

# Travel Behavior of Access-Egress Mode Users at Rapid Transit Stations-Case Study Kolkata, India



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**Abstract** In a multimodal public transportation system, feeder service is often more disappointing to commuters than rapid transit service. This paper aims to investigate commuters' needs from access-egress modes by analyzing their travel behavior using a stated preference survey. A travel chart is used to assess modal preferences of access-egress modes where names of travel modes are obscured. The characteristics of different alternative modes during peak hours are represented by relevant images to avoid bias on any particular mode and to get authentic as well as consistent responses. Regular rapid transit users at three metro stations in Kolkata, India stated their preferences for access-egress trips using this travel chart. According to this study, majority of commuters are willing to pay more to reduce their in-vehicle travel time by accepting longer waiting time. They are also willing to pay more for comfortable daily trips when travel time is fixed. Better convenience and lesser number of transfers get more priority than lower travel cost and shorter travel time. However, travel cost remains as a secondary parameter upto a certain cost increment. This limit varies depending on the user's perceptions and socio-economic characteristics.

**Keywords** Access-egress mode · Travel behavior · Stated preference survey · Rapid transit

## 1 Introduction

Presently, majority of commuters in metropolitan cities have to avail a multimodal public transportation system. In such cases, sometimes the service of feeder system

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L. Devi et al. (eds.), *Proceedings of the Sixth International Conference of Transportation Research Group of India*, Lecture Notes in Civil Engineering 272,

[https://doi.org/10.1007/978-981-19-3494-0\\_8](https://doi.org/10.1007/978-981-19-3494-0_8)

may not be as much satisfactory as of rapid transit due to improper planning of feeder service. These usual problems are forcing citizens to use private transport instead of public transport. The consequence of that is making the situation even worse by inventing issues like severe traffic congestion, uncountable traffic accidents, intolerable air, and noise pollution. Commuters' satisfaction is definitely a measure of effectiveness of public transport services. The aim of this paper is to search the needs of users from public transportation in terms of travel mode attributes.

The specific objectives of this paper include:

- To investigate users' preference on access or egress modes at rapid transit stations by stated preference survey
- To identify users' willingness to pay and ability to pay.

To search for the most accountable factor for increasing ridership a nationwide survey of transit agencies in the USA between 1995 and 1999 was conducted by Hess et al. [8]. Their report revealed that the most frequently cited factors were service improvement, i.e., more reliable, safer, cleaner service with attractive stops, and also an acceptable fare structure which attracted new riders and stretched the ridership growth. For a sustainable public transportation system, a balance between its customer responsiveness and cost-effectiveness is to be ensured. A case study of sub-regional governance of bus services in Los Angeles County was conducted by Chen [4]. Users have some expectations or needs from public transportation system in terms of its service aspects; that can be identified by evaluating how much money they are willing to pay to improve the service quality. Those qualities for which commuters are ready to pay are also to be identified. In 2008, Eboli and Mazzulla [6] examined commuter's willingness to pay to improve the service quality of bus service in Cosenza, Italy by considering qualitative service aspects, namely reliability, frequency, proximity to bus stop, bus stop facilities, bus overcrowding, ticket fare, cleanliness, helpfulness of personnel, and information at bus stops. In 2017, Bachok and Ponrahono [2] stated that most of the commuters, who were willing to pay increased fare for an improved bus service in Malaysia, choose mostly cleanliness and comfort following by safety or security, punctuality, waiting facilities, and infrastructure as bus improvement priority areas. In 2017, Li et al. [13] considered five attributes, namely speed, connecting distance, transfer time, degree of crowding, and reliability for analyzing willingness to pay of commuters to get more improved service quality in Beijing, China. In 2017, Ingvardson and Nielsen [9] revealed that travel time reduction in bus rapid transit can increase attractiveness to commuters significantly. In 2005, Advani and Tiwari [1] presented an evaluation of Delhi metro, India concerning its travel time, capacity and accessibility from commuters' perspective. In 2015, Goel and Tiwari [7] conducted a detailed study on access-egress service of Delhi metro, India. In 2016, Chandra et al. [3] evaluated the modal share for work trips only using multinomial logit model along a busy street corridor in Kolkata, India. Three types of surface transportation mode including transit, paratransit, and personal vehicles were considered in this study. The model was developed based on both the quantitative criteria such as travel time, travel cost, waiting time, and the qualitative criteria such as comfort, reliability, dust, and noise. Above literature states

that users' satisfaction has a great influence on ridership and users can pay more for better service. Moreover, there would be a trade-off between service quality and user cost. The present study wants to capture this trade-off, i.e., users are choosing which parameter over which.

