Identification of key determinants of travel satisfaction for developing policy instrument to improve quality of life: An analysis of commuting in Delhi

Abstract

Commuting between an origin and destination pair is one of the most critical components of an individual's daily activity, and the associated trip satisfaction significantly influences a commuter's well-being. Owing to negative externalities associated with urban travel such as increased congestion, poor roadway infrastructure, inadequate and unreliable public transport system, safety and security concerns, a reduction in perceived trip satisfaction could be observed among Indian commuters. Thus, it is prudent to analyze commuters' perception towards associated trip satisfaction and related components for formulating policy instruments to improve commuters' experience. This paper identified the key determinants of perceived satisfaction related to different types of trips in the Indian capital Delhi. A Travel survey questionnaire was designed to elicit commuters' perceived satisfaction associated with daily, work, and non-work trips. Based on 898 responses, a set of ordered logit models were estimated. It was found that socio-demographic factors such as gender and age, accessibility and built-environment characteristics such as street level of congestion, availability and existing condition of sidewalks, bus stop safety, and security were significant determinants of commuters' trip satisfaction. Results also indicated that the choice of mode and associated safety perception played a vital role in commuters' trip satisfaction levels. Public transport users were less satisfied compared to the car commuters for both work and non-work trips. Based on the findings, a set of policy measures such as illumination of roadways, reduction in street-congestion levels, up keeping existing sidewalks, improving public transportation accessibility, etc. could be implemented for enhancing the trip-satisfaction level of urban commuters belonging to a typical metropolitan city of a developing country like India.

***Keywords*:** Trip-Satisfaction, Daily Trip satisfaction, Work Trip Satisfaction, Other than Work Trip Satisfaction, Ordered Logit Model, Built Environment, Quality of Life

1. Introduction

The investigation of commuter's perception and associated trip satisfaction has been receiving increasing attention in the transportation planning-related research field (Clark et al. 2019; Handy and Thigpen, 2019; Lee and Sener, 2016; St-Louis et al., 2014). An individual's perceived satisfaction associated with commuting influences (Handy and Thigpen, 2019; Lancée et al. 2017; Olsson et al. 2013) the subjective well-being (SWB). Stress experienced during commuting affects an individual's physical and psychological health adversely – gradually acts as an impedance to one's professional performance and/or personal relationships (Lyons and Chatterjee, 2008). Hence, identifying the trip satisfaction determinants would help the city administration to formulate appropriate policy measures for lowering commuting stress. Better commute quality will boost the trip maker's overall productivity, as travel is considered a vital component of an individual's Quality of Life (QOL) (Novaco and Gonzalez, 2009; Spinney et al., 2009; Steg and Gifford, 2005;). Any change in the quality of the trip could potentially influence a larger population (Clark et al. 2019); hence it is essential to recognize the connections between QOL and trip satisfaction, and a theoretical foundation needs to be established for broader understanding (Lee and Sener, 2016). In this regard, De Vos et al. (2013) suggested that ensuring commuters' access to safe, healthy, and affordable transportation would reduce the negative externalities on an individual's Subjective Well-Being (SWB).

The above-cited research and several other relevant studies (Sweet and Kanaroglou, 2016; Elias et al., 2015; St-Louis et al., 2014; Choi et al., 2013; Friman et al., 2013; Bergstad et al., 2011) attempted to analyze the intersection of QOL/SWB/Satisfaction with travel in developed countries like USA, Canada, England, Australia, Netherland, Japan, etc. However, no such research reported for a country like India, where there is not one, but several commuting modes (walk, bicycle, two-wheelers, three-wheelers or auto-rickshaw, intermediate public transit, car, bus, suburban train, and metro) ply in a heterogeneous traffic condition. Indian commuters experience negative externalities such as congestion, longer travel time, lower safety standards, poor air quality, lower health standards due to emission, etc., especially during travelling in megacities. The public transit share in megacities such as Delhi, Kolkata, and Mumbai are 55%, 76%, and 78%, respectively, and the per capita travel trip rates in these cities are 1.5, 1.5, and 1.78, respectively (TUC, 2018). The total daily travel trips are 45.5 million in Delhi, 25.2 million in Kolkata, and 45.18 million in Mumbai. Citizens are also concerned about night travel from

