



Working Women, Delhi Metro and Covid-19: A Case Study in Delhi-NCR

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Abstract

Availability of safe, reliable and affordable public transport facilitates access to work opportunities. This relationship between transport and economic independence is not gender neutral. Delhi's Metro Rail Network marked a milestone in this regard as it provided a gender-sensitive means of mass transit with specific facilities for women passengers. However, the onset of Covid-19 pandemic, followed by restrictions on mobility and change in working habits, brought the urban public transport network to a standstill. Given this background, the paper explores the impact of Metro Rail Network on the commuting pattern and preferences of working women in Delhi-NCR region as well as the travel-related challenges faced by women that were magnified during the pandemic.

Keywords Covid-19 · Delhi metro · Domestic duties · Working women · Commuting problems · Safe transport

1 Introduction

Women's labour force participation is influenced by several factors, some of which facilitate their entry into the workforce, while others constrain their continuation and growth in the job market. Access to safe, reliable and affordable public transport facilitates women's mobility and is increasingly recognized as a critical determinant

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of women's economic engagement. A report by the International Labor Organization (ILO) finds that limited access to safe transportation is likely to reduce female labour force participation rate in developing countries by 16.5 percentage points (Kühn et al. 2017). Other studies have highlighted the effect of sex differences in household "roles" in influencing women to work "closer to home" (Fanning 1981). The disproportionate burden of domestic responsibilities at home forces women to shorten their commuting time (MacDonald 1999). The relatively lower wages of women and higher time constraints due to the compulsion of fulfilling multiple demands, increase the opportunity cost of travel time to and from the workplace. The trade-off for time over wages tends to increase for working mothers, especially those with little children (Gutierrez 2018).

Traffic congestion, measured by commuting time, may prevent substitution between work in the home and market (Black et al. 2014; MacDonald and Peters 2000; Agénor and Canuto 2012). Women are often more restricted than men due to safety concerns, inequality in access to personal vehicles (car or bicycle), and cultural disapprovals, all of which make it difficult for them to travel farther away from home. As a result, all over the world, women are more likely than men to be frequent and regular users of public transport (Duchène 2011). Hence, it is important to ensure that access to public transportation is gender sensitive.

The beginning of the Metro Rail Network in Delhi, in December 2002, marked a milestone in laying the foundation for access to a gender-sensitive means of mass transit. Buses and metro rail are the most popular means of transportation for intra-city travel in the National Capital Territory of Delhi (Government of NCT of Delhi 2021: 212). Until 2014–2015, the average daily ridership on buses was two to three times higher than that in the metro. However, this gap has declined substantially since then especially with the massive expansion in areas covered by the metro. While metro ridership is not provided separately for males and females, one estimate is that "33% of Metro commuters are women" (Sengar 2019). Apart from intra-city buses and metro rail, transport needs are met by inter-state bus services, suburban railways, auto-rickshaws, cycle rickshaws, hired cars and personalized modes such as cars and two wheelers (ibid.) (Table 1).

The metro has been instrumental in ushering in a new era in the sphere of urban transportation through provisioning of facilities specifically for women passengers. This rapid means of public transport provides a reliable, efficient and safe means of commuting for women. In an ethnographic study of Delhi metro, Sadana (2010) finds that women feel safe while travelling in the Delhi metro.

However, the onset of the Covid-19 pandemic led to a stoppage of urban public transport systems in many parts of the world. The World Health Organization (WHO) recommended that people should avoid closed and crowded places and should maintain a physical distance of at least one metre from others (WHO 2020). In India, a stringent nation-wide lockdown was imposed from 24 March to 31 May 2020. In an effort to stop the spread of the virus, Delhi metro services were suspended for over 5 months from 22 March 2020 to 6 September 2020. Services were resumed with strict guidelines pertaining to physical distancing, mask-wearing, sanitization, no cash transactions and no travel through tokens, but average daily passenger ridership was far lower than pre-Covid-19 levels at 13 lakh (including the

Table 1 Average daily ridership in the metro and in buses in NCT of Delhi (in lakh)

Year	Average daily ridership in lakh		Ridership on buses/metro
	Metro	DTC + cluster buses	
(1)	(2)	(3)	Column 3/2
2005–2006		30.52	
2006–2007		26.77	
2007–2008	6.25	24.04	3.85
2008–2009	7.22	22.62	3.13
2009–2010	9.19	24.16	2.63
2010–2011	12.59	30.32	2.41
2011–2012	16.60	44.20	2.66
2012–2013	19.26	46.77	2.43
2013–2014	21.90	49.83	2.28
2014–2015	23.86	48.82	2.05
2015–2016	26.00	45.98	1.77
2016–2017	27.61*	41.80	1.51
2017–2018	25.37*	41.51	1.64
2018–2019	25.97*	42.39	1.63
2019–2020	50.65***	51.02	

Source: Government of NCT of Delhi 2021

*Estimates for the metro do not include Airport line and Rapid metro

***Line utilization (line utilization calculates a metro journey in terms of the number of corridors used by a passenger)

Airport Line and Rapid Metro, Gurugram) on November 30, 2020 (Rai 2020; Times of India 2021).

Given this background, this paper explores the impact of Metro Rail Network on the commuting pattern and preferences of working women in Delhi-NCR region. It also draws attention to the travel-related challenges faced by women that were magnified during the pandemic.

2 Methodology and Sample Description

The paper is a part of a primary survey-based study conducted for an ICSSR-funded project in the Delhi-NCR region. Quantitative and qualitative information was collected from 462 women in the age cohort of 20 - 65 years. While most of the women in our sample belong to middle-income families, a few women from lower income families were also included. We focused on three categories of women:

- (i) those who never worked outside the home¹;
- (ii) those who earlier worked outside the home but left their job due to some reason(s)²;
- (iii) those currently working outside the home³.

This paper is based on a subset of the sample comprising 145 women professionals in Delhi-NCR who were employed during the pre-Covid period and retained their employment after the onset of Covid (category (iii) above). However, Section 5 on challenges faced by women while commuting by Delhi metro, is based on the full sample of 462 women respondents.