## 2 Methodology

### 2.1 *Adopted Methodology*

To reach rapid transit station, commuters often avail a mode. This mode is known as access mode. After getting off from rapid transit, commuters get dispersed to avail their suitable travel mode to reach their destination; that is egress mode. The characteristics of interface between rapid transit and surface transportation are to be studied through reconnaissance survey.

Based on those characteristics, a travel chart is to be prepared. The names of travel modes are to be suppressed there, and the characteristics of different types of existing modes are to be represented by relevant images. Using this chart, regular rapid transit users have to state their preferences of modes as access or egress according to their suitability for daily trips for a certain distance (e.g. upto 10 km travel). From these data, preferences perceived by individual of access/egress mode of rapid transit along with travel attributes of public transport modes would be evaluated. In travel chart, relevant images are to be used to avoid biasness to any particular mode, to get more authentic and consistent results and also to reduce the monotony of questionnaire.

Then, to clarify the reason for choosing any mode, some stated preference questions are to be added in questionnaire. Every question would represent a pair of situations with the help of suitable images, and commuters have to choose one from them as per their suitability. In most of these cases, travel cost would be the objective function. These data would represent commuters' willingness to pay. These questions also check the reliability (if same answer is obtained in the same context) and validity (if the intention of asking question and users' response match accurately).

Commuters' socio-economic and trip characteristics are also to be noted by revealed preference survey to identify the reason of variation in responses and to reveal whether the respondents are true representatives of this study or not. The following flowchart states the adopted methodology of this paper briefly (Fig. 1).

### 2.2 *Case Study Region: Kolkata*

Kolkata is the capital of Indian state West Bengal. Versatility can be observed in surface public transport modes in this city such as fixed route transit like suburban rail and ancient tram, air conditioned and non-air conditioned buses, paratransit like

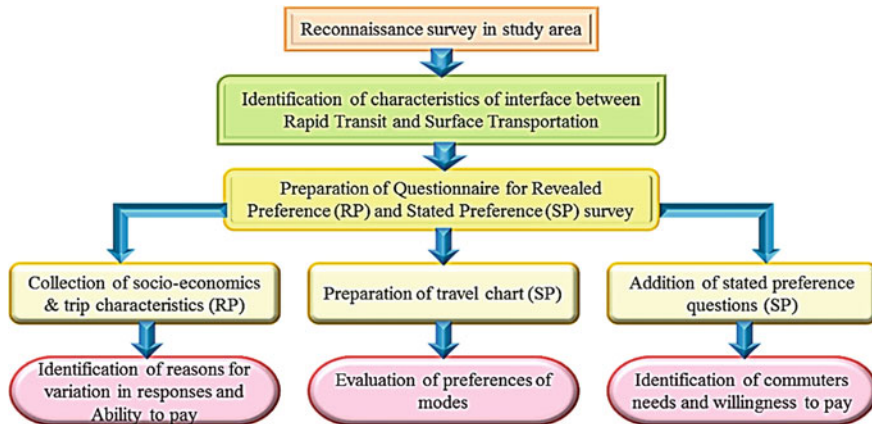


Fig. 1 Adopted methodology

auto-rickshaw and Carpool, demands responsive transit like Meter taxi and App-cab. 687,918 motorized vehicles are registered (including two and three wheelers) on roads in Kolkata [5]. In this city, approximately 54% of all trips are made through public transportation and that is the highest in India [10].

The rapid transit system, Kolkata Metro, has made the public transportation system in Kolkata strong. Line 1 (North–South Metro) Metro Network runs between Noapara and Kabi Subhas over 24 stations and Line 2 (East–West Metro) is partially operational between Saltlake Sector V and Saltlake Stadium, serving six stations, and two more networks are under construction and two are in proposal to connect surrounding suburban areas with this city [11, 12, 14].