the safety and security point of view. Congestion levels are about 56% and 65% in Delhi and Mumbai during peak hours of travel; also, Delhi ranks at one and Mumbai at three as far as pollution is concerned. Like any other city, these externalities impede the QOL in Indian megacities. Investigating the interaction of trip-satisfaction aspects with commuter's perception will lead to developing policy guidelines for improving commuters' well-being. Identification of determinants for various trip satisfaction (daily, work, and non-work trips) is imperative as there is no consensus on improving the trip quality by public transport. Evidence from this study will assist planning authorities in improving the existing transportation infrastructure in Indian megacities. Delhi, the capital of India with an apparent higher trip rate among several megacities – the capital of India, was considered as the geographic focus for conducting this research. In particular, to the research gaps discussed here, this paper investigates the factors associated with three components of trip satisfaction, namely (a) perceived trip satisfaction associated with daily travel, (b) perceived trip satisfaction associated with work trips, and (c) perceived trip satisfaction associated with non-work trips. The next section presents a brief review of relevant literature followed by the methodological framework, data collection, results, analysis, and policy discussions.

2. Literature Review

Several of the existing studies explored the relationship between trip satisfaction and subjective well-being. Lee et al. (2016) defined the four components of well-being, namely, physical, mental, social, and economic, and evaluated them with commuting activity. They reported that physical well-being relates to a person's fitness or health, which can be improved through active transportation (walking and cycling). Mental well-being describes a person's psychological health, which depends on travel duration and comfort. Social well-being refers to the quality of one's friend's support, family, and relationships and is influenced by accessibility and mobility (Stanley et al., 2011). Economic well-being is explained in terms of finances, employment status, etc., which is also significantly influenced by mobility and trip quality (Fan et al., 2012). Olsson et al. (2013) mentioned that commuting trip satisfaction has a positive association with an individual's overall well-being. Sweet and Kanaroglou (2016) explored whether travel and activity participation was associated with SWB in Canada and found that participation in daily activities was linked with higher SWB in women, while there was no such evidence for men. They recommended focusing on activity participation as a significant policy objective instead of focusing on travel time savings mechanisms to achieve a higher quality of life. Elias et al. (2015) analyzed the gender effect on activity and travel behaviour in the Arab world. They suggested that improving transit service for school trips would positively influence women's daily activity patterns and quality of life.

Among several attributes, travel time and mode (Choi et al., 2013; Clark et al., 2019) considerably influence commuters' trip satisfaction. The more time a person spends on travel, the less time he/she has for other activities - leading to increased stress, poor mental health, and adverse impact on an individual's job satisfaction (Clark et al. 2019). However, people derive higher trip satisfaction by walking or cycling to work than travelling by bus or car (Clark et al., 2019). Turcotte (2011) inferred that commute satisfaction and travel time are inversely related as congestion causes dissatisfaction for bus and car users. Handy and Thigpen (2019) studied perceived trip satisfaction using Campus Travel Survey data of staff and students at the University of California, Davis, USA. They found that those people, especially women and undergraduates living outside the Davis city, are more likely to experience stressful commutes when compared to men and university staff. Walk commute groups are the most satisfied, closely followed by cyclists, while bus riders are the least satisfied indicating the role of active transportation on trip satisfaction. Carse (2011) observed that light-rail and train users perceived higher trip satisfaction than bus-commuters in terms of reliability, availability, accessibility, and travel time in Manchester, UK.

Wener and Evans (2011) found that commuting by private vehicles is more stressful than train travel as the car users find the journey to be more effortful and unpredictable than train-users in New York, USA. On the contrary, Friman et al. (2013) reported that commuters who travelled by public transport are the least satisfied when compared to other mode commuters. Some more studies (Lancée et al., 2017; Turcotte, 2011; Friman et al., 2013) inferred highest trip satisfaction is derived from walking and cycling followed by car- and public transport users. Frequent cycling is also associated with higher travel satisfaction, especially among males, while no significant association is reported for females in

Sydney, Australia (Crane et al., 2014). St. Louis et al. (2014) compared commuter satisfaction across modes and inferred that increased travel time is the most critical attribute influencing trip satisfaction across all modes. Expectedly, car, metro, and train users were more negatively impacted by longer travel time than their bicyclist or pedestrian counterparts.

