

A Study on Barriers Affecting Women's Mobility in Bus Transportation: A Case Study of Chennai

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Abstract- Transportation services facilitate mobility, thus providing access to economic resources as well as to education, employment, recreation and healthcare. These services must be equally accessible and affordable to all for which they should be designed by considering the unique needs of different groups of people. Public transportation systems are designed with little consideration to the needs of women hence causing them to change their travel behaviour. This study focuses on determining the trip characteristics of women, identifying the barriers that women face and the impact of those barriers on women's travel for two study areas in Chennai. Data were collected by conducting household questionnaire survey among women to identify various parameters which have an impact on women's travel characteristics and to identify the barriers that women face. The various barriers identified are economic barriers, physical barriers, emotional barriers, system barriers and barriers faced while boarding and alighting. The collected data were analysed statistically. Descriptive Analysis was done to determine the sociodemographic and trip characteristics of women and to identify the key factors and barriers which have an influence on women's travel. Pearson correlation test was conducted to determine the correlation between variables and their magnitude. Regression analysis was carried out to determine the impact of these barriers on women's travel by bus. Based on the identified barriers and their impact, suitable measures have been suggested.

Index Terms- safety, affordability, bus stops, satisfaction, overcrowding, barriers.

I. INTRODUCTION

Transportation services are ideal means of mobility and they provide access to economic resources, education, employment and services. At the same time, they contribute substantially to pollution. It is important to focus on sustainable mobility, which facilitates efficient movement of people while having minimum impact on the environment. People refers to all citizens irrespective of their age, gender, socio-economic status, literacy rate, physical condition and age. The 11th goal of the 17 sustainable development goals is to provide access to safe, affordable, accessible, and sustainable transport systems for all and improve road safety by expanding public transport and paying special attention to the needs of people in vulnerable situations, such as women, children, people with disabilities, and the elderly. The National Urban Transport Policy of 2014 also aims at providing better mobility and sustainability by focusing on mobility of people and not the mobility of vehicles. Hence it is important to promote the use of public transport as they play a vital role in reducing congestion and emission as they carry a greater number of passengers in a single vehicle. Besides this, all modes are not equally accessible, affordable, available and safe for all sections of the society due to various factors thus resulting in inequality. The key factors are the socio-economic status of the people, education level and gender. Gender is in tightly entangled with the other factors.

Women are more dependent on public transport. Women are amongst the biggest users of public transport in India, World Bank (2023) said. Among the various modes of public transport available, buses are preferred due to their greater accessibility and flexibility. Unfortunately, most of our transportation policies and infrastructure fail to meet the needs of women and reduce their mobility. Women face barriers in using bus transportation due to the gender insensitive design elements during waiting at stops, transfers, during boarding and alighting and while travelling. Transportation services are less accessible, available, comfortable and safe. Barriers to women's mobility actively restrict their choices around education and employment. Public transport systems are designed for the ideal rider. They are designed with little concerns about the barriers faced by women hence causing them to change their travel behaviour. Hence there is an urgent need to focus more on the needs of women and thus ensure that transportation facilities meet their specific needs too. This will reduce inequality and hence fuel the empowerment of women.

II. LITERATURE SURVEY

Trip characteristics of women

Authors have examined the gender differences in travel behaviour for Jaipur city in Rajasthan [18], India taking the socio-economic class differences into account. Women belonging to higher income groups have greater choices of modes, while those belonging to the middle- and low-income groups have restricted access. With improvement in socioeconomic class, usage of public transport decreases. Women prefer to walk for short distances and use public transport for longer distances.

Darshini Mahadevia and Deepali Advani [6] studied about gender equity in transport services and the need to move towards low carbon transport in Rajkot, Gujarat. As the family income increases, the number of trips made by women as well as the trip length decreases. Walking is the most prominent mode among women. Trip purpose also has a strong influence on mode share. Mobility of women is low especially among those belonging to lower-income groups and most of them are no-choice walkers.

Taru Jain and Purnima Parida [17] have found that the mobility difference between men and women are symptoms of transport exclusion based on gender. Women travel differently than men. Their trips are short, frequent and chained. Women belonging to lower income groups do not have access to private modes. With increase in income, the travel pattern varies. Women are more dependent on public transport. The modes used, length of commute and average time spent per kilometre varies across the genders.

Fear of crime and harassment

Authors have studied the perception of insecurity in public transport, the factors affecting and the impact of gender in Santiago, Chile [5]. Women feel unsafe while waiting for public transport at night as well as while travelling.

