Impact of Covid-19 on Urban Mobility in Indian Cities

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ABSTRACT

Covid-19 is the biggest disruption of the century. It has had an unprecedented impact on the mobility sector across the world. This research presents the perceptions of people living in Indian cities with regards to the impact of Covid-19 on the urban transport sector following India's nationwide lockdown. The paper investigates the impact of lockdown on various parameters like mode choice, vehicular ownership, public transport patronage, frequency of travel and expectations from public transport operators. It also compares how globally public transport operations were altered during the pandemic. The study suggests that public transport will experience an ongoing reduction in demand as existing public transport users prioritise their health and safety while commuting. Moreover, many do not trust the current public transport system found across most of the Indian cities as a result of inadequate supply and poor operation. Middle-income group families, many of whom were previously dependent on public transport to commute, will contribute the highest in new vehicular purchases. As public transport will remain the pillar of urban transport to cut GHG emissions and reduce congestion, the paper discusses vision and actions that will help in creating a resilient, decarbonized and sustainable mobility system both in the short- and long-term.

Key words: Public transport, physical distancing, Covid-19, GHG emissions

1. Introduction

The Covid-19 pandemic has been one of the most abrupt shocks to the global economy in modern times (Hausler et al. 2020). The situation has been so unprecedented that almost everyone has been effected, some to a lesser degree than others, but the impact of Covid-19 on the mobility sector has been universal. Travel needs, travel options and commuter behaviour around the world have been forced to change drastically to mitigate the effects of Covid-19, as well as to meet the prescribed physical distancing protocols (Budd and Ison 2020).

The map below illustrates the status of operations of public transport globally on 30th May 2020. 80% of the world had either suspended or significantly reduced the PT operations to limit the spread of the pandemic. Countries like India, China, Pakistan, Egypt, Brazil, Argentina, and Ukraine completely prohibited the operation of public transport. Meanwhile, countries like Japan, Norway, Sweden, Finland,

Australia, New Zealand and Germany kept their public transport services operating without any reduction in supply.
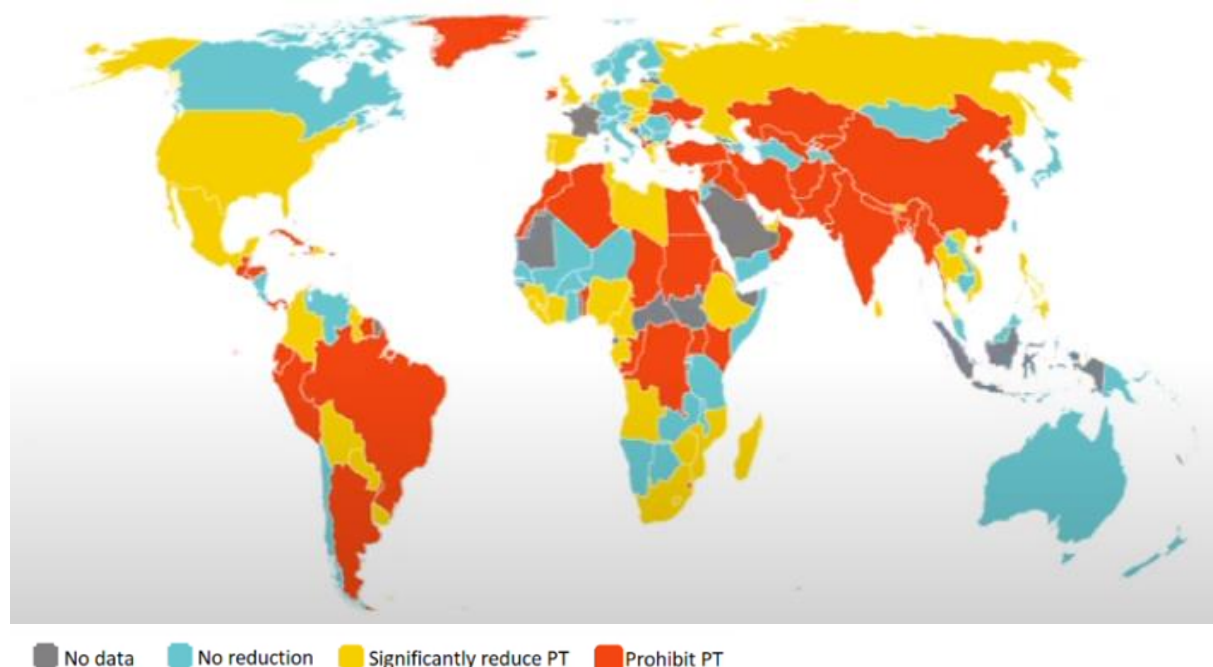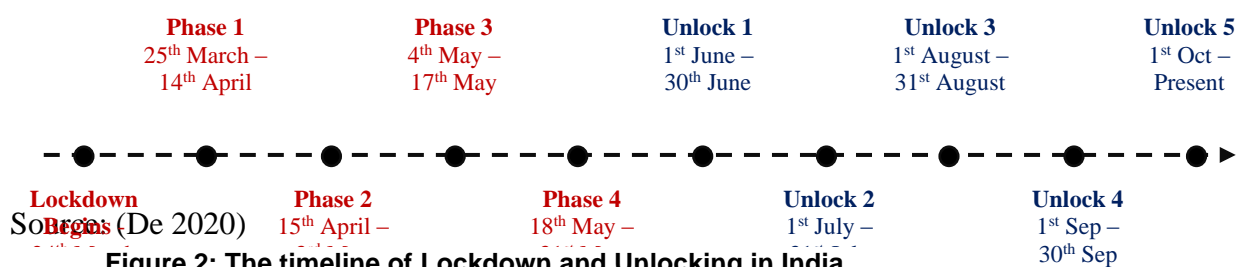

(source: Blavatnik School of Government, University of Oxford, Radcliffe Observatory Quarter 2020)

Figure 1: Status of operation of public transport globally on 30th May 2020

Internationally, public transport operators took concrete measures to make public transit safe for passengers and staff. Measures such as the regular disinfection of public transport, strict adherence to physical distancing protocol, and extensive contact tracing and communication helped various cities to keep public transport systems operating with no reduction in supply (Canon and Darido 2020). The results led to growing evidence to show that public transport riders are not at higher risk of infection (Arturo 2020). A robust public transport system, such as those seen in Japan and France, is able to adapt with appropriate sustained actions and therefore be more resilient, highlighting the need for scalable and resilient public transport infrastructure in cities (Sullivan 2020).