Socio-economic factors such as age, gender, income, etc., influence user perception towards trip satisfaction. Spinney et al. (2009) found age to be significantly associated with trip satisfaction in Canada. They inferred that isolation and restrictive licensing policies coupled with reduced health and physical abilities negatively influence the trip satisfaction of elderly Canadians. In another Canadian study, Latif (2010) found out that employment has a significant effect on SWB, which again influences the trip satisfaction level. Lancee et al. (2017) found that elder, higher-educated male commuters with high income are more satisfied with their trips compared to their other counterparts. St. Louis et al. (2014) presented an interesting finding that trip satisfaction is reduced by almost 3.5% for a female metro user than male commuters in Montreal, Canada. This could be attributed to a higher sense of insecurity from criminal activities in the metro as perceived by women.

In another interesting study, Reardon and Abdallah (2013) evaluated the commuting relationship with well-being and recommended that transport policy measures are the most efficient approaches to reduce the adverse effects on well-being. Nakamura et al. (2017) suggested that transit-oriented development planning would improve transit rider's trip satisfaction and in Bangkok. Putra et al. (2016) observed that the trip satisfaction associated with public transportation services in Medan City of North Sumatra is very low. They suggested specific improvement measures such as better seating arrangement, better ticket purchasing facility, improved safety, and security for improving trip satisfaction levels. Bergstad et al. (2011) also suggested specific measures to improve public transport service quality and trip satisfaction. Ettema et al. (2010) recommended that leisurely activity engagement during commuting will improve the SWB of travellers. Commuting quality can also be improved by integrating sustainable transportation scenarios with the QOL aspect (Steg and Gifford, 2005). Based on a Manchester, UK-based study, Thompson and Schofield (2007) suggested that ease in public transport (PT) use affects an individual's satisfaction, as transport facilities at a destination make it more attractive. Kolodinsky et al. (2013) inferred that an inadequate supply of PT significantly reduced commuters' overall trip satisfaction in rural New England, USA. Stanley et al. (2011) recommended to reduce trip lengths rather than reducing the number of trips to improve traveller well-being in Victoria, Australia. Table 1 summarizes the most relevant studies, used methods, and major findings useful for the present research.

Based on this critical review of literature, it is apparent that the topic 'trip-satisfaction and well-being' are well researched in developed countries (See Table 1). We did not find any evidence of such studies neither in India or any developing countries, where the travel behaviour is quite different from that of other developed countries, and the results may not be directly transferred. Next to it, though investigations of SWB with commuting are very much available, not many studies attempted to analyze the association of trip satisfaction specifically with commuting and non-commuting trips. This research need is worthy of investigation for developing suitable policy measures. Also, it is crucial to understand the effects of different modes of commuting across different aspects of trip satisfaction. This paper examines the determinants associated with various aspects of trip satisfaction: daily travel satisfaction, work-trip satisfaction, and non-work trip satisfaction in New Delhi –Capital of India.