A study was conducted in Hawassa, Ethiopia [8] to assess the safety and security of women and girls in public transport and also to identify the factors that contribute to violence. They have pointed out that sexual violence was most prevalent followed by psychological and physical. Violence was most prevalent during the late evening hours followed by rush hours. Poor accessibility, affordability and availability could be observed. Unmarried women are more susceptible to violence. The factors contributing to violence against women and girls are age, marital status, time of travel, lighting in bus stops and overcrowding.

The authors [10] have explored actual and witnessed victimizations by female students in Lucknow. Sexual harassment can have a debilitating effect on women's lives. Women's fear and concerns of safety negatively affect their travel decisions. Buses were rated most insecure or very insecure. Every respondent had been a victim and witness. The risk was equally distributed during days and across the seasons. Young women were found to be more susceptible, but it was time independent.

Gita Neupane and Meda Chesney-Lindin [9] have explored the prevalence, dimension, consequences of harassment, the type of abuse and the way in which they respond to it. Women's responses to victimization are feelings of fear, emotional distress, and disempowerment. Harassment in public transport substantially limits women's freedom and mobility. Reasons for harassment are a male-dominated society, lack of rules and regulations, marital status and overcrowding. Unmarried women were more affected.

Barriers encountered by women

Lucia Mejia-Dorantes and Paula Soto Villagranin [11] have found out that women face accessibility barriers such as physical barriers and overcrowding. They also face economic barriers, emotional barriers such as fear of crime and institutional barriers such as lack of gender perspective in planning, spatial inequalities and poor public infrastructure. Women have broad and diverse demands and barriers which differ based on educational and socio-economic levels. Accessibility is a key factor that has strong impact on women belonging to low-income groups.

The authors have studied the travel pattern of women, the cultural restrictions they face and also their collective impact on the usage of public transport in Dammam, Saudi Arabia [13]. It has been revealed that trips made by women varied based on their occupation. Women's travel choices depend on accessibility, availability and their daily travel needs. The gender responsive parameters are accessibility, comfort, security and affordability. The main barriers identified were lack of privacy, security, facilities, limited operation hours and gender insensitive infrastructure. In a nutshell, socio-cultural parameters influence mobility. The authors in [2] have pointed out that inequitable distribution of transit systems and services in urban areas has increased safety and environmental risks. Public infrastructure is oriented toward an ideal rider. Low-income groups are entirely dependent on public transport. The authors have identified physical, social and economic barriers. The safety issues identified were that buses were taken before everyone was seated, overcrowding and harassment.

III. STUDY AREA

The study has been conducted in Chennai, the capital city of Tamil Nadu. Two study areas have been selected from the city based on the income spectrum.

(1) Anna Nagar

Anna Nagar is a well-developed neighbourhood in Chennai Metropolitan city, located in the northwestern part. It is one of the prime residential areas in Chennai and is home to several prominent doctors, lawyers and politicians. Anna Nagar has several established schools and colleges, places of worship, shopping areas with both independent shops and chain stores, and numerous restaurants. There are also a number of midsize hospitals and nursing homes catering to the local population. Anna Nagar has roads in grid pattern. The stretch selected for the study is the 3rd Avenue in the eastern part of Anna Nagar. The public transportation modes available here are bus and metro rail facilities.

(2) Medavakkam

Medavakkam is a suburb along the southern part of Chennai, adjacent to the neighbourhood of Sholinganallur, Madipakkam, Selaiyur, Keelkattalai, Velachery and Tambaram. This location is fast developing residential locality due to its proximity to the IT corridor OMR and SEZ in Medavakkam Sholinganallur Road. The stretch selected is Velachery-Tambaram Road. The only public transportation mode available here is bus.

IV. DATA COLLECTION

Data has been collected by conducting household questionnaire survey among women to determine the sociodemographic and trip characteristics of women and the barriers that they face while waiting for bus as well as while travelling by bus. About 140 women were surveyed.

V. ANALYSIS AND RESULTS

Socio-demographic and trip characteristics

The collected data were statistically analysed using Statistical Package for Social Sciences (SPSS). The socio-demographic characteristics of the study areas have been determined. About 50% hold a bachelor's degree in Anna Nagar while about 44% hold a bachelor's degree in Medavakkam. About 50% have a monthly income of more than ₹50,000 in Anna Nagar whereas 24% have a monthly income between ₹30,000 and ₹50,000. About 44% women are homemakers in Anna Nagar whereas 27% are homemakers in Medavakkam. About 39% own two two-wheelers in Anna Nagar and 36% own a car, meanwhile in Medavakkam, 29% own two two-wheelers, and 16% own a car. It could be observed that in Anna Nagar about 50% of the respondents own a two-wheeler. Meanwhile, in Medavakkam, about 64% own a two-wheeler.