The survey was conducted in two phases in order to explore the impact of Covid-19 on changes in the working women's metro usage and commuting pattern to their workplace. The first phase of quantitative data collection was completed between April and May 2020, during the lockdown, through administration of a household questionnaire. Since fear of contracting the virus was rampant, it was not possible to use random sampling and approach unknown persons for the survey. Hence, the questionnaires were initially administered to female professionals who were either known to the researchers or were known to those within their networks. Subsequently, those who were interviewed were asked if they could connect us with working women professionals known to them. Thus, a combination of purposive sampling and snowball sampling techniques was used for undertaking the survey during the extreme circumstances created by the pandemic and lockdown.

The second phase of the survey was conducted between October and November 2020, when the Indian economy started finding ways of resuming normalcy. In Delhi, the metro, which is the most widely used means of public transport by all working women, resumed its services from September 2020. It was also marked by the re-opening of several offices, which required employees to commute to and from the workplace. In this phase, we selected and requested 30 working women for additional time for detailed personal interviews. The survey was undertaken through an open-ended qualitative questionnaire, asking the participants about the impact of Covid-19 on their challenges of commuting to the workplace.

Several criteria were used to select the women respondents for the survey. The working women must be traveling to their workplace post-lockdown, even if occasionally. We selected participants belonging to diverse industries and occupations like administration, marketing, banking, information technology, academicians, healthcare professionals, service providers, as well as unskilled workers. We also wanted our sample to have women at different stages of their work life. This necessitated the selection of respondents such that they included new entrants into the

¹ In recognition of the fact that many women who are at home are not only engaged in unpaid work domestic work but are also engaged in various economic activities, the nomenclature used for the first category is "those who have never worked outside the home" or do not travel for work.

² These are women who were travelling to work but have left their job and are currently not working outside the household.

³ These are women who are working outside the household and were travelling to and from the workplace at the time of the onset of Covid-19.

labour market, women in the middle of their career graph, as well as those at a senior level with ample work experience. The aim was to capture the different dimensions of the commuting preferences, patterns and problems of working women.

3 Delhi Metro and Working Women

The National Capital Territory of Delhi has made rapid progress in developing urban infrastructure. One such milestone in the transport arena has been achieved by the setting up of the Delhi Metro Rail Network which is globally recognized as an ultra-modern means of public transport capable of alleviating the mobility challenges associated with a rapidly growing population (Siemiatycki 2006). It has changed forever, the way people travel, integrating the NCR towns with the capital city.

Over the nearly two decades since the first metro train connected the 8.5 km distance between Shahdara and Tis Hazari stations, in December 2002, the services have expanded to cover 389 kms. Beyond the boundaries of Delhi, they now reach Noida, Ghaziabad, Gurugram, Faridabad, Bahadurgarh and Ballabhgarh (Delhi Metro Website 2021a). It has ushered in a new era in the sphere of gender-sensitive means of mass transit through specific provisions for safety of women passengers, like reserved seats for women in every coach; women CISF staff for frisking of female passengers; CCTV surveillance at stations, etc. Introduction of an exclusive lady's coach was an additional important measure which received public applaud (Tara 2011).

In the following paragraphs, we examine the dynamics of metro usage by working women in Delhi.

3.1 Usage Pattern of Metro

We study the commuting pattern of women to their workplace on the basis of the frequency of their metro usage, and the extent of their dependence on alternative means of transport.

Women were classified into three categories—those using metro service on a daily basis for commuting to and from the office; those using it occasionally; and those who have never used it for this purpose. We find that 47.6% of the respondents are regular metro riders, while 28.3% used it occasionally (Table 2).

Table 2 Frequency of metro usage by working women

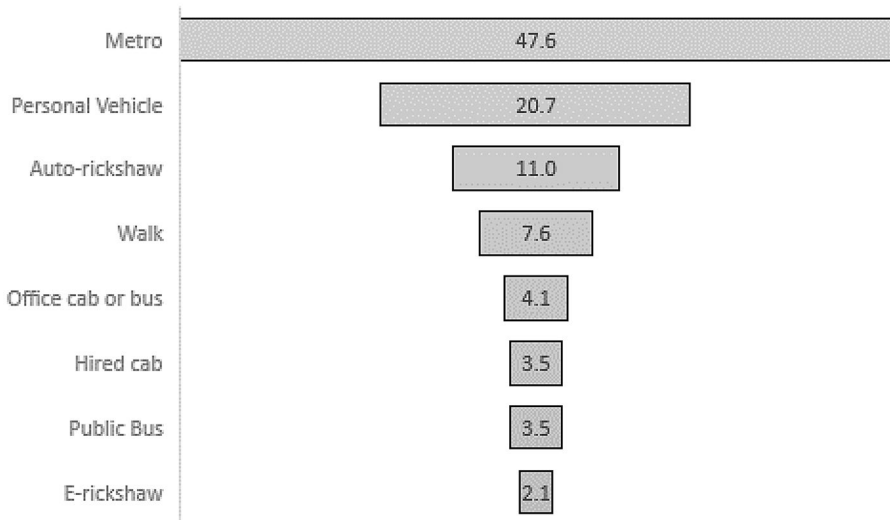
Metro usage	Frequency	Per cent
Regular	69	47.6
Occasional	41	28.3
Never	35	24.1
Total	145	100

Source: primary survey

Almost half the women who were travelling to work (47.6%) regularly used the metro to commute to and from office, while 20.7% usually used their personal vehicle and 11% travelled by auto-rickshaw. Official cab or bus, hired cab and public bus are the other modes of transport that were used by some of them (Fig. 1).

3.2 Average Commuting Time

Using the average commuting time to office (one-way), as a proxy for the distance between home and workplace, we found a direct positive association between travel time and the frequency of metro usage. Table 3 shows that as the average commuting time increases from less than or equal to 30 min to over an hour, the dependence on metro tends to rise.