Table1 Literature Review Summary

Author (Year)	Location	Research focus	Attributes	Method	Findings/Implications
Clark et al., 2019	England	Assessing the impact of commuting time and mode on SWB	Commute mode and time	Order Logistic regression model	Shorter commute times and walkable commutes can contribute to improved SWB
Handy and Thigpen, 2019	California, USA	Effect of travel mode, location, and personal characteristics on commute quality and satisfaction	Socio-demographic variables travel mode and location	Bayesian linear regression model	Bicycle commuters and train commuters report the highest quality commutes, followed by car and bus users, respectively.
Lancée et al., 2017	Netherlands	Investigating the effect of commuting on SWB	Travel mode, travel time, commute type	Econometric model	Increasing commuting times can even lead to an uplift of mood when the commute is by bicycle or foot.
Nakamura et al., 2017	Bangkok, Nagoya	Comparing QOL for residential location in station areas between Bangkok and Nagoya	Access, amenity, and safety	Linear utility function	QOL in station areas in Nagoya is lower, because of the lower quality of safety and amenity. Transit-oriented development was recommended for improved QOL.
Lee and Sener, 2016	United States	How transportation and QOL intersect and how metropolitan planning organizations (MPO) in the US address QOL outcomes.	Mobility/ accessibility, the built environment, and vehicle traffic.	Frequency analysis	US Municipal planning agencies primarily targeted QOL enhancement from the perspective of physical well-being, while mental and social well-being were rarely considered.
Sweet and Kanaroglou, 2016	Canada	Explore the link between travel, activity participation, and subjective well-being	Age, number of children, Marital status, household size and income,	Structural Equation Modelling (SEM)	Higher activity participation means higher SWB for women. Travel time was found to be significantly influencing SWB for both male and female.
Putra et al., 2016	Medan city, North Sumatra	To assess the level of public transport services in Medan city	Measured insurance, empathy, reliability, responsive, tangible and comfort of public transport services	Simple linear regression	Public transport commute quality significantly influences the QOL of commuters.
Elias et al., 2015	Israel	Investigating gender differences concerning QOL	Demographic, socio-economic, daily activities and travel behaviour variables	SEM	Improving public transportation services for school trips and improving urban design through a friendlier environment, will beneficially affect the women's daily activity patterns and QOL
Guliani et al., 2015	Canada	Examine the link between neighbourhood characteristics, traffic	Socio-demographic information, perceptions of traffic safety and	SEM	Infrastructure-centred interventions, like constructing sidewalks and implementing traffic calming measures, would increase walk trip share.

		safety in school travel mode choice behaviour	neighbourhood environment		
St-Louis et al., 2014	Montreal, Canada	Assessment of trip satisfaction across modes	Travel time, personal and trip characteristic, travel and mode preferences	Multiple Linear Regression (MLR)	Pedestrians, train commuters and cyclists are more satisfied than drivers, metro and bus users.
Crane et al., 2014	Sydney, Australia	Studying the association between QOL and cycling frequency	Socio-economic variables, Cycling frequency	MLR	Cycling was positively associated with psychological well-being for male commuters.
Kolodinsky et al., 2013	New England, USA	Effect of built amenities, natural amenities, weather and attitudes toward transportation QOL	Socio-demographic variables, trip-related variables like trip purpose, time of start etc.	SEM	Unserved travel demand significantly decreased quality of life, while the number of trips taken had no impact on Quality of Life of commuters
Choi et al., 2013	United States	Investigating the impacts of commute time on subjective well-being (SWB)	Socio-demographic and socio-economic characteristics, travel time	Ordinary least squares, Logit regression models,	Commute time is found to be statistically significant and negatively related to SWB
Cao, 2013	Minneapolis, USA	To explore the impacts of light rail transit (LRT) on Satisfaction With Life (SWL)	Variables related to satisfaction with life, travel, and perceived neighbourhood characteristics	SEM	LRT positively influences SWL through enhanced access to different activities, improved transit service, enhanced accessibility.
Olsson et al., 2013	Sweden	Happiness and Satisfaction with Work Commute	Socio-demographic variables	MLR	Satisfaction from work-commuting contributes to overall happiness. Walking and biking yields more satisfaction than driving and public transit.
Friman et al., 2013	Sweden	Examining of psychometric properties of satisfaction with travel scale	Socio-demographic characteristics, trip type, start time, duration.	Confirmatory factor analysis	Commuters travelling by bicycle or on foot are more satisfied with their work commute than people using other travel modes.
Bergstad et al., 2011	Sweden	To assess if satisfaction with daily travel has a positive impact on SWB	Housing conditions, car access and use, daily travel, frequency of activities	MLR	Reduction in satisfaction with daily travel has a negative impact on SWB.
Stanley et al., 2011	Melbourne, Australia	To explore the links between mobility, social exclusion and well-being	socio-economic variables, measures of social exclusion like Political activity, Social support, employment etc.	Three-stage least Squares	Reduction in social exclusion was associated with improved personal well-being and increased mobility of commuters
Wener and Evans, 2011	New York, USA	To Compare stress of car and train commuters	Socio-demographic information	Multiple regression	Train commute is less stressful with less negative mood while car commuters reported significantly higher levels of stress with more negative mood