59% of the respondents in Anna Nagar have access to private vehicles. About 39% of respondents from Medavakkam have access to private vehicles. If we observe the trip characteristics, it could be seen that women in Anna Nagar travel a longer distance i.e. More than 15 km but have less travel time due to greater access to private vehicles. Women in Medavakkam travel lesser distance due to greater proximity to Sholinganallur and Velachery. Moreover, many women work close to their residences. Time travelled is also less due to greater access to private vehicles and walking. Respondents from Anna Nagar are more dependent on private vehicles and use two-wheelers to a greater extent. Meanwhile, respondents from Medavakkam are dependent on two-wheelers as well as buses. About 41% of the respondents from Anna Nagar practice trip chaining due to greater access to private vehicles. Only 27% practice trip chaining due to comparatively lesser access to private vehicles. About 59% of women use buses in Anna Nagar and only 15% use buses daily. The figures are higher in Medavakkam. About 76% of women use buses in Medavakkam and 36% use buses daily.

Barriers identified

Based on the data collected from the survey, the barriers faced by women in both the study areas have been identified. The barriers have been discussed below

Economic barriers

Economic barriers refer to the fare fixed by the authority. Currently, due to the introduction of free bus for women scheme in Tamil Nadu, this problem has decreased. Hence women make use of this scheme. But for those who prefer or have access to only deluxe buses or AC buses, this is still a significant barrier. In Anna Nagar, about 46% of the respondents have expressed that the fare is not affordable while in Medavakkam about 53% feel that the fare is not affordable.

Physical barriers

The important physical barriers are insufficient space to accommodate baggage, inconvenient height of floor level of buses, crowding in free bus, internal infrastructure of buses and condition of bus stops. Respondents from Anna Nagar as well as Medavakkam expressed that they neither have sufficient space for baggage nor do they find the height of floor level of buses convenient enough for boarding. Overcrowding could be observed in women free buses in both the areas but dominantly in Medavakkam due to higher usage. In Anna Nagar, free buses operate frequently along certain routes. But in Medavakkam, free buses operate only along certain routes. They do not have inbuilt doors. This raises concern among women passengers. If we observed the condition of bus stops, it could be seen that Anna Nagar has properly sheltered and well-lit bus stops with proper seating arrangements. The route numbers of buses operating along that area are also displayed giving them a feeling of security. In contrast, Medavakkam does not have sheltered or well-lit bus stops. Bus shelters have been dismantled because of the construction of metro rail stations. Hence women do not feel safe while waiting for buses in Medavakkam.

Emotional barriers

Emotional barriers refer to the perception of safety while waiting for bus as well as while travelling by buses. Inappropriate behaviour towards women by some fellow male passengers affects their perception of safety. Girl students who use buses regularly have experienced inappropriate behaviour and constant staring by few of the fellow male passengers. Around 20% of the respondents have expressed this in Anna Nagar whereas it is slightly less in Medavakkam. They also feel unsafe while waiting for bus.

System barriers

These are barriers prevalent in the transportation system. The key barriers are less frequency of buses, poor adherence to schedule, stopping of buses away from the designated place in bus stops and location of bus stops far away from origin of trip or inaccessible bus stops. In Anna Nagar as well as in Medavakkam, respondents expressed that the frequency of buses is less and that buses do not adhere to schedule. Besides these, in Medavakkam, respondents expressed that buses are being stopped away from bus stops. They also feel that the bus stops are located far from the origin of the trip. Reasons for not sticking to the scheduled time could be due to drainage and water works being carried out and traffic congestion on some of the stretches of the road.

Barriers faced while boarding and alighting

54% from Anna Nagar and 64% from Medavakkam feel that the time provided for boarding and alighting is insufficient. 20% and 51% from Anna Nagar and Medavakkam respectively feel that buses are overcrowded and difficult for boarding and alighting. These barriers create fear in the minds of women.

Statistical Analysis

Table 1 Results of statistical analysis

Pearson correlation R for income	Private vehicle ownership	Fare affordability	Satisfaction with free bus
Anna Nagar	0.361	0.607	-0.32
Medavakkam	0.547	0.522	0.398

From Table 1, it could be observed that there is a strong correlation between income of family, vehicle ownership and affordability in Anna Nagar. However, there is negative correlation with respect to satisfaction with the free bus facilities. Whereas in Medavakkam, the positive relationship between income, vehicle ownership and fare affordability is 0.547 and 0.522. Although the correlation between income and satisfaction with free bus is positive, correlation is less due to socioeconomic status. Income has a strong influence.