The paper presents the outputs from a study on the impacts of Covid-19 on travel behaviour carried out across various cities in India through an online survey in the months of May and June 2020. This paper is divided into six sections. The first section provides an overview of global fluctuations in travel demand during the initial Covid-19 lockdown. The second section is focused on the scenario of urban mobility during the first unfolding of Covid-19 infections and cases in India. The third section describes the research methodology framework followed by sample descriptions. Section 4 presents the findings from the perception study, with a particular focus on the impact of Covid-19 on mode choice, public transport user expectations and vehicular ownership. To conclude, Sections 5 and 6 discuss various actions to facilitate resilience in urban mobility in the future.

2.   The scenario of urban mobility during Covid-19 in India

| Phase 1
25th March –
14th April | Phase 3
4th May –
17th May | Unlock 1
1st June –
30th June | Unlock 3
1st August –
31st August | Unlock 5
1st Oct –
Present |

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| Lockdown
Begins
Sources (De 2020) | Phase 2
15th April – | Phase 4
18th May – | Unlock 2
1st July – | Unlock 4
1st Sep –
30th Sep |

Figure 2: The timeline of Lockdown and Unlocking in India

The figure above shows the Lockdown and Unlock phases in India. The first case of Covid-19 in India was reported on 30th January 2020 (Perppadan 2020). Given the steady rise in cases in February and March, the lockdown was announced from 24th March 2020 (Figure 2) and public transport services were put on hold for more than two months during the 4 phases of lockdown (24th March 2020 – 31st May 2020). Unlock phase one was announced from 1st June, however, access to public transport remained limited to essential workers in the Indian cities (Sharma and Ghosh 2020). In the subsequent Unlock phases, and as economic activity gradually resumed, public transport gradually resumed operations, though numbers were still not at pre-Covid-19 levels. Travel demand through public transport has improved, but is still significantly lower than the pre-Covid-19 levels (Kaushik et al. 2020). Bangalore Metropolitan Transport Corporation (BMTC) reported an average daily ridership of 35 lakhs before lockdown. However, the perceived risk associated with the spread of the virus and physical distancing norms has meant that BMTC's current ridership is at 10 lakhs per day (July 2020), 30% of pre-Covid-19 ridership (The Hindu 2020). BEST Mumbai is also experiencing a similar 65% to 70% reduction in ridership from pre-Covid-19 times (Sen 2020). People have restricted their travel to the most necessary purposes and, for many, typical commuting activities for reasons related to work and education are still being replaced by teleworking or online systems. Positive preferences of people have also been observed as a result of increased personal safety concerns, with a shift towards walking and cycling (Thakur et al. 2020).

Google has been releasing Covid-19 community mobility reports of various countries, including India. According to the reports, which are released periodically, trips to the public transport nodes were reduced significantly as compared to the baseline (Pre-COVID times denoted as 0 at the Y-axis) in the initial lockdown period from March to mid-April. Since mid-April 2020, when the lockdown norms were eased, the trips to PT nodes have witnessed steady growth (**Figure 3**). However, the trips to the PT nodes are at -37.18 to the baseline and reflect the reduced demand for travel (Google 2020).
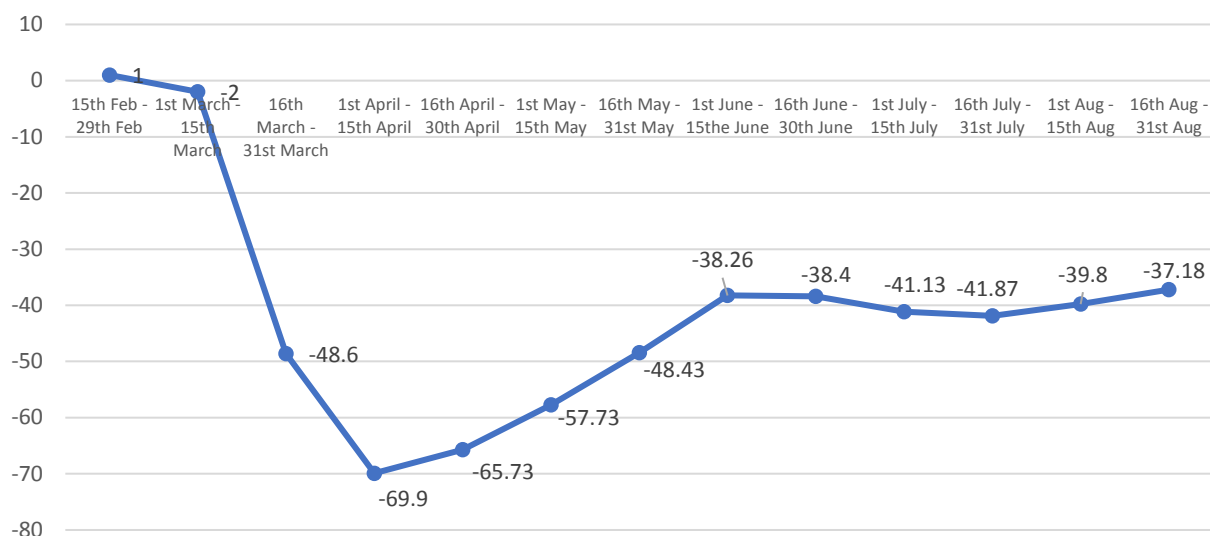
Figure 3: Covid-19 Community mobility report of India at public transit nodes by Google

Overall, mobility in India has been significantly impacted by the lockdown imposed as a result of the pandemic. Even during the 'unlocking' stages, public transport has witnessed reduced ridership and travel demand has not reached pre-Covid levels.