Thompson and Schofield, 2007	Greater Manchester, UK	Studying the effect of urban public transport performance on destination satisfaction	Travel mode, public transport Ease of use, Efficiency and safety, ease of parking private vehicle	Principal component analysis, Multiple regression analysis	Influence of public transport's ease of use is greater than the influence of efficiency and safety on destination satisfaction

3. Data Collection

The data collection process was administered in three stages: questionnaire design, respondent recruitment, and survey implementation.

3.1 Questionnaire design

The questionnaire is designed after reviewing the past studies and several reports, and it covered several aspects of the transport users and their perceptions on travel satisfaction. The attributes in the questionnaire are presented in a five-point Likert Scale. Likert Scale quantified the level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements related to trip satisfaction. Appendix – 1 presents the variables used in the survey and associated statements. The questionnaire consisted of four parts.

- Part A was used to collect respondents' socio-economic and latest trip-related information
- Part B captured respondents' perceptions associated with various journey aspects, built environment-specific factors, travel mode, namely, the most frequently used mode for different trip purposes, opinions on bus-stop safety and security, attitude towards the presence of sidewalks, etc.
- Part C was used to elicit user-perception towards trip satisfaction associated with (a) daily travel, (b) work trips, and (c) non-work/other trips.

3.2 Respondent Recruitment and survey implementation

All commuters of New Delhi, India, were considered as the target population for this research. A simple random sampling method was adopted for respondent identification to conduct the survey. Key trip generators such as college, hospital, market, office area, metro station across New Delhi were identified as data collection points. A team of four skilled survey interviewers were positioned at such locations to conduct face-to-face interviews during weekdays of the 2018 summer season. Required administrative approvals were obtained, and respondents were initially approached for their willingness for survey participation. A pilot survey was conducted based on their positive responses, and the questionnaire was refined to improve the response in the final survey. Pen-and-Pencil Interview (PAPI)/ Face to face interview was used for the survey purpose. PAPI is a conventional method and results in a relatively higher response rate and is associated with minimal cost components, making it a plausible form of the survey instrument (Khan, 2007). A total of 1000 responses were collected; among them, 102 responses were excluded due to incomplete responses. Finally, a total of 898 complete and consistent responses were used for the analysis.

4. Initial Findings

A descriptive analysis of the data was conducted to understand the data and its characteristics. Table 2 presents the socio-demographic statistics of the respondents. Figure 1 shows the descriptive summary of Daily Travel Satisfaction (DTS), Work Trip Satisfaction (WTS), Other than Work-Trip Satisfaction (OTS) for the sample data. Based on the descriptive analysis presented in Table 2, 3, and Figure 1, the following observations are made.