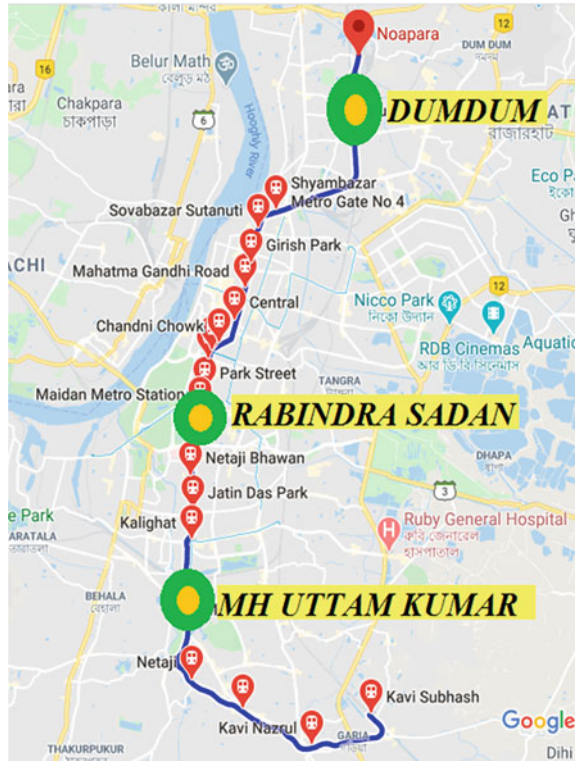
**Study Area.** Three existing stations of Line 1 in Kolkata Metro Network, namely Dumdum, Mahanayak Uttam Kumar and Rabindra Sadan have been selected as survey area; one was toward north, one was toward south, and rest one was exactly middle of the corridor. All of them are one of the busiest stations and have enough versatility in present interface between rapid transit and surface transportation (Fig. 2).

### 3 Data Collection and Analysis

#### 3.1 Design of Questionnaire

The questionnaire has been designed to achieve the aim of this paper. There were two parts in that designed questionnaire. In the first part, commuters' trip characteristics such as frequency of trip, purpose of journey, starting time of journey, trip

**Fig. 2** Study area. *Source* <https://www.google.co.in/maps>














length, and socio-economic characteristics such as age group, gender, highest education, occupation, no. of cars and motorbikes in household, and monthly income and monthly expenditure on public transportation were added. In some previous study, it was observed that respondents showed reluctance in revealing their exact age and income; hence, these questions are modified by making classification groups for age and monthly income.

In the second part, a travel chart (Table 1) was attached including all the existing surface transport modes but the names of modes were suppressed. The subjective characteristics for each mode such as length of waiting queue and crowding level were perceived by author during reconnaissance survey. Based on that, the characteristics of different existing modes are represented by relevant images (Sect. 2.1). Respondents were asked their preferences among those modes as access or egress mode for upto 10 km according to suitability for their daily trips. To get more clarity and validity in the reason for choosing any mode, some stated preference questions were kept in this questionnaire with relevant images (Sect. 4.2).

In Table 1, App-cab is denoted by Mode A, Meter taxi by Mode B, Suburban rail by Mode C, Non-AC bus by Mode D, Carpool by Mode E, Auto-rickshaw by Mode F, and AC bus by Mode G.

**Table 1** Travel chart in designed questionnaire

Mode	Waiting time during peak hours	Scheduled time-table	Seat availability during peak hours	Comfort	Travel-time delay and average speed during peak hours	Fare Rs./10 km
A	<i>Too short</i> 	<i>NO</i>	<i>Seat is assured and very comfortable</i> 	<i>AC</i>	<i>Delay ~ Low Speed ~ 35 km/h</i> 	<i>₹180</i>
B	<i>Short</i> 	<i>NO</i>	<i>Seat is assured and comfortable</i> 	<i>Non-AC</i>	<i>Delay ~ Low Speed ~ 30 km/h</i> 	<i>₹150</i>
C	<i>Long</i> 	<i>YES</i>	<i>Overcrowded</i> 	<i>Non-AC</i>	<i>Delay ~ Very low Speed ~ 45 km/h</i> 	<i>₹5</i>
D	<i>Medium</i> 	<i>YES</i>	<i>Crowded</i> 	<i>Non-AC</i>	<i>Delay ~ High Speed ~ 10 km/h</i> 	<i>₹11</i>
E	<i>Medium</i> 	<i>NO</i>	<i>Seat is assured and more or less comfortable</i> 	<i>Non-AC</i>	<i>Delay ~ Moderate Speed ~ 25 km/h</i> 	<i>₹30</i>
F	<i>Too long</i> 	<i>Mostly YES</i>	<i>Seat is assured but may be uncomfortable</i> 	<i>Non-AC</i>	<i>Delay ~ Moderate Speed ~ 25 km/h</i> 	<i>₹22</i>
G	<i>Too long</i> 	<i>YES</i>	<i>Can stand comfortably</i> 	<i>AC</i>	<i>Delay ~ High Speed ~ 15 km/h</i> 	<i>₹35</i>

Source Field survey

The following modes were observed at three metro stations during reconnaissance survey. The respondents were asked to rate all the modes irrespective of availability; so that their perception on any new mode can be captured.

