vehicle number, locating electric vehicles charging stations, and facilitating a passenger and official complaint and feedback system (63). Women can also buy a no-cost (pink) ticket from the application. The following table illustrates the existing data collected by transit agencies of bus-based public transport.

Table 2: Data collected by the existing fare collection system in bus-based public transport in Delhi

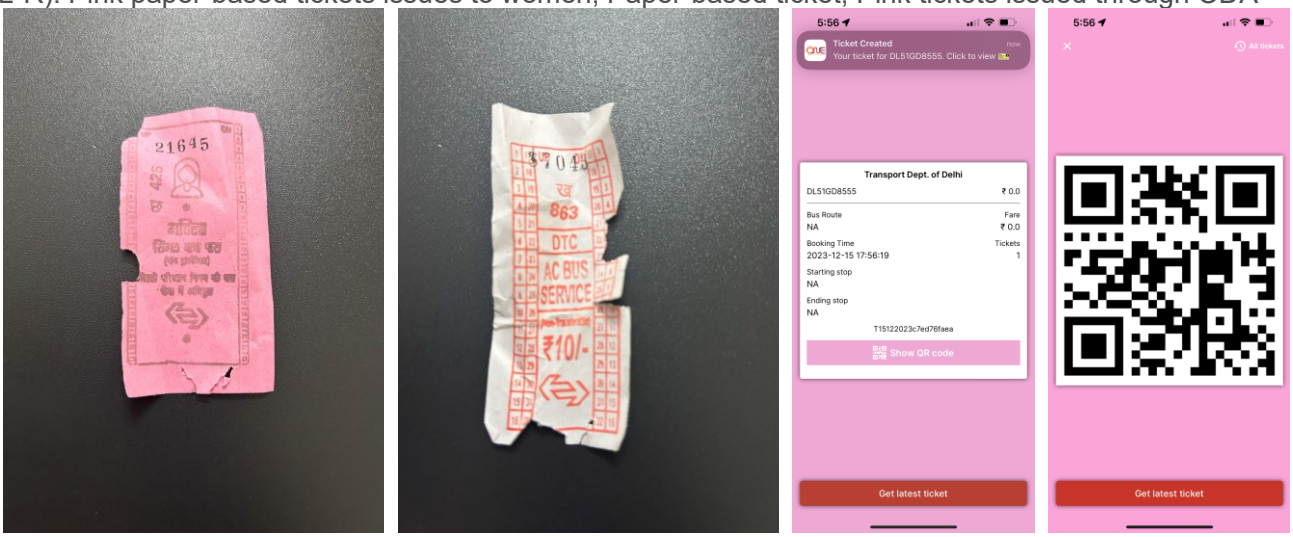
| Fare Collection method | Data collected | Use of data |
|---|---|---|

[6] DMRC, since 2018, considers individual trips on separate lines as separate trips, departing from the previous practice where the complete journey between the origin and destination stations was counted as a single trip (119).
[7] As of December 2023
[8] The electric buses are operated by private entities.

| | | |
|---|---|---|
| Paper-based ticket | • Route direction (Up or down);<br>• Trip fare; | • Daily ridership, by route and gender (as pink tickets are issued to women) |
| Paper-based tickets generated by ETMs (Currently available in cluster buses only) | • Ticket purchase time;<br>• Boarding & alighting location;<br>• Trip Fare; | • Daily ridership, by route and gender (as pink tickets are issued to women);<br>• Revenue collected;<br>• Bus stops predominantly used by male commuters *(pre-printed pink tickets are issued to female commuters);*<br>• Time of travel of male commuters; |
| Metro Card | • Boarding and alighting time;<br>• Boarding & alighting location (for metro-rail as only one tap is required in buses);<br>• Trip fare; | • Daily ridership, by route;<br>• Revenue collected;<br>• Predominant origin & destination of metro users;<br>• Time of travel; |
| One Delhi Application (ODA) | • Gender;<br>• Route no.;<br>• Route Direction;<br>• Bus number;<br>• Boarding & alighting location[9]<br>• Trip fare;<br>• Ticket purchase time; | • Number of e-tickets bought via application, by gender;<br>• Predominant O-D *(only for male commuters);*<br>• Time of travel, by gender; |

*Source: The Urban Catalysts*

(L-R): Pink paper-based tickets issues to women; Paper-based ticket; Pink tickets issued through ODA




[9] This information is not collected for female passengers.

## 3.2 Evidence on what works to improve the safety of women, girls, and other sexual minorities

The literature widely acknowledges and experts consistently recommend that the effectiveness of these measures is enhanced when implemented collectively as a package. Yavuz & Welch (2010) also emphasize that a stand-alone initiative might not suffice to enhance the safety of women, girls, and other sexual minorities in public transport. A multifaceted approach, akin to the Guardian project in London, proves effective in addressing the safety concerns in public transport. There is limited literature on the effectiveness of these strategies in the Global South. The EMPOWER's She Can Tool, funded by the High-Volume Transport Applied Research Programme, is a user-friendly, internet-based resource, assisting policymakers and transport providers to develop an evidence-based approach to addressing sexual harassment and personal security within public transport (20).

There is growing literature on the type, and frequency of gender-based violence faced by women and girls on public transport (12) (64) (65). While there is little research on the experiences of trans and other sexual minorities, the emerging literature highlights the high rate of sexual harassment faced by them on public transport (66).

Despite the growing awareness surrounding sexual harassment and assault in public transportation, there remains a dearth of comprehensive, large-scale, and systematic data to understand the extent of these offenses. The scarcity of evidence is partly attributed to underreporting and the absence of a well-defined mechanism for collecting and analysing data. The existing evidence stems from independent studies conducted on a small scale, yielding substantive insights. For instance, as per a survey of 5,010 commuters (3,816 of whom were women) in Delhi, 50 percent of women were sexually harassed on public transport, while 42 percent reported being sexually harassed while waiting for public transport (17). In 2020, our study, funded by the High-Volume Transport Applied (HVT) Research Programme, underscored the alarming and concerning emergence of sexual harassment within public transport systems. This issue notably affects women's utilisation of bus-based public transportation, which serves as the predominant mode of travel for women in developing countries (67). This concern is prevalent in cities across India, Bangladesh, Afghanistan, Pakistan, and Nepal.

A keyword[10] search was conducted on Google Scholar and Google Web search for evidence to improve the safety of women, girls, and gender minorities. The articles predominantly focused on the evidence to highlight the prevalence of sexual harassment in public transport and there is limited evidence on what works to reduce gender-based violence in public transport. Additionally, gauging the impact of individual initiatives proves challenging, as both international and national literature reveal the implementation of multiple strategies simultaneously to enhance the safety of women, girls, and other gender minorities (68).

A comprehensive study of English-language literature on sexual harassment and assault in transit environments (1980-2020) summarizes the five key intervention categories - design, policing, technology, policy, and education and outreach - implemented to address gender-based violence in public transportation. Several scholars have advocated for a whole-of-journey approach, which includes the first- and last-mile connectivity within the scope (69). The whole-of-journey approach requires the inclusion of all stakeholders who deliver, service, and use parts of the public transport system (ibid).

The following sections review literature on the effectiveness of the strategies in reducing gender-based violence in public transport.

### 3.2.1 CCTV Cameras and other technological innovations

CCTV cameras are widely used as crime prevention techniques in public transport and public spaces (70) (71). It is also one of the most popular recommendations for planning smart and safe cities around the world (20). The idea behind their implementation is that potential offenders will be deterred from committing crimes knowing that they are more likely to be caught, thus increasing the perceived safety among

[10] The key words used for the search include "interventions to reduce gender-based violence on public transport" OR "Strategies" OR "impact OR "impact" OR "women" OR "girls" OR "effectiveness" OR "public transport" OR "safety" OR "measures" OR "gender minorities" OR "what works" OR "public transport".

passengers. Transit agencies also consider CCTV cameras as one of the most effective measures to combat crimes against women in public transport. As a result, many transit agencies, both in developing and developed countries, have installed CCTV cameras in their systems to improve safety (72) (73) (74).

However, there is a substantial body of work that demonstrates how the presence of CCTV cameras may not necessarily result in an increased perception of safety, particularly among women. Women often prefer the presence of police or staff personnel over CCTV cameras for safety assurance (75) (68). Studies exploring the impact of CCTV cameras in various settings, such as in Seoul, indicate that their effect on perceived safety is limited, even in public spaces (76,77). The limited impact of CCTV cameras is due to the lack of follow-up protocols (20). CCTV cameras are generally more effective in evidence collection after a crime has occurred unless they are actively monitored in real-time, in which case they can serve as a proactive crime prevention tool.

In addition to CCTV cameras, various technology-based solutions have emerged to tackle sexual harassment on public transport. These solutions include reporting (non-emergency) crimes to the police, data collection and analysis, identification of crime hotspots, and real-time tracking of journeys. Some examples of such technology-based solutions include Safetipin in India and HarassMap in the Middle East. These applications utilise crowdsourcing, enabling users to report instances of sexual harassment, which are then displayed on an online map for better awareness and analysis. However, unless a well-defined and formal follow-up protocol is in place, these interventions and data collected through these applications will have limited impact (20).

Transit authorities have also developed their applications, such as the One Delhi app, which enables users to report cases of sexual harassment. However, these apps may not offer an instant response to the reported incidents. Also, the implementation of the technology-based solution not only depends on the technical and financial capacity of the government but also on the accessibility and digital literacy of users. According to our 2019 study in Delhi involving 800 resource-poor women, it was found that only 10% of them had access to a personal or shared smartphone, and out of those, only 5% used phones for browsing (67).

### 3.2.2 Policing

An evaluation of various human policing strategies implemented in different regions, such as Project Guardian in London (2013), an elite group of 11 officers in Bogota (2014), the Targeting policing initiative in West Yorkshire (2002), and the employment of security guards in trains in New South Wales, indicates that these programs have had a positive impact on enhancing the safety of women. Increasing security by providing policing at stations or within public transport not only deters offenders but also enhances the sense of security among female passengers (78). Additionally, it can also facilitate the reporting of such instances. The Project Guardian resulted in an increase of 32% in the detection of sexual harassment cases and a 20% increase in reporting of sexual harassment. A five-year assessment of the initiative in New South Wales revealed that while the number of sexual offenses remained steady during the implementation of this programme, the perception of safety among passengers had increased from 27% at the start of the programme to 35% (68). Multiple surveys with female passengers also support these findings as they state that they feel safer in the presence of police or station staff in public transport or at stations (79) (80) (75).

However, in the case of West Midlands, England, the pilot schemes of "*Travel Couriers*" on buses were discontinued due to several significant reasons. These reasons included employing people who were too young and lacked the ability to handle various situations of sexual harassment as well as the low awareness about the initiatives among passengers (78).

### 3.2.3 Reporting mechanism

Studies conducted globally, particularly in developing countries, have consistently shown that women often hesitate to report incidents of sexual harassment. A World Bank study in four Indian cities supports this finding, revealing that a significant number of women commuters in Delhi (88%), Chennai (>50%), Pune (63%), and Mumbai (75%) experienced instances of sexual harassment in public transport, but reported very few cases - Delhi (1%), Chennai (6%), and Pune (12%) (81). The reasons behind this reluctance are twofold: some women are unaware of the reporting mechanisms, while others perceive the existing systems to be ineffective (78). Similarly, a survey conducted among 1,338 commuters (86% of whom were women) of TransMilenio in Bogota revealed that lack of support from authorities, lengthy and cumbersome

reporting processes, and a general lack of awareness about the reporting systems deterred women from reporting incidents of sexual harassment in public transport (13). The underreporting of these incidents not only underestimates the scale of the problem but also leaves transit authorities with insufficient data on patterns and trends of violence—a crucial element for formulating effective responses to address the issue. There is also widespread confusion on what constitutes sexual harassment and the difference in how men and women perceive what is acceptable and what is not (20).

Awareness campaigns are widely adopted initiative implemented by cities to promote reporting of instances of sexual harassment in public transport. These campaigns primarily aimed at empowering women to voice their concerns and to highlight acceptable and unacceptable behaviour in transit. For instance, Washington Metropolitan Area Transit Authority (WMATC) launched the *'You have the right to speak up'* campaign in 2018, while Massachusetts Bay Transport Authority (MBTA) in the USA introduced awareness campaigns with slogans like 'Respect my space,' 'Keep your hands off me,' and 'No means no.' Another campaign in the UK, titled "Know the Difference," was designed to address men's behaviour and raise awareness about acceptable and unacceptable conduct while using public transit. This initiative featured taglines such as 'Back to Mine. Back Off', 'Get it On. Get off Me', 'Flirt. Harass', and 'Harmless Fun. Sexual Assault', each emphasizing the distinction. These taglines were united by the central message: 'Real Men Know the Difference. And so does the Law'. In London, the 'Report it to Stop it' campaign was launched in 2015 under Project Guardian.

An impact analysis of the *'Report it to stop it'* campaign, involving a survey of 450 women and an analysis of police-recorded crime data, demonstrated a positive effect on reporting data, resulting in an increase in reported cases (82). Similarly, an evaluation of the anti-harassment campaign by MBTA revealed a 32% increase in reported incidents after four years of the campaign (68). These findings demonstrate that awareness campaigns do have an impact; however, continuous and long-term implementation is necessary, as their results are likely to become more apparent over time.

Lack of clarity on means to report to and consequent lack of action from the authorities' end are some of the other reasons for underreporting (83). To address this issue, various campaigns have been introduced with a focus on clarity and efficiency. Examples include Edmonton Transit's *'Safe Ride'* campaign, which emphasizes clear policies on sexual harassment, and Transport Authority of River City's #WeBelieveYou campaign in Louisville, USA, promoting solidarity among authorities, passengers, and peer-to-peer support (84).

In developed countries, such as Canada, initiatives like the 'See Something, Say Something' campaign implemented by Metro Vancouver Transit Police in 2014 have proven effective. This campaign enabled passengers to report incidents through phone or text messages, which were received by dispatch team available 24/7, allowing for appropriate responses. As a result, there was a 28% increase in crime reporting (68).

### 3.2.4 Women-only services

A prevalent policy response to address gender-based violence in public transport is the provision of gender-specific accommodations. Many cities worldwide have implemented women-only carriages or sections in their public transport systems. For instance, metro rail systems in Mexico, Tokyo, Cario, Jakarta, Delhi, Bengaluru, Chennai, and Dubai (during peak hours) offer women-only carriages (85). In buses, the scheme tends to apply in whole buses rather than sections, for which the examples are present in Dhaka in Bangladesh, Kuala Lumpur in Malaysia, Nepal, and multiple Indian cities like Delhi, Mumbai, Bengaluru, etc. However, in Lahore's bus rapid transit system, women-only sections are designated at the front of the bus, with separated queuing and female security staff monitoring boarding and alighting at the stops (78). The underlying rationale behind these services is to eliminate a key condition for gender-based violence: the convergence of potential offenders and vulnerable victims.

The available literature illustrates mixed results regarding the utilisation of gender-segregated transportation services. However, women's perceptions of women-only transportation have generally been positive. Mexico's experience with the women-segregated initiative under the "Viajemos Seguras" ('Women Traveling Safely') program in 2008 reported success in reducing the number of sexual harassment cases from five to one per day (86). Other studies also indicate that women commuters feel safer in gender-segregated coaches or sections. For instance, a survey conducted by Thomson Reuters Foundation in 15 major capital cities worldwide, including Delhi in India, revealed that 70% of women expressed a preference for gender-segregated sections on public transport for enhanced safety (87) In

London, about 45% of women stated that they would feel safer in sex-segregated transport. Similarly, in a survey conducted in 11 cities in Japan (88) women recommended the implementation of gender-segregated services for safer travel. Additionally, a commuters' survey on KTM Komuter services in Bangladesh found that women preferred having gender-segregated sections in public transport (89). Likewise, evidence from a study in Mexico suggests a reduction in instances of sexual harassment following the introduction of women-only coaches in the subway system in 2000 (90). The effectiveness of partially segregated section in buses is yet to be explored.

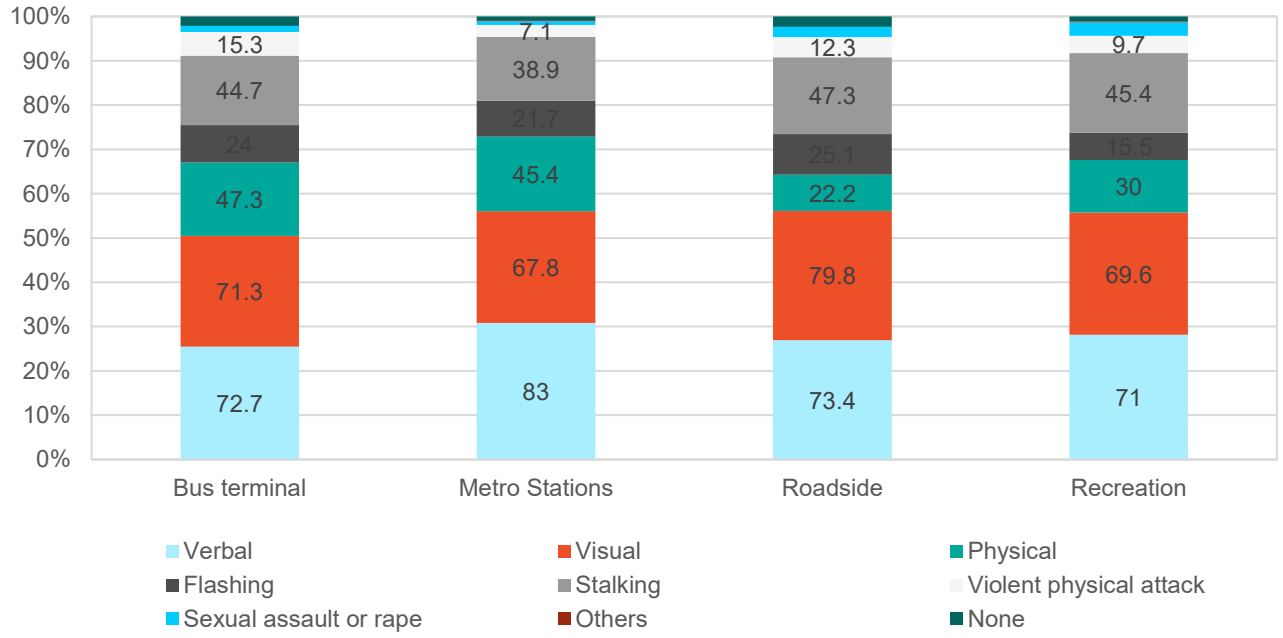
However, experts and gender scholars have different views on this. They consider gender-segregated sections on public transport as a band-aid treatment that may further exacerbate gender inequalities (11). Some women and men have also expressed reservations about women-only services. Furthermore, some women and men express reservations about women-only services. For instance, in Mexico City, men consider women-only services as a joke, while women in Japan worry that using mixed carriages might label them as "willing" victims (68).

## 3.3 Perception and experience of safety and sexual harassment in bus-based PT in Delhi

The literature review of studies conducted from 2010 to the present reveals minimal variation in the perception of safety among women and girls in public spaces and public transport. A substantial body of literature highlights the continued experiences of sexual harassment among women and girls in public transport in Delhi. However, there is no or very limited research on the experiences of trans persons concerning their safety in public transport and public spaces in Delhi. This literature review was employed using keywords such as "safety," "women," "girls," "trans," "public transport," "buses," and "Delhi" on Google and Google Scholar, applying a timeline filter for post-2010 publications.

In 2010, Jagori surveyed around 5,000 participants (76% were women) which revealed that around 70% of women faced sexual harassment on streets, followed by 50% while using public transport and 42% faced it while waiting at bus stops (17). Girls in the age group 15-19 are the most susceptible to such incidents. Verbal and visual forms of harassment are particularly prevalent in public transportation and public spaces, followed by physical harassment.