3. Research Framework

This study aims to assess the impacts of Covid-19 on mode choice, public transport ridership, and vehicular ownership. Moreover, the study discusses various actions that have the potential to help rebuild public trust in public transport, to enhance understanding during such unprecedented circumstances, and to facilitate sustainable mobility in the future.

To capture the perception of Indian citizens, an online survey was conducted through electronic mail and various social media platforms. The survey was live during phase 4 of lockdown (18th May – 31st May 2020) and 1st phase of unlock (1st June – 30th June 2020) from 19th May to 16th June 2020. The form was divided into two sections – the first section included the socio-economic profile of respondents such as city of residence, age, gender, profession, household income, and household and individual vehicular ownership. Section two was focused on capturing the impact of Covid-19 on travel behaviour, which includes stated mode preference after lockdown, reasons for change in travel behaviour and willingness to buy new vehicles. Respondents were also asked to rate various implementable measures that would help to reduce the spread of Covid-19, particularly when using public transport. A total of 1202 responses were received from people across 72 Indian cities.

It should be noted that the purpose of this survey was to assess the general trend towards the change in travel behaviour during lockdown and in the unlock phase, and the stated perceptions in the later phase, and not to extrapolate this across the entire population. An additional limitation of the survey was that it was not able to reach out to respondents who are without access to internet and social media.

3.1 Sample Profile

A total of 1202 samples were collected from 72 different cities spread across 22 states and Union Territories **(Figure 4)**. The sample size of some major Indian cities is also mentioned along with the state-wise distribution of samples (**Table 1**).
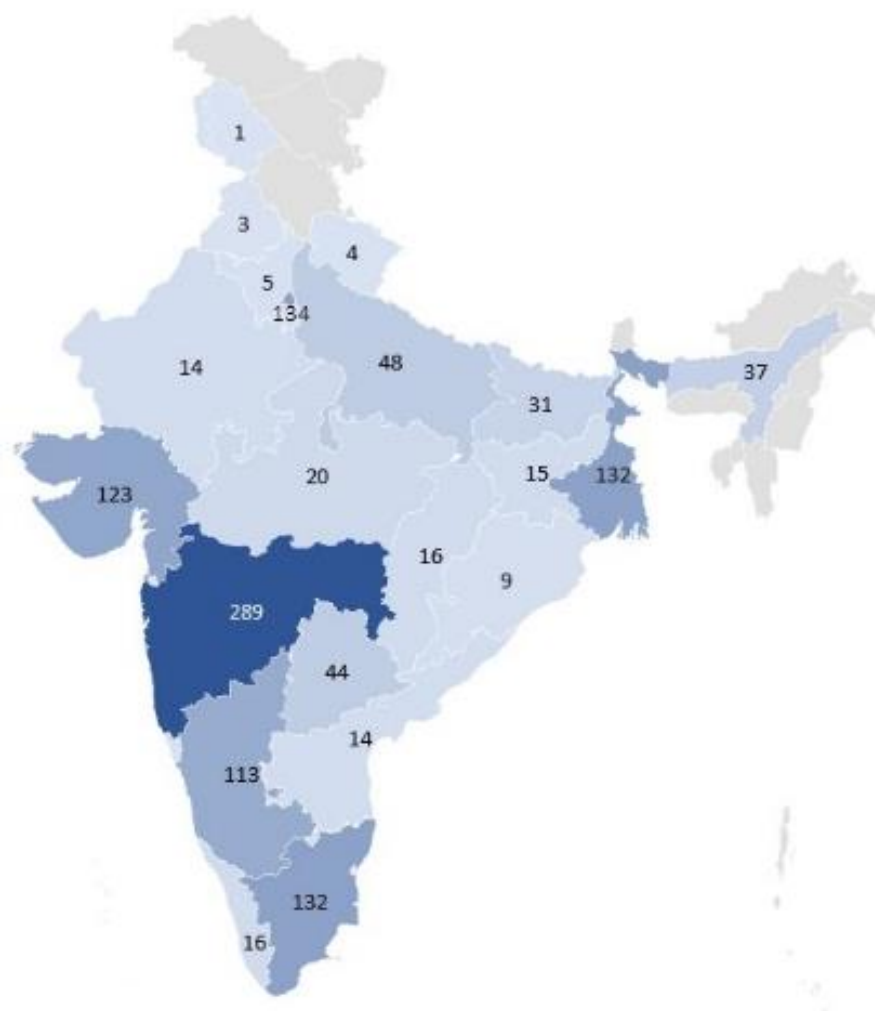

Figure 4: State-wise distribution of samples
Table 1: Number of Samples from major Indian cities

City	Samples
Ahmedabad	90
Bengaluru	91
Chennai	130
Delhi	134
Hyderabad	42
Kolkata	116
Mumbai	169
Pune	34

The sample distribution by gender reveals responses from 43% females and 57% males. In terms of occupation, the private service respondents have the highest share (41%), followed by students (27%). The smallest sample collected was from the retired (5%) and housemaker (8%) category (**Table 2**).