- (a) At Dumdum metro station, AC bus, Non-AC bus, Suburban rail, Auto-rickshaw, and App-cab are found to provide the access or egress service.
- (b) At Rabindra Sadan metro station, AC bus, Non-AC bus, Meter taxi, Carpool, and App-cab play the role of access or egress mode of metro rail.
- (c) At Mahanayak Uttam Kumar metro station, AC bus, Non-AC bus, Auto-rickshaw, Meter taxi and App-cab act as interface between metro rail and surface transportation.

### ***3.2 Data Collection and Distribution***

With the help of designed questionnaire, data collection was implemented through a survey of face-to-face interview by author from September 2019 to November 2019. A convenient sample of 100 regular metro users at each of three metro stations in Kolkata was interviewed directly on working days, i.e., Monday to Saturday (9 a.m.–1:30 p.m., 2 p.m.–7 p.m.). Random sampling method was adopted for sampling technique.

The observations from collected data are stated below which indicate that the respondents are true representatives for this study.

- At all of these three stations, five trips per week are made by majority of the respondents for either work or education, and their starting time of journey is within 8–10 a.m. As most of the respondents have neither a personal car nor a motorbike in their household, they are true representatives of the regular trip makers during peak hours of the day.
- Majority of the respondents are young or mid-aged people (18–35 years old) and male. Most of them completed graduation. In an average scenario, 54% trips are made by servicemen, 38% by students, 7.5% by businessman, and rest is by homemakers.
- Average access/egress trip length of respondents at Dumdum, Rabindra Sadan, and Mahanayak Uttam Kumar station is 6.4 km, 6 km, and 9 km, respectively.

The characteristics of monthly income and monthly expenditure on public transportation of respondents are stated in Table 2.

**Table 2** Monthly income and monthly expenditure on public transportation of respondents

Distribution of monthly income (in terms of % of respondents)									
Station	Monthly income								
	₹0– ₹10,000	₹11,000– ₹20,000	₹21,000– ₹30,000	₹31,000– ₹40,000	₹41,000– ₹50,000	>₹50,000			
Dumdum	41%	15%	19%	17%	4%	4%			
Rabindra Sadan	31%	18%	16%	12%	10%	13%			
MH Uttam Kumar	27%	18%	19%	11%	8%	7%			
Distribution of monthly expenditure on public transportation (in terms of % of respondents)									
Station	Monthly expenditure								
	≤₹500	₹600– ₹1000	₹1100– ₹1500	₹1600– ₹2000	₹2100– ₹2500	₹2600– ₹3500	₹3600– ₹4500	₹4600– ₹6000	>₹6000
Dumdum	4%	16%	19%	20%	9%	15%	10%	4%	3%
Rabindra Sadan	2%	9%	16%	13%	15%	22%	6%	6%	11%
MH Uttam Kumar	1%	9%	18%	13%	11%	25%	8%	13%	2%
Mean of monthly income and monthly expenditure on public transportation									
Station	Dumdum	Rabindra Sadan	MH Uttam Kumar						
Mean of monthly income of respondents	₹24,000	₹29,100	₹28,200						
Mean of monthly expenditure on public transportation for all purpose	₹2362	₹2950	₹2958						
% of monthly expenditure on public transportation for all purpose	9.84%	10.14%	10.49%						
Mean of monthly expenditure on public transportation for work trip	₹1250	₹1685	₹1480						
% of monthly expenditure on public transportation for work or educational trip	5.21%	5.79%	5.25%						
Access + egress travel cost (Rs./10 km) in this particular trip	₹15	₹25	₹25						