Figure 4: Type of sexual harassment faced by women

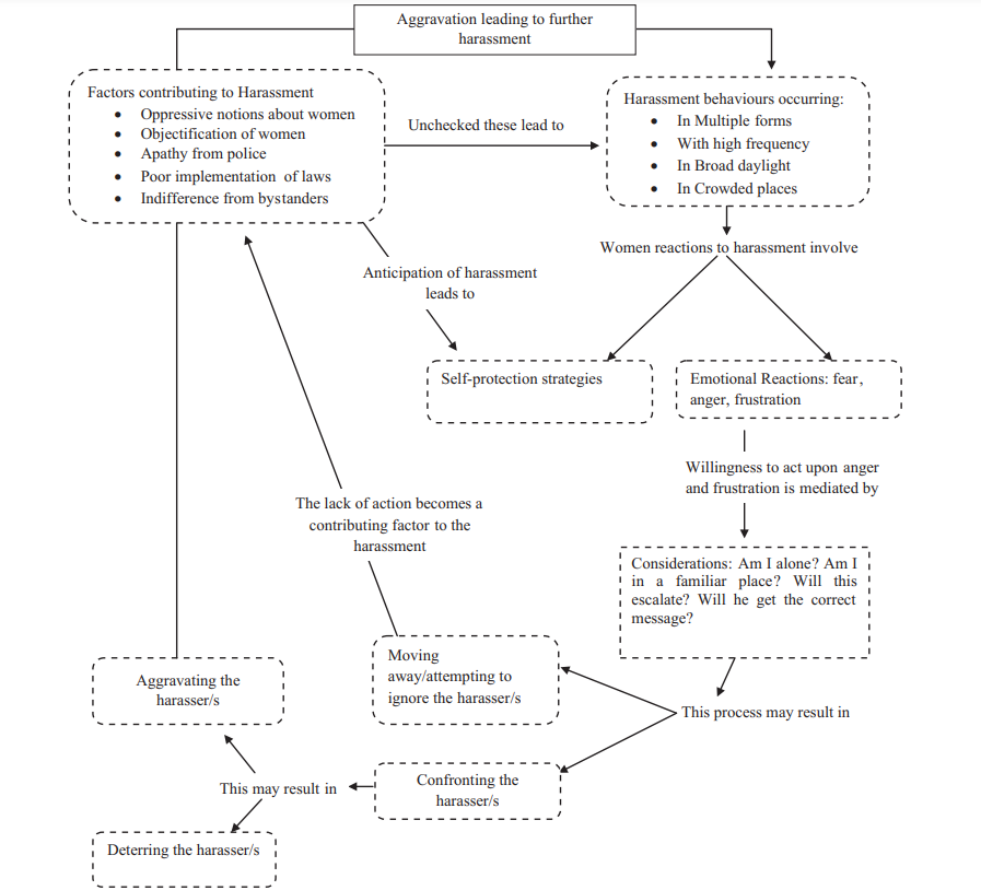



*Source:* (17)

In 2013, the International Center for Research on Women conducted another study involving 2,000 women and 1,000 men aged 16 to 49 years. The study yielded similar results, indicating that 95% of women and

girls feel unsafe in public spaces in Delhi (91). Additionally, a qualitative study was conducted the same year, involving 20 women from the middle- and upper-income classes, aged 18 to 30. The purpose of this study was to explore their coping mechanisms in response to instances of sexual harassment. The subsequent figure illustrates the women's reactions to harassment and the factors they consider before taking any action against such harassment. This underscores the fact that the absence of proactive measures from law enforcement and the lack of intervention by bystanders discourage women from reporting incidents of sexual harassment. As a consequence, this leads to underreporting of such incidents and exacerbates the situation.

Figure 5: Coping mechanism of women in case of sexual harassment




*Source:* (92)

The Thomson Reuters Foundation surveyed in 15 capital cities around the world in 2017, including Delhi, and found that Delhi has the 4th most unsafe public transport (93). Even in the Safe Cities Index 2021, prepared by The Economist Intelligence Unit, Delhi is ranked at 48 among 60 world cities.

Madan & Nalla (94) surveyed 1,387 respondents (55% female) in 2016, including both men and women in Delhi to explore the gender-based disparities in perceptions of the occurrence and location of sexual harassment in public spaces as well as the extent to which such behaviours are considered serious. The results of the study indicate that for every 5 women, 3 women have experienced sexual harassment at least once in their lifetime while traveling. Over 3/4th of women respondents stated that they experience sexual harassment during the day (94). Another study that tried to investigate the strategies adopted by women to address sexual harassment on public buses found that women in India try to avoid sexual harassment due to conditioning of being polite or “not to make a scene” or “draw attention” (95).

In the context of a doctoral study (2018), a survey was conducted with 2,695 students (65% female) from Delhi University to understand their perceived risk of sexual harassment and its impact on their educational choices. Among the female respondents, 89% reported having faced sexual harassment while traveling in Delhi. Specifically, 63% of female students experienced unwanted staring, 50% received inappropriate comments, 40% were touched, groped, or grabbed, and 26% were followed (96). The study highlighted that female students are willing to compromise on educational quality for safer travel options.

In 2019, Safetipin conducted safety audits in Delhi to evaluate the perceived safety in public spaces, including bus stops, metro stations, and streets. An assessment of 275 bus stops was done. 44% of them received an average safety score ranging from 2 to 3.5 out of 5. The study generated a spatial map of the safe and unsafe locations across the city and highlighted issues such as inadequate lighting, and damaged & fragmented footpaths as major concerns.

A recent study conducted by the Praja Foundation in 2019 found that 42% of women in Delhi feel insecure, with 44% of them experiencing insecurity while traveling between different locations. Despite the provision of free travel for women in Delhi buses, overcrowding and sexual harassment are the issues that remain unaddressed (84).

According to the National Crime Control Bureau, the crime against women in Delhi has increased by 40% from 2020 to 2021. However, it doesn't provide a separate category for crime against women in public spaces and public transport. The 2022 survey conducted by the OMI Foundation, which involved 1,979 women, revealed that 50% of women feel unsafe while traveling on buses and metro (97).

## 3.4 Existing strategies implemented by the GNCTD for the safety of women and girls in public spaces and transport

Delhi introduced a fare-free travel scheme in public buses for women in October 2019, which, according to the Delhi Economic Survey, increased women's ridership from 33% to over 44% that year (57) (98). A 2020 study focused on resource-poor women revealed that buses do not stop for women after the free bus travel scheme (67). The study further highlighted additional reasons cited by women, such as the lack of real-time information, insufficient bus frequency, and long queues at bus stops, all of which have contributed to their challenges in accessing public transportation.

In light of the recent reports of bus drivers neglecting to stop at designated bus stops, the Transport Department has released an official notice, assigned the responsibility of prosecuting or issued challans to DTC bus drivers who violate bus lanes and skip designated bus stops, to the Enforcement Wing of the Transport Department and Delhi Traffic Police. The notice explicitly states that in the event of a third offense committed by the same driver, their driver's license will be suspended, and they will be required to undergo a one-month refresher training at the DTC school in Nand Nagri before resuming their driving duties. However, this might not apply to e-bus drivers as they are recruited by private operator who are operating buses under Gross Cost Contracts. In November 2020, DTC deployed 20 mobile enforcement vans as the first responders in case of any emergency (99).

### 3.4.1 Bus Marshal Scheme

The Bus Marshal Scheme was introduced in Delhi in 2015 and again restructured in 2019 to increase the safety of women in public buses (100). Bus Marshals are civil defence volunteers (CDV) and home guards deputed in public buses during the evening and night shifts to ensure safety of female commuters, inform them about their rights, ensure enforcement of seat reservation for women, the elderly, and persons with disabilities and support women in case they want to file a complaint against the perpetrator. In 2022, there were around 12,238 bus marshals (with 8,000 being Civil Defence volunteers) deployed in all buses of Delhi (60,101). According to a survey conducted in 2019, female passengers expressed a greater sense of comfort and willingness to interact with female bus marshals (102). In 2022, 11.7% (1,438) of the total deployed marshals were women (60).

However, as of November 1, 2023, the services of CDVs have been discontinued, and only home guards are now deployed as bus marshals, only in the evening shift (103).

### 3.4.2 CCTV Cameras and Panic Buttons

As per the Delhi Economic survey 2023-24, all the cluster buses and DTC fleet are equipped with 3 IP CCTV Cameras, 7'' screen, 10 Panic Buttons with Hooter & Strobe, two-way communication for driver and conductor seat, and Automatic Vehicle Location (AVL) system (57). Also, as per statutory requirements, all newly deployed electric buses are being deployed also have these features (60). Delhi government has also set up a Command-and-Control Centre (CCC) at Kashmiri Gate to manage and monitor the real-time data generated by AVL system, CCTV cameras, and ETMs. However, as per the audit conducted by the Anti-Corruption Branch of Delhi, there is no integration of panic buttons, CCC, and helpline number (104).

This means that while pressing the panic button will activate a hooter on the bus, the information will not be transmitted to the CCC.

### 3.4.3 Reserved Seats and Ladies Special Buses

25% of seats in all DTC buses are reserved for women, which accounts for 10 seats in low-floor buses and 12 seats in standard-floor buses. In electric buses, 10 seats are reserved for women apart from 2 for Persons with Disability (PwD), which accounts to 29.6% of total seats. As per DTC (2023), 28 ladies' special buses are being placed on 28 routes during peak hours. DTC also ply buses at Night service at 27 routes which are operational from 11 pm to 5 am.

### 3.4.4 Gender Sensitization Programme

In September 2022, the Delhi government mandated to undergo gender sensitization training for drivers of all public service vehicles to renew their licenses or to get the fitness certificate for their vehicles (105). The Economic Survey of Delhi 2022-23 also mentioned that bus crew is given gender sensitization training. However, who are given this training, the specific components included in the program, and the frequency of this training remain unclear.

DTC operates an e-learning portal (https://www.dtc-elearning.com/) with the primary objective of supporting the current workforce, including drivers, conductors, and other allied staff, by facilitating the acquisition of knowledge and essential skills necessary for optimal work performance. This e-learning portal provides a selection of instructional videos available on an open platform. The pertinent videos focusing on women's safety are "Conductor Duty for women, elderly and other passengers" (uploaded on 2nd May 2022) and "Duty of drivers in case of eve teasing" (uploaded on 27th September 2021). These videos provide basic guidance to conductors, including seat reservations for women and assistance for passengers with disabilities. They also address driver 's responsibilities, such as handling instances of sexual harassment by taking proactive measures like changing seats and ensuring the safety of women while promptly reporting incidents to the police. There is no integration of the bus marshal scheme in these videos and how frontline staff can work together to identify and address the instances of sexual harassment against women.

### 3.4.5 Employment Opportunities

In 2022, the Delhi government relaxed the height and experience requirements to encourage the induction of women drivers for DTC and cluster buses. They lowered the minimum height requirement from 159 cm to 153 cm and reduced the required experience period after obtaining a Heavy Motor Vehicle (HMV) license from three years to just one month. Also, on July 22, Delhi government launched "Mission Parivartan" to train women to obtain licenses for HMVs at the Society for Driving Training Institute in Burari (102). Currently, there are 34 women drivers in DTC, which constitutes 0.2% of total drivers (15,034) (106). Delhi government aims to develop an all-women deport once the number of women drivers reaches to 100 (107). In 2022, there were 732 women conductors in DTC, which constitutes 4.7% of the total 15,433 bus conductors (108).

### 3.4.6 Grievance Redressal Mechanism

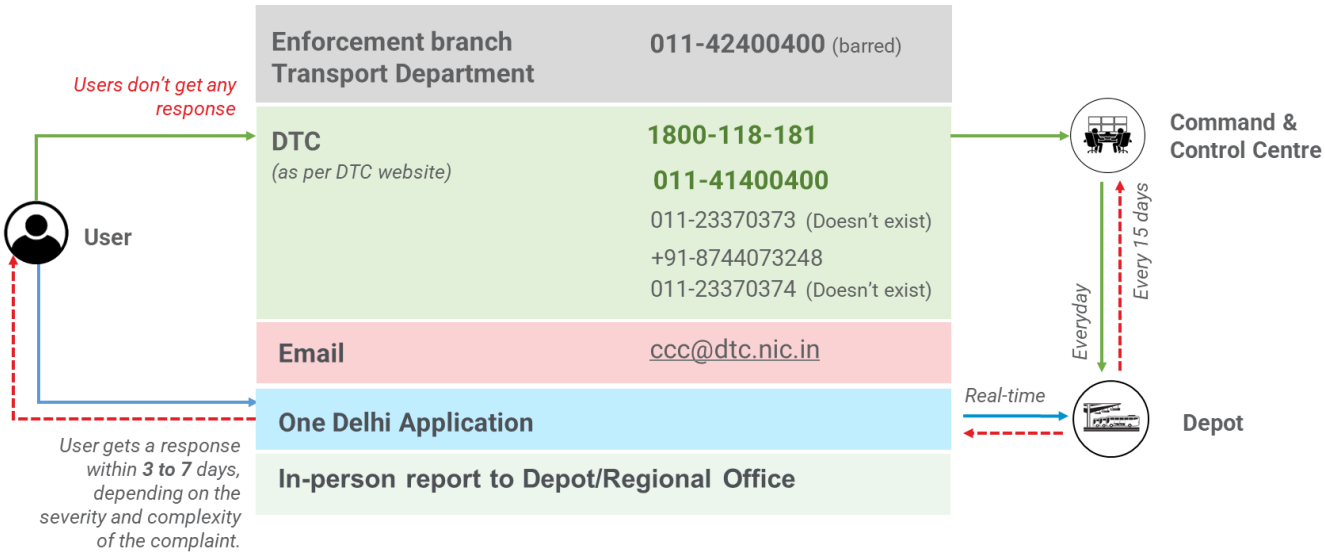
Currently, commuters have several avenues to register complaints (Figure 6). These include a helpline number, sending an email to the Complaints Central Cell of DTC, submitting an in-person report at a regional office or depot, and via the One Delhi mobile phone application.

Complaints received via the helpline numbers are directed to the CCC at DTC headquarters, where they are subsequently forwarded to the appropriate unit officers. In contrast, the One Delhi application has a backend portal that enables complaints to be directly displayed on the depot-level dashboard. Passengers also have the option to directly report complaints to conductors while travelling inside the buses. The conductors hold the responsibility of communicating these complaints to the depot authority, where they are further relayed to the appropriate personnel for resolution.

Passengers can register their complaint under the following categories: (i) Rash driving; (ii) Not stopping at the bus stop; (iii) Driving the bus slow or fast; (iv) Late arrival or departure of the bus; (v) Wrong route;

(v) Driver not allowed ladies /senior citizen to board from the front gate; (vi) Driver misbehave; (vii) The conductor refused to give a complaint book; (viii) Conductor misbehave; (ix) Conductor not issuing ticket after taking fare; (x) Excess fare charged; (xi) Marshal misbehave; (xii) Marshal was busy using phone; (xiii) Not displaying the destination board; (xiv) Bus cleanliness; (xv) AC not working; and (xvi) Damaged condition of bus.

Figure 6: Complaint reporting mechanism of DTC



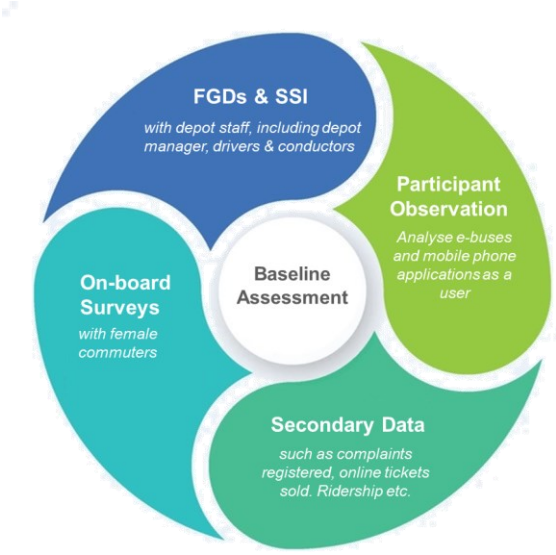

*Source: The Urban Catalysts*


100% ELECTRIC. 0% SMOKE.
GO SLOW
DON'T JUMP RED LIGHT

# 4. Rapid Baseline Assessment

The baseline assessment involved a comprehensive approach, including primary surveys targeting female commuters, focus group discussions with frontline personnel such as drivers and conductors, and semi-structured interviews with depot staff at the pilot e-bus depot. Additionally, a participant observation methodology was employed to critically evaluate the infrastructure and service delivery from the users' perspective.

Figure 7: Analytical framework for baseline assessment




*Source: The Urban Catalysts*

## 4.1 Baseline Assessment- On-board surveys

This section presents the findings of the primary survey conducted with 296 female commuters on the pilot e-bus route during the weekdays of September and October 2023. The geographical landscape along this route is primarily characterized by residential areas, including Jughi Jophri resettlement colonies and commercial hubs.

### Summary of findings

**72% of female commuters travel for paid work, followed by education (18%)**

The predominant female commuters (77%) are younger women in the age group of 18-35. The average trip rate for female commuters is 2.1. 72% of the total trips taken by female commuters are for paid work, followed by education (18%). Only 4% of female commuters use buses to travel for social, health, and recreational purchases. An intersectional analysis of the primary occupation and education level of women reveals that those traveling by bus tend to be employed in low-paying jobs. As 55% of female commuters who work as regular wage/salaried employees have an education level up to the 12th grade.

The morning peak period for female commuters starts at 9:00 am and extends till 11:00 am on this route. Additionally, female commuters engage in travel during typical non-peak hours in the afternoon, starting from 11:00 am to 3:00 pm. The evening peak period is observed from 5:00 pm to 6:00 pm. As per the perception of female commuters, the average waiting time on this route is 15 minutes. However, the waiting time is comparatively higher in the evening hours than morning.

Walking is the predominant mode of travel used by female commuters to access bus stops, followed by e-rickshaws. The average distance travelled by female commuters to access the bus stop is 1.0 km by walking and 2.7 km by e-rickshaw. However, more women take e-rickshaws in the evening after 04:00 pm, regardless of the travel purpose. There could be multiple reasons for this trend, including time pressure arising from the need to fulfil domestic roles and a perceived sense of insecurity in the evening.

**Though 77% of female commuters have access to a smartphone (shared/individual), the level of digital literacy among them is low**

77% of female commuters have access to a smartphone and 94% (215 of 228) of them have access to the internet. However, 26% (of women who have access to a smartphone) have never used Google Maps, and 30% use it once in a while. Additionally, a mere 2% of female commuters are aware of the One Delhi Application, a smartphone application introduced by the Delhi government for real-time information, route details, ticket purchases, and submitting feedback.

**Issues faced by female commuters are underreported as 91% of female commuters who have faced sexual harassment while boarding and alighting have never registered a complaint**

Around 23% of the surveyed female commuters lack awareness of any helpline number to contact in a distressed situation and only 10% are acquainted with the DTC helpline number (1800-118-181). 91% of female commuters who have faced sexual harassment while boarding and alighting have never registered a complaint. Among the female commuters who have never registered a complaint, 27% expressed a belief that filing a complaint would not lead to any meaningful change. Not a single female commuter has filed a complaint for sexual harassment. This underscores the serious concern that women may not perceive day-to-day instances of sexual harassment as significant enough to register a complaint.

At the pilot e-bus depot, only 12%[11] of complaints are registered by female commuters, with most issues related to drivers not stopping at designated bus stops. Frontline staff have observed that women frequently hesitate to file complaints. The underreporting of issues by female commuters is primarily due to a lack of awareness about available complaint channels, hesitancy in reporting, and a lack of trust in the grievance redressal mechanism.

**Only 12% of female commuters are aware of bus marshal schemes and 5% of panic buttons in the e-buses**

Female commuters have limited awareness of the existing initiatives implemented by the Delhi government. Despite the Bus Marshals Scheme being in place for eight years (since 2015), only 31% of female commuters are aware of its existence, and a mere 12% understand the purpose and intentions behind the scheme. Younger women are more aware of the scheme than older women. 8% of female commuters know about the panic buttons available in e-buses, and only 5% are familiar with its location and purpose.

**Women and frontline staff find e-buses comparatively better than CNG buses**

87% of female commuters stated that e-buses are comparatively better than existing CNG buses. The female commuters highlighted that they prefer e-buses because they have better air conditioning systems (86%), are well maintained (69%), and are quieter than CNG buses (51%). The primary concerns highlighted by the respondents for e-buses include high waiting times (57%) and frequent breakdowns (39%). 29% of the respondents also reported that the PIS (Passenger Information System) board doesn't work in e-buses.

Frontline staff also prefer e-buses to CNG buses, citing reasons such as improved air conditioning, reduced noise levels, lower air pollution, and increased comfort. Areas for improvement include installing fans near seats for better ventilation, more hand support for passengers, and addressing challenges posed by narrow gangways, making passenger manoeuvrability difficult.

In e-buses, drivers manually control the announcement system, which includes five preset messages. However, the manual activation, requiring repeated button pressing, becomes distracting for the driver.

**Female commuters feel comparatively less safe while traveling inside the bus (69%) than waiting at the bus stops (21%)**

69% of female commuters reported feeling unsafe while traveling inside the bus as compared to 21% who reported feeling unsafe while waiting at the bus stops, and boarding & alighting. This perception of safety primarily pertains to daytime travel, given that women predominantly commute during daylight hours

[11] This data pertains to the first two months of the pilot depot—July and August 2023—at the time of assessment.

(Figure 18). Discussions with female commuters also indicated that the perception of safety further diminishes during night.