Table 2: Profile of samples

Category	Sub-category	% of samples
Gender	Male	57%
	Female	43%
Age	<20	21%
	20-40	38%
	40-60	23%
	>60	18%
Occupation	Private service	41%
	Student	27%
	Self-employed	10%
	Govt. service	9%
	Housemaker	8%
	Retired	5%
Monthly Household and Income	< 25000 INR	18%
	25000 – 50000 INR	33%
	50000 – 100000 INR	31%
	> 100000 INR	18%
Household and individual Vehicular Ownership	No vehicle	25%
	Only cycle	3%
	Only 2-wheeler	31%
	Only 4-wheeler	15%
	Multiple vehicles	26%

Lockdown restrictions meant that the survey was conducted online. However, samples collected have the proportional distribution of low, medium and high-income groups. Levels of vehicular ownership appear to be correlated to the income levels of the respondents (**Figure 5**), as vehicular ownership for the low income category is low and increases with increment in income levels. Overall, 25% of the respondents do not own any vehicles, 3% only cycle, 31% own only a 2-wheeler, 15% only a 4-wheeler and the remaining 26% own a combination of either a cycle and 2-wheeler, 2-wheeler and 4-wheeler, or all three modes.
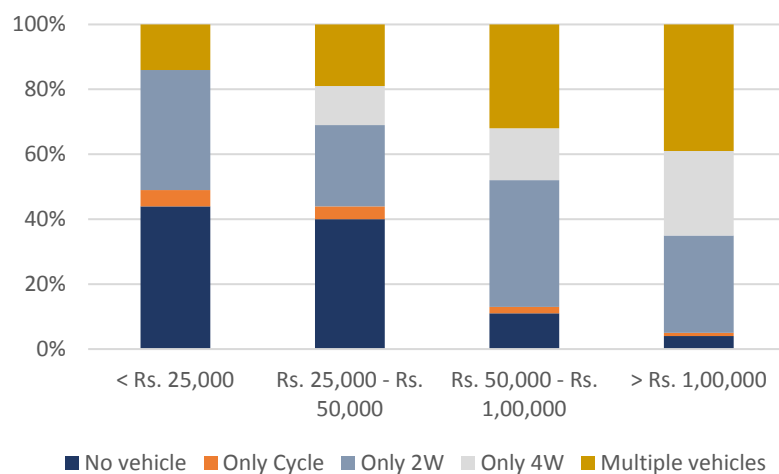
No vehicle ■**Only Cycle** ■**Only 2W** ■**Only 4W** ■**Multiple vehicles**

Figure 5: Income group-wise percentage distribution of vehicular ownership

4.   Data Analysis

4.1 Impact on mode choices

The new physical distancing advice of maintaining a 2 metre distance between individuals seems to have reduced levels of public transport users' trust in the operators. 67% of the respondents suggest that safety from Covid-19 is the most significant criteria while travelling. The graph below illustrates the likely modal shift that cities may witness after lockdown from the stated choice of the respondents (**Figure 6**).

The sample survey suggests that all the public transport modes (bus, rail, metro, and shared auto/cab) will experience a drop in user demand. Simultaneously, the private modes are likely to become the preferred mode of travel, with results indicating that the 2-wheeler mode share will likely increase from 15.6% to 19.2% and 4-Wheelers from 12.3% to 17.2%. Non-motorized modes are also anticipated to witness an increase. It is interesting to note that 3% of the respondents indicated that they are likely to work from home and will not be making any regular trips (**Figure 6**). Therefore, it is probable that the pandemic will significantly alter the mode choice and travel patterns in cities. Working from home is expected to be widely accepted and adopted, and improved virtual infrastructure in cities may further reduce the need for travel.
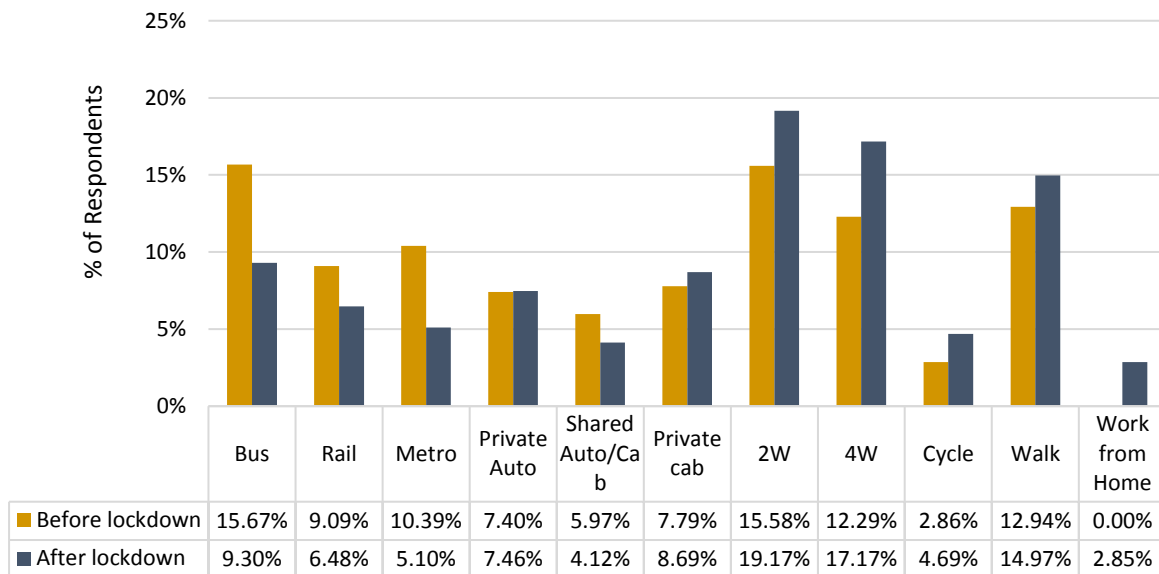
	Bus	Rail	Metro	Private Auto	Shared Auto/Cab	Private cab	2W	4W	Cycle	Walk	Work from Home
Before lockdown	15.67%	9.09%	10.39%	7.40%	5.97%	7.79%	15.58%	12.29%	2.86%	12.94%	0.00%
After lockdown	9.30%	6.48%	5.10%	7.46%	4.12%	8.69%	19.17%	17.17%	4.69%	14.97%	2.85%