Source Field survey

## 4 Results and Discussion

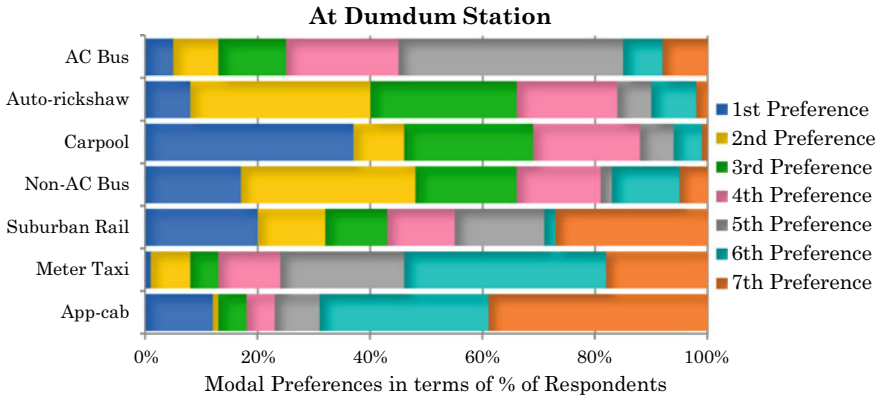
### 4.1 Preferences of Modes from Travel Chart

Figures 3, 4, and 5 show number of commuters those have chosen a particular mode as their 1st preference, 2nd preference, and so on to access or egress the Kolkata metro.

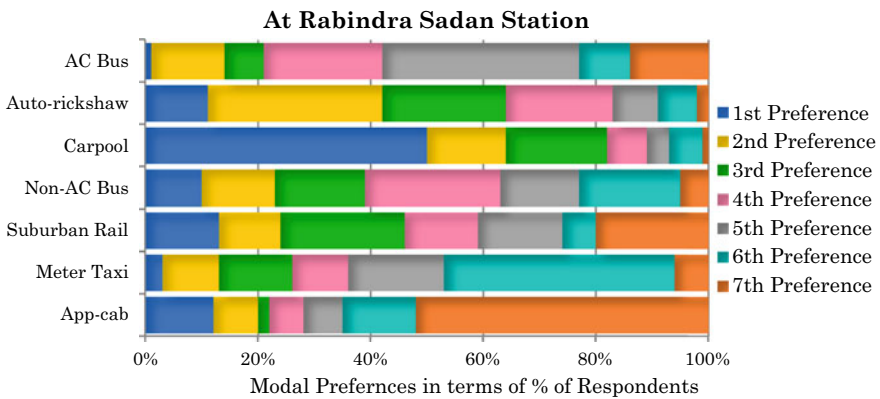
#### Analysis and Inference

- At all the three stations, on an average 48% respondents have chosen Carpool as their 1st preference. Most of them (about 70%) earn ₹0–30,000/month, i.e., belong to low and middle income group [15]. As all the respondents are either work or educational trip makers, they prefer a mode by which their overall journey





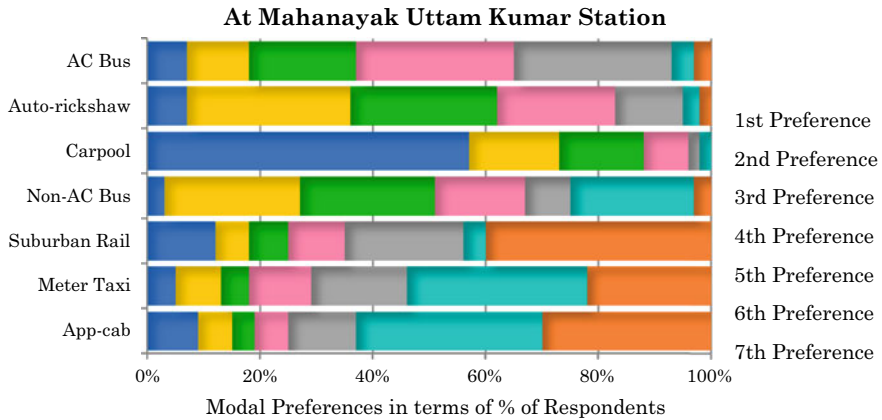
**Fig. 3** Modal preferences in terms of no. of respondents at Dumdum. *Source* Field survey



**Fig. 4** Modal preferences in terms of no. of respondents at Rabindra Sadan. *Source* Field survey

can be completed in comparatively lesser time. Though Carpool has no schedule time, commuters have chosen it for its comparatively lesser travel time delay and an assured seat with an affordable travel cost.