Source: Primary Survey

Fig. 1 Regular means of commuting to workplace (%)

Table 3 Average commuting time to office and dependence on the metro

S. No	Average commuting time (min)	Frequency of metro use		
		Regularly	Occasionally	Never
1	30 min or less	17.0	32.2	50.9
2	31 min to 60 min	58.2	36.4	5.5
3	61 min and above	87.1	6.5	6.5
Total		47.6	28.3	24.1

Source: primary survey

Eighty-seven per cent of the women who take an hour or more to commute to office, use the metro regularly because it is the only reliable and safe means of transport for reaching a distant location. Women who never used the metro service or used it only occasionally were primarily those who either had an office cab or bus assigned for the purpose, or could afford to use their personal vehicle.

3.3 Extent of Metro Connectivity

We tried to examine the extent of respondent's access to the metro in four different ways. These were:

- (a) coverage of the entire route between home and office by the metro combined with access to it within 3 km of the office/home;
- (b) partial coverage of route between home and office by the metro combined with access to it within 3 km of the office/home;
- (c) those who had metro connectivity, but it was too far (beyond 3 km) from their office and home; and
- (d) those who had no metro connectivity near their office and home.

The extent of metro connectivity is a major determinant of the frequency of metro usage by working women. For instance, where the metro covered the entire distance between office and home, as many as 81.1% of women used it regularly. Where the metro covered only part of the distance, 76% of women preferred to use it regularly and 12% used it occasionally. Although regular dependence declined to 3.7%, when the nearest metro station was at a distance of over 3 km, occasional usage was as high as 77.8% (Table 4).

For instance, Ms A, is a 26 year old automation engineer who works at the Nehru Place office of an IT company for the past 3 years. She is single and lives with her parents and two younger school going siblings. Though she can afford to use a personal vehicle, she prefers to use the metro for commuting to-and-from office. Only under exceptional situations do her parents allow her

Table 4 Metro connectivity and frequency of using the metro

S. No	Coverage	Frequency of metro use		
		Regularly	Occasionally	Never
1	Metro covers entire route (within 3 km)	81.1	10.8	8.1
2	Metro covers partial route (within 3 km)	76.0	12.0	12.0
3	Metro is too far (beyond 3 km)	3.7	77.8	18.5
4	No metro connectivity	0	32.3	67.7
Total		47.6	28.3	24.1

Source: primary survey

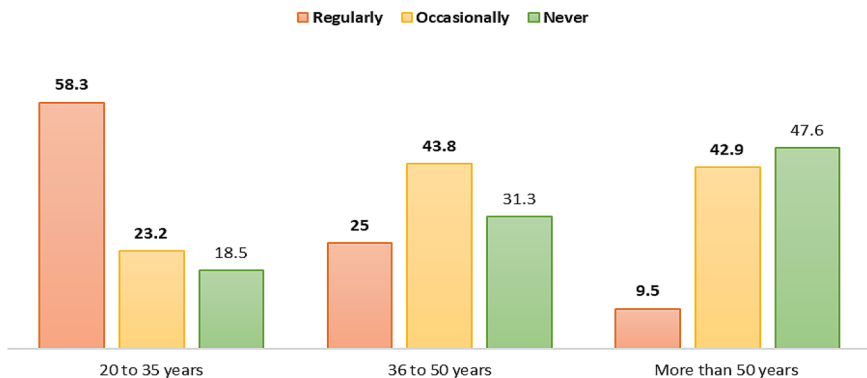
to return home by the official cab, if accompanied by office colleagues known to her.

In addition to the commuting time and extent of connectivity, there are some other factors that determine the usage pattern of Delhi metro by working women. We examine them in the following paragraphs.

3.4 Age of Women as a Factor in Metro Usage

There was a negative association between the age and frequency of metro usage. The metro is a popular means of transport among young educated women of Delhi-NCR region. Nearly 60% of the women in the age cohort of 20–35 years depend on it regularly (Fig. 2). With an increase in age (36–50 years), the frequency of metro usage shifts from regular to occasional. However, women professionals who are above the age of 50, prefer using their personal vehicles (47.6%) rather than depending on the metro (Table 5).

The age-driven differences in metro usage pattern arise because the older adults face a transport disadvantage or have difficulties in travelling as per their requirement (Abe et al. 2020). Age-specific health issues and related physical barriers, restrict them in accessing public transport (Hine 2012). Studies in London, Canada and several other countries indicate that with increase in age, women have a strong preference for using a car rather than public transport, especially if a car is available and they can afford to use it (Schmöcker et al. 2008; Turcotte 2012). This is because they find it more comfortable to use their personal vehicle rather than public transport (Rosenbloom 2001; Schwanen et al. 2001; Mifsud and Attard 2013). The use of a car provides older women the flexibility and autonomy to fulfil their professional requirements together with household responsibilities (Nobis and Lenz 2005). This seems to be applicable in India too. For instance,



Source: Primary Survey

Fig. 2 Frequency of metro usage by age cohort of working women

Table 5 Age-cohort-wise regular mode of travel to the workplace (%)

Age-cohorts	E-rickshaw	Auto-rickshaw	Hired cab	Metro	Office bus	Office cab	Personal vehicle	Public bus	Walk
20–35 years	1.9	10.2	2.8	58.3	0.9	4.6	15.7	3.7	1.9
36–50 years	8.3	14.3	0.0	25.0	0.0	0.0	28.8	0.0	23.6
More than 50 years	0.0	19.1	9.5	9.5	0.0	0.0	47.6	4.8	9.5
Total	2.1	11.0	3.5	47.6	0.7	3.5	20.7	3.5	7.6

Source: primary survey

Ms M is a 53 year old Assistant Professor of Delhi University. She said that using a car for her daily commute to-and-from office helps her in completing other tasks, like purchasing essential items, on her way back home. She is also able to pick up her children from tuitions or from a friend's place, etc. Its use for commuting provides her the flexibility and personal space to move and stop at different places, depending upon her requirements.

The Delhi metro has made several provisions for the convenience of elderly and differently abled people in the form of availability of wheelchairs and reservation of seats for them in metro coaches. Nevertheless, they face difficulties due to overcrowding and pushing by fellow passengers during peak office hours. This makes it hard for them to make their way to the desired metro coach after walking long distances up and down the escalators (or lifts). Dependence on other modes of travel like e-rickshaw, auto-rickshaw, etc., for reaching the metro station adds to the problems of elderly women, particularly those suffering from ill health. A similar concern was shared by some women in our primary survey.