Figure 6: Impact of Covid-19 on Mode Share

4.2   Impact on public transport

In the perception survey, 40.1% of regular pre-Covid public transport users suggested that they would still not prefer to use public transport. This is because of the perceived high risk of contamination on public transport, and the belief that maintaining physical distancing when using public transport would be difficult. As these respondents deemed public transport to be unsafe, the following are the modes the respondents would prefer to use post lockdown (**Figure 7**).
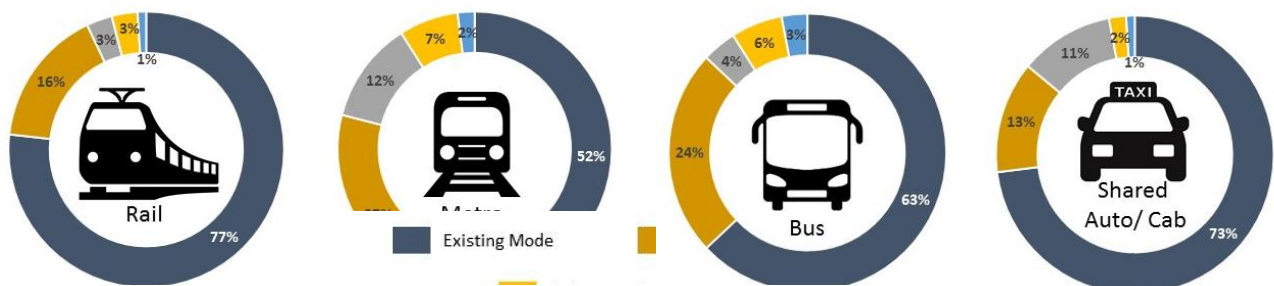

Figure 7: Post lockdown probable mode share of various collective modes

From the survey, it is likely that collective modes will experience decreased demand and riders will shift to personalized modes, e.g. 2-Wheelers, 4-Wheelers, Cycle and Walk. Interestingly, metro users indicate the maximum likelihood of a shift, with 12% indicating preference for 4-Wheelers and 27% for 2-Wheelers. A large proportion of these metro users belong to the income group who earn greater than 50,000 INR per month and have higher vehicular ownerships compared to other income groups. However, the urban rail, which is extensively used in Mumbai and Chennai for intra-city travel, is expected to see a much lower shift of 23%. This is because most of the rail users do not own vehicles and belong to the income group who earn less than INR 25000 per month. Shared cab service is also anticipated to witness a 27% reduction in demand, as people currently using the service belong to medium and high-income groups and own 2-Wheelers or cars.

Based on the perception study, the occupation that is likely to shift from public transport the most is the retired category (age group above 60). 44% of these respondents were public transport users and, out

of these, 49% indicated an inclination to shift to personalized modes for commute in the future. Interestingly, occupations such as 'Housemaker' and 'Student' indicated a desire to continue the use of public transport relatively more than other occupations. Additionally, 42% of these respondents do not own personal vehicles. A logical conclusion to deduce from these results is that not owning a vehicle compels these public transport users to continue with the service.

4.3 City-wise impact on public transport

City-wise analysis indicates that Ahmedabad, Hyderabad, and Bangalore are likely to witness the maximum shift of PT users to other modes as compared to Mumbai, Delhi and Kolkata. This is likely due to long trip lengths, increased congestion, and high travel time in private vehicles in big cities like Mumbai, Delhi and Kolkata (Error! Reference source not found.).
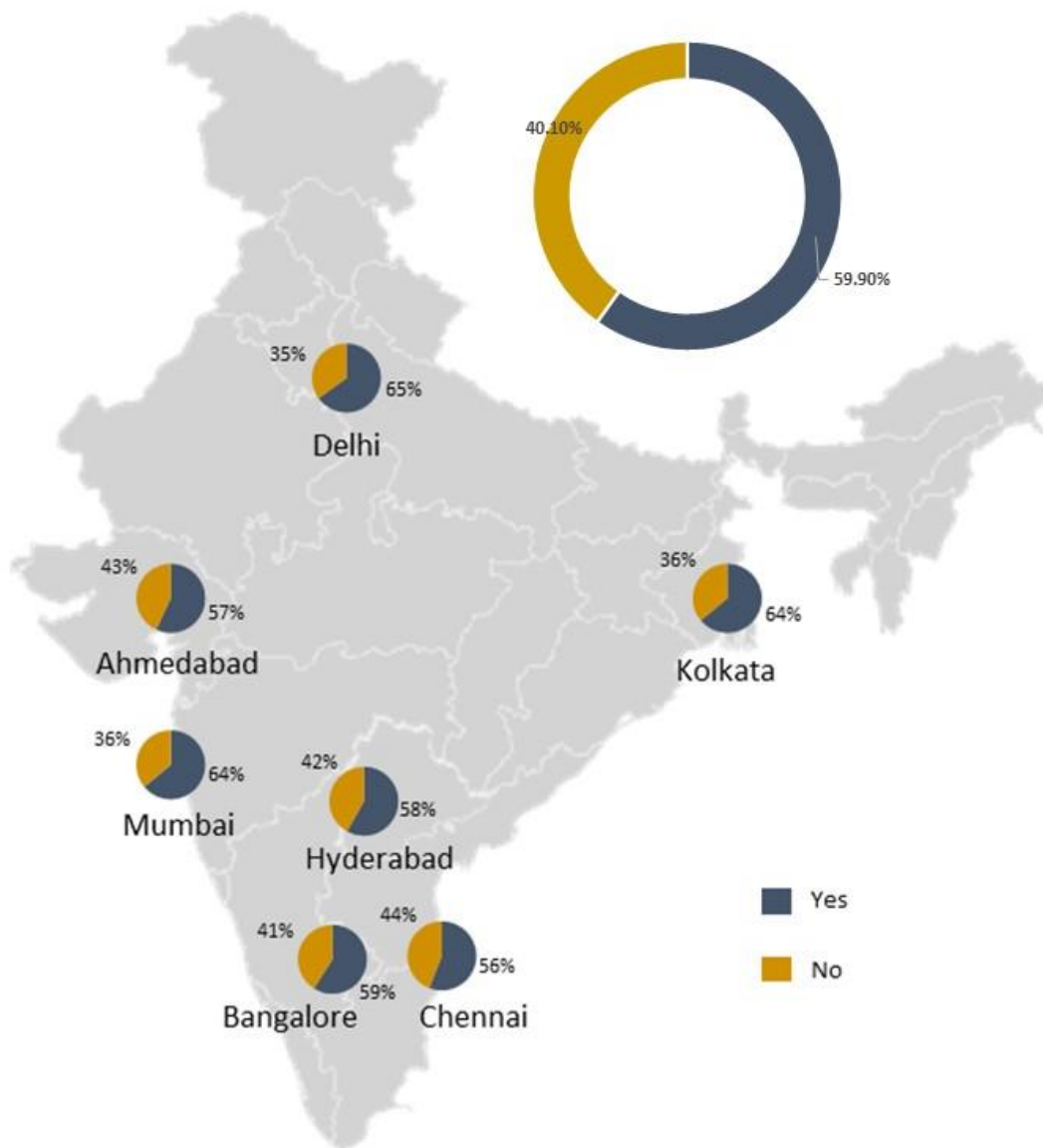