- About 30% respondents at these three stations have chosen Auto-rickshaw as their 2nd preference. Most of them have chosen Carpool as their 1st preference. From this observation, it can be inferred that they can pay a little bit more cost to reduce waiting time and a comfortable seat. AC bus and Auto-rickshaw have same waiting time but Auto-rickshaw provides less travel time delay while AC bus provides more comfort. In this case, travel cost has no such significant role. So, it can be inferred that they prefer less travel time over air conditioned mode.
- More than 30% respondents have chosen Meter taxi as their last or 2nd last preference at these three stations, while another 30% respondents have chosen App-cab. Meter taxi and App-cab charge travel cost much higher than other five modes.



**Fig. 5** Modal preferences in terms of no. of respondents at Mahanayak Uttam Kumar. *Source* Field survey

Thus, commuters do not prefer them for their daily trips. But it is notable that some commuters prefer App-cab over Meter taxi; that means to get a comfortable trip they are ready to spend some more charges when the increment in charge is not much significant.







Finally, it can be stated that majority of these three stations’ commuters prefer the characteristics of Carpool the most. Then they go for Auto-rickshaw; they are ready to wait in a long queue to get an assured seat and less travel time. Meter taxi and App-cab are the least preferred at all of these three stations. Though the middle ranker modes are different at these stations, the first and last two choices are same in everywhere.

#### 4.2 Clarification of Reasons for Modal Preference

To clarify the reason of commuters’ modal preference, six more stated preference questions were added in questionnaire. Every question represented a pair of situations with the help of suitable images. The pairs were decided on an assumption: Choice is a compensatory process. Commuter will compensate some lower parameter if there is sufficiently higher parameter. For example, high travel time + low cost and low travel time + high cost can be equivalent. The study find out that the majority of respondents want to compensate which parameter over which.

In Table 3, the 1st mode is charging more fare than the 2nd one with longer waiting time and lower travel time delay. The increment in fare for 1st mode is not much notable while waiting time for 1st mode is significantly longer and travel time delay is lower than the 2nd one. Here, about 60% respondents preferred the 1st situation over the 2nd one; that indicates majority of respondents are willing to pay more and

**Table 3** 1st pair of situation in SP survey

Waiting time (during peak hours)	Travel-time delay (during the journey)	Travel cost	% of respondents <sup>a</sup>
<i>Too long</i>  Source: <a href="https://es.123rf.com">https://es.123rf.com</a>	<i>Very low</i>  Source: <a href="https://www.crazyvector.com">https://www.crazyvector.com</a>		D → 60 R → 62 M → 58
<i>Very short</i>  Source: <a href="https://www.alamy.com">https://www.alamy.com</a>	<i>Very high</i>  Source: <a href="https://frinkiac.com">https://frinkiac.com</a>		D → 40 R → 38 M → 42

D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station






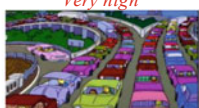


Source Field survey

\*\*Respondents those preferred respective situation

ready to wait in a long queue to reduce their travel time delay. This observation can be a reason why commuters prefer Carpool and Auto-rickshaw over Non-AC bus.

In Table 4, the 1st mode is providing a significantly better service in frequency, travel time, and comfort but it is charging more fare than the 2nd one and this increment in fare is really notable. More than 65% respondents preferred 2nd situation over 1st one; that indicates those respondents do not want to invest that much increment in travel cost to get a better service of transportation in their daily trips. This

**Table 4** 2nd pair of situation in SP survey






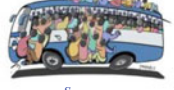
Waiting time (during peak hours)	Travel-time delay (during the journey)	Seat availability (during peak hours)	Travel cost	% of respondents <sup>a</sup>
<i>Very short</i>  Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a>	<i>Very low</i>  Source: <a href="https://www.crazyvector.com">https://www.crazyvector.com</a>	<i>Can stand comfortably</i>  Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a>		D → 34 R → 32 M → 29
<i>Too long</i>  Source: <a href="https://www.vectorstock.com">https://www.vectorstock.com</a>	<i>Very high</i>  Source: <a href="https://frinkiac.com">https://frinkiac.com</a>	<i>Crowded</i>  Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a>		D → 66 R → 68 M → 71