**Lack of real-time information of bus arrival at bus stops, limited information on the existing grievance redressal mechanism, overcrowding during peak hours, and taunting by male passengers on free bus travel scheme are the main issues highlighted by female commuters**

The absence of real-time information on bus arrival at bus stops is the major concern highlighted by 79% of female commuters as the average waiting time is around 15 minutes on this route. More than half of the respondents also noted issues like buses not stopping for them and drivers halting away from bus stops. 30% of female commuters have reported experiencing sexual harassment while boarding and alighting buses. However, they perceive this behaviour as normal, attributing it to the crowded conditions during these times.

77% of the female commuters have voiced concerns about the overcrowding in e-buses during peak hours. The other issues highlighted by female commuters include a lack of information on reporting mechanism (68%), e-bus drivers driving rashly (53%), and insensitivity of frontline workers towards women's safety (41%).

**Gender-based stereotypes, incentive structures tied to kilometers, and a lack of awareness regarding roles and responsibilities contribute to drivers not stopping at bus stops**

The focus group discussions with frontline staff revealed that there is an inherent bias among frontline workers who prioritize travel for paid work, considering it more important than women traveling for leisure, household purchases and care-related work. As a result, they believe that women traveling for household chores or recreational purposes are exploiting the free travel scheme.

Drivers skip stopping at bus stops for women if they subjectively believe that women are not traveling for significant purposes like paid work. This behaviour is also motivated by the incentives drivers receive for exceeding the stipulated 100 km limit. Drivers and conductors also hold the perception that DTC incurs losses due to the fare-free travel scheme, which indirectly impacts their behaviour with female commuters.

E-bus drivers also lack awareness of their responsibilities. Drivers often perceive that they only need to stop at bus stops where passengers signal, but the roles and responsibilities as per the DTC mandate stopping at all designated stops.

**Despite frontline staff witnessing instances of sexual harassment on buses, they hold the perception that female commuters are safe while traveling inside the bus**

Staring, verbal, and physical touch are the three most prevalent forms of sexual harassment observed by frontline staff on buses. The primary form of verbal abuse faced by female commuters is taunting by male passengers on fare-free travel scheme, particularly by older men.

There is a stark contrast between the perception of frontline staff on e-buses, who believe female commuters are safe inside the vehicles, and the actual feelings of female commuters (69%) who reported feeling unsafe during their travels. This implies that the frontline staff do not consider sexual harassment faced by women as a safety concern. Also, female bus conductors further note that these incidents are so commonplace that even female passengers have normalized them and no longer consider them within the realm of safety concerns.

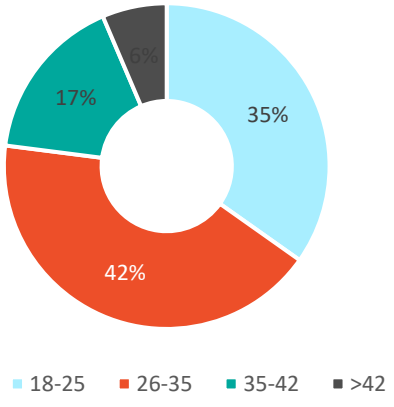
### 4.1.1 Demography

#### Age, education, and marital status

The survey findings indicate that 42% of female commuters on this route are within the 26-35 age group, while 35% are in the 18-25 age group. Only 6% of the respondents are over 42 years old. Around two-thirds of female commuters have an educational attainment below the 12th grade. Among the female commuters surveyed, 48% are reported to be married.

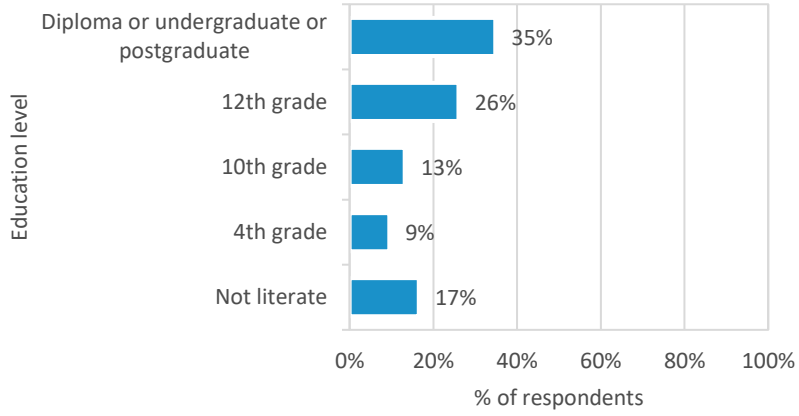
The intersection analysis of age and education indicates that older women have lower education levels as 63% of those in the age group >42 are illiterate. Approximately 25% of female commuters aged 26-35 and over 50% in the age groups >35 have an education level below the 4th grade (Figure 10).

Figure 8: Age groups



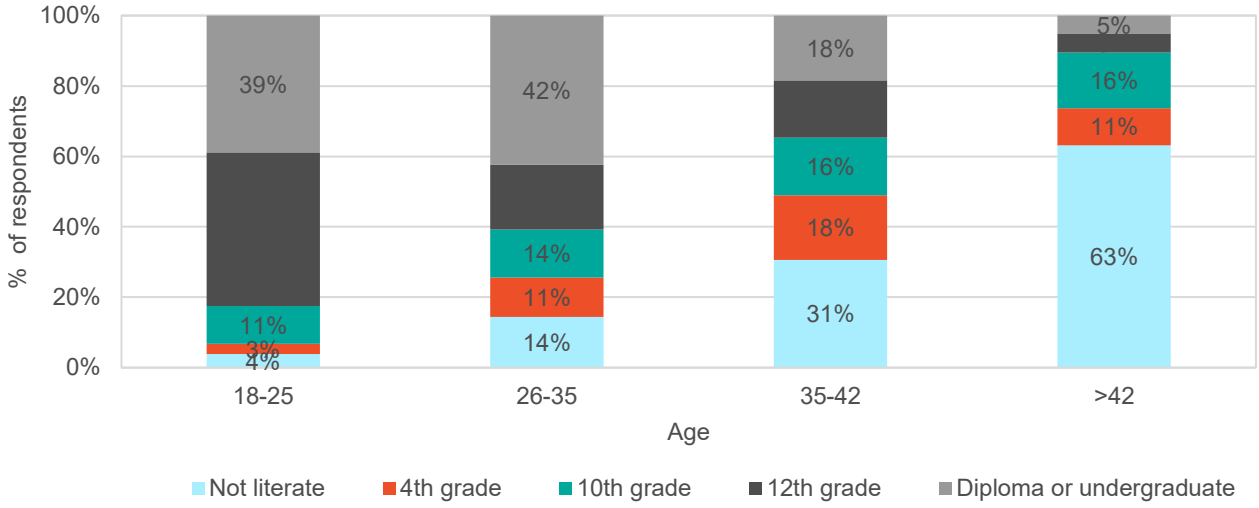

*N: 296*

Figure 9: Education level




*N: 296*

Figure 10: Age and education




*N: 296*

## Primary Occupation

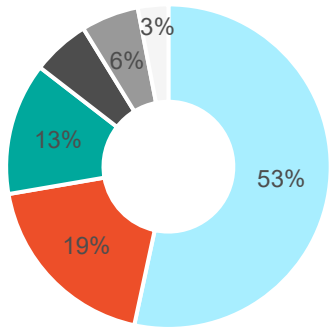
In our sample, more than half (53%) of the female commuters are regular wage/salaried employees, followed by students (19%) and helpers in household enterprise/own account workers (13%).

67% of illiterate women and 74% of women with a diploma/graduation/post-graduation are engaged in paid work as regular wage/salaried employees or casual workers (Figure 12). The findings resonate with national-level statistics from the Periodic Labour Force Survey 2022-23 that show a higher level of Female Labor Force Participation Rate (LFPR) among illiterate (44.6%) and college-educated[12] women compared to those who have only studied up to secondary (25.8%) and higher secondary (22.5%) levels (109).

Also, 55% of female commuters employed as regular wage/salaried employees have an education level up to 12th grade (Table 3). This indicates that these women are engaged in low-paying jobs as compared to women with higher education levels (110,111). This is also corroborated by the International Labour Organization, which indicates that women with lower education levels (below primary) engaged in regular wage work earn 4.6 times less than women with higher education levels (above diploma) in India. While the wage difference is lower in casual work, the trend persists, with women at lower education levels earning 1.4 times less than those with higher education levels (112).

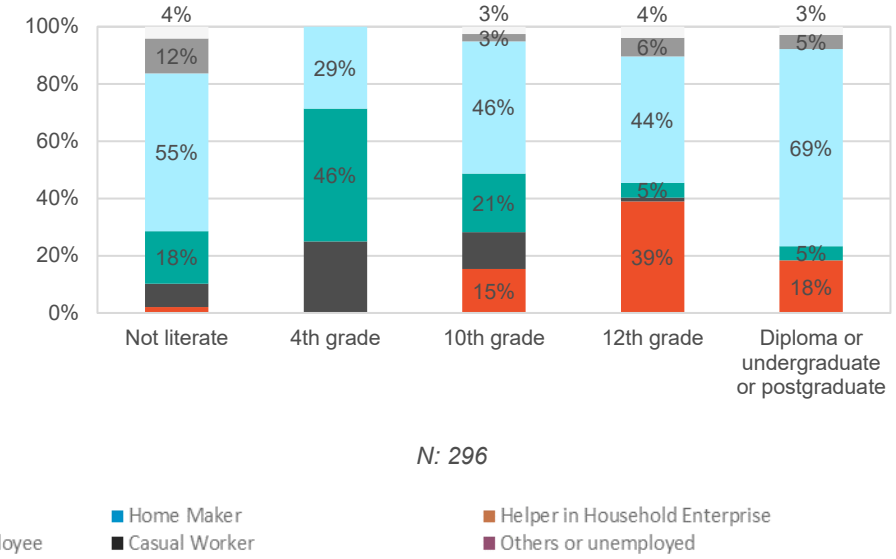
[12] Diploma: 51.9%, Graduate: 35.4%; Post-graduate: 49.8%

Figure 11: Primary Occupation




N: 296

Figure 12: Primary occupation and education level




N: 296

Student
Home Maker
Helper in Household Enterprise
Regular Wage/Salaried Employee
Casual Worker
Others or unemployed

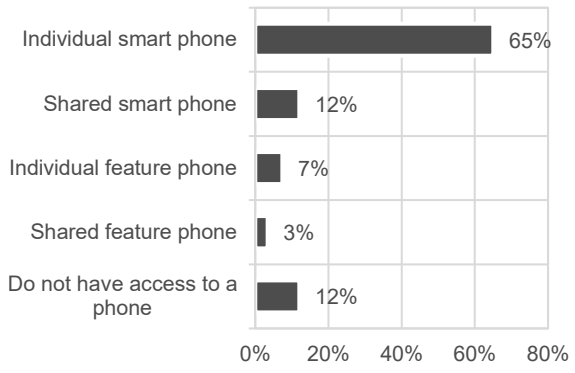
Table 3: Education level of women engaged in different occupations

| | Not literate | 4th grade | 10th grade | 12th grade | Diploma or undergraduate or postgraduate |
|---|---|---|---|---|---|
| Student | 2% | 0% | 11% | 54% | 34% |
| Home Maker | 24% | 41% | 29% | 6% | 0% |
| Helper in Household Enterprise | 23% | 33% | 21% | 10% | 13% |
| Regular Wage/Salaried Employee | 17% | 5% | 11% | 22% | 45% |
| Casual Worker | 35% | 0% | 6% | 29% | 29% |
| Others or unemployed | 22% | 0% | 11% | 33% | 33% |

## Access to a phone and internet

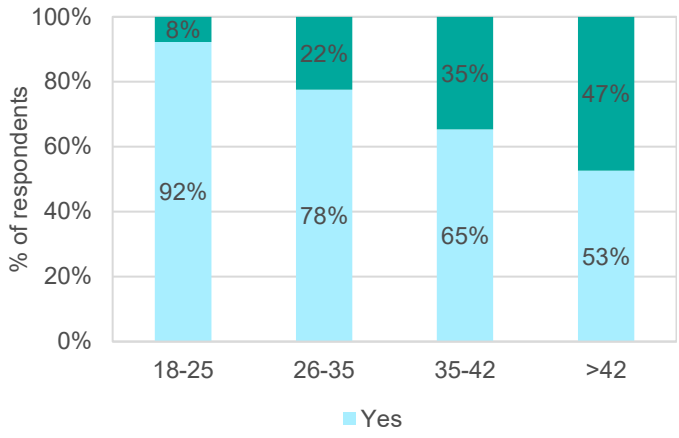
12% of the surveyed female commuters do not have access to a phone and 77% have access to a smartphone (individual & shared). Even though 79% of the female commuters have access to the internet, 26% of them have never used Google Maps and 30% have used it once in a while. The intersectional analysis by age indicates that access to the internet is higher among young women compared to older women above 35. The access to the internet and use of Google Maps is also high among women with higher education levels (Figure 15).

Figure 13: Access to a phone



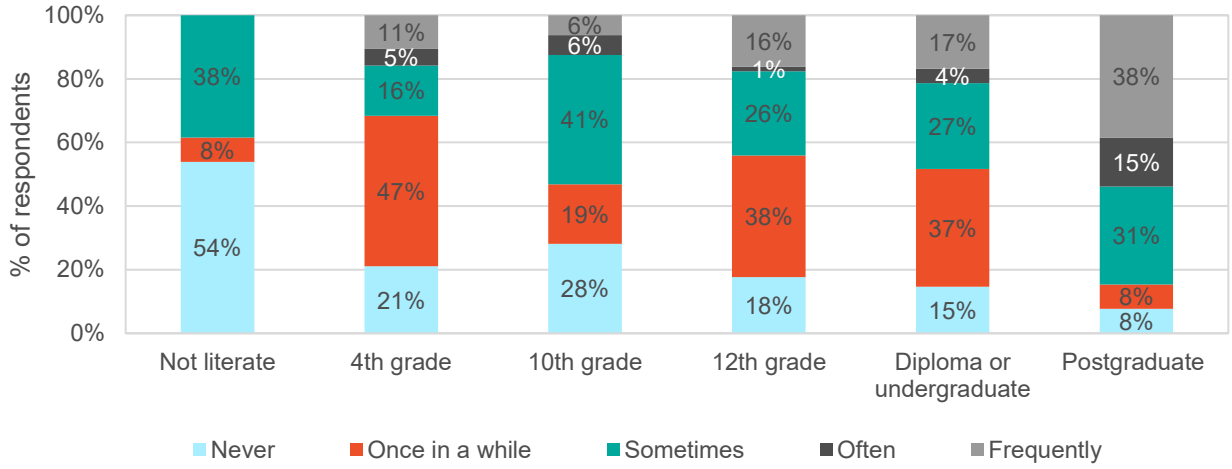

*N: 296*

Figure 14: Age and access to the internet




*N: 296*

Figure 15: Education level of respondents & use of google maps




*N: 296*

## Travel Behaviour

60% of the surveyed female commuters travel for at least 6 days a week by bus. The total number of captured trips is 629. The average trip rate for female commuters by bus is 2.1. The intersectional analysis by age indicates that younger women in the age group <35 travel more frequently by bus compared to older women.

## Travel Purpose

72% of the total trips taken by female commuters are for work purposes, followed by education (18%). Only 4% of female commuters use buses to travel for social, health, and recreational purchases. The intersectional analysis by age indicates that, within age groups, predominantly, women aged >42 travel for health, recreation, and social purposes by bus, while women among 35-42 travel comparatively more for household purchases and caregiving-related work (Figure 17).

Figure 16: Travel Purpose

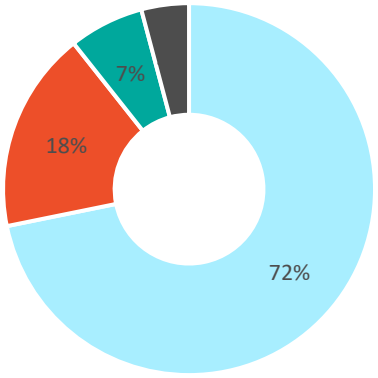
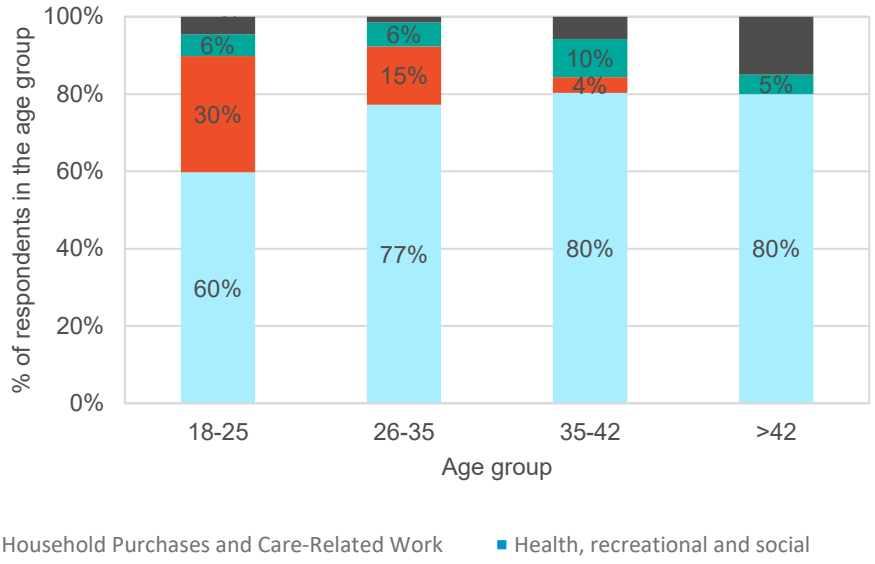



Figure 17: Travel purpose by age




*N: 629*

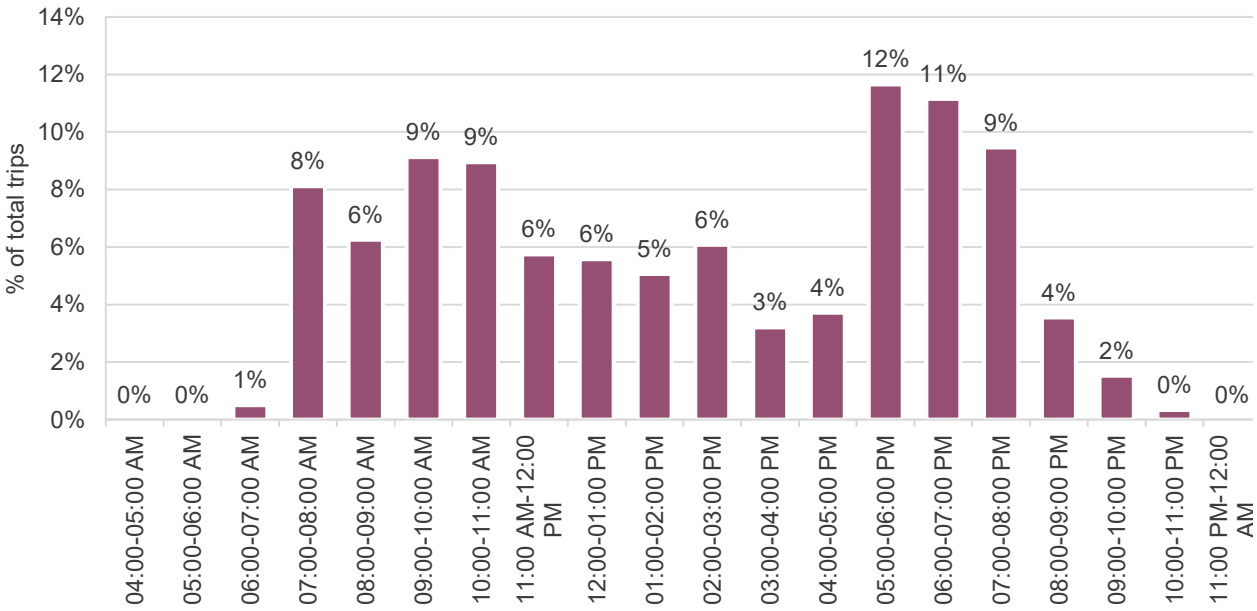
## Travel time on board

The average travel time on board is 33 minutes. The analysis of travel time on-board by travel purpose indicates that women spend more time traveling for household purchases and care work (40 mins) compared to travel for work (33 mins) or educational purposes (27 mins).

## Time of travel

The morning peak period for female commuters starts at 9:00 am and extends till 11:00 am. Additionally, female commuters engage in travel during typical non-peak hours in the afternoon, starting from 11:00 am to 3:00 pm. 25% of trips during this period are for education purposes and 8% for HH and care-related work. The evening peak period is observed from 5:00 pm to 7:00 pm.