Ms C is a 55 year old married woman residing in Najafgarh who teaches at a University in Dwarka. She suffers from health problems resulting in leg pain. This restricts her ability to use an e-rickshaw for commuting to-and-from the metro station. As a result, she was forced to shift her place of residence to Dwarka so that she could retain her job. She is now able to drive to her workplace.

3.5 Domestic Work Burden

We enquired about the average time spent by working women on fulfilling domestic chores like cleaning the house, washing utensils, laundry, and cooking food, care for children and elderly. During weekdays, 45.5% of women spent up to 2 hours per day on such work, 32.4% spent 3–4 hours a day, and 20% spent more than 4 hours a day. However, during the weekends, 40% of them said that they devote more than 5 hours or more per day for completing all the household work (Table 6).

Differences in the gendered division of work and time conflict faced by working women are more pronounced in larger families than smaller families (Craig and Mullan 2010). However, in the Indian context the composition of the family also matters as will be seen from some of the cases discussed later in the paper.

Table 6 Average time spent (per day) on domestic chores by working women during weekdays and weekends

No. of hours	Weekdays	Weekends
0	2.1	1.4
1–2	45.5	28.5
3–4	32.4	29.9
5 or more	20.0	40.3
Total	100.0	100.0

Source: primary survey

Given the disproportionate double burden of domestic work and paid work, availability of Delhi metro as a fast and dependable means of public transport helps women in managing their time and physical resources efficiently. We found that with an increase in the average family size to 5 or more members, the likelihood of using the metro service regularly also tends to rise from 40.6 to 54% (Table 7).

Moreover, married women, particularly those with pre-school children, prefer shorter work trips (Pazy et al. 1996). They are more likely to opt for easily accessible and faster means of transport due to constraints on the amount of time available for travelling (Iwata and Tamada 2008; Lee and McDonald 2003). In our study, more than 70% of the mothers said that they prefer to travel by metro because it enables them to rush back home to their children in the shortest possible time (Fig. 3).

For instance, Ms S, a middle-rank employee in a semi-government organization at ITO says that she leaves her office at 5:45 pm and has to pick-up her two-and-a-half-year-old daughter from a day-care centre near her home in Pitampura, before 7 pm. The Mandi House metro station is near her office and enables her to avoid traffic jams and reach home in the shortest possible time.

Table 7 Frequency of metro usage by family size of working women

Number of family members	Regularly	Occasionally	Never
Less than equal to 4	40.6	29.0	30.4
5 or more	54.0	27.6	18.4
Total	47.6	28.3	24.1

Source: primary survey

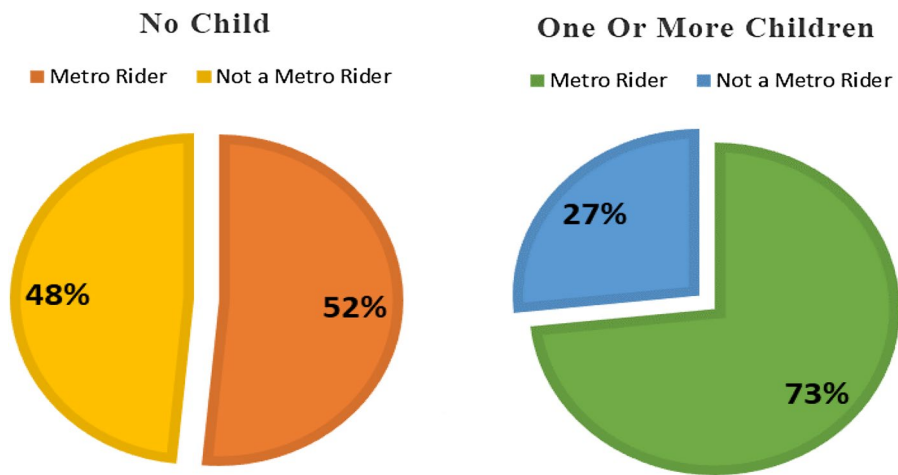


Fig. 3 Metro usage by married women. Source: primary survey

3.6 Job Characteristics (Or Income Earned)

Travel expense as a proportion of monthly income is another key variable influencing the choice of mode of commuting by working women (Ola Mobility Institute 2019). We utilize job characteristics and position of women in the vertical hierarchy to assess the linkage of this dimension with the metro usage pattern of women in Delhi-NCR region. A relatively higher percentage of women in temporary jobs (55.2%) rather those in permanent jobs (42.5%) are regular metro users. Occasional dependence on metro is also higher among those in temporary jobs (Table 8).

Similarly, rise in the hierarchical position of women tends to reduce the likelihood of their using the metro service. Table 9 shows that 57.6% of the women at entry level are regular metro users, and the proportion reduces to 50% for women at the middle level and 24.2% for those at the senior level.

The above findings are similar to those of other studies which indicate that women with low-income levels and students cannot afford to use their personal vehicle on a daily basis, and prefer to commute by public transport or cover the possible distance on foot (Gautam et al. 2019). However, with increase in income level, dependence on personal vehicle tends to increase (Sánchez and González 2016).

4 The Metro Changed the Commuting Preference of Women

The Delhi metro has changed the perception of women towards public transport in the city. Earlier, Delhi Transport Corporation (DTC) buses were the primary means of public commute. Since buses were overcrowded, erratic and required

Table 8 Job permanence and frequency of metro usage

Job characteristics	Frequency of metro use		
	Regularly	Occasionally	Never
Permanent	42.5	26.4	31.0
Temporary	55.2	31.0	13.8
Total	47.6	28.3	24.1

Source: primary survey

Table 9 Job designation and frequency of metro usage

Job designation	Frequency of metro use		
	Regularly	Occasionally	Never
Junior	57.6	30.3	12.1
Middle	50.0	23.9	26.1
Senior	24.2	30.3	45.5
Total	47.6	28.3	24.1

Source: primary survey

long waiting times, they were used only by those who could not afford any alternative transport. Although the Delhi Government has recently made travelling in public buses free of charge for female commuters, women consider the Metro to be a more comfortable and safer commuting option.