D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station

Source Field survey

\*\*Respondents those preferred respective situation

**Table 5** 3rd pair of situation in SP survey

Waiting time (during peak hours)	Travel-time delay (during the journey)	Seat availability (during peak hours)	Comfort	% of respondents <sup>a</sup>
<p><i>Too long</i></p>  <p>Source: <a href="https://es.123rf.com">https://es.123rf.com</a></p>	<p><i>Very high</i></p>  <p>Source: <a href="https://www.gettyimages.in">https://www.gettyimages.in</a></p>	<p><i>Seat is assured and very comfortable</i></p>  <p>Source: <a href="https://www.canstockphoto.com">https://www.canstockphoto.com</a></p>	<p>AC</p>	D → 36
				R → 43
				M → 56
<p><i>Very short</i></p>  <p>Source: <a href="https://www.alamy.com">https://www.alamy.com</a></p>	<p><i>Very low</i></p>  <p>Source: <a href="https://www.crazyvector.com">https://www.crazyvector.com</a></p>	<p><i>Overcrowded</i></p>  <p>Source: <a href="https://www.deccanherald.com">https://www.deccanherald.com</a></p>	<p>Non-AC</p>	D → 64
				R → 67
				M → 44

D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station

Source Field survey

\*\*Respondents those preferred respective situation

observation can be a reason why commuters’ preference for App-cab and Meter taxi falls down.





In Table 5, the 1st mode is providing a far better service in comfort but its performance in frequency and travel time is very much poor than the 2nd one. At Dumdum and Rabindra Sadan metro station, more than 60% respondents preferred 2nd situation over 1st one which indicates those respondents give more importance in reduction in waiting time and travel time delay than a confirmed and comfortable seat for their daily trips.

But at Mahanayak Uttam Kumar station, majority of respondents go for the 1st mode. Those respondents cannot accept such overcrowded transport mode daily for the sake of reduction in total travel time. Though travel cost is a vital factor, this observation can also be a reason why commuters prefer Non-AC bus over AC bus and vice-versa.

Table 6 gives that in 1st situation, the mode is charging more fare than the 2nd one with an assured and comfortable seat but the increment in fare is not much notable. More than 65% respondents preferred the 1st situation over the 2nd one; that indicates majority of respondents are interested to pay more to get a comfortable journey daily. This observation can be a reason why commuters prefer Carpool and Auto-rickshaw over Non-AC bus.

In Table 7, the 2nd mode is providing far better service in travel time, seat availability, comfort, and convenience but it is charging more fare than the 1st one and this increment in fare is really notable. More than 60% respondents preferred 2nd situation over 1st one; that indicates most of the respondents do not want to invest that much increment in travel cost to get a better service in their daily transportation.

**Table 6** 4th pair of situation in SP survey


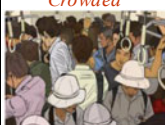
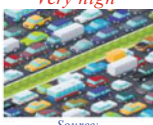



Comfort	Seat availability (during peak hours)	Travel cost	% respondents <sup>a</sup> of
AC	<i>Seat is assured and very comfortable</i>  Source: <a href="https://www.canstockphoto.com">https://www.canstockphoto.com</a>		D → 65
			R → 65
			M → 67
Non-AC	<i>Overcrowded</i>  Source: <a href="https://www.deccanherald.com">https://www.deccanherald.com</a>		D → 35
			R → 35
			M → 33

D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station

Source Field survey

\*\*Respondents those preferred respective situation

**Table 7** 5th pair of situation in SP survey

Travel cost	Walking time to reach next mode's stop (min)	Seat availability (during peak hours)	Comfort	Travel-time delay (during the journey)	% respondents <sup>a</sup> of
	8	<i>Crowded</i>  Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a>	Non-AC	<i>Very high</i>  Source: <a href="https://www.gettyimages.in">https://www.gettyimages.in</a>	D → 61
					R → 62
					M → 69
	2	<i>Seat is assured and very comfortable</i>  Source: <a href="https://www.canstockphoto.com">https://www.canstockphoto.com</a>	AC	<i>Very low</i>  Source: <a href="https://www.cmyvector.com">https://www.cmyvector.com</a>	D → 39
					R → 38
					M → 31







D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station

Source Field survey

\*\*Respondents those preferred respective situation

The 2nd pair of situations is made by clubbing waiting time, travel time, seat availability, and travel cost; for this 5th pair of situations instead of waiting time, convenience is added. In 2nd pair of situations, on an average 31% respondents want to invest more travel cost to get a good service in their daily transportation and in this 5th pair average the number of interested respondents is 36%. So, it is evident that these extra 5% commuters are interested about mode's convenience.