Figure 8: City-wise response on the use of public transport post lockdown

59.9% of existing public transport users will continue to use the service post-lockdown. There are different factors behind this figure. Out of the continuing public transport users, 72% do not own vehicles and are hence forced to use PT or endure long trip distances. Approximately 28% of the same group of respondents believe that the PT operations will improve, and safety will be ensured (**Error! Reference source not found.**).

City-wise analysis indicates that commuters have maximum trust in the PT operators of Bangalore (43%) and Delhi (35%), as they believe the government and operators will take appropriate measures to ensure public user safety, as compared to other cities (**Error! Reference source not found.**).
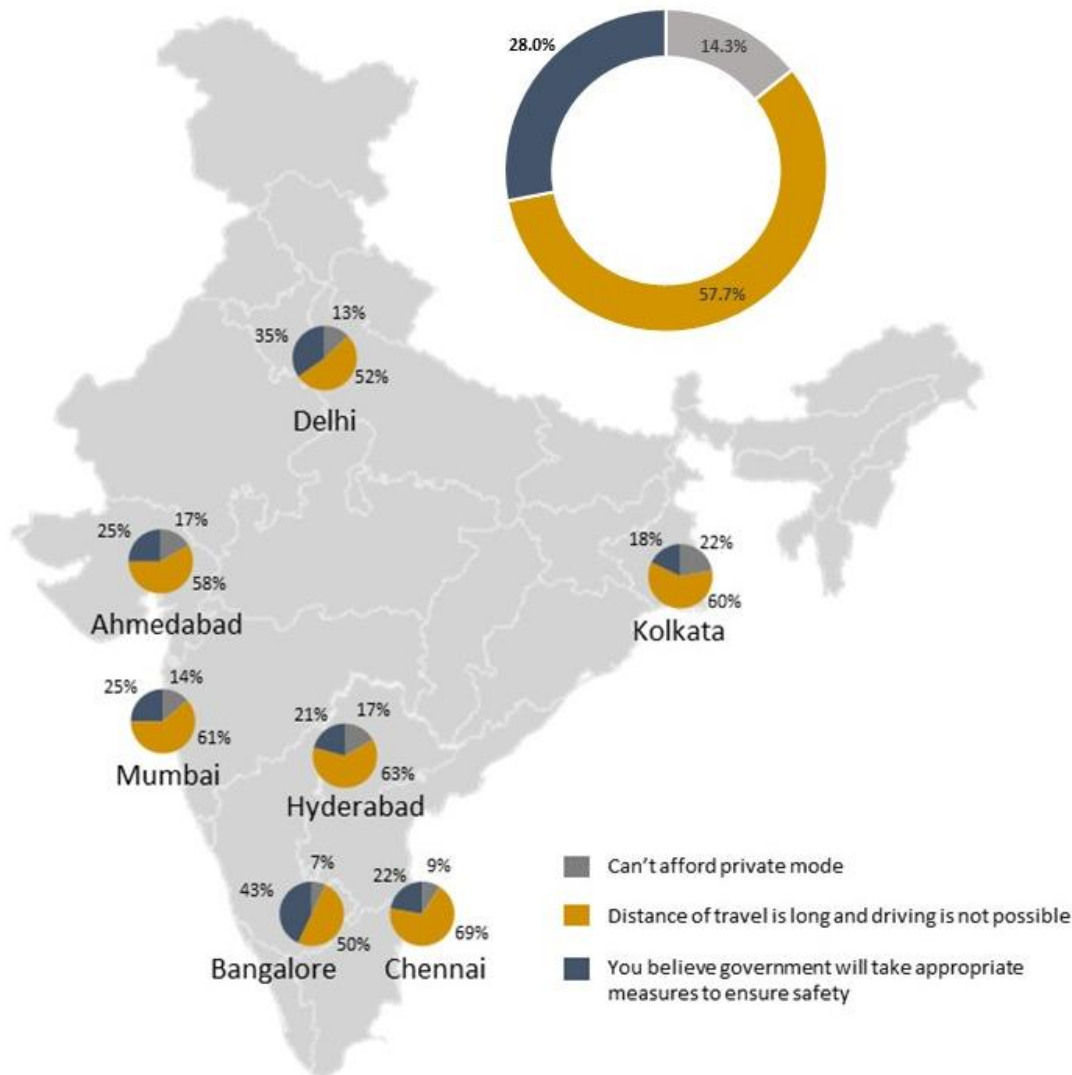