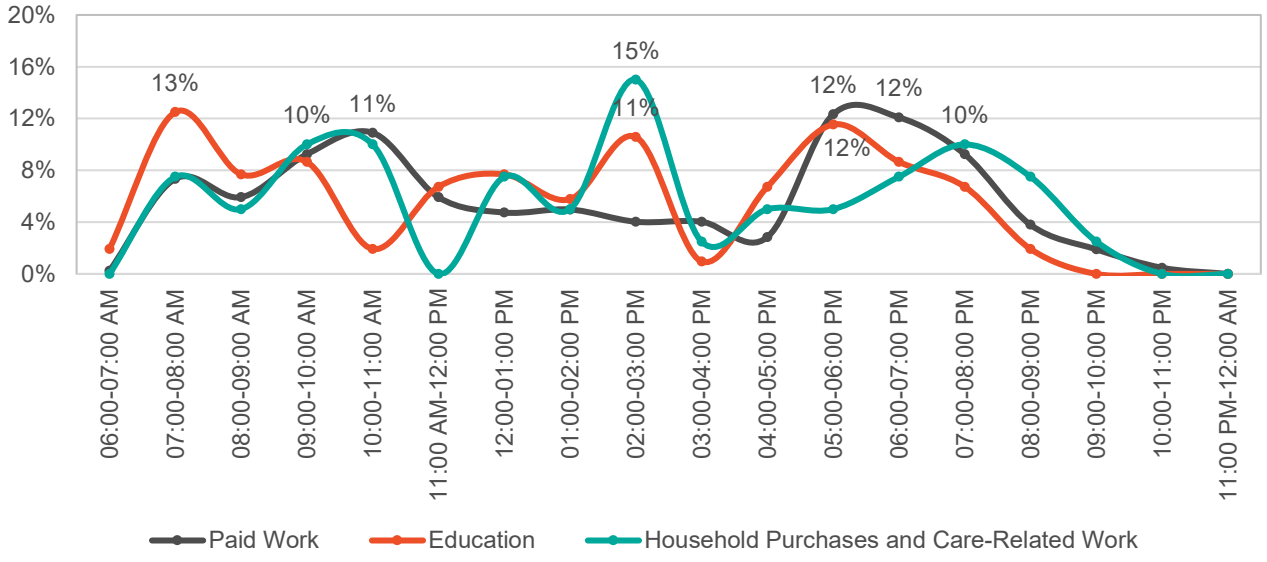
Figure 18: Time of travel




*N: 1,260 (including both onward and return journey)*

The peak period differs for different travel purposes (Figure 19). For students, the peak periods are 07:00-08:00 am, 02:00-03:00 pm, and 05:00-06:00 pm. The peak periods for household and caregiving work are 02:00-03:00 pm which accounts for 15% of total household trips, but women also travel for household purchases and care-related work during the morning peak period from 09:00-11:00 am and in the evening from 07:00-08:00 pm. The peak period for work-related travel is from 10:00-11:00 am and 05:00-07:00 pm.

Figure 19: Time of travel by purpose

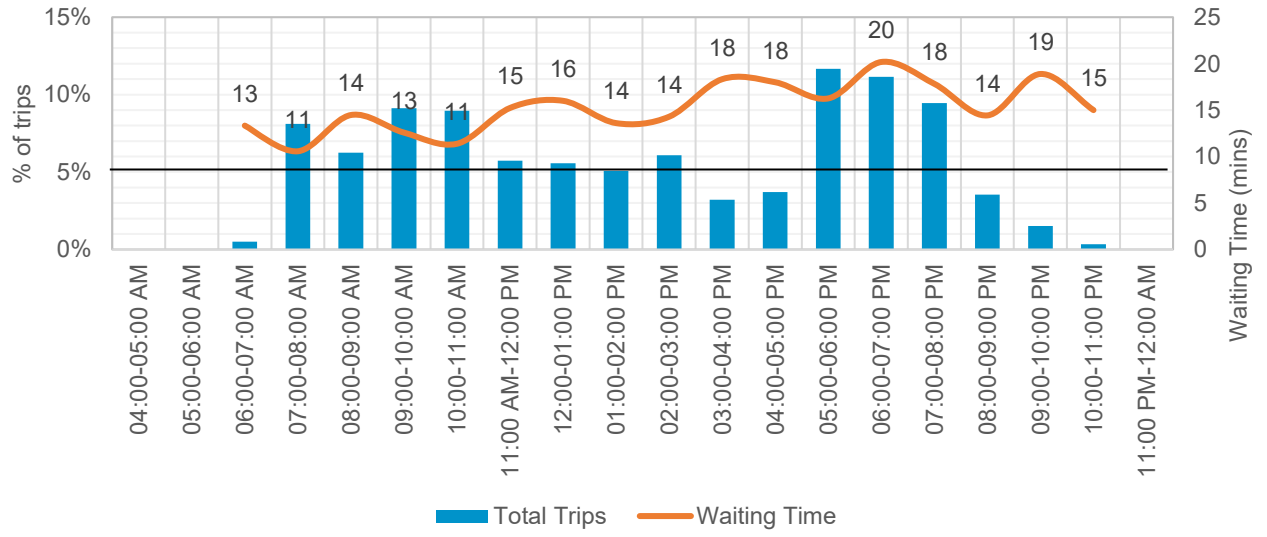



*N: 903 (PW); 220 (E); 82 (HPCRW)*

## Waiting Time

The scheduled waiting time as per the out-shedding details on this route is 10 minutes. However, women reported that the average waiting time on this route is 15 minutes. The waiting time is comparatively higher in the evening hours than morning.

Figure 20: Waiting time and time of travel



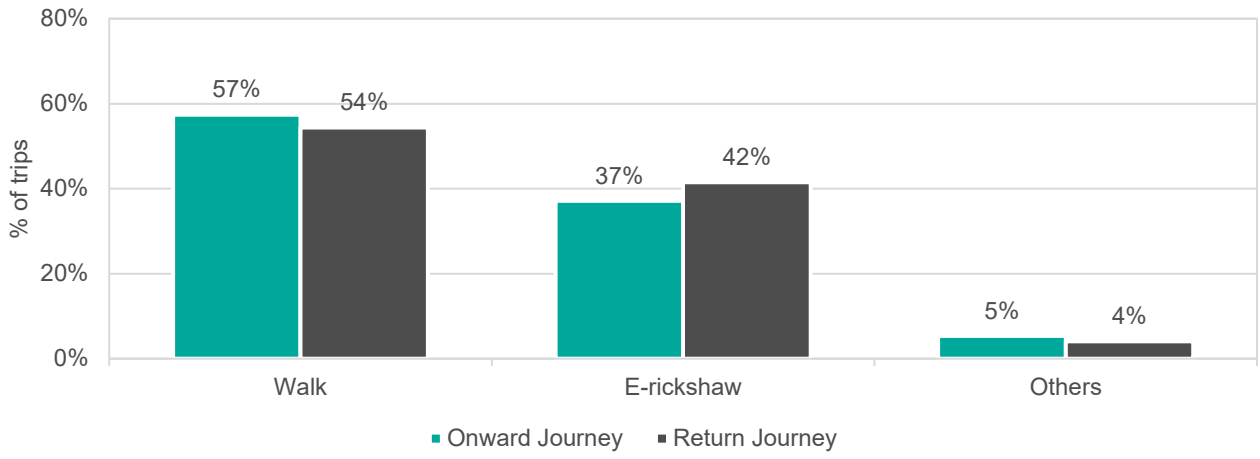

*N:1,258*

*Note: The black line indicates the average waiting time.*

## Mode of travel to access bus stop

Walking is the predominant mode of travel used by female commuters to access bus stops, followed by e-rickshaws. Approximately 5% of female respondents opt for other modes for their first- and last-mile trips, including trips by auto-rickshaws or with someone dropping them off. On average, women travel for approximately 15 minutes to reach the bus stop. The average distance[13] travelled by female commuters to access the bus stop is 1.0 km by walking and 2.7 km by e-rickshaw.

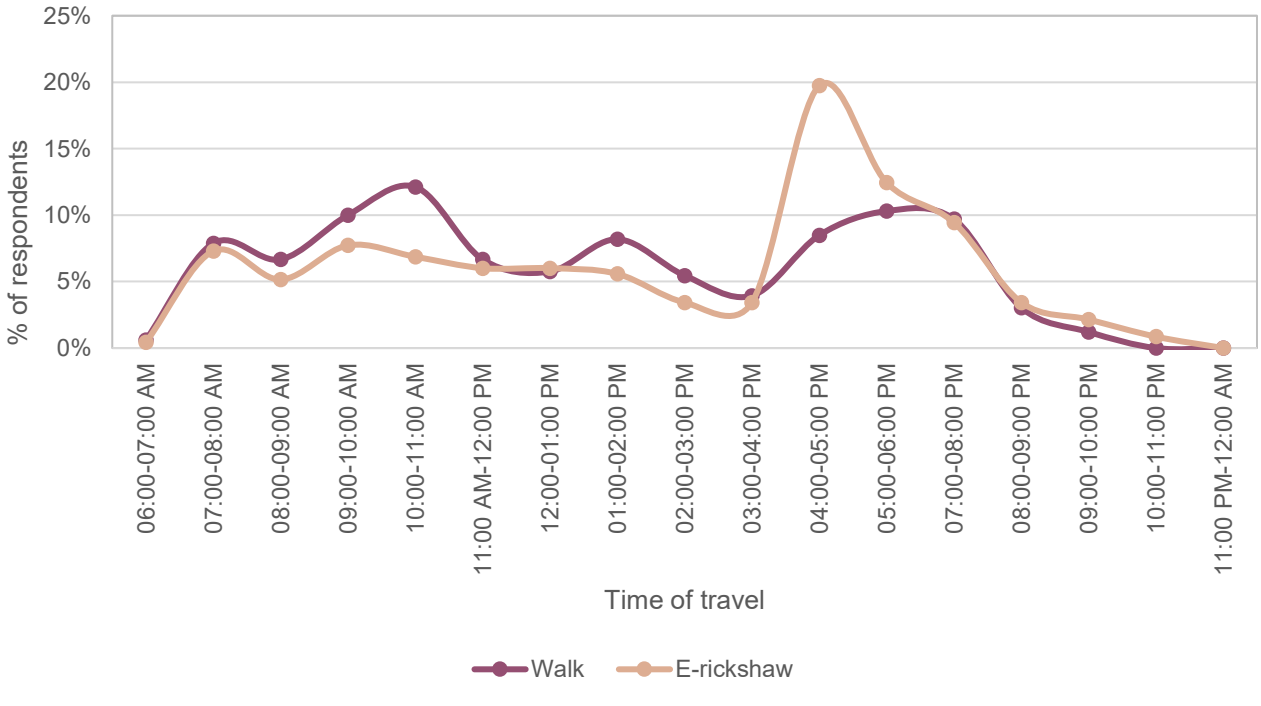
Figure 21: Mode of travel to the access bus stop




*N: 296 (OJ); 296 (RJ)*

Women predominantly use e-rickshaws to reach the bus stop when traveling for paid work purposes for their onward journey. However, more women take e-rickshaws in the evening after 04:00 pm, regardless of the travel purpose. There could be multiple reasons for this trend, including time pressure arising from the need to fulfil domestic roles and a perceived sense of insecurity in the evening.

Figure 22: Mode of travel to access bus stop and time of travel




*N: 296 (OJ); 296 (RJ)*

[13] Considering a walking speed of 4.8 km/hr and the speed of the e-rickshaw as 10 km/hr.

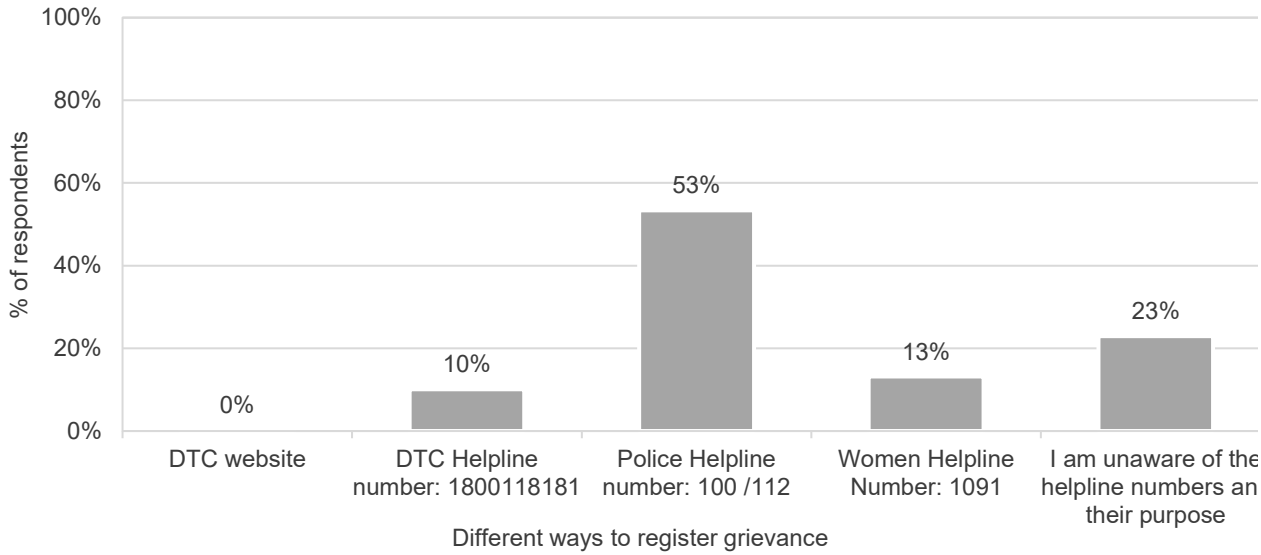
## 4.1.2 Awareness of the Existing Initiatives

### Grievance Redressal Mechanism

The awareness level among female commuters regarding helpline numbers is notably low. Approximately 23% of female commuters lack awareness of any helpline number to contact in distressed situations. Only 10% of surveyed female commuters are acquainted with the DTC helpline number (1800-118-181), and 13.2% are aware of the women's helpline number (1091). It is interesting to note that only 53% of female commuters are aware of the police helpline number (100).

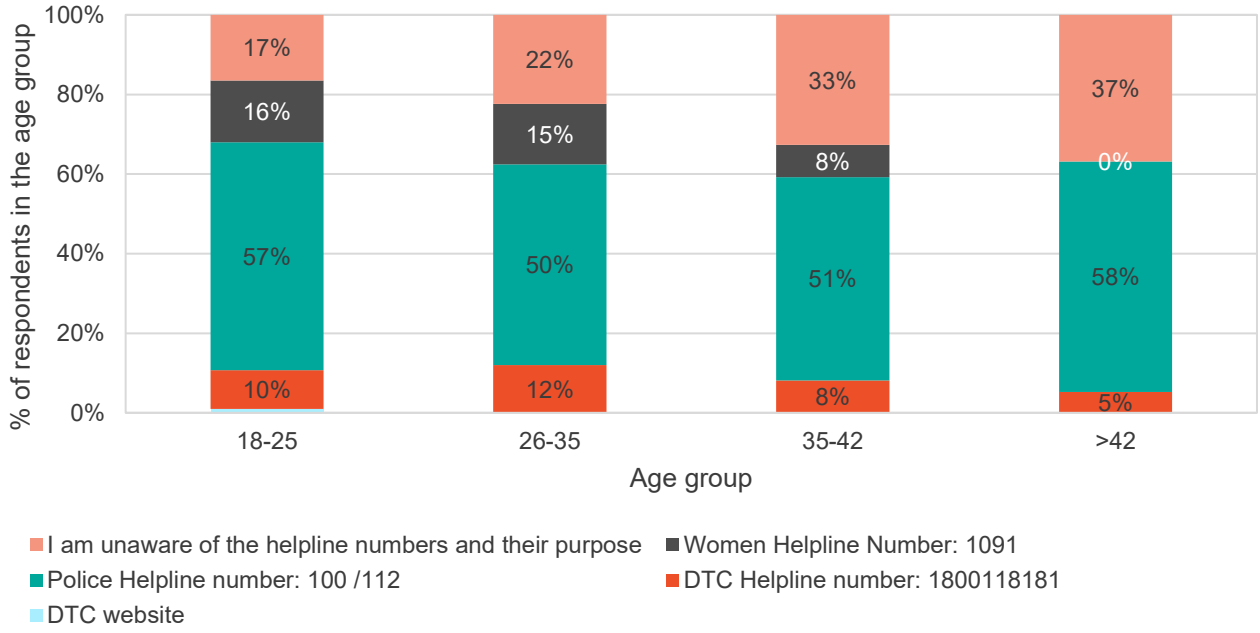
The intersectional analysis by age indicates a lack of awareness of helpline numbers among older women. Younger women aged <35 have a comparatively better awareness level of police and women's helpline numbers. This is also due to the comparatively lower education levels among older women (Figure 10). The awareness of the DTC helpline number is notably low among all age groups.

Figure 23: Awareness of grievance redressal mechanism




*N: 296*

Figure 24: Age and awareness of grievance redressal mechanism

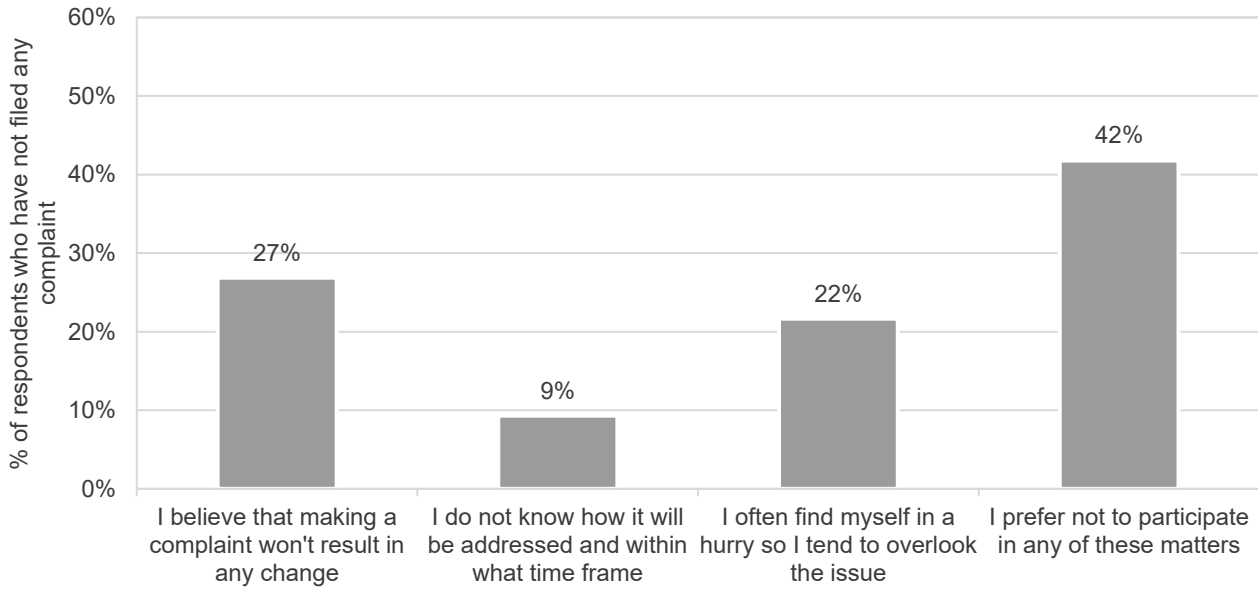



*N: 103 (18-25 age group), 125 (26-35 age group),49 (35-42 age group),19 (>42 age group)*

`

91% (268 of the 296) of female commuters reported that they had never registered a complaint. Among the female commuters who have never registered a complaint, 27% expressed a belief that filing a complaint would not lead to any meaningful change. Additionally, 42% prefer not to engage in the process, while 19% have normalized the issues, citing time constraints as a reason for not dedicating time to the complaint process. These findings suggest a lack of trust in the grievance redressal mechanism among female commuters.

Figure 25: Reasons for not registering a complaint




*N: 268*

## Types of complaints registered

Only 12 women reported that they had registered a complaint. Among the minimal number of complaints filed, the majority are directed against bus drivers, particularly concerning issues related to not stopping buses at designated bus stops. Other reasons for which female commuters have registered a complaint

include incidents of theft and instances of bickering. Not a single female commuter has filed a complaint for sexual harassment. This underscores the serious concern that women may not perceive day-to-day instances of sexual harassment as significant enough to register a complaint.

## Awareness of Bus Marshals

Even though the bus marshal scheme was introduced in 2015 for the major purpose of the safety of women, only 12% of surveyed female commuters are aware of the scheme and 19% are somewhat aware. The intersectional analysis by age indicates that the awareness level decreases significantly among women older than 25.