For instance, Ms R, a senior nurse at AIIMS hospital, lives in the Geeta colony with her husband, adult daughter, and 85 year old mother-in-law. She said, “I always used public transport for covering a distance of around 45 kilometres between home and workplace. Earlier, the public bus was my primary means of commuting. The availability of the metro service has reduced my dependence on buses. Whereas there are many incidents of eve-teasing in buses, the safety measures in the metro prevent occurrences such incidents to a large extent. I am easily able to manage my emergency shifts at the hospital by using the metro.”

Women who are not working outside the home identified commuting related problems as one of the critical barriers faced by them. As many as 42% of the 252 respondents in this category said that if a job is available, they are willing to travel to the workplace now that they can use the Delhi metro network.

Young women consider the metro to be the most favoured means of commuting to their educational institution, and for job search. Some of them said, “*now websites of companies and their vacancies are accompanied by a map displaying the nearest metro station(s) and corresponding route for reaching the exact location.*” These young commuters constitute the largest section of women utilizing metro service for their career growth and progress.

Metro connectivity has been particularly beneficial for women traveling long distances between their home and workplace. It helps them avoid the fatigue and delays from traffic jams on Delhi roads during peak office hours.

Ms P lives in Uttam Nagar. She works as a senior communications manager in a semi-government Institute in Patparganj. Her family has 10 members that include her husband, daughter, parents-in-law, husband’s grandmother, as well as her brother-in-law and his wife, and their two children. She said, “Metro is my lifeline. I live in a big joint family, and it would have been impossible for me to work outside the home in the absence of metro connectivity. Despite long commuting hours extending to 120 minutes (one-way), I feel that it is the safest, most reliable, and comfortable means of rapid transit. It helps me to manage the time constraint and physical stress of travel. I feel very relaxed while I ride back home from a long day of hard work at the office”. She said, “Metro is dependable because I can calculate the exact amount of time that I will take to reach office in the morning and reach home in the evening. There might be some 10 to 15 minutes of variation in the traveling time, which is much less than the time wasted in unpredictable traffic and jams on the roads of Delhi”.

Women from diverse professions and family compulsions depend on the Delhi metro. This means of mass transit has enhanced the feasibility of their working

outside the home instead of being restricted to the domestic sphere. In this regard, we cite the situations of three respondents, for whom the metro facilitated their spatial mobility and enabled them to gain economic independence despite the unsupportive attitude of the family members.

Ms G is a middle-aged woman currently employed as an administrative head in a private company. She was able to change jobs and work at new locations due to the availability of the metro. She lives in Mayur Vihar with her husband, two sons and mother-in-law. Her first job was as an administrative assistant at a company in Chirag Delhi in the year 2000. She lived in Andrews Ganj and the ease of commuting while using public buses was the reason for her choice of job location. After marriage her residence shifted to Mayur Vihar. Since the metro services had started she joined a semi-government research institute at ITO. She said that "It was because of the metro connectivity on my office route that my husband and mother-in-law permitted me to continue work post-marriage." Her current job at Chanakyapuri is also linked with the metro network. She appreciates the Delhi metro as a safe means of public transport for working women. It helps her to manage her domestic responsibilities as she is able to save time by avoiding the unpredictable traffic on the roads of Delhi.

Ms H, a 35 year old school teacher, lives in Preet Vihar with her husband, two children and parents-in-law. She teaches in a school in Shahdara. Her school hours are from 7:30 am to 3 pm. She never uses the school bus because it takes a long round-about route. Additionally, the early morning schedule does not permit her to complete her household chores. Metro is her primary support system for commuting to-and-from the school. Earlier, she was dependent on the metro network's blue and red line and felt it was very uncomfortable due to overcrowding. The start of the pink line in 2018 eased her commuting issues. She is very content with the expanding connectivity network and its utility for working women.

Ms K is a 29 year old marketing executive working in the social media department of a consulting company. She is living in a family of 5 members in Kirti Nagar. Her husband has a business of rental cars, and her brother-in-law has a tours and travels company. She has to take care of her young 3 year old daughter and elderly mother-in-law and is unable to hire domestic help. She joined her current job in 2016. Her family is not keen on her working outside the home. They would prefer it if Komal uses her marketing skills for the family business. She transferred her office location from the head office at Gurugram to a smaller branch in Connaught Place in order to address their concerns. She is entirely dependent on the Delhi metro for commuting to-and-from the workplace. She said that "it is the metro connectivity to the office which helped me convince my family that I should continue working. I can reach back home on time and manage my multiple responsibilities."

We found that metro has become a preferred means of transport not only for the office-going women who have to travel regularly but also for those women who are staying at home or working from home. A group of homemakers from Badli in North-West Delhi narrated their experience by saying, *“together we make shopping trips to Chandni Chowk using the metro service. The coach reserved for women provides us with personal space to discuss everyday issues.”* They said, *“travelling together in the metro is like a picnic, and they all enjoy spending time together, shop together, and eat together. Earlier, they used to travel alone or had to hire multiple auto-rickshaws...”*.

Moreover, access to metro is now an essential part of the commuting pattern of the people in Delhi. In our personal interviews, women from Karol Bagh said *“all our travel plans with friends and relatives begin with whether metro connectivity is available on our route or how far is the nearest metro station from the destination.”*

Thus, irrespective of the purpose of commuting, the metro has emerged as a reliable and dependable means of public transport. Access to and availability of the service is linked with a feeling of mental peace for women and their family members. In our study, 97.8% of our respondents agreed that traveling by metro makes them and their families feel less anxious about their safety while commuting. We quote a mother saying, *“mujhe apne bete ke liye zyada chinta nahi hai kyuki metro toh ha hi uske travel route par”*. (*I am not worried much for my daughter because of the availability of metro connectivity on her travel route*).