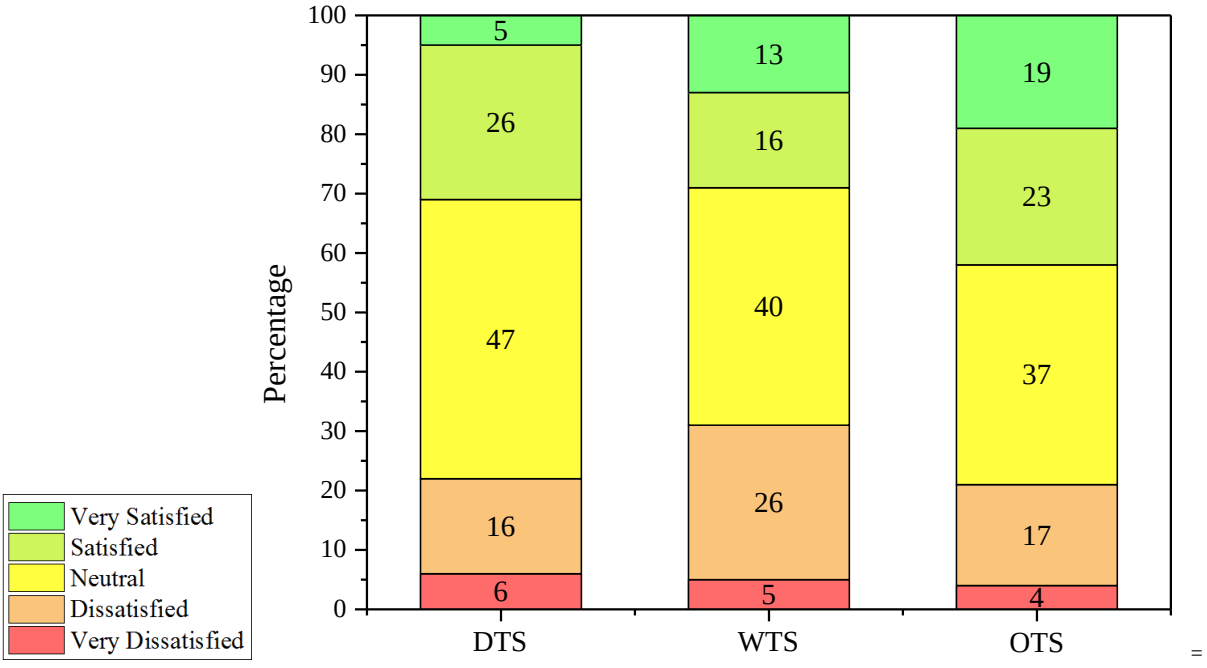
Table 3 gives some insight into Delhi commuters' profile. Out of 898 respondents, 61.2% were males, and 38.8% were females, with most of the respondents being in the age group 25-34 years of age. Most of the respondents held an undergraduate degree or higher (88.9%). About 39.2% of respondents have an income in the range of 20000-50000 rupees per month; 72.8% of the respondents are married while the rest are unmarried; 71.6% are found to possess a driving licence, while 28.4% are not owning one.

Preliminary observation indicates that 32% of the respondents used metro services for work trips, followed by private cars (19%); bus and two-wheelers shared 15% each. Use of auto-rickshaws and shared mobility was much less in work commutes while walking share was the lowest (4%). In non-work trips, respondents mostly used private cars (27%); metro was the next dominant mode with 16%, closely followed by shared mobility with 15%. The least popular mode was 'walking' as in work commutes, with 4% of modal share.

Based on Figure 1, a basic understanding of commuter trip satisfaction in Delhi can be obtained. For example, almost 22% of commuters perceived that they are “dissatisfied” or “very dissatisfied” with the overall daily travel quality. Similarly, 31% and 21% of users were either “dissatisfied” or “very dissatisfied” with work and non-work trips. On the other hand, a total of 31%, 29%, and 42% of users were observed to perceive their daily trips, work trips, and non-work trips to be either “satisfactory” or “very satisfactory”. However, most users were observed to be neutral towards trip satisfaction associated with different types of trips. Such observations indicate a wide variety of responses among users towards different types of trip satisfaction components to understand these aspects better; a detailed investigation is indeed required.

Table 2 Demographics Statistics (all indicative values are in percentage)

Total number of respondents: 898		**Males**: 61.2	**Females**:38.8
Age group		**Educational status**	
18-24	9.9	Middle School	3
25-34	36.4	High School	8.1
35-44	26.7	Under graduates	55.6
44-54	19.4	Graduates or higher	33.3
55 and above	7.6		
Monthly Income level		**Marital status**	
<10000	4.6		
10000-20000	15.7	Married	73
20000-50000	39.2	Unmarried	27
50000-100000	26.8		
>100000	13.7		



DTS - Daily Travel Satisfaction; WTS - Work Trip Satisfaction; OTS - Other Than Work Trip Satisfaction