Figure 9: Reasons for continuing to use public transport post-lockdown

4.4 User expectation from bus operators

Public transport operators have a significant role in rebuilding the trust of public transport users. The impact of Covid-19 can be turned into an opportunity to overhaul the quality and function of public transport in Indian cities. This research study presents user expectations from the public transport agencies/operators. While there are innumerable measures to ensure safety, a set of 11 measures were outlined based on the liiterature review. These measures were presented to the respondents, who

were asked to rate them in terms of effectiveness in reducing transmission of Covid-19 when using public transport. Figure 9 shows the rating of 11 different measures. According to the respondents, the 5 highest rated measures are i.) Provision of sanitizers at stops and inside the public transport (4.4) ii.) Not allowing people without a face mask inside the public transport vicinity (4.3) iii.) Cleaning and disinfecting the bus after every trip (4.1) iv.) Web ticketing (4) v.) Increased frequency of public transport (4) **(Figure 10).** Adhering to the social distancing norm has been rated between the range of 'medium to high', representing users' desire for operators to maintain social distancing inside public transport vehicles. The low to medium (between 2-3) rating for queue-based entry and thermal screening of passengers reflects passenger behaviour patterns, as these measures would be time-consuming and affect travel time.
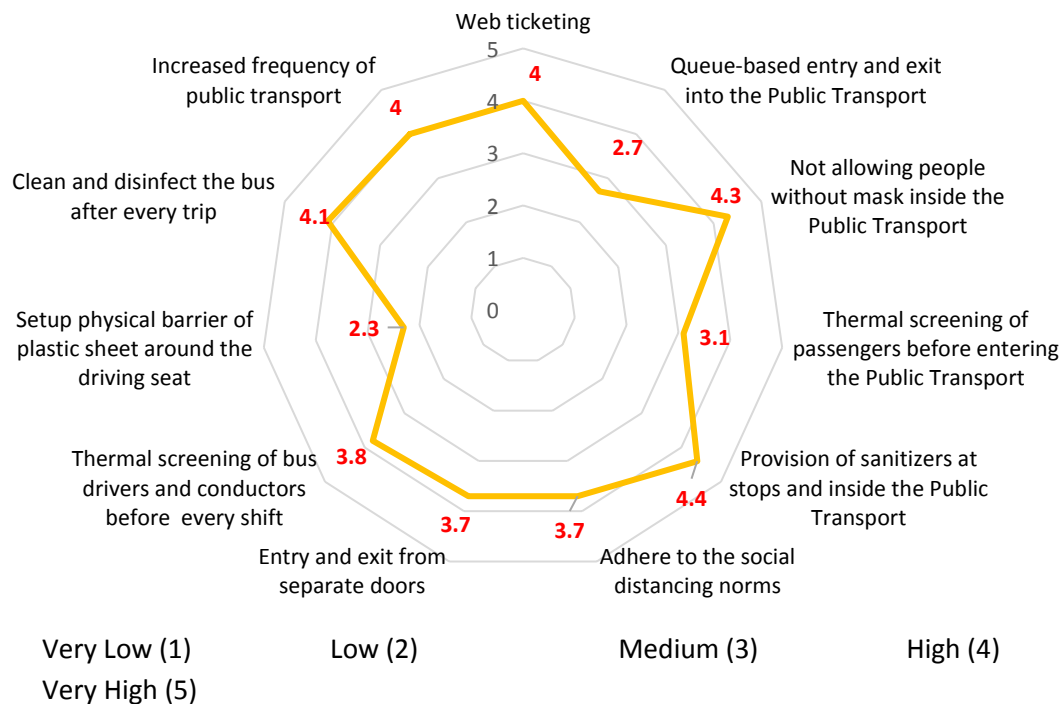

Figure 10: Rating for various measures to reduce the risk of Covid-19 while using public transport

4.5 Impact on Vehicular Ownership

Overall, 76% of the respondents are not willing to buy any new vehicle post lockdown. Of the 24% of respondents who indicated their willingness to buy new vehicles post lockdown, the percentage is highest in the income group between Rs. 25,000-50,000 (**Figure 11**). This is likely to be because this income group can afford a private vehicle but had preferred to use PT until now. Meanwhile, the high-income group already own a vehicle, hence they score highest in being the least willing to purchase a new vehicle. The vehicular segment corresponds both to income level and cost of the vehicle, as low- and middle-income groups are willing to buy a 2-Wheeler while the high-income group prefers the 4 Wheeler (**Figure 12**).
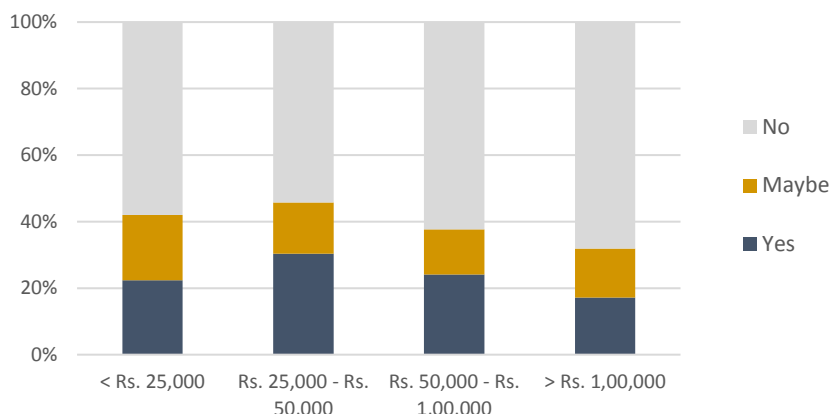
Figure 11: Income-wise percent distribution of sample for willingness to buy new vehicle
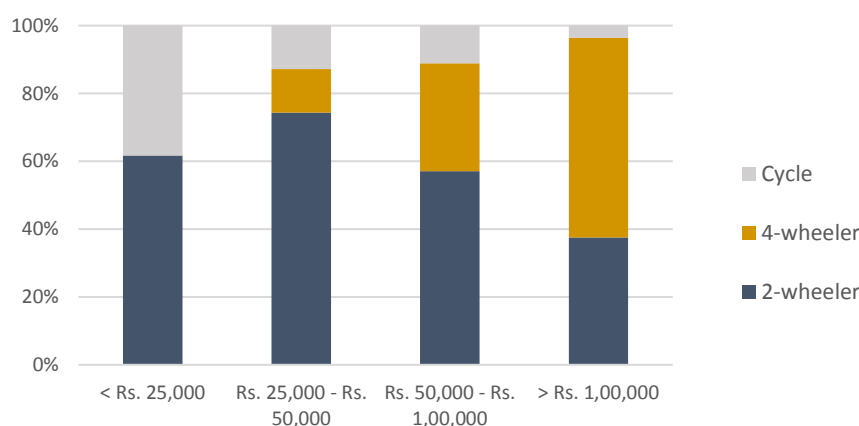