5 Delhi Metro, Challenges faced by Women and Covid-19

The Covid-19 pandemic has affected the operation and ridership of urban public transport globally (Gkiotsalitis and Cats 2020) due to advisories regarding travel to crowded places (WHO 2020). Use of public transport was also discouraged and limited to situations of absolute necessity. In India, the Delhi metro resumed its services in September 2020, after a halt for a total duration of 169 days. Strict guidelines were issued, and fines were imposed for violation of social distancing and face mask-wearing protocols.

The metro has undoubtedly been the preferred means of public transport for women in Delhi, but there are some challenges that need to be addressed. We use our complete primary sample of 462 women (and not just the sub sample of women who retained their jobs after the onset of Covid-19), in order to understand the problems that women face while using the metro. Overcrowding, safety and affordability are the major issues raised by metro riders though lack of user friendliness has been mentioned as well (Table 10).

These challenges have also negatively influenced the willingness of women to use Delhi metro during the Covid-19 pandemic. In one of the findings from our survey, post-lockdown, 33% of the respondents said that the Delhi metro is not a preferred means of transport for them until the pandemic is over. Another 45.2% were doubtful about using it for commuting regularly. However, 22% of the respondents were optimistic and were willing to resume their metro ridership.

Table 10 Challenges of Delhi metro for women (%)

S. No	Problems	Per cent
1	Overcrowding	69.9
2a	Safety problems of last-mile connectivity	47.4
2b	Safety issues while commuting	17.5
3	Affordability	45.7
4	System is not user friendly	0.4
5	No issues	0.6

Source: primary survey

5.1 Overcrowding

Overcrowding of metro stations and coaches, as well as in buses, shared rickshaws and other means of transport, especially during peak hours, are usually experienced. The major intersection stations like Kashmere Gate, Rajiv Chowk, Anand Vihar, etc., face heavy footfall, due to which there are large and unmanageable crowds. Women find it challenging to use the metro during rush hours due to the crowds at the station and in the metro.

For instance, it is because of the difficulties arising due to overcrowding that Ms N, a 27 year old married woman quit her job during the 6th month of her pregnancy. She lives in Dichaon Kalan, Najafgarh. Her husband works in a private company. She has a 9 month old son. Before her son was born, she worked in an NGO at Rohini. Metro was her preferred means of travel from Najafgarh to Rohini. It helped her cover the long stretch of more than 25 kilometres in approximately one-and-a-half hour. However, due to overcrowding of metro stations she agreed to her family's decision and quit her job in 2019.

Overcrowding raises apprehensions about the possibility of traveling safely during the Covid pandemic. Globally, transport operators are authorized to minimize contagion risk both on-board and during passenger waiting time by strict adherence to social distancing norms (UITP 2020). However, physical distancing challenges the very concept of mass public transit and is difficult to comply with during peak times and at nodal exchange points on a metro network (Tirachini and Cats 2020). The precautionary measure of keeping a distance of 1 to 2 m may be effective in open spaces. However, its utility in containing infection in closed spaces, particularly in longer journeys with prolonged exposure time, is still doubtful (Nishiura et al. 2020). The risk of catching infection increases with the level of passenger occupancy within the coach and the stations (Tirachini and Cats 2020). The perceived threat results from the airborne nature of Covid-19 virus transmission (Shen et al. 2020). Air conditioning, together with lack of proper ventilation in confined spaces, acts as a facilitator in the spread of infection (Lu et al. 2020; Sun and Zhai 2020).

Crowds also make it difficult to avoid physical contact with the surfaces like doors, windows, seats, elevators, handrails, etc., which can transfer germs in

public vehicles (Jiang et al. 2020). The feasibility and effectiveness of measures like frequent spraying of disinfectant and installing hand sanitizers (Moreno et al. 2021) is doubtful. It also raises the question of the long-term sustainability of such measures because it imposes additional workforce and logistics costs on the transport authorities (Musselwhite et al. 2020).

Strict enforcement of face mask-wearing by passengers may help contain the risks. Still, this measure's effectiveness is subject to face mask material, which is linked with its filtration capacity (Konda et al. 2020). People also lack awareness about the proper way of handing and fitting face masks such that it completely covers the nose and the mouth (Prather et al. 2020).

All such fears seem to have stigmatized public transport's utility and shifted women's dependence to a personal or hired vehicle. The extent to which people's commuting patterns diverted away from public transport in response to the pandemic is also dependent on their economic access to alternative means of commute (Pawar et al. 2020). Several respondents in our survey depicted this preference shift due to Covid-19 pandemic.

Ms R, the healthcare worker at AIIMS hospital is not in the favour of using the bus or metro because it will enhance her risk of catching an infection. In the present situation, her husband has taken the responsibility of driving her to-and-from the workplace.

Ms G, our respondent who was able to change her job mainly due to metro connectivity, also stopped using it. Her current job at Chanakyapuri is contractual, and she is under constant fear of losing it due to pandemic. She hires an auto-rickshaw for commuting to-and-from the office. She worries about taking the infection back home.

Similarly, Ms P, our respondent who said that the metro is her lifeline, abandoned using it during Covid-19. Her office has shifted from Patparganj to Okhla. Despite metro connectivity in the new location, she said, "my family has not allowed me to use the metro". The overcrowding issue of the metro makes it impossible to follow the physical distancing guidelines. "Since my husband's office is also in Okhla, I accompany him in our own car. But if my husband does not need to go to his office, I have no option but to spend money on a hired cab for fulfilling my professional commitments."

On the other hand, our respondent Ms V is forced to use the metro due to lack of alternative options. She is a 26 year old unmarried girl living in Rajapuri, Dwarka and her family is facing financial problems during Covid-19. Since her salary is low, she uses the metro for commuting to-and-from the workplace daily. She said that when the metro started re-functioning post lockdown, the guidelines pertaining to physical distancing, mask-wearing, and sanitization were followed. However, over time people seem tired of following the rules. Social distancing isn't followed by the crowd during office hours. They continue to push each other in order to catch the metro. She is always travelling

under the psychological stress of catching an infection and taking it back home. From the work domain, she is also under continuous fear of losing her job and again becoming unemployed.

5.2 Affordability

Women have to manage their monthly expenditure on commuting to and from the workplace within the overall budget for household expenditure. Thus, the cost of transport becomes a vital factor in their choice of means of commuting.