Specifically, 46% of female commuters in the age group of 18-25 are aware of the bus marshal scheme, compared to around 1/4$^{th}$ of female commuters in the age groups of 26-35 and 36-42, and only 16% among those aged >42.

Figure 26: Awareness of Bus Marshal Scheme

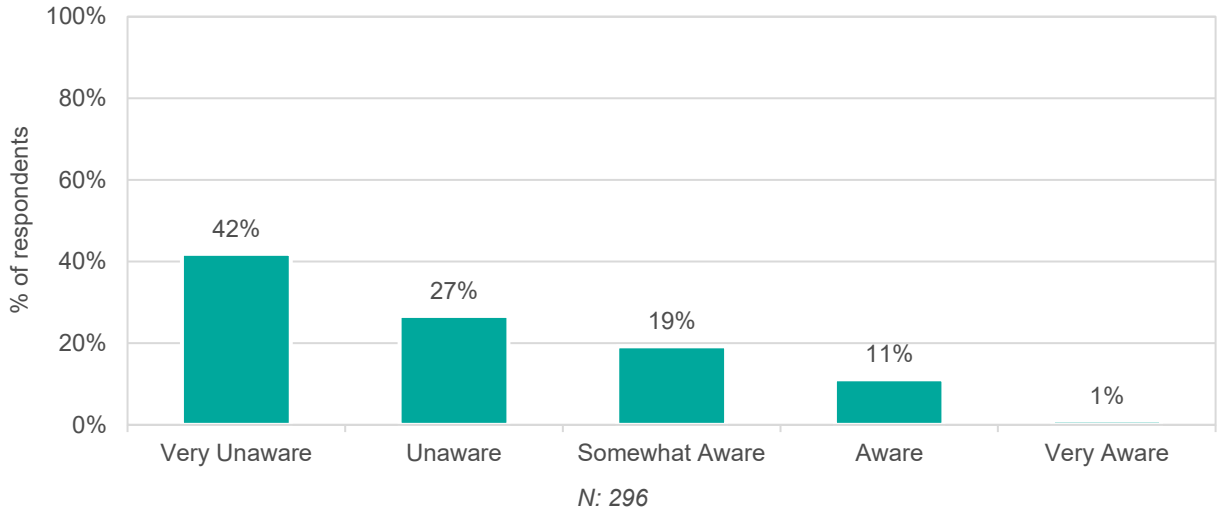
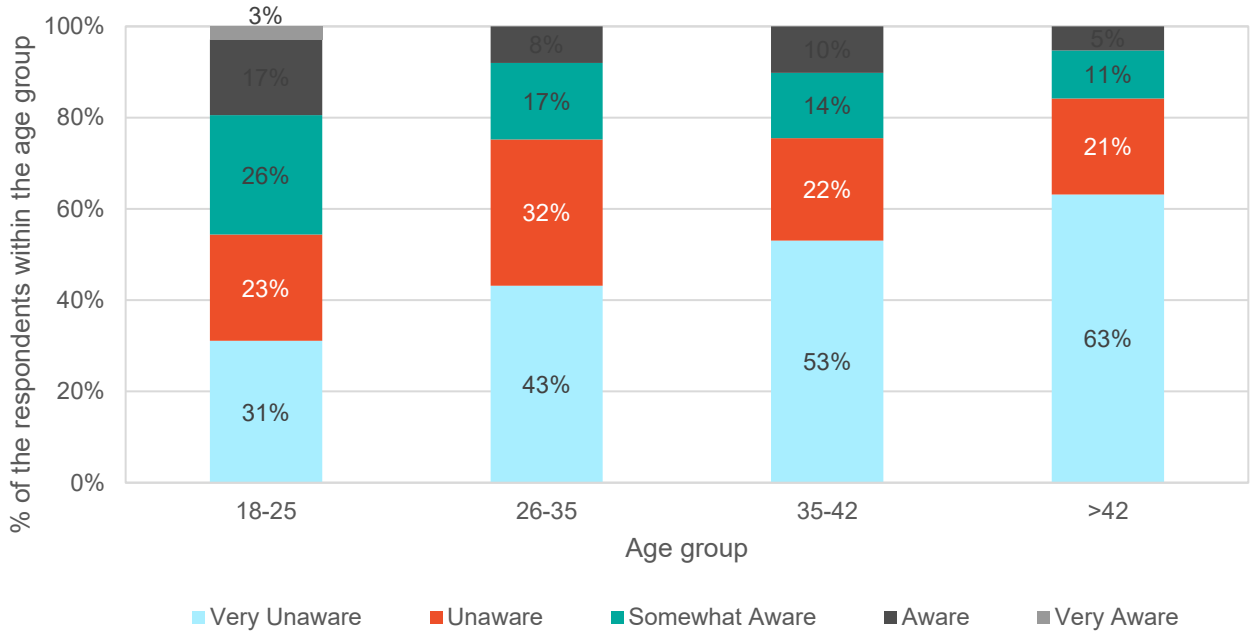



Figure 27: Age group and awareness of the bus marshal scheme



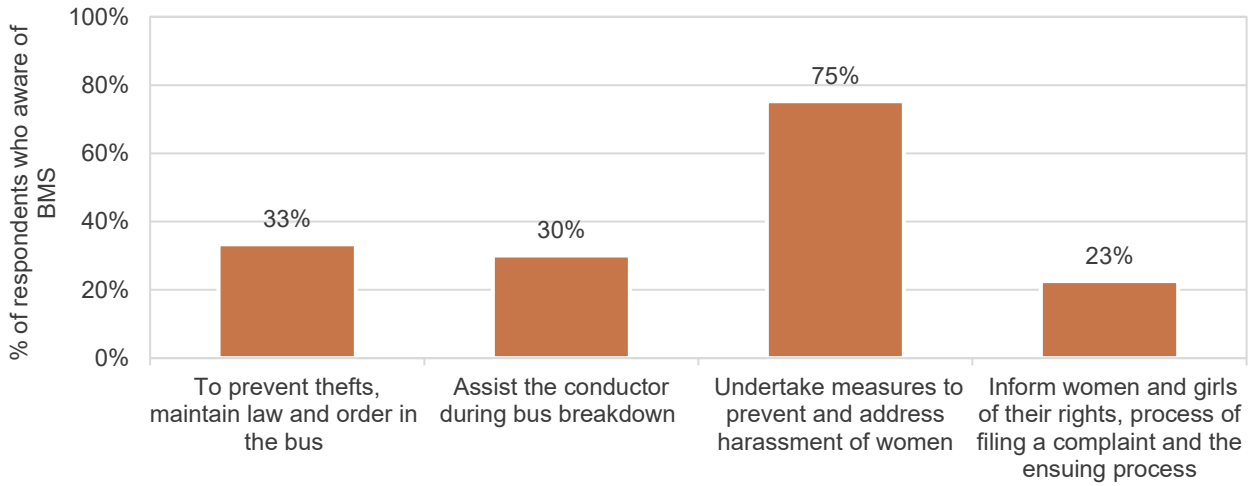

*N: 103 (18-25 age group), 125 (26-35 age group),49 (35-42 age group),19 (>42 age group)*

### Role of bus marshals

As per the guidelines of the bus marshals' scheme, their role is to prevent theft, maintain law and order in the bus, assist the conductor during bus breakdowns, inform women and girls of their rights, guide them through the process of filing a complaint, and undertake measures to prevent and address incidents of sexual harassment.

Among women who reported being aware of the bus marshals' scheme, 75% are aware that bus marshals are primarily responsible for ensuring the safety of women and preventing sexual harassment in buses. However, only 23% are aware that one of their responsibilities is also to inform women and girls about their rights and the process of filing a complaint.

Figure 28: Awareness of roles of bus marshals




*N: 93*

In the course of qualitative surveys, it was observed that the pilot bus depot had 10 female bus marshals, all of whom were CDVs. These individuals were primarily assigned morning duties. However, following the changes implemented after November 1, there are no longer any female bus marshals deployed.

Despite the Bus Marshals Scheme being in place for eight years, only 31% of female commuters are aware of its existence, and a mere 12% understand the purpose and intentions behind the scheme. Feedback from focus group discussions with both male and female conductors revealed a common perception that bus marshals are not being useful. According to conductors, bus marshals appear to invest insufficient effort in ensuring the safety of women passengers. Male bus conductors noted instances where marshals occupied seats or engaged in conversations near the driver, rather than actively assisting passengers.

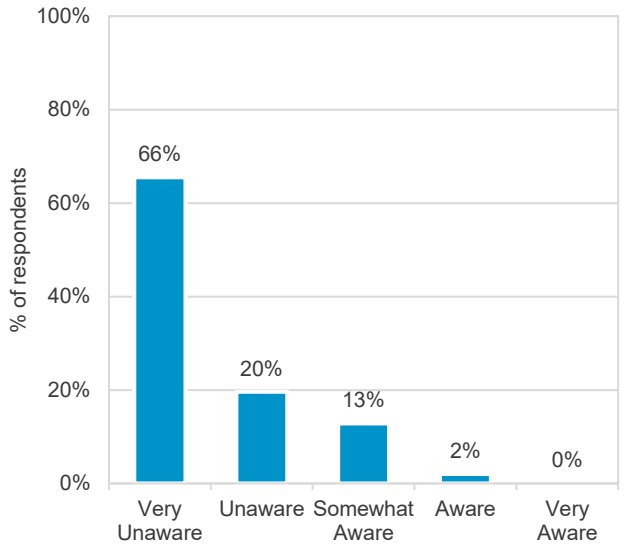
## Awareness of One Delhi Application

The first version of the One Delhi Application (ODA) was launched in 2019, and an upgraded version was introduced in 2022, featuring functionalities such as ticket purchase, complaint registration, real-time information, and journey planning.

The awareness of the One Delhi application among female commuters is notably low. Despite 77% of female commuters having access to a smartphone, and 92% among them having internet access, only 2% of female commuters are fully aware of ODA. 13% of female commuters have some awareness with limited information about the features of the application. Female commuters who are aware of ODA predominantly belong to the 25-32 age group.

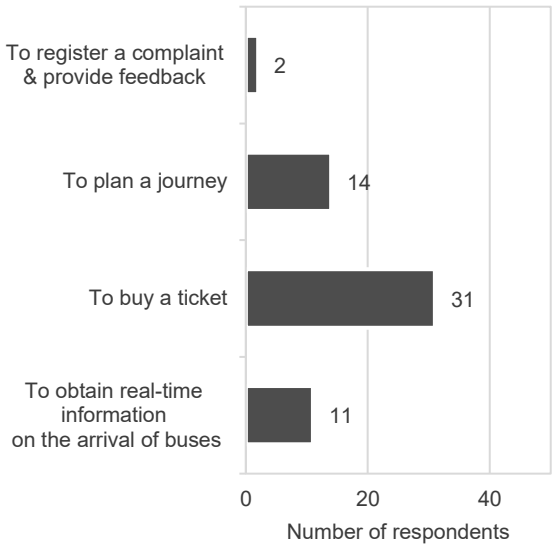
Among the female commuters who are aware of ODA, 30% (13 out of 44) have not used the application yet. The predominant reason for not using the application is that they do not know how to use it. Female commuters have predominantly used the application to buy the ticket (**Error! Reference source not found.**).

Figure 29: Awareness of One Delhi Application




*N: 296*

Figure 30: Purpose of the using the application



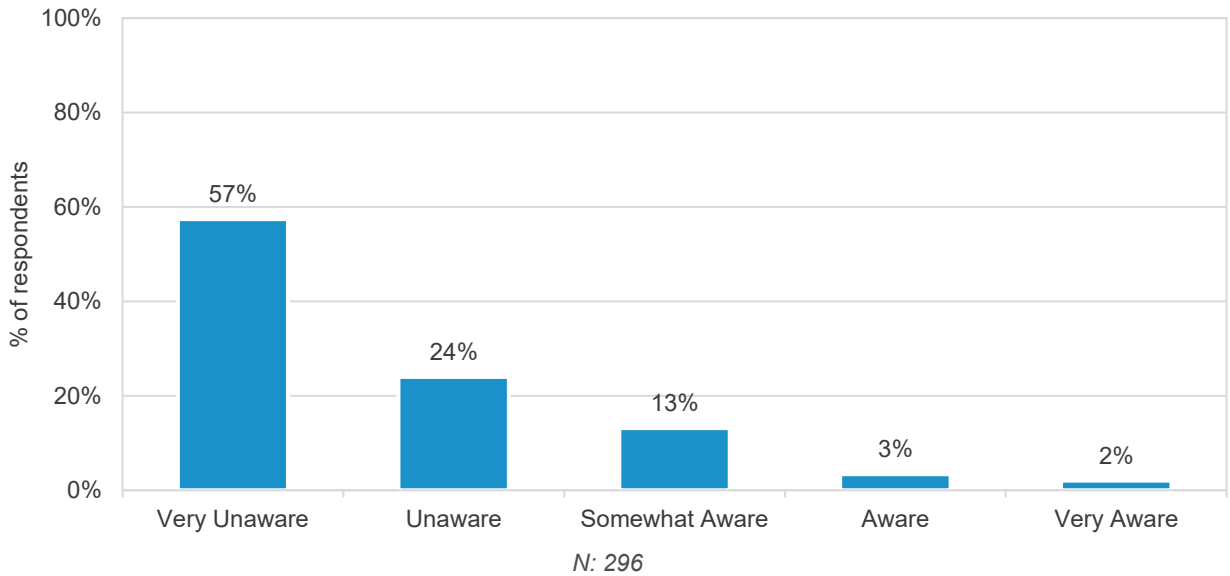

*N:44*

## Awareness of Panic Buttons

The primary survey indicates that 81% of female commuters are not aware of the panic buttons installed in the e-buses. Predominantly women younger than 35 years are aware of the panic buttons in e-buses. Among older commuters, none are aware of the panic button, as only 1 out of the 68 respondents who are >35 reported awareness of it.

This finding is also corroborated by bus marshals, who reported not having seen any incidents of panic buttons being pressed. They suggested that this might be due to some passengers, especially women, possibly being unaware of the presence of panic buttons.

Figure 31: Awareness of panic buttons

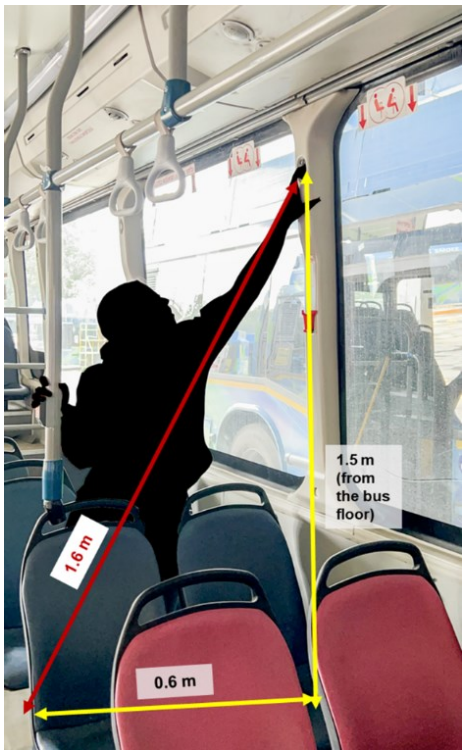



*N: 296*

### Purpose of panic buttons

45% of female commuters responded that panic buttons are to alert everyone on the bus of a mishap or incident of sexual harassment. The surveyed commuters have also mentioned that the panic button is not accessible to them, especially when buses are crowded. While the panic buttons are positioned at a height of 1.5 meters, corresponding to the average height of an Indian woman, there exists a challenge in accessing them. To reach the panic button, a woman must extend her reach diagonally, taking into consideration the width of the seats, as depicted in Figure 32. This illustration highlights the impediments associated with accessing the panic button in e-buses.

Figure 32: Accessibility of panic button

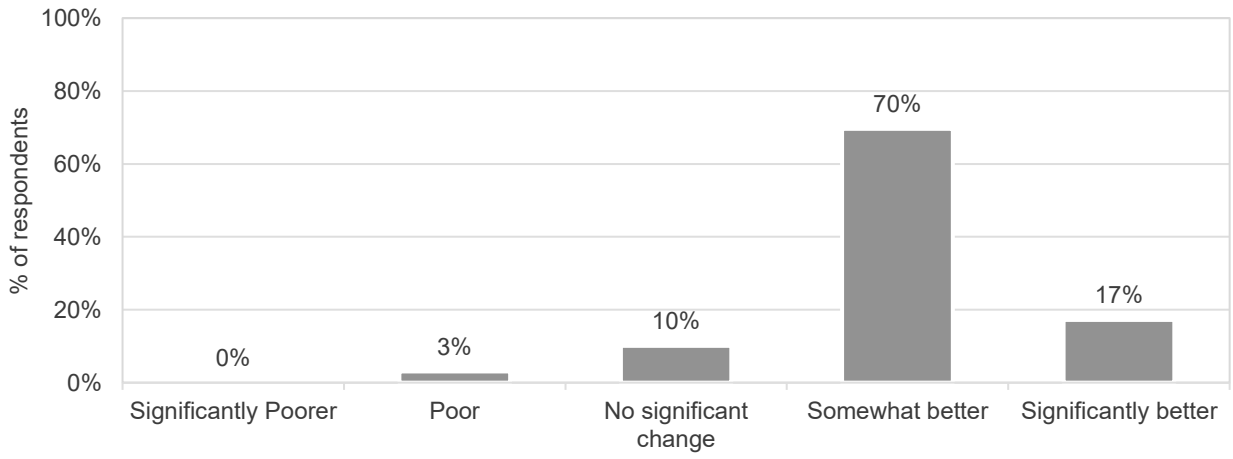



*Source: The Urban Catalysts*

## 4.1.3 Perception of e-buses

87% of female commuters stated that e-buses are comparatively better than existing CNG buses. The female commuters highlighted that they prefer e-buses because they have better air conditioning systems (86%), are well maintained (69%), and are quieter than CNG buses (51%). The primary concerns highlighted by the respondents for e-buses include high waiting times (57%) and frequent breakdowns (39%). 29% of the respondents also reported that the PIS (Passenger Information System) board doesn't work in e-buses.

Figure 33: Perception of e-buses as compared to CNG buses




*N: 296*

Figure 34: Advantages of e-buses

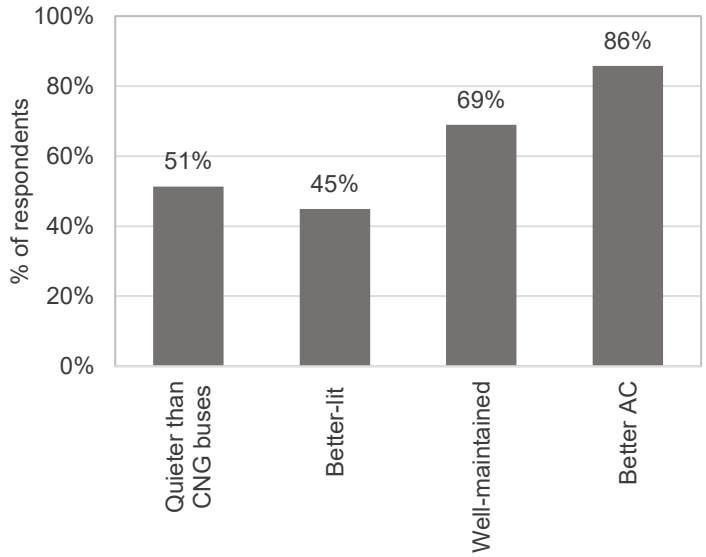
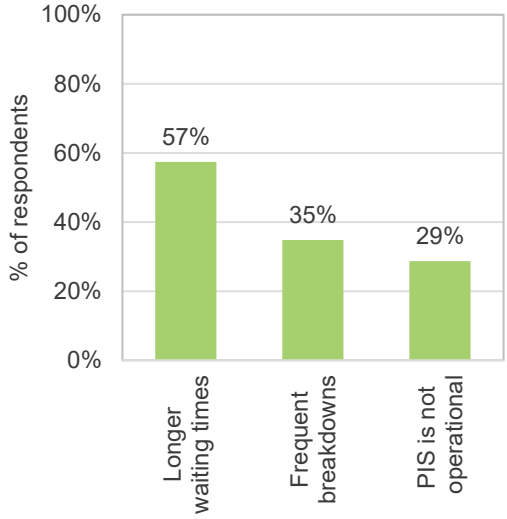



Figure 35: Disadvantages of e-buses




*N: 296 (for each response)*

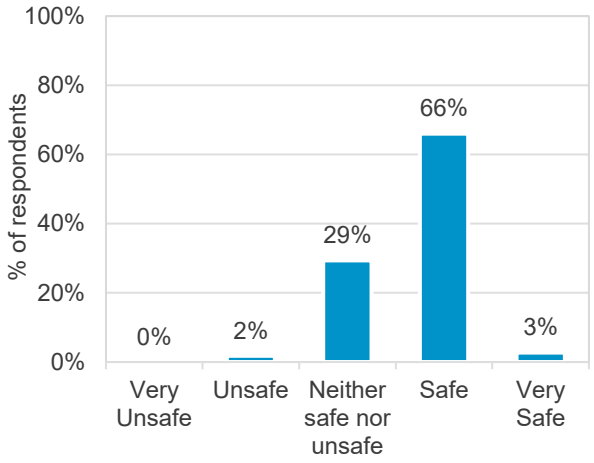
## 4.1.4 Safety perception of female commuters

### Safety while waiting at the bus stop, during boarding and alighting

69% of female commuters have reported feeling safe while waiting at the bus stop and during boarding and alighting. This perception is predominantly during the day, as the ridership of female commuters decreases significantly after 8 pm (Figure 18). The conversations with female commuters revealed that the perception of safety further decreases during the night.