Figure 12: Income-wise percent distribution of sample for preferred mode of new vehicle

5. Discussion

Despite the easing of lockdowns around the world, it is clear that, at least in the short- to medium-term, physical distancing will continue to be the norm. The current supply of public transport in Indian cities means that such physical distancing will pose a significant challenge. As suggested by the responses received, public transport is likely to be negatively impacted in the short-term. There is also a possibility of increased vehicular ownership post lockdown. This shift away from public transport to private modes will lead to increased demands on an already congested road space. Increased traffic, vehicular pollution, road safety and noise pollution are major concerns. It is clear that there is therefore an urgent need to develop a comprehensive strategy, one which addresses the immediate impact of Covid-19 as well as the bigger challenge of the global climate crisis.

Restoring public trust in using city buses and addressing the health-related risks of doing so are both essential. Web ticketing, demarcating seats to maintain the physical distancing, disinfecting the bus after each trip, installing handwash stations at bus stops, face shields and regular thermal screening for drivers and conductors, and entry from the rear gate and exit from the front gate, can all help in building trust in riders (GIZ India 2020). Moreover, improving the supply of buses by fleet expansion, making PT fares more attractive, and ensuring high levels of safety will help re-establish passenger trust (Thakur et al. 2020).

In addition, staggering office timings in metropolitan cities can help to flatten the peak rush hours (MoHFW 2020). In order to provide adequate supply of buses, all inter-city buses can be used for city services irrespective of the kind of contract buses hold, while still ensuring physical distancing (Suman, Agarwal, and Bolia 2020). The extraordinary situation that Covid-19 has brought upon the world has also provided an opportunity to address India's existing institutional challenges. Enhanced technology, such as the sharing of bus on-board occupancy and the real-time information of bus positions through web-based applications and on the digital boards of bus stations, can also be effective strategies. Additional funding can be pulled from central and state governments to cover the shortfalls due to reduced farebox revenues. Exemptions can be made in motor vehicle tax for the months when services are limited and ridership is poor, as this will help reduce the monetary burden for operators (UITP 2020).

As previously mentioned, the challenges posed by Covid-19 can be taken as an opportunity to refurbish the urban transport sector and steer it toward a more desirable future. Technology and sustainability can be used to demarcate a better future for urban mobility. As the government proceeds toward a phased unlock, urban mobility can progress towards a more desirable 'new' normal. This new normal mobility can be defined as a system where streets are for all, congestion and pollution are less, public transport is safe and non-motorised transport is extensively used. To achieve the desired normal for urban mobility in cities, the focus must be on dedicated non-motorised transport infrastructure, land use and transport integration, promotion of electric vehicles across all modes, and institutional unification to ease and accelerate the implementation of transport policies, programs and schemes. A collective effort from the community and authority can bring this desirable change in the urban transport sector. While strategies are many, financial support to implement these strategies is the key. Public transport has been widely regarded as a social obligation for a long time. The pandemic is an opportunity to make the proposed measures to improve PT a reality. PT users are not the only ones whom stand the gain from such improvements: non-riders and property owners, indeed the whole of wider society, will benefit from an overall enhanced quality of life, reduced congestion, a decline in road accidents, and better air quality due to lower GHG emissions. A comprehensive plan to attain revenue from all these sources (carbon taxation from 4-wheeler and congestion pricing) is crucial. This revenue can therefore be diverted to help improve the bankability of State Transport Undertaking's, with a revised focus on fleet expansion and desired service.

In conclusion, the lasting legacy of the pandemic has brought about a realisation that the larger crisis we face - climate change - could lead to similar disruptions of the same magnitude in the near future. Addressing climate change by adopting decarbonized modes, implementing awareness initiatives among communities and working towards resilience for such a crisis can hugely help cities peddle towards a greener future.

6. Conclusion

As the world's population increases and urbanisation expands, the needs of urban mobility have become increasingly urgent. The disruption that has resulted from Covid-19 has significantly impacted the mobility sector across the globe. This research paper attempts to capture the influence of Covid-19 on various aspects of mobility. The perception study suggests that mode choices will probably be altered post Covid-19, with a marked shift away from public transport to walking, cycling or personalised modes expected, at least in the short term. The study suggests that Mumbai, Delhi, and Kolkata may experience comparatively smaller shifts from public transport modes as compared to Ahmedabad, Chennai and Hyderabad. Various implementable measures have been rated by the respondents

towards addressing the concerns while traveling through public transport. The analysis depicts that web ticketing and improved supply of public transport are two prime demands of the respondents. Vehicular ownership is another parameter that has been explored through the perception study and 24% of the samples are planning to buy new vehicles. Interestingly, the respondents belonging to the income category of 25,000-50,000 INR per month are more likely to buy new vehicles as compared to other income categories.

The pandemic has resulted in notable improvements in local air quality in cities globally and a glimpse, perhaps, of a greener future. We now have an opportunity to transform the urban mobility sector by promoting sustainable and decarbonised transport. Public transport is widely considered to be the pillar of sustainable mobility. Reviving the sector with public health interventions, better frequency and coverage, and scalable infrastructure could help make great gains in addressing the rise in GHG emissions and the ever-increasing congestion in Indian cities.

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