The affordability of metro service is another key challenge faced by women in Delhi. This is particularly true for the women employed at the lower end of the hierarchy and in the daily wage earner category. The increase in travelling cost due to the rise in Delhi metro fares remains an overriding concern for them. In 2002, the minimum tariff for metro users was Rs. 6, while the maximum fare was Rs. 22. In 2009, the minimum tariff was raised to Rs. 8, and the maximum fare to Rs. 30. Further, in 2017, the minimum fare increased to Rs. 10 and the maximum fare to Rs. 50 (Delhi Metro Website 2021b). In addition to metro fares, women have to spend money on e-rickshaw, auto-rickshaw, cycle-rickshaw, buses, cabs, etc., for covering the distance between the metro station and workplace or home. This further increases the total commuting expenses.

The problem of affordability has constrained several women from utilizing the services of the Delhi metro. Such unequal access to public transport reinforces the persisting socioeconomic inequalities in our society (Gutiérrez et al. 2020). The pandemic has brought into sharp focus this widely discussed dimension of the Delhi metro. The relatively better educated and skilled women with secure jobs have the option of work-from-home. Women in occupations that cannot be performed remotely are unwilling to use the metro due to the fear of infection. They prefer using personal vehicles or hired cab/auto for commuting to and from the workplace.

On the other extreme, the lesser educated women, employed in unskilled jobs have none of the above options. In fact, the lockdown and economic contraction have increased the risk of job loss more severely for them (Adams-Prassl et al. 2020). With low wages and high metro fares, they cannot utilize Delhi metro's services. Deprived of access to affordable public transport facility, they are often forced to walk to their workplace and are termed as "no choice walker" (Mahadevia 2017).

In this regard, we cite the experiences of our respondents employed as daily wage earners. Working women residing in the Trilokpuri area of East Delhi mentioned affordability as the prime concern hampering their use of the Delhi metro for daily commute to and from the workplace. Women in this area belong to low-income families and constitute migrant workers from the states of Bihar and Uttar Pradesh. The average education level of women is secondary school. Most of them live in a joint family set up with an average family size of 6 members. The average monthly family income is in the range of Rs. 15,000–Rs. 20,000. Most women are employed in the private sector manufacturing units in Noida (sectors 7 to 15). They are paid on the basis of 12 h of work per day. On weekends, they try to earn extra income by

working on an overtime basis. The nearest metro station from their place of residence in Mayur Vihar Phase-1 is at a distance of 1.5 kms.

Ms E is a 39 year old woman, educated up to secondary level. She has a family of 6 members. She is employed as an assembly helper and earns a monthly income of Rs 10,000 only. The distance between the metro station and her workplace is 2 kilometres. She cannot afford to use the metro for commuting to her office because this would incur a monthly expense of Rs 2,400. Besides the daily metro fare of Rs.40, she has to bear additional travelling costs of Rs. 40 linked with the expenses on shared e-rickshaw (home to metro station) and shared auto-rickshaw (metro station to the office). She prefers to use the DTC (Delhi Transport Corporation) bus, which allows her a free ride. With the onset of Covid-19, followed by a complete lockdown of the Indian economy, the manufacturing firms in Noida were closed, and she did not receive any salary. Subsequently, with the relaxation in the lockdown restrictions, the manufacturing units re-started functioning in a limited manner (shut down after 6 pm and closed during weekends). Despite, the risks of catching the infection, she immediately re-joined their workplace. Covid-19 increased her commuting problems. Besides monetary constraints and the fear of catching infection at the workplace, she also faced the issue of travelling to the workplace. The unavoidable social distancing norm prevented her from using a shared auto-rickshaw, which carries 4 to 5 riders in a single trip. She also stopped using DTC bus for the same reason. Hence, in order to save her commuting expenses and risk of infection, she preferred to cover the entire stretch of 5 to 6 kilometres between her residence and workplace by walking. She said that "I have no option but to walk to-and-from the workplace. In order to reach the manufacturing unit on time, I start at 7 am. In the evening, I reach home by 7:30 pm. I also suffer from the additional stress of walking alone on the deserted roads during dawn and dusk as the lockdown restrictions have only partially been lifted and factories shut early".

5.3 Safety

Delhi metro has several provisions for ensuring the safety and security of women passengers. One coach in every train is reserved for female commuters. Men who try to travel in this coach are subject to penalty or punishment. In addition, seats are earmarked in other cars for women. There is CCTV surveillance in train coaches, at the stations and on the platforms. Women CISF staff are deployed at the stations for frisking of female passengers. Security arrangements at the metro stations are escalated after sunset.

Despite all possible measures, the safety of women continues to be a cause of concern. Women prefer to take up jobs where the working hours are limited from 9 am to 5 pm. Any late stay at the office is possible only occasionally. Jobs that require women to stay late in the office on a frequent basis are not acceptable to family members.

Table 11 Preference pattern for using metro during late evening

Is metro the preferred means of transport	Per cent
Yes	83.8
No	16.2
Total	100.0
Other preferred means of transport	
Office cab	46.7
The family picks up from the office	70.7
Private cab or auto	28.0

Source: primary survey

We asked if travelling by Delhi metro was preferred if they were delayed at the office. We found 83.8% of the respondents preferred the metro for late evening travel, but the remaining 16.2% stated their apprehensions. Among the respondents who did not prefer using the metro, 70.7% said they would like a family member to pick her up from her office and bring her home, while 46.7% were in the favour of availability of an office cab, and 28% preferred using a hired cab or auto-rickshaw (Table 11).

Nevertheless, a common observation is that women traveling back home from work should not travel alone, whether by metro or otherwise. They should be accompanied by a relative(s) or friends or office colleagues. Otherwise, it is preferable for them to stay overnight near the office, at the residence of a relative or friend.

The safety dimension of Delhi metro is linked with issues faced by women both within the metro stations and outside the metro stations that are described below.

5.4 Safety Within the Metro Station

Traveling in a coach reserved for women gives them a sense of safety by providing them personal space, within which they do not have to worry about men staring at them or pushing them. However, despite penalty, punishment and vigilance, there are instances of men trying to travel in the car reserved for women. This is more common during late evening hours if security staff are absent.