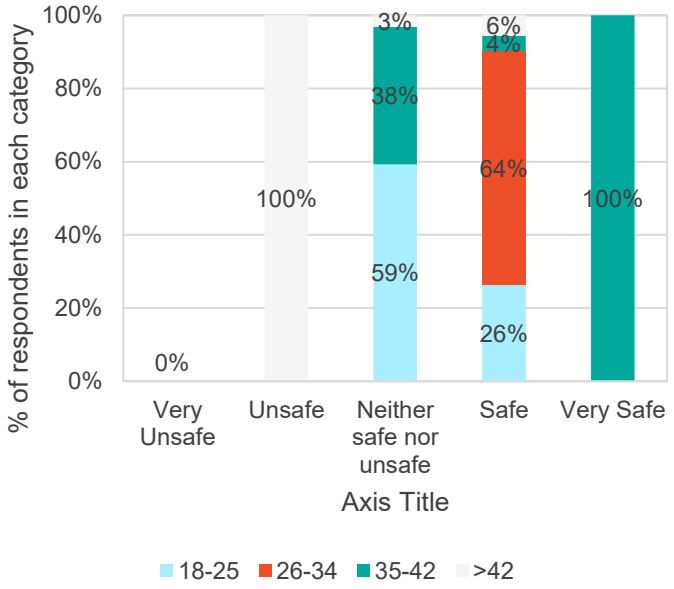
Younger women seem to be unable to categorize bus travel as completely safe or unsafe. Among women who have reported moderate safety, stating that they feel neither safe nor unsafe, 59% of them fall within the age group of 18-25 (Figure 37).

Figure 36: Perception of safety while waiting at the bus stop, and during boarding & alighting




N:296

Figure 37: Perception of safety while waiting at the bus stops and boarding & alighting, by age




N:296

## Safety perception while traveling inside the vehicle

Only 28% of female commuters have reported feeling safe while traveling inside the vehicle. 47% of the commuters have stated that they feel unsafe. This indicates a lack of sense of safety among female commuters while traveling inside the buses. Younger women, especially those aged between 25-32, who constitute the predominant users of buses, feel comparatively less safe than other female commuters. Younger women, especially those aged between 25-32, who constitute the predominant users of buses, feel comparatively less safe than other female commuters (Figure 39).

Figure 38: Perception of safety while traveling inside the vehicle

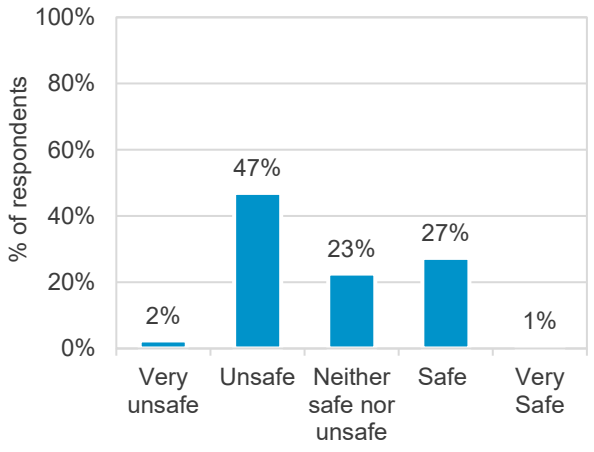
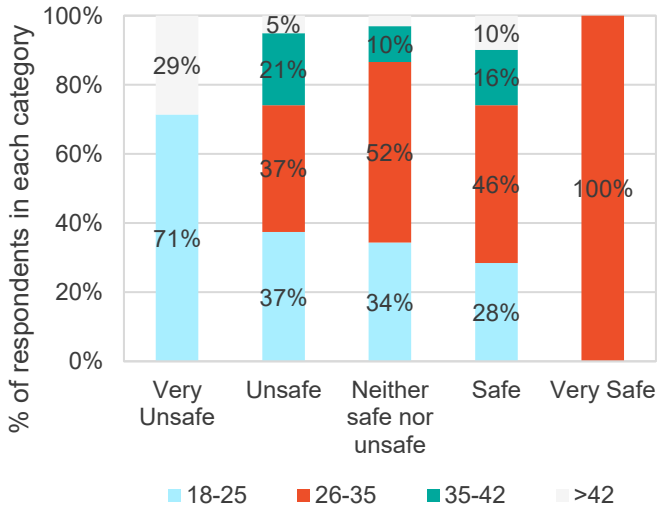



Figure 39: Perception of safety while traveling inside the vehicle, by age




N:296

## 4.1.5 Issues highlighted by female commuters

Several issues were highlighted by female commuters during the preliminary discussions conducted in the initial pilot test. Building on insights from the previous study (84) and these preliminary discussions, specific issues were identified and subsequently validated through the primary survey. These issues were categorized based on the stages of a public transport journey and are illustrated below.

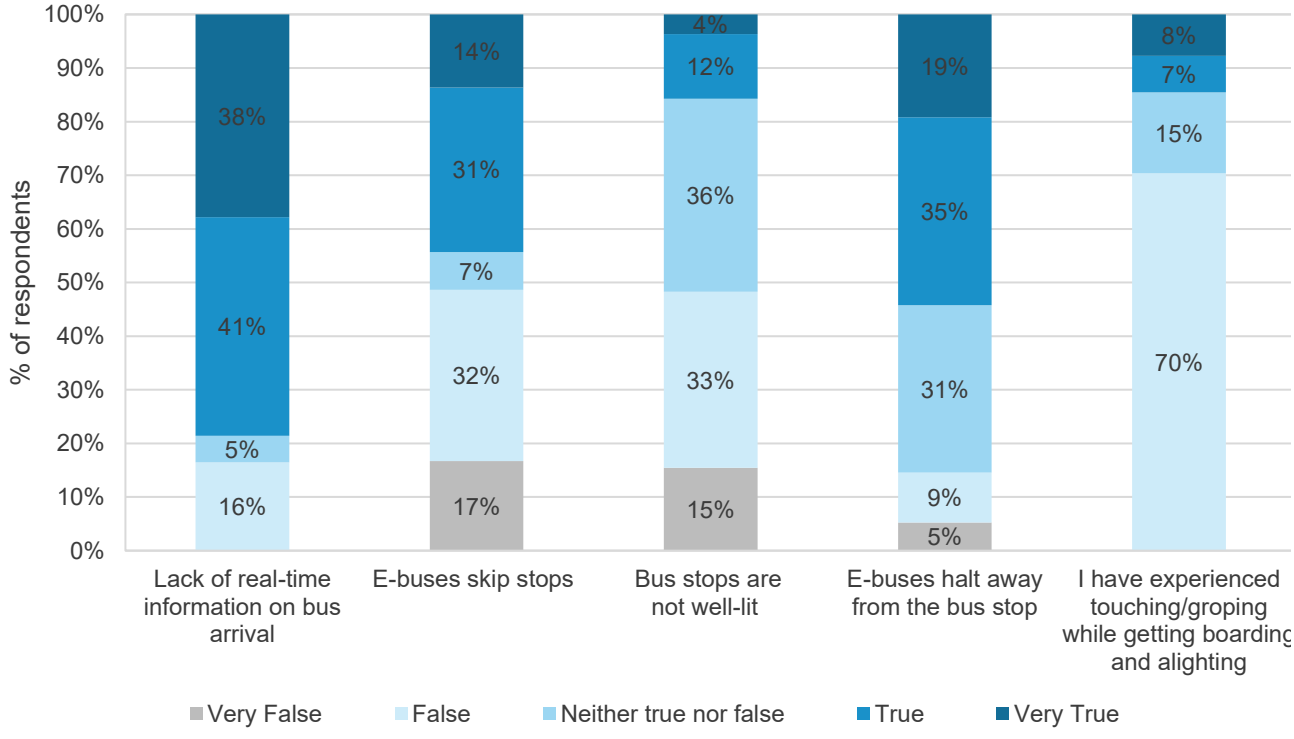
### Stage of PT journey: While waiting at the bus stop and boarding and alighting

The absence of real-time information emerged as a significant issue faced by female commuters. A substantial 79% of female commuters expressed that there is no information available at bus stops about the arrival of buses. 54% of female commuters reported that e-buses halt away from the bus stops, with this occurrence happening frequently, while 35% stated that it happens sometimes (Figure 40). Some of the reasons highlighted by female commuters for e-buses not halting at the bus stops include bus bunching at the stops, commuters standing on the road while waiting at the bus stop, e-rickshaws and auto-rickshaws standing on the bus route to pick up passengers and driver's behaviour. However, vehicles such as auto-rickshaws and taxis, are permitted to pick up and drop off passengers at a distance of 75 meters ahead of the designated bus stop (113). 51% of female commuters stated that e-bus drivers skip bus stops when they are waiting at the bus stops.

The discussions with frontline workers, including e-bus drivers, revealed that these workers seem to perceive that they are only required to stop at the bus stops if a passenger signals their intent to board by raising their hands; otherwise, it is not necessary. However, as per the responsibilities listed by DTC for drivers, drivers are required to stop buses at all designated bus stops.

30% (89 out of 296) of female commuters reported instances of sexual harassment while boarding and alighting. However, they perceive that this happens due to crowding and have normalized this. 50% (44 out of 89) of women who have experienced sexual harassment are aware of the Police helpline number and 12% are aware of the Women's helpline number. However, 91% (81 out of 89) of them have never registered a complaint.

Figure 40: Issues faced by female commuters while waiting at the bus stops and boarding & alighting




*N:296 (for each response)*

## Stage of PT journey: While traveling inside the e-bus

Female commuters feel comparatively less safe while traveling inside the bus (69%) than waiting at the bus stops (21%) (Figure 38). A substantial 77% of the female commuters have voiced concerns about the overcrowding in e-buses during peak hours. 68% of female commuters have reported a lack of information on the reporting mechanism. Only 12 women have reported a complaint (Section 1.3.1), and they stated that they are unaware of the subsequent actions or outcomes after the reporting.

More than half of the surveyed female commuters reported frequent taunting by male passengers regarding the free bus travel scheme, and 9% stated that this happens sometimes. Following are some examples of taunts by male commuters:

***"पहले इन्हें चढ़ाओ, फ्री की सवारी को जल्दी है।"***

*(Let them board first; they are eager for the free ride)*

***"टिकट फ्री भी है, ऊपर से तुम्हें सीट भी चाहिए।"***

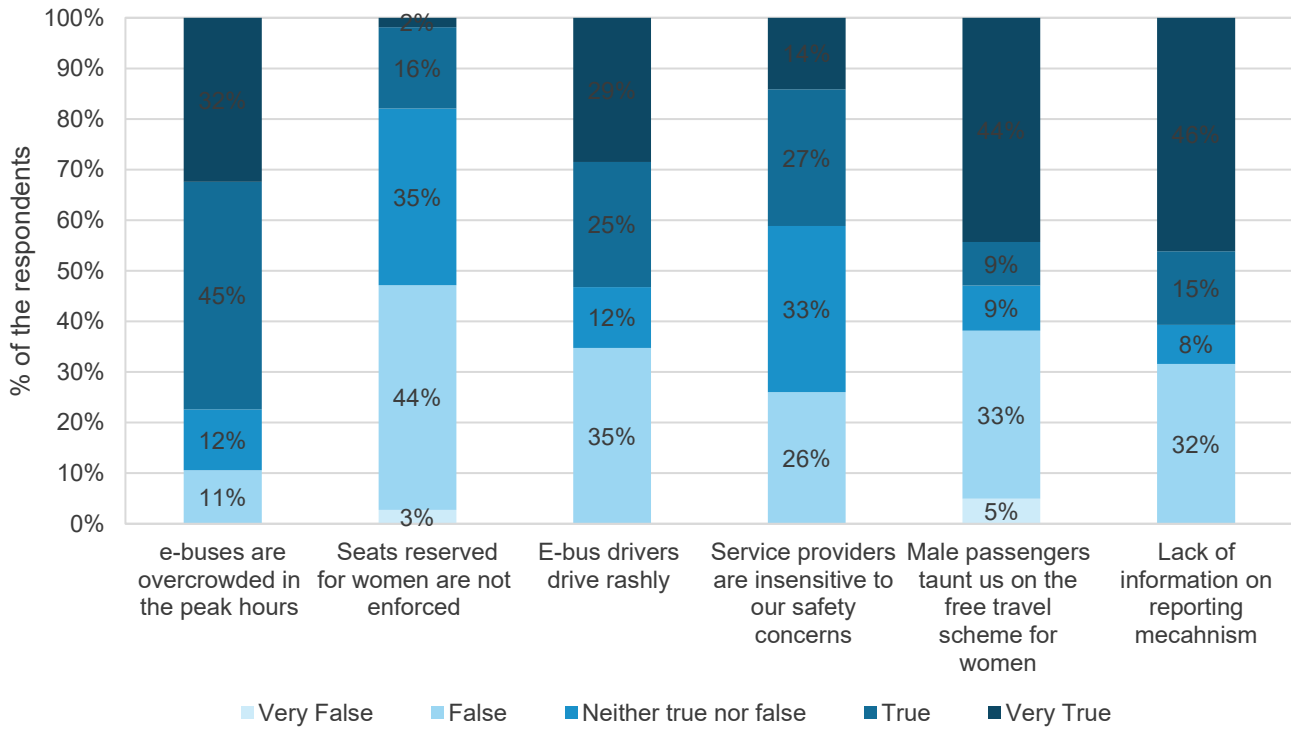
*(The ticket is free, and on top of that, you want a seat too)*

***"इनको घर में कुछ काम नहीं है, फ्री में बस में एसी के लिए आ जाती हैं।"***

*(They don't have any work at home; they come to the bus for free AC)*

53% of women and girls reported that e-bus drivers drive rashly, and this issue is more prevalent in e-buses compared to other CNG buses. 41% of female commuters reported that service providers are insensitive to their safety concerns, while 33% stated that some frontline workers make efforts to ensure safe travel for women.

Figure 41: Issues faced by female commuters while traveling inside the e-buses




*N:296 (for each response)*

## 4.2 Baseline Assessment- Qualitative Analysis

Qualitative surveys were conducted to gauge the perceptions of frontline staff on women's safety in buses. The aim was to comprehend their working environment, their perspectives on challenges encountered by female commuters, and the specific issues they face. Some of the preliminary recommendations were also explored during FGDs. All the FGDs were summarized and a thematic analysis was done. The identified themes include:

### 4.2.1 Profile of male and female frontline staff deployed at pilot e-bus depot

All frontline workers work in buses in two shifts i.e., from 05:00 am-02:00 pm and 02:00 pm-10:00 pm. However, female bus marshals and conductors are intentionally assigned to the morning shift. This is being done to avoid having them work at late night for safety reasons. There are no female drivers at the pilot e-bus depot.

The educational attainment of female frontline staff is relatively higher compared to their male counterparts. Predominantly, female frontline staff have education levels up to diploma or undergraduate degrees, while male frontline staff typically have education levels up to the 12th grade.

### 4.2.2 Working in buses

Both bus marshals and conductors express a perception of safety during their working hours on e-buses. Female frontline staff attribute their perception of safety to their uniform, which resembles that of the police, deterring passengers from engaging in misconduct.

Female bus marshals stated that, in crowded situations, they tend to stand near the front gate of the bus. This adjustment is motivated by safety concerns. Standing at the back during crowded situations makes them feel insecure, as their relatively shorter stature among men is overwhelming, contributing to a sense of vulnerability. Female conductors also share safety precautions, mentioning that they make an effort to avoid having a man seated next to them for safety reasons.

Both female bus marshals and conductors perceive their work environment as safe. However, subconsciously, they have developed techniques or strategies to avoid unsafe locations within buses. They also mentioned that having a male colleague on the bus contributes to their sense of safety. This implies that despite the overall positive perception, there are nuanced safety concerns that prompt these female frontline staff to take precautionary measures.

### 4.2.3 Safety perception of female commuters

All frontline staff share a common perception that both women and girls feel safe while traveling by e-buses, attributing this sense of safety to the presence of frontline workers. The frontline staff perceive that there is no difference in the experiences of young girls and women when they travel in public transport. However, this is in contrast to the primary survey which indicates that younger women, especially in the age group 25-32, feel more unsafe than other age groups.

Despite all frontline workers reporting instances of harassment on buses, they generally regard women as relatively safe during their travels. This implies that they do not perceive sexual harassment as a prominent safety concern for women and girls during their everyday journeys.

When asked about women feeling unsafe in the bus when men stare at them or pass comments, the female bus conductors replied that women in Delhi are used to incidents like staring and passing comments, due to which, women do not regard these concerns in the ambit of safety. Staring, verbal harassment, and physical contact are identified as the three most common forms of sexual harassment experienced by female commuters, according to observations by frontline staff on buses.

Male bus marshals have highlighted the reluctance of women to report these incidents, often attributing it to shyness. The bus marshal expressed that women prefer to ignore such situations as they prefer not to engage in such incidents daily. Even the depot manager acknowledged the issue of underreporting due to

a lack of awareness among commuters and the common tendency for people to overlook issues in their daily routines.

**"महिलाओं को ऐसा भी लगता है कि अब उन्हें रोज़ की आदत हो गई है; अगर वे रोज़ उलझेंगी, तो काम पर कैसे पहुँचेंगी।"**

*(These instances are so frequent that women also feel that now it is a daily occurrence. If we get into reporting every day, how will we reach work?)*

- **A female conductor**

All frontline workers reported to have seen male passengers taunting women on the free bus travel scheme. Additionally, they have observed situations where male passengers initiate arguments or make derogatory remarks when requested to vacate reserved seats for women. It was highlighted that predominantly elderly male passengers taunt women, stating that, at the age of 60, they still purchase tickets while women travel for free. Some of the comments observed by frontline workers are:

**"इनको हर स्टैंड पर उतरना और चढ़ना होता है।"**

*(They have to get on and off at every stop)*

- **A male passenger**

**"इनके बाप ने सीट फ्री कर दी है।"**

*(Their father has made the seat free)*

- **A male passenger**

**""मैं 60 का होकर भी टिकट ले रहा हूँ, और यह मुझसे आधी उम्र की महिला को फ्री में यात्रा करनी है।"**

*(Even at the age of 60, I am buying a ticket, and she wants to travel for free, despite being half my age)*

- **An elderly male passenger**

Typically, frontline staff refrain from getting involved in these discussions. However, when questioned about their response to such comments, they mentioned that their customary action involves promptly intervening to separate the offending passenger from the women involved.

## 4.2.4 Issue of bus driver not stopping the bus for female passengers

### Bus marshals and conductors

Among the 12 male conductors who attended the FGD, five acknowledged that bus drivers do not stop for women at designated bus stops, while seven expressed disagreements with this perception. All male bus marshals unanimously concurred that bus drivers do not stop for women at designated bus stops. In contrast, female bus marshals and conductors asserted that only a few drivers exhibit this behaviour, and it is largely contingent on the individual behaviour of the drivers.

It is perceived that drivers typically make subjective judgments regarding the purpose of a woman's travel and, based on these assumptions, decide whether to skip the stop. Frequently, drivers presume that women are traveling either to purchase milk or solely to enjoy the air conditioning, which results in them not stopping at bus stops where only women are waiting. This contrasts with the findings of the primary

survey, which states that 78% of trips by female commuters are for work purposes, a viewpoint also highlighted by bus marshals and conductors.

The other reason for not stopping buses for female commuters, as per the frontline staff is that e-bus drivers often employed by private agencies, may lack comprehensive training and tend to operate independently. These e-bus drivers adhere to a kilometre-based incentive scheme where they get additional monetary benefits above 100 km per day, incentivizing them to cover a specific distance each day, with additional rewards for surpassing set targets. This incentive structure fosters a sense of urgency among drivers, and in situations with only female passengers waiting or when the bus is crowded, they may skip stops, citing an unwillingness to accommodate passengers who travel for free.