Multiple regression analysis was performed to determine the factors which affect the perception of safety while waiting, while travelling, satisfaction with existing bus stops and satisfaction while travelling by bus.

Key factors that affect the perception of safety while waiting for buses are inappropriate behaviour by some of the fellow male passengers, time of travel, age of respondents, distance of bus stops, sheltered condition of bus stops and lighting in bus stops. Time of travel has a significant influence as during peak hours and late evening hours. The higher the distance of bus stops, lower is the perception of safety. Distance from bus stops decreases the perception of safety in Medavakkam as the bus stops are far in contrast to Anna Nagar. The lighting and sheltered condition of bus stops is more pronounced in the case of Medavakkam as there are no properly constructed bus stops. These factors decrease the perception of safety.

Factors affecting satisfaction with existing bus stops are perception of safety while waiting for buses, sheltered condition of bus stop, lighting in bus stops, time of travel and adherence to schedule of buses. In Medavakkam, the condition of bus stops plays a significant role among the factors influencing the satisfaction. Due to the poor condition of bus stops, satisfaction decreases. In contrast, in Anna Nagar, these factors increase satisfaction. Less frequency of buses and poor adherence to schedule increase the waiting time thus resulting in overcrowding. This decreases satisfaction in both the areas.

Key factors affecting the perception of safety while travelling by buses are overcrowding, frequency of buses, adherence to schedule, availability of seats while boarding, overcrowding while boarding and alighting, time provided for boarding and alighting. Inappropriate behaviour from fellow male passengers, age and marital status. Overcrowding in buses reduces the perception of safety. Availability of seats while boarding increases the perception of safety. Overcrowding of buses is prevalent in both the areas during peak hours and this decreases the chances of seat availability while boarding. Poor adherence to schedule results in overcrowding. Overcrowding and provision of insufficient time while boarding and alighting decrease perception of safety. Inappropriate behaviour towards women by few fellow male passengers instigates fear in the minds of women. Young and unmarried women are more susceptible to inappropriate behaviour. In both the areas, women feel safe while travelling during day time, thus increasing their perception of safety.

Factors such as height of floor level of the bus, adherence to schedule, time of travel, frequency of buses, space available for accommodating baggage have a strong influence on satisfaction of bus commuters. The barriers which hinder their movement are overcrowding, fare affordability and inappropriate behaviour from fellow male passengers, rude behaviour from bus crew while travelling by free bus. Perception of safety pops up while travelling during peak hours when it is overcrowded, during night time and when the bus stop is not properly lit. Fare affordability is more pronounced for Medavakkam, as they belong to the middle-income group. Besides this, the increase in the number of trips by buses could be observed in Anna Nagar and Medavakkam after the introduction of free buses, thus increasing satisfaction.

VI. CONCLUSIONS

In Anna Nagar, it could be observed that with increase in income, mode choice varies. As people in Anna Nagar belong to the high income group, they have varied choices of private modes and higher access to private modes. The higher the income, lower is the public transport usage. The key barriers identified in Anna Nagar are infrastructure barriers such as floor level of buses, inadequate space for accommodating baggage and overcrowding in free buses. Besides these, they face emotional barriers such as inappropriate behavior from fellow male passengers. This barrier is completely dependent on age and marital status. They face system barriers such as less frequency of buses and poor adherence to schedule.

In Medavakkam, it could be observed that the respondents' income is slightly lower than that of Anna Nagar. Hence, they are more dependent on buses. Medavakkam does not have proper bus stops. Hence it is one of the key infrastructure barriers that they face. Besides these, a greater number of free buses are being operated along that route. The free buses have poor infrastructure such as absence of inbuilt doors. Free buses are overcrowded. Women do not have adequate place to accommodate their baggage and the floor level of buses is also not convenient enough for boarding. Young and unmarried women face emotional barriers. They face system barriers such as less frequency of buses, poor adherence to schedule and location of bus stops at greater distance from the origin of their trip.