**Table 8** 6th pair of situation in SP survey

Number of mode transfer	Waiting time (during peak hours)	Travel-time delay (during the journey)	Seat availability (during peak hours)	% of respondents <sup>a</sup>	
4	<i>Medium</i>  <small>Source: <a href="https://www.freepik.com">https://www.freepik.com</a></small>	<i>Low</i>  <small>Source: <a href="https://www.vectortock.com">https://www.vectortock.com</a></small>	<i>Crowded</i>  <small>Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a></small>	D → 57 R → 54 M → 42	
	2	<i>Too long</i>  <small>Source: <a href="https://www.vectortock.com">https://www.vectortock.com</a></small>	<i>Moderate</i>  <small>Source: <a href="https://images.slideplayer.com">https://images.slideplayer.com</a></small>	<i>Can stand comfortably</i>  <small>Source: <a href="https://www.shutterstock.com">https://www.shutterstock.com</a></small>	D → 43 R → 46 M → 58

D → Dumdum, R → Rabindra Sadan, M → Mahanayak Uttam Kumar metro station

Source Field survey

\*\*Respondents those preferred respective situation

Table 8 gives that in 1st situation, the mode is providing lower total travel time than the 2nd one with more number of mode transfers and poor service in comfort. At Dumdum and Rabindra Sadan station, more than 50% respondents preferred 2nd situation over the 1st one; that indicates those respondents prefer long waiting time, moderate long travel time delay, and a little bit more comfort over more number of transfers of modes for their daily trips. At Mahanayak Uttam Kumar station, majority of respondents have chosen 2nd situation. Thus, commuters of this station mostly want a comfortable journey than lesser travel time.

The 3rd pair of situations is made by clubbing waiting time, travel time, seat availability, and comfort. For this 6th pair of situations instead of comfort, the number of mode transfer is added. In 3rd pair of situations, around 65% respondents preferred less travel time over assured and comfortable seat and in this 6th pair the number of % of respondents choosing less travel time falls down. It happens because there is not much significant difference between travel time delay of these two situations, one is low and another is moderate. In the 1st pair of situation, it is evident that commuters can stand in long queue to get their suitable mode. So, the reason behind reduced number of respondents (choosing less travel time) is more number of mode transfers. As 2nd situation provides less transfers of modes, commuters prefer this one. This observation state that not only reduction in travel time but also number of mode transfers can be considered in efficient transportation planning.

## 5 Conclusions

In this study, the pictorial stated preference questions explained reasons behind choosing access-egress modes from the travel chart well. The response obtained

from travel chart and paired SP questions matched reasonably well. Thus, this type of survey can test the reliability and validity of the users' response.

This study concludes that the most of the commuters needs from access-egress modes are lesser travel time delay, an assured comfortable seat, and an affordable travel cost. Air conditioned mode is not their concern at all. The paired SP questions revealed that

- The commuters are willing to pay more and can accept longer waiting time to reduce in-vehicle travel time. They are also interested to pay more to get comfortable daily trips when travel time is constant.
- In both the cases, increment in travel cost was comparatively less. When this increment becomes notably high, respondents go for the mode incurring lower travel cost. Thus, it is evident when commuters choose any mode for their daily trips, travel cost remains a secondary parameter upto a certain limit of increment. This limit varies person to person depending on their perception, work characteristics, and definitely on socio-economic factors. As majority of respondents belong to low or middle income group in study area, they want to find a suitable mode along with an affordable travel cost for their daily trips.
- Travel modes' better convenience and lesser number of mode transfers get more priority than lower travel cost and reduction in travel time, respectively.

The RP survey of this study reveals that in the Indian metropolitan city Kolkata, commuters spend on an average 10% of their personal monthly income as monthly expenditure on public transportation for all purpose and around 5% only for their daily work or educational trips.

These observations can be taken account for planning of an efficient access and egress service for any new rapid transit. For example, in Kolkata a number of metro lines are in proposal and under construction. Kolkata East–West metro service would be operational in very recent times. In such cases, the outcomes of this study can be applied for access-egress service implementation. But, the land use and traffic characteristics of those new stations should be checked before the application if they are similar to the study area of this study.

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