During peak hours, several women reported incidents of pick-pocketing and eve-teasing. At times, due to overcrowding, women are forced to travel in the general coaches, i.e. coaches other than the one reserved for ladies. There are instances of abuse and harassment in those coaches. Moreover, the crowd of men around makes it difficult to pinpoint the culprit (Sharma 2020, India TV Newsdesk 2014).

5.5 Safety Outside the Metro Station

The thin presence of fellow women passengers within and outside the metro stations has enhanced the vulnerability of the few who continue to use the metro. They often have to wait alone on poorly lit deserted streets risking their safety, but with no plausible options (United Nations 2020).

Outside the metro stations, women's safety is jeopardized due to the problem of last-mile connectivity or end-to-end connectivity. This as a major issue is cited by 47.4% of our respondents. It relates to the availability of safe means of transport for covering the distance between workplace and metro station as well as between metro station and place of residence.

Ms G, our respondent who travels daily from Mayur Vihar to Chanakyapuri, said that "my only complaint relates to the end-to-end connectivity of the metro. From the metro station, I need to board a public bus to reach the office. At times due to delay, I find it very difficult to run after the bus in order to catch it. My work hours are 9:30 to 5:30 for five days a week. Any delay in leaving office, particularly during winter, arouses fear about reaching the metro station from my workplace in Central Delhi."

The common apprehensions of metro riding women arise from the lack of proper lighting in the parking lots of metro stations, and dark lonely stretches on roads connecting the stations. Several instances of snatching and eve teasing have been reported, particularly after rush hours. Some respondents expressed such fears about safety outside metro stations. One section of respondents belonged to Najafgarh, and other to Burari.

Najafgarh is located in South West Delhi. Till 2019, Dwarka and Nagli metro stations were the two nearest stations at a distance of 6 kilometers and 7 kilometers, respectively. Since 2020, Dilli Gate metro station also started functioning. The problem faced by female commuters relates to their safety on the entire stretch between their residence and the metro station. The area becomes deserted during the evening as the road passes through agricultural lands of villagers residing in this place. Street lights are missing at several vacant spots. Moreover, due to some wine shops, men get drunk and can be found roaming around. Since agriculture and rental income are the main source of livelihood, most of the time, they are found sitting idle, passing comments, or chasing women commuting to-and-from the area. They even stop the women riding a scooty or e-rickshaw. Given these problems, women are not allowed to travel alone by their families after 5 pm.

Ms B is a 28 year old single woman living alone with her widowed mother in a rented house in Burari. After completing her post-graduation, she is pursuing her Ph.D. She supports the family through private tuitions and school projects, which she can complete from home, along with her studies. Their average monthly income, including her mother's widow pension, is Rs 12,000. Despite good qualifications, safety concern have restricted her job search to places where she can commute by DTC bus or auto-rickshaw. The nearest metro station is GTB Nagar, which is 4 kilometers away. Though it is a crowded place with easily available shared-autorickshaw and RTV buses for commuting to-and-from the metro station, women avoid late evening travel as there is a wine shop on the route.

Based on the findings of research on safe cities conducted in partnership with the Government of Delhi and others, Jagori (2010a, b) identified the lack of effective and visible police or civil guards, men taking alcohol or drugs, crowded public transport, bus stops and stations, poor lighting, poor signage and poor maintenance of open public spaces as reasons for making Delhi unsafe.

6 Conclusion

The Covid-19 pandemic has affected the lives, livelihoods and working situations across the globe. It led to advisories regarding cutting down on all travel unless absolutely essential. The pandemic has altered the commuting preferences of working women due to fear of infection while using public transport and difficulty in maintaining physical distancing. Travel has also declined due to the increased use of online work platforms.

However, with the exception of this unprecedented time of anxiety created by Covid-19, the metro has undoubtedly become the preferred means of public transport for women in Delhi and has led to a massive improvement in the availability of public transportation in Delhi. Nevertheless, there are several challenges that women face while using the metro such as overcrowding, safety both while commuting in the metro and in metro stations as well as outside them due to problems in last-mile connectivity from the metro station to the destination, affordability and user friendliness.

It is important that policy measures are implemented to address these challenges. For instance, overcrowding can be reduced by increasing the frequency of trains and the number of coaches in each train, especially during peak hours. The Delhi metro has just announced a decision to increase the number of coaches in its trains. However, if this can be combined with flexible timing in offices, that may help to reduce the crowds at the metro stations and in metros during office rush hours. CCTV footage in metro stations and in coaches must be monitored on a real time basis and immediate remedial action taken to address safety concerns. Announcements regarding action taken could act as a deterrent and make women feel safer while using the metro. Functional street lights, clear footpaths for walking, frequent plying of female operated e-rickshaws and taxis in the evening hours together with better police patrolling will address concerns regarding last-mile connectivity. In the context of safety, efforts have also been made by the Delhi Government to form women safety teams.

Affordability is a major issue as metro fares are unaffordable for a large proportion of the working population that struggles for survival in the city. The Delhi Government had announced that metro rides, DTC bus rides and feeder buses will be made free for women in Delhi as the metro fare hikes “hit women the worst forcing them to shift to more unsafe modes of transport like private buses, ride sharing, or even walking. This move will help them return to the Metro’s safety ...and help women reclaim public spaces” (Sengar 2019). However, while free travel for women has been implemented for DTC bus rides, it has yet to be implemented for metro rides. Light rail systems lead to “less congestion, less travel

time and less pollution” (Fageda 2021). Apart from reduction in congestion and pollution, travel by the metro is comfortable and reduces the wastage of time and energy in waiting for the uncertain arrival of buses and traffic jams on the road. It is therefore important for metro travel to be affordable and for fares to be kept low in order to provide access to women from lower income classes too.

Lack of user friendliness and difficulties in access for those with health issues or age-related difficulties have been identified areas that needs attention. Support for using escalators, finding the correct platform, interchanging from one line to another and automated walkways where distances between platforms are large, would be enabling for those with access issues.

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