REFERENCES:

1. Amy Dunckel-Graglia and SUNY Stony Brook, "Women-Only Transportation: How "Pink" Public Transportation Changes Public Perception of Women's Mobility", *Journal of Public Transportation*, vol. 16, No. 2, pp. 85-105.
2. Amy Lubitow, Jennifer Rainer and Sasha Bassett, "Exclusion and vulnerability on public transit: experiences of transit dependent riders in Portland, Oregon", *Mobilities*, 2017.
3. Anvita Anand and Geetam Tiwari, "A Gendered Perspective of the Shelter-Transport-Livelihood Link: The Case of Poor Women in Delhi", *Transport Reviews*, vol. 26, No. 1, pp. 63-80, 2006.
4. Ayesha Umme, Kojima Aya, Kubota Hisashi, "Gap Analysis between Women Passengers' Perception and Expectations about Bus Service: A Case Study on Bangladesh", *Journal of Transportation Technologies*, vol. 12, pp. 258-285, 2022.
5. Carolina Busco, Felipe González and Nelson Lillo, "Safety, Gender, and the Public Transport System in Santiago, Chile", *Sustainability* 2022, vol. 14

6. Darshini Mahadevia and Deepali Advani, "Gender differentials in travel pattern – The case of a mid-sized city, Rajkot, India", *Transportation Research Part D*, vol. 44, pp. 292-302, 2016.
7. Deborah Salon and Sumila Gulyani, "Mobility, Poverty, and Gender: Travel 'Choices' of Slum Residents in Nairobi, Kenya", *Transport Reviews*, vol. 30, No. 5, pp. 641–657, 2010.
8. Deribe Kaske Kacharo, Emebet Teshome and Tesfaye Woltamo, "Safety and security of women and girls in public transport", *Urban, Planning and Transport Research*, vol 10, No.1, pp. 1-19, 2022.
9. Gita Neupane and Meda Chesney-Lind, "Violence against women on public transport in Nepal: sexual harassment and the spatial expression of male privilege", *International Journal of Comparative and Applied Criminal Justice*, vol. 38, No. 1, pp. 23–38, 2014.
10. Kartikeya Tripathi, Herve Borrión and Jyoti Belur, "Sexual harassment of students on public transport: an exploratory study in Lucknow", *India, Crime Prev Community Saf*, vol.19, pp. 240–250, 2017.
11. Lucía Mejía-Dorantes and Paula Soto Villagrán, "A review on the influence of barriers on gender equality to access the city: A synthesis approach of Mexico City and its Metropolitan Area", *Cities* 96, 2020.
12. Morgan Campbell, "Gender, income, and transportation mobility in Bangalore's IT sector", *The 5th International Conference on Women's Issues in Transportation*, 2014.
13. Muhammad Ahmad Al-Rashid, Kh Md Nahiduzzaman, Sohel Ahmed, Tiziana Campisi and Nurten Akgün, "Gender-Responsive Public Transportation in the Dammam Metropolitan Region, Saudi Arabia", *Sustainability* 2020, vol. 12.
14. Nathalie Havet, Caroline Bayart and Patrick Bonnel, "Why do Gender Differences in Daily Mobility Behaviours persist among workers?", *Transportation Research Part A*, vol. 145, pp. 34-48, 2021.
15. Sazida Binta Islam, Muhammad Tanjimul Islam and M Toufiqul Haque, "An Analysis of Women's Constraints in Public Transport System in Bangladesh: Survey on Local Bus at Dhaka City", *Proceedings of Academics World International Conference*, Singapore, 2016.
16. Subeh Chowdhury and Bert van Wee, "Examining women's perception of safety during waiting times at public transport terminals", *Transport Policy*, vol. 9, pp.102-108, 2020.
17. Taru Jain and Purnima Parida, "Gender appraisal of mobility patterns and instances of exclusion for working population in Delhi", *The 5th International Conference on Women's Issues in Transportation*, 2014.
18. Taru Saigal, Arun Kr. Vaish and N.V. Muralidhar Rao, "Gender and class distinction in travel behavior: evidence from India", *Ecofeminsim and climate change*, vol. 2, No. 1, pp. 42-48, 2021.
19. Valentina Montoya-Robledo and Germán Escovar-Álvarez, "Domestic workers' commutes in Bogotá: Transportation, gender and social exclusion", *Transportation Research Part A*, vol 139, pp. 400-411, 2020.
20. Wei-Shiuen Ng and Ashley Acker, "Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies", *International Transport Forum Discussion Paper*, No. 2018-01, 2018.
21. Xuemei Fu and Zhicai Juan, "Exploring the psychosocial factors associated with public transportation usage and examining the "gendered" difference", *Transportation Research Part A*, vol. 103, pp. 70–82, 2017.