It was also highlighted that drivers typically only stop at bus stops where passengers signal their intent to board by raising their hands. In situations where passengers, particularly women, fail to signal, drivers may choose not to stop. Female bus marshals attributed the responsibility for buses not stopping at certain stops to passengers, stating that it is the passengers' responsibility to signal the drivers to stop by showing their hand. However, as per the responsibilities listed by DTC for drivers, drivers are required to stop buses at all designated bus stops.

### Bus drivers

All e-bus drivers deny the statement that drivers skip stops. They state that they stop at all the bus stops where passengers indicate that they have to board and alight, putting the onus of the issue on commuters. They also mention that they are not required to stop at all bus stops, which is in contrast to what is mentioned in the duties and responsibilities of drivers as per DTC.

Drivers state that they are hired on a contractual basis and are given incentives based on the scheduled kilometres travelled. They operate under a kilometre-based incentive scheme that requires them to cover a certain distance each day, with additional incentives provided for exceeding these targets. It becomes difficult for them to stop at each bus stop to finish their scheduled km, which will cost them their incentive.

The depot manager was not aware of the issue of drivers not stopping at the bus stops. However, when shown statistics of registered complaints, he admits that the issue is indeed serious and requires attention.

## 4.2.5 Frontline staff believe that women are given preferential treatment

All frontline staff, including drivers, bus marshals, and conductors, unanimously believe that women are given preferential treatment by providing them with a free bus travel scheme and reserved seats. Frontline workers believe that women are taking advantage of the current scheme by using buses for short distances and everyday household tasks. They emphasized that such usage patterns may impact the comfort of those who genuinely need the bus service for essential purposes like paid work.

Drivers seem to hold strong stereotypes, asserting that the provision of free bus travel has enabled women to venture outside their homes for relatively minor activities, such as grocery shopping, activities they believe should not be done using buses. According to them, women were doing these activities even when bus travel was not free. They stated that the availability of free bus travel has seemingly expanded travel options for women, leading to what is perceived as unnecessary short trips for various purposes. One of the drivers stated:

> **"फ्री सेवा देने से महिलाओं की नकेल ढीली हो गई है और वे बेवजह परेशान करती हैं।"** *(The free bus travel scheme has provided travel freedom to women and now they causing issues for us)*
>
> - **A driver**

All frontline workers believe that the reserved seats for women are unfair towards men who pay for the ticket and do not even get a seat. They stated that the free bus service should be exclusively provided to individuals from lower-income groups or instead of entirely free travel, women should pay a subsidized amount for tickets to avoid potential misuse and ensure that genuinely deserving women benefit. Both drivers and conductors hold the perception that the free travel scheme is causing financial losses for DTC.

**"दूध लेने के लिए भी महिलाएं बस में चढ़ जाती थीं, और उनके चक्कर में जो पुरुष खड़े होते थे, वे चढ़ नहीं पाते थे।"**

*(Even for buying milk, women use buses, and as a result, poor men waiting at the bus stops are unable to board)*

- **A female bus marshal**

### 4.2.6 Performance appraisal system

Our focus group discussions revealed there is no formalized regular performance appraisal system for bus marshals and conductors. An annual performance report is typically prepared for conductors, evaluating their performance based on criteria such as attendance records and disciplinary actions taken by the depot manager. Character assessment is also conducted, considering parameters such as personality, intelligence, and integrity, rated on a qualitative scale from fine to poor. This is filled by the traffic inspector based on the observations. The overall assessment results in a classification of either satisfactory or unsatisfactory performance. Although an annual performance report is prepared for each conductor, there is no reward system for good behaviour. However, a penalty system is in place to discourage negative conduct.

As highlighted earlier, e-bus drivers receive a daily incentive based on the number of kilometres travelled. However, it appears that this incentive scheme inherently motivates them to skip stops to ensure they complete their daily kilometres and receive the incentive.

### 4.2.7 Internal coordination among frontline staff

The conductors expressed limited control over the privately employed drivers, resulting in a breakdown of the previously established understanding and cooperation among conductors, drivers, and bus marshals. Additionally, conductors indicated reluctance to file complaints against drivers, citing concerns for the drivers' job security. Even when complaints were lodged, there were reported instances of inadequate response or resolution. During the semi-structured interview, the Depot Manager mentioned that they impose a fine of Rs. 100 per complaint on the agency responsible for hiring drivers.

**""जब DTC की बसें थीं, तब ड्राइवर और कंडक्टर के बीच तालमेल था। अब वे किसी की नहीं सुनते और उनके कारण DTC की छवि खराब हो रही है।"**

*(When there were DTC buses, there was harmony between drivers and conductors. Now, they don't listen to anyone, and because of them, the reputation of DTC is deteriorating)*

- **A male bus conductor**

10 of the 12 male conductors expressed disagreement with the notion that bus marshals play a significant role in ensuring the security of women in buses and enforcing seat reservations. According to the conductors, bus marshals appeared to put insufficient effort into ensuring the safety of women passengers. Male bus conductors stated that they have observed instances where bus marshals occupied seats or engaged in conversations near the driver, rather than actively assisting passengers in finding seats.

Female bus conductors also hold the same perception. The conductors contended that buses operated effectively even without the presence of marshals, and women passengers felt secure.

### 4.2.8 Perception of women-only section within e-buses

In response to the proposal of implementing a system where only women would use the front door for boarding and alighting, while all genders could use the rear door, conductors, bus marshals, and the depot manager expressed reservations about the feasibility of this idea. They raised concerns about the potential impact of this intervention on dwell time, which will then increase the total journey time.

Concerns regarding the implementation of women-only sections on buses extend beyond gender-related considerations. Participants expressed apprehension that such a configuration could increase overcrowding at the rear gate, potentially increasing the risk of accidents. Furthermore, conductors underscored the importance of passengers exiting in front of the driver for safety reasons, as deviating from this practice could heighten the risk of accidents. The proposed measure will require drivers to focus on both doors to ensure that all the passengers deboard safely. In response to the suggestion that conductors could signal the driver, participants noted that conductors were frequently occupied with ticket distribution, making it difficult to take on additional responsibilities. Drives also hold the same perception.

The depot manager shares a similar viewpoint and has reservations about the concept of introducing a women-only section on buses. On the idea of allowing elderly men to also board from the front gate, he expressed concern that it could pose difficulties for them when manoeuvring from the ladies' section to the conductor for ticket purchases.

## 4.3 Perception of e-buses

All frontline workers stated that they find e-buses better than CNG buses. The reasons for preference for e-buses include improved air conditioning, reduced noise levels, lower air pollution, and increased overall comfort. However, despite the better air conditioning in e-buses as compared to CNG buses, it was highlighted that the minimum temperature is set at 22 degrees Celsius which is ineffective in crowded situations.

Frontline workers highlighted the issues with ventilation. The e-buses on the pilot route lack small fans near windows, resulting in a sensation of suffocation during overcrowding. The limited ventilation in electric buses reportedly leads to more instances of passengers vomiting compared to CNG buses.

Figure 42: Design of e-buses

*Source: The Urban Catalysts*

A few conductors noted the discomfort they experienced during extended hours of sitting due to the inadequately cushioned seats in e-buses. Additionally, e-buses were reported to have a narrower gangway compared to older CNG buses. Bus drivers and conductors also highlighted that the space in the front of electric buses is constrained, causing difficulties for passengers trying to board and alight simultaneously from the front door. Furthermore, due to reduced space near the front gate, bus marshals feel uncomfortable standing in the front, as there are instances when people brush past them while alighting from the bus.

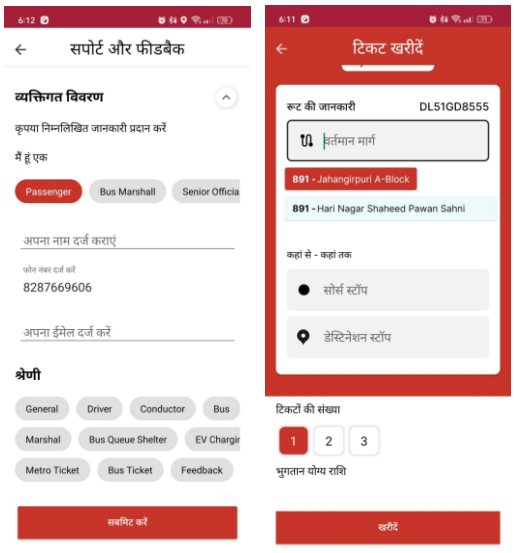
In e-buses, drivers manually control the announcement system. There are five preset announcements covering seat reservation, safety from theft, traveling with a valid ticket, taking care of personal belongings, and holding your child while sitting. These announcements are intended to be activated manually by the driver, which becomes cumbersome as it requires repeated pressing of individual buttons, which further distracts the driver.

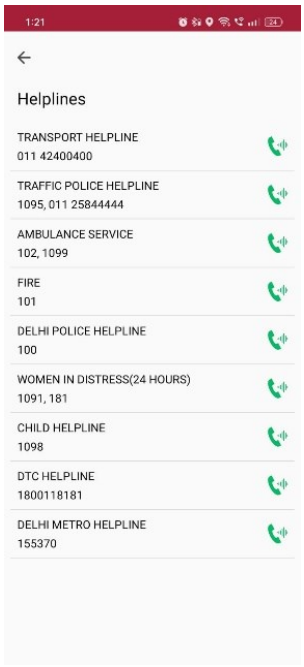

SAMSUNG
STOP

# 5. Implementation

Based on the survey findings and discussions with the Delhi Transport Department and Delhi Transport Corporation, strategies were co-created to improve the safety of female commuters in DTC buses. The following table highlights the implemented strategies:

Table 4: Implemented strategies during the project period

| Interventions | Underlying Issues Identified | Implementation Status |
|---|---|---|
| **Real-time information of bus arrival at bus stops** | This required sharing of Application Programming Interface (API) with mobile phone application providers by bus operator which was not being done. | Efforts were focused on ensuring that e-buses are available on existing mobile phone applications such as One Delhi and TUMMOC.<br><br>By March 2024, 1,000 e-buses were successfully integrated into the One Delhi application. This integration allowed users to purchase tickets online and provide feedback related to e-buses. |
| **Real-time information within buses** | PIS system did not work in all e-buses plying on the pilot route. | The root cause of the issue—incorrect latitude-longitude data for bus stops—was identified. The project team captured the accurate latitude-longitude data and, with support from government stakeholders and the bus operator, updated it in all e-buses operating on the pilot route.<br><br>As a result, announcements for upcoming bus stops are now functioning correctly in all e-buses operating on the pilot e-bus route. |
| **Improving the user-friendliness of mobile applications with a focus on women's needs** | Considering the educational attainment of female commuters on the pilot route, it was recommended that the One Delhi Application incorporate bilingual support in English and Hindi.<br><br>Additional recommendations included integrating DTC's helpline and introducing a new SOS button feature. | As of April 2024, the application is available in Hindi and includes the DTC's helpline number.<br><br>Figure 43: Hindi language feature in One Delhi application<br>  |

| | | |
|---|---|---|
| | | Figure 44: Helpline n umber of DTC in the application<br>  <br><br>The discussion regarding the integration of the SOS button into the application is currently ongoing. |
| **Awareness Campaign** | Low awareness among commuters regarding safety features and app functionalities; | The safe city awareness campaign was implemented on the pilot route under the project to increase awareness on the existing strategies implemented by the Delhi government to ensure their safety in e-buses.<br><br>The campaign employed a three-pronged strategy to engage female commuters: (i) direct engagement on e-bus pilot route, (ii) workshops at colleges and institutes, and membership-based organisations, and (iii) outreach through social media platforms in both Hindi & English language. |

*Source: The Urban Catalysts*

Figure 45: Safe City Awareness Campaign on ground (Phase-I)


Figure 46: Safe City Awareness Campaign (Phase-II)

Figure 47: Safe City Awareness Workshop

*Source: The Urban Catalysts*

Figure 48: Safe City Awareness Workshops in educational institutes

*Source: The Urban Catalysts*

| | | |
|---|---|---|
| | Information on helpline number and panic buttons within buses | The project team designed stickers to be displayed in buses to provide information on helpline numbers and panic buttons. These stickers have been placed in all DTC e-buses. |
| **Informational stickers** | Figure 49: Stickers displayed in the buses<br>  <br>  <br>*Source: The Urban Catalysts* | |
| **Announcements in buses** | Informational audio announcements within buses | The existing audio announcements were updated to disseminate awareness on online ticketing, safety measures, panic buttons, the helpline number, and reserved seats for women.<br><br>A pilot test was conducted on one e-bus and scaled up in all buses. |
| **Use of technology to capture the issue of bus not stopping at the bus stop or halting away from the bus stop** | Provided feedback on Bus Management System | Criteria have been developed for the backend algorithm that can be implemented in the Bus Management System to capture instances where bus drivers do not halt at designated bus stops (114). |
| **Gender Sensitization Training of bus drivers and conductors** | | GST were conducted with all the bus driver and conductors working on pilot e-bus route during March-June 2024. The objective of this training was to sensitize conductors towards gender biases, raise awareness about the importance of free travel schemes for women, emphasize their role in ensuring the safety of female commuters, and help them identify and address sexual harassment incidents. |

Figure 50: GST with male conductors

*Source: The Urban Catalysts*

Figure 51: GST with drivers

*Source: The Urban Catalysts*

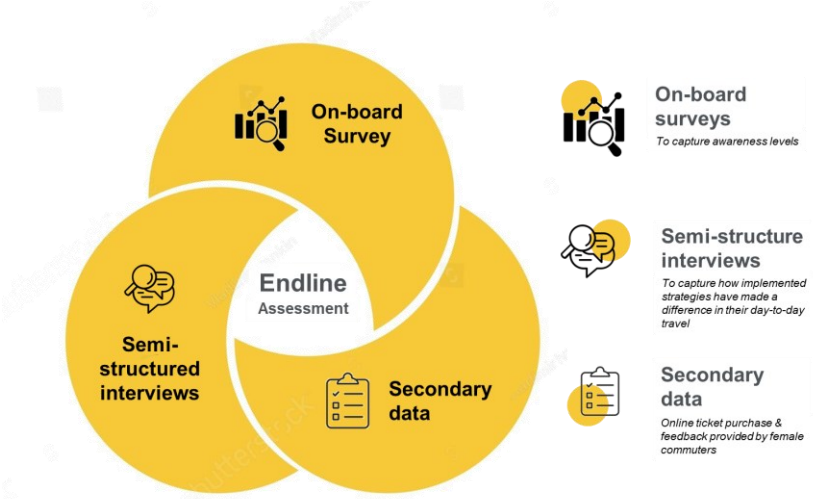
# 6. Endline assessment

The endline assessment aims to evaluate the project's impact and to derive lessons that can be utilized to improve future implementation strategies aimed to improve the safety of female commuters in bus-based public transport[14]. The surveys for endline assessment were conducted in June 2024 on the e-bus pilot route. While the implementation efforts are ongoing, the endline assessment sought to capture preliminary insights into the early effects of these initiatives. As a result, the focus

## 6.1 Methodology

A mixed-method approach was adopted, consistent with the baseline assessment. The same questionnaire, with some improvements, was used to measure awareness levels and to understand the specific features of the One Delhi Application as utilized by female commuters. A total of 40 surveys were conducted to facilitate comparison with baseline data. Additionally, semi-structured interviews were carried out with female commuters on the pilot route to gather comprehensive narratives and qualitatively assess the impact of increased awareness on their daily travel. The impact was also evaluated through secondary data, including metrics such as online tickets purchased by female commuters through ODA and feedback submitted via the helpline number or the ODA.

Figure 52: Analytical framework for endline assessment




## 6.2 Findings

### 6.2.1 Profile of the respondents

A total of 40 survey responses were collected, with 40% of female commuters in the age group of 18-25, 33% in the 26-34 age group, and 28% aged 35 and above. Education levels among female commuters are similar to those of baseline survey respondents, with 75% of women aged 18-25 and 62% aged 26-34 have diplomas/undergraduates, or postgraduate degrees. All surveyed female commuters above the age of 35 have education levels at or below the 12th grade.

33% of the respondents are regular wage/salaried employees, followed by 25% students, 18% helpers in household enterprises or own account workers, and 15% homemakers. Among the 95% of the total respondents have either a shared or individual smart phone (70% individual smart phone).

[14] Therefore, the focus is on assessing impact of initiatives and not repeating the baseline assessment.

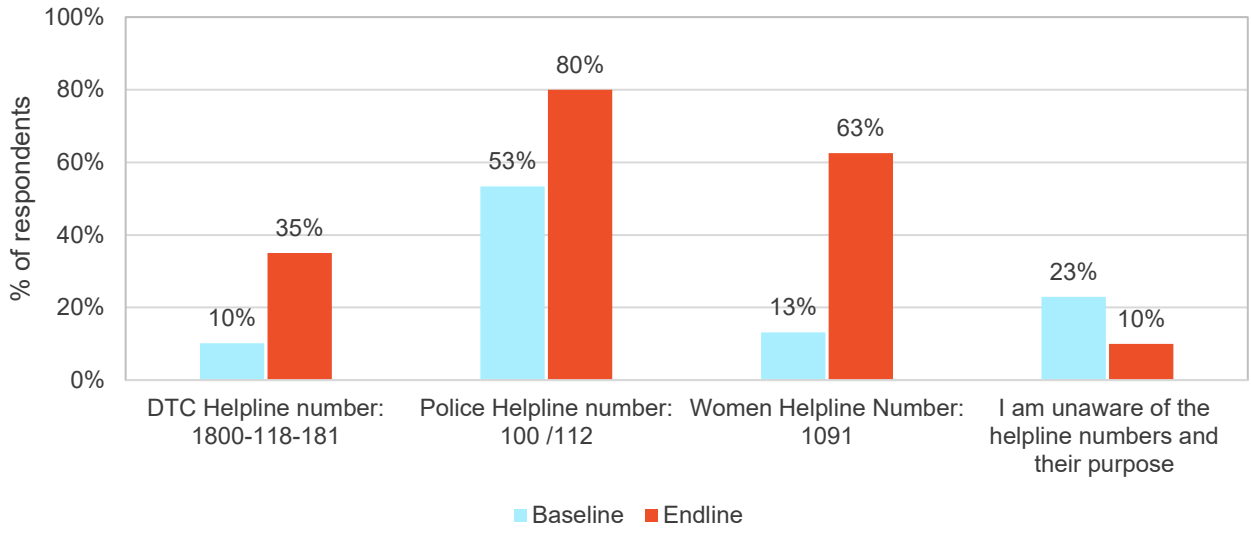
## 6.2.2 Awareness of the existing initiatives

### Grievance Redressal Mechanism

The endline assessment shows increased awareness of existing helpline numbers compared to the baseline assessment. Around 35% of female commuters reported awareness of the DTC helpline number, up from 10% in the baseline assessment (Figure 53). Similarly, more women are now aware of the Police (80% compared to 53% in baseline) and women's helpline numbers (63% compared to 13% in baseline).

93% of female commuters who reported awareness of DTC helpline numbers stated they learned about them through stickers displayed in buses. These stickers- designed by the project team- displaying DTC helpline number, women and Police helpline number were put up in all e-buses in Delhi.

Figure 53: Comparison of awareness of the grievance redressal mechanism in baseline and endline assessment




## One Delhi Application

Around 63% of female commuters reported being aware of the One Delhi Application and more than two of its features. The One Delhi Application, introduced by the Delhi Transport Department, allows bus users to purchase online tickets, obtain route information, real-time information of bus arrival and provide feedback. There has been a significant improvement in awareness of the application since the baseline, which was at 2% (Figure 54). The observed difference in the awareness level is statistically significant at $p<0.01$. Among female commuters who are aware of ODA, 60% are frequent users, and 32% are occasional users (Figure 55).

ODA is primarily utilized by female commuters for purchasing online tickets (96%), followed by obtaining route information (48%) and accessing real-time bus arrival (44%). About 8% of female commuters who know about ODA haven't used the app because they don't own a smartphone.

34% of female commuters aware of the One Delhi Application learned about it through route-based campaigns, 42% discovered it via QR codes available on buses, and 29% became aware through workshops held at institutes and colleges.

Figure 54: Comparison of awareness of ODA- Baseline & Endline

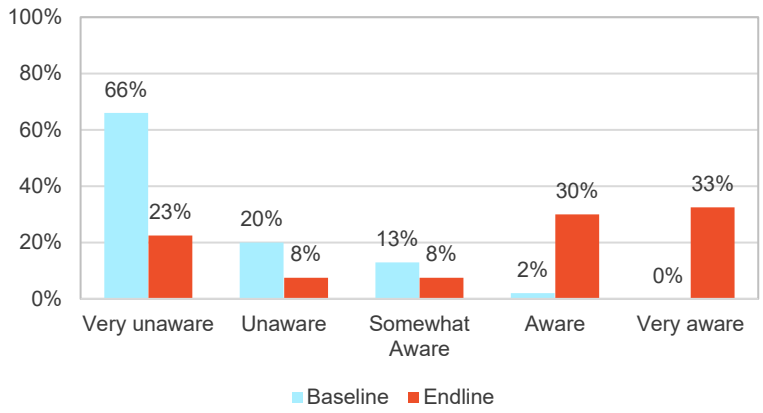
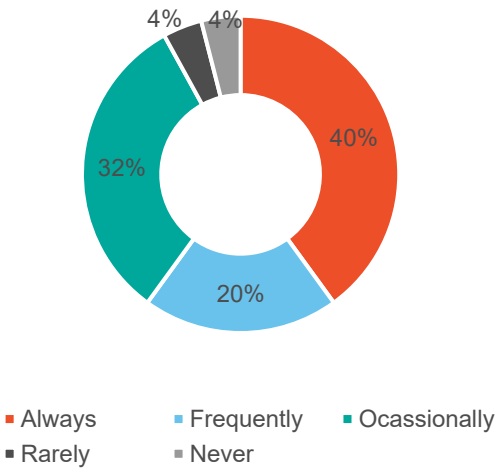



Figure 55: Frequency of the use of ODA as report in endline assessment



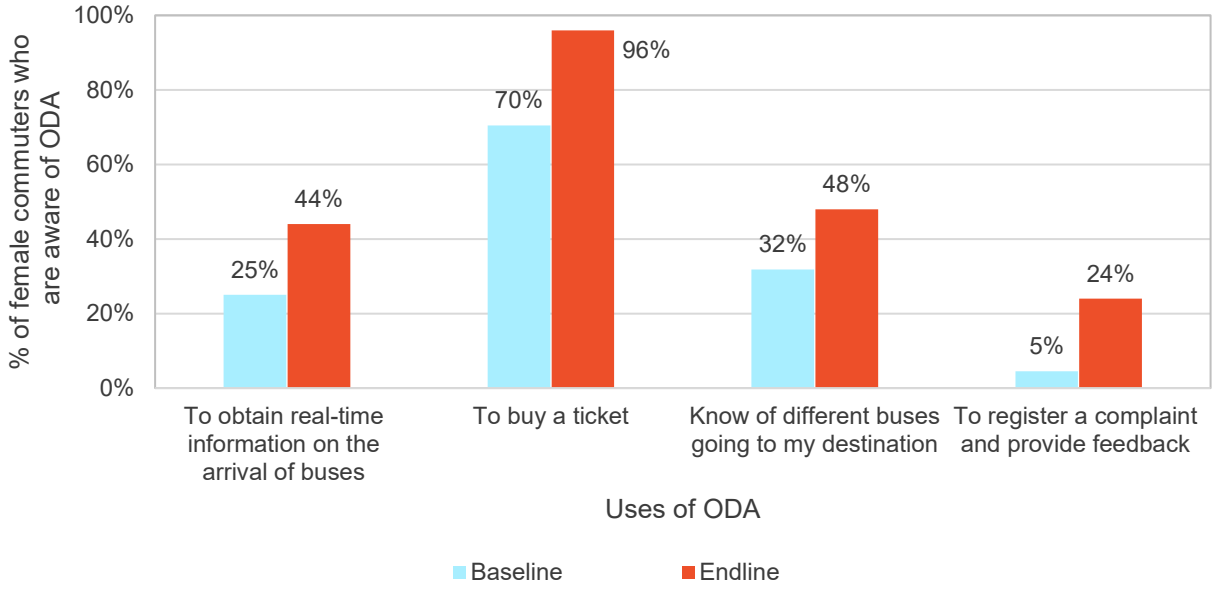

*"हम वन दिल्ली की एप्लिकेशन उपयोग करते थे पर हमें समझ नहीं आती थी, आपके बताने से और ब्रोशर से हमको ज्यादा मदद मिली है। अब हम आराम से अपना रूट चेक कर सकते हैं। धन्यवाद।"*

*(We have tried using the One Delhi application, but we couldn't understand it. Your explanation and the brochure have been more helpful to us. Now, we can easily check our route. Thank you.)*

*"वन दिल्ली एप्लिकेशन की मदद से जब भी हमें बस में भीड़ मिलेगी, तो कंडक्टर से टिकट लेने की बजाय हम सीट पर बैठकर आराम से टिकट ले सकते हैं। इससे हमें बड़ी सुविधा मिल गई है।"*

*(When faced with crowded buses, we can now easily obtain tickets by sitting in our seats, bypassing the need to approach the conductor. This is very convenient for us.*

Figure 56: Purpose for which female commuters use ODA- Baseline & endline assessment





The qualitative assessment revealed that, despite being aware of the One Delhi application, female commuters faced difficulties using it. These challenges were primarily due to lower education levels and the fact that only certain parts of the application are available in Hindi. Additionally, the absence of e-buses on the application created obstacles in purchasing online tickets and providing feedback, as tickets could only be bought if the specific e-bus was listed on the portal.

### Panic buttons

65% of the surveyed female commuters reported of being aware of panic buttons as compared to 5% during the baseline. This is statistically significant on two-tailed independent t-test at p<0.01. The awareness of panic buttons has improved across all age groups. Among female commuters who are aware of the panic buttons, 73% are familiar with their location. However, 29% still confuse panic buttons with stop buttons, which are positioned on the vertical poles within e-buses.

The display of stickers to highlight the location of panic buttons has had a noticeable increase, with 96% of female commuters reporting awareness of panic buttons through these stickers. Additionally, 27% reported hearing information on the location and use of panic buttons through awareness campaigns, while 15% learned that through safe city awareness workshops organised at colleges & institutes.

In reporting awareness of the use of panic buttons among female commuters, 96% are aware of their use in health and fire emergencies, 77% for incidents of sexual harassment, and 46% for other mishaps such as theft.

Figure 57: Awareness of panic buttons

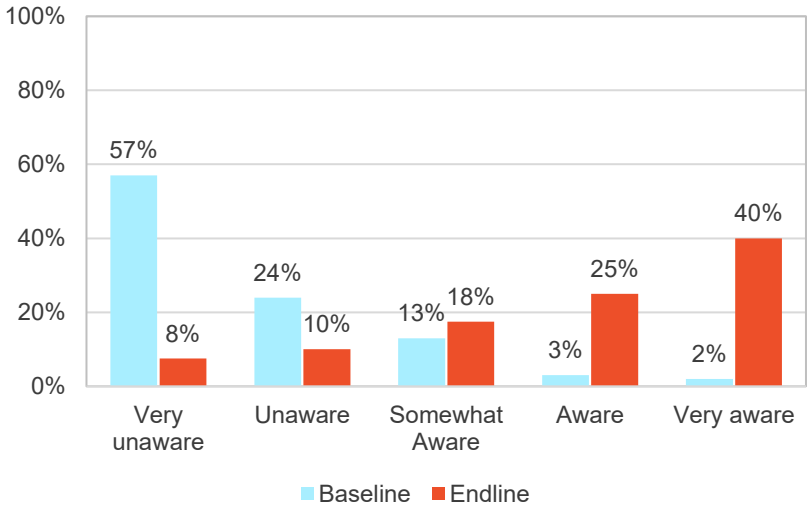
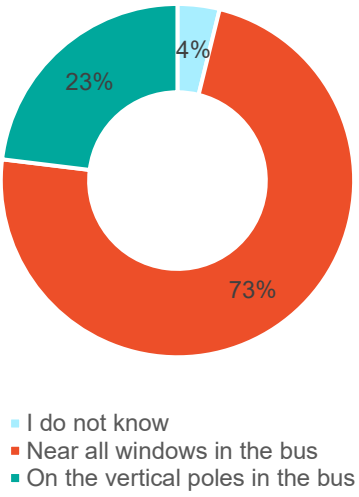



Figure 58: Awareness on the location of panic buttons within e-buses- Endline assessment

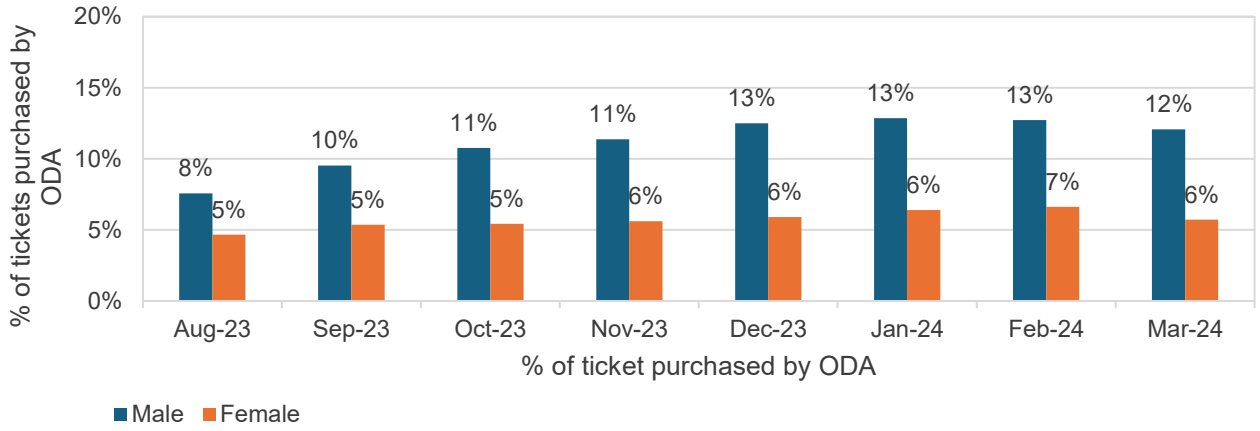



## 6.3 Secondary sources

### 6.3.1 Online ticketing by female commuters

This section aims to determine if the awareness campaign has impacted the increase in online ticket sales. According to data provided by the pilot depot, the total tickets purchased via One Delhi Application by female commuters averaged around 5% in the first three months (Jul-Sept 2023) of the project. A slight increase from 5% to 7% in the last three months (January-March 2024). While a direct correlation with the awareness campaign cannot be established, Figure 59 shows a slight increase in online ticket purchases among female commuters starting in January, coinciding with the implementation of the awareness campaign. Although the observed impact is minimal, it indicates a need for a large-scale awareness campaign to increase awareness of the available multi-modal applications.

Figure 59: Online ticket purchase at pilot bus depot




*Source: DTC, 2024*

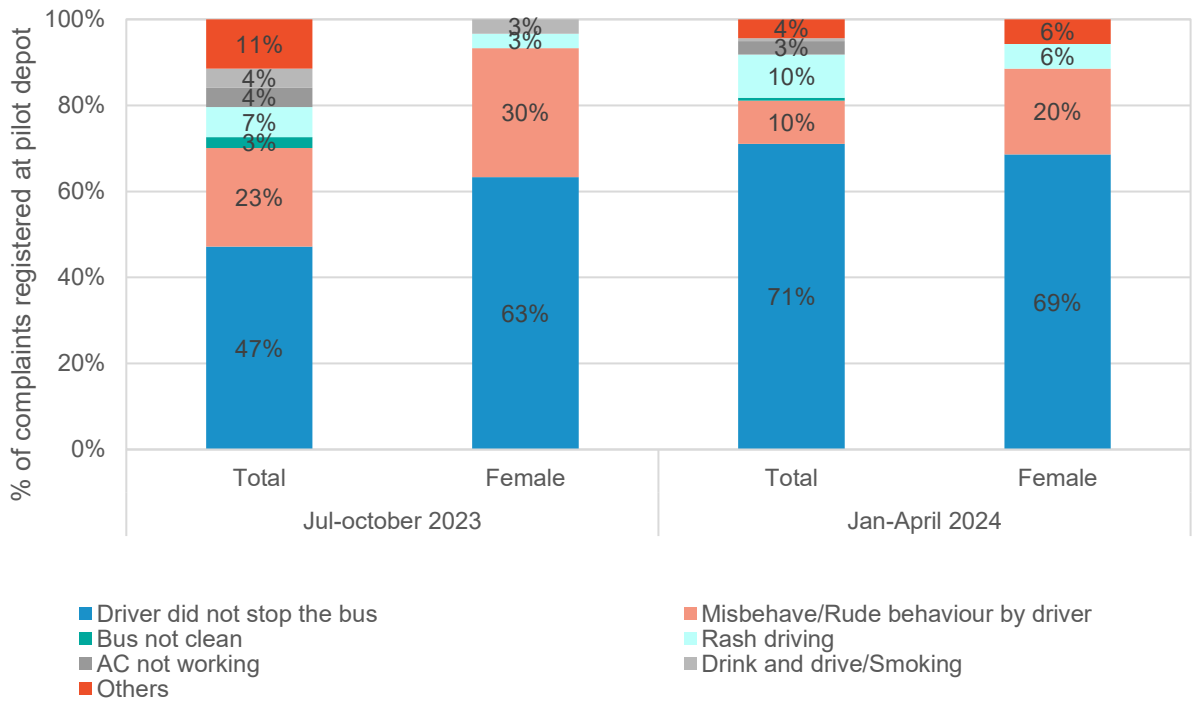
## 6.3.2 Analysis of complaint/feedback

Underreporting of issues by female commuters was noted during the baseline assessment. Data from the pilot depot indicates that only 12% of complaints were filed by female commuters, with the majority concerning drivers not stopping at designated bus stops. Consequently, the awareness campaign included a component aimed at informing female commuters about available channels for submitting feedback or complaints, including the One Delhi application.

The aim of this section is to evaluate the impact of the awareness campaign on the behaviour of female commuters in reporting issues by analysing the number of complaints registered at the pilot depot. Although a significant impact may not be expected due to the short-term nature of the campaign, any observed changes will help assess the effectiveness of the strategy and determine if it is feasible for scaling up. Thus, this section analyses the complaints submitted by commuters to the pilot depot, the pilot e-bus route depot, via helpline numbers and the One Delhi Application during the project period.

During the first four months of the project (July-October 2023), a total of 157 complaints were registered at the pilot depot, with 19% filed by female commuters. In the last four months (January-April 2024), this percentage increased to 22%, indicating a slight rise in the proportion of complaints from female commuters. Preliminary analysis indicates that the predominant issues are related to drivers not stopping at the bus stop.

Figure 60: Complaints registered by commuters at pilot depot




*N: JO-157 (T), 30 (F); JA-159 (T), 35 (F)*

*Source: DTC, 2024*

## 6.4 Summary of the analysis of key indicators

The following section demonstrates the impact of the project through the implemented strategies on key indicators. The key indicators for assessing this impact include changes in female commuters' awareness of existing Delhi government initiatives, such as the DTC helpline number, panic buttons, and One Delhi Application. Additionally, secondary data such as complaints or feedback registered by female commuters and changes in the number of tickets sold via ODA at the pilot depot are also used to evaluate the impact. The tables below compare baseline and endline assessments, with the baseline conducted in September-October 2023 and the endline in June 2024.

Table 5: Project impact through baseline and endline assessment

| Key parameters | | Baseline 2023 | Endline 2024 |
|---|---|---|---|
| **Awareness among female commuters** | Awareness of One Delhi Application | 2% | 63% |
| | Awareness of panic buttons | 5% | 65% |
| | Awareness of DTC helpline number | 10% | 35% |
| **Complaints/feedback registered** | % of complaints registered by female commuters at the pilot depot | 19%[15] | 22%[16] |

[15] Jul-October ,2023
[16] January-April 2024

| | | | |
|---|---|---|---|
| **Online ticketing** | % of online tickets purchased by female commuters via ODA | 5% | 6% |

The data indicates that the level of awareness of One Delhi Application has increased from 2% during the baseline assessment to 63% in the endline assessment. A two-tailed independent t-test was conducted to assess the statistical significance of the observed difference in awareness levels in the baseline (n=296) and endline assessment (n=40). The mean score is observed to change from 1.51 (SD-0.794) to 3.53 (SD-1.56). The results indicate that the observed difference in the awareness level is statistically significant at $p<0.01$. The observed increase in the awareness level of panic buttons from 5% during the baseline assessment to 65% in the endline assessment is also statistically significant on two-tailed independent t-test at $p<0.01$.

The awareness of the DTC helpline number increased from 10% at baseline to 35% in the endline assessment. Given the small expected cell frequencies, Fisher's Exact Test was employed to determine the statistical significance of this change. The analysis confirmed that the increase in awareness is statistically significant, with a p-value of less than 0.01.

# 7. Scale up and learnings

This project has provided insights into effective strategies and identified the underlying causes of issues faced by female commuters. Based on the implementation and impact of these strategies, a scale-up plan has been developed to extend these initiatives to a larger scale, such as at the depot or city level. The following table outlines the actions required and the responsible departments for implementing these activities:

- Systematic **collection and analysis of gender-disaggregated ticketing data**[17] is required in order to create safe, secure, and reliable public transport systems for women and girls. This can be supplemented by perception surveys;
- An **integrated approach** that employs multiple strategies is critical for have a concerted impact;
- Given that resource-limited women may face barriers to accessing digital technologies, implementing **targeted awareness campaigns is crucial**;
- **Pilots** serve as effective methods for testing integrated approaches and their impact before full scale implementation**;**
- **Impact evaluations with gender disaggregation** should be conducted to assess the effectiveness of implemented strategies. These evaluations will provide valuable insights for data-driven adjustments and enhancements;
- In addition to the implementation of strategies, **consideration must be given to maintenance** and long-term sustainability of the implemented strategies.

Table 6: Scale-up plan

| | Strategies | Actions | Type of scale up | Scale up level (Depot/City) | Responsible Dept within DTC |
|---|---|---|---|---|---|
| 1 | Real-time information on the bus arrival in mobile phone application | E-bus operators should be mandated by the public transport agency to provide the APIs for e-buses to the mobile phone application vendor within a specified timeframe. This mandate is essential to ensure the integration of e-buses into the multi-modal application. | Vertical | City | IT Department |
| 2 | Passenger information system within buses | Update latitude-longitude of bus stops for audio announcement of the upcoming bus stops | Horizontal | Depot wise | IT Department |
| | | The informational announcements on online ticketing, helpline number, panic button, sexual harassment within buses should be integrated in the PIS system of all e-buses | Horizontal | Depot wise | |

[17] A technical note titled " ***Framework to collect and analyse gender disaggregated travel data from public transport ticketing systems***" is developed based on the experience and learnings of this project to assist public transport authorities in collection and use of gender-disaggregated data through their ticketing system. This is available on the HVT/ The Urban Catalysts website.

| | | | | | |
|---|---|---|---|---|---|
| 3 | Use technology to address the issue of buses not stopping at the designated bus stops[18] | This requires an implementation of Bus Management System in al depots.<br>A technical criterion should be integrated in the BMS to capture the instances of buses not stopping at bus stops (114) . A pilot test should be done to assess the effectiveness of the algorithm on the ground. | Vertical | Depot wise | IT Department |
| 4 | Awareness campaign | Use social media platforms to disseminate awareness on the existing initiatives implemented for the safety in buses;<br>Collaborate with relevant departments such as health, education, Women and Child Development to utilise their existing network to spread awareness among female bus commuters | Horizontal | City | Public Relations Dept |
| 5 | Gender Sensitization Training for conductors | Institutionalise gender sensitization training of depot staff, including drivers, conductors, traffic inspectors and bus marshals (if present) | Vertical | City | Training School |
| 6 | Revise conductors' roles & responsibilities to include women's safety and link it to their annual performance evaluation | Institutionalise Annual Performance Evaluation form linked to the roles & responsibilities of conductors | Vertical | City | DTC HQ |
| 7 | Collect and analyse gender-disaggregated data | Mainstream gender-disaggregated data in ticketing systems (115) | Horizontal | Depot wise | DTC HQ |
| 8 | Assess and improve the quality of bus infrastructure | Conduct climate and gendered audits of bus shelters, depots (116) and terminals and implement the recommendations | Horizontal | Depot wise | DTC HQ |

*Note*: ***Vertical scale up****: —institutionalization through policy, political, legal, budgetary or other systemic change;* ***Horizontal scale up****: expansion/replication*

[18] A technical note titled "Use of technology to address the issue of buses skipping stops" is developed based on the experience and learnings of this project to assist public transport authorities in using technology to capture the instances of buses not stopping at the bus stops. This is available on the HVT/ The Urban Catalysts website.

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The Urban Catalysts
Delhi, India

Email: communications@theurbancatalysts.org
Web: https://www.theurbancatalysts.org/

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