Figure 1 Percentage of Likert Scale responses for each dependent variable

5. Analytical Approach

The trip-satisfaction data are in Likert Scale or ordered in nature; thus, ordered logistic regression models are appropriate for modelling tip satisfaction (Washington et al., 2011). Ordered probability

models are developed by defining an unobserved (latent) variable *Z* that is used as a basis for modelling the ordinal ranking of data, which are typically specified as a linear function for each observation of user perception on travel satisfaction, such that,

$$Z = \beta X + \varepsilon \quad (1)$$

Where, X = A vector of variables determining perceived travel satisfaction, β = A vector of parameters, and ε is a random disturbance assumed to be logistically distributed with mean = 0 and variance =1. As per equation (1), measurements of satisfaction *y* can be defined as follows for each response:

$$y = \begin{cases} 1, \ if \ Z \leq 0 \\ 2, \ if \ 0 < Z \leq \mu_1 \\ 3, \ if \ \mu_1 < Z \leq \mu_2 \\ 4, \ if \ \mu_2 < Z \leq \mu_3 \\ 5, \ if \ Z \geq \mu_3 \end{cases} \quad (2)$$

Where, *y* represents DTS/WTS/OTS and μ_1, μ_2, μ_3 indicates estimable threshold parameters with respect to ordering level. Readers are suggested to refer to Washington et al. (2011) for more details on ordered logit model theory. The threshold parameters and model parameters are jointly estimated in NLOGIT6.0. Initially, a large set of independent variables were used to model the selected dependent variables; subsequently, variables with statistically significant coefficient estimates are retained, and all other variables are excluded. Based on the estimated coefficients and threshold parameters, the influence of various variables on DTS, WTS, and OTS are analyzed and interpreted in the following section.

6. Results and Discussion

Table 3 presents the estimated models for DTS, WTS, and OTS with co-efficient estimates associated with the independent variables. The signs and magnitudes of the coefficient estimates are as expected. The goodness-of-fit of the models is measured by McFadden Pseudo R-squared values, which are also reported along with modelling results. The McFadden Pseudo R-squared values vary from 0.0102 to 0.0721; previous studies (Clark et al., 2019) also reported a similar range from 0.004 to 0.2057. Such findings indicate that the estimated models are satisfactory. Further, marginal effect analysis was carried out to assess the influence of a specific level of an attribute on different types of travel satisfaction, and results are presented in Table 4. Coefficient estimates could be adopted to interpret the influence of a particular independent variable towards the dependent variable, however, for an in-depth understanding, marginal effects analysis is essential for the Ordered regression model's interpretation.

Table 3 Model Estimates for DTS, WTS, and OTS

	DTS		**WTS**		**OTS**	
Variable	**Estimate**	**t-stat**	**Estimate**	**t-stat**	**Estimate**	**t-stat**
Constant	-1.3340***	-3.102	1.295****	4.214	2.5606***	8.982
Gender (M/F)	-0.2182*	1.709	-0.2368*	-1.895	0.0356	0.286
Age	0.1115*	1.945	0.1016*	1.820	-0.0849	-1.496
Vehicle ownership	----	---	----	---	-0.0834	-1.496
Sidewalk availability	0.2281***	3.475	---	---	---	---
Bus stop safety and security	0.3144***	4.468	0.3064***	4.824	----	---
Bus stop accessibility	0.2002***	3.079		---	---	---
Street Congestion	0.0973	1.591	0.2649***	4.671	---	---
Walking health benefits	---	---	0.0734	1.454	---	---
Street Light Condition	-----	---	---	---	0.1485**	2.440
Installation of GPS in buses	----	---	----	---	0.1942	1.466
Travel mode						
Bus – safety	0.0912**	2.428	----	---	----	----

	Bus – work commute	-0.3779**	1.841	-0.3383**	-2.081	0.6765***	2.836
	Car – work commute	0.2890*	1.841	0.2679*	1.782	0.2920**	1.532
	Walking – work commute	---	---	0.7169**	2.430	0.5066**	2.134
	Walking – safety	0.1549**	2.528	---	---	---	--
	Walking – satisfaction	0.2231***	3.474	---	---	---	---
	Metro - night travel safety	0.1078***	2.610	----	---	---	---
Threshold parameters							
μ_1		1.60***	20.5	2.20***	29.31	1.76***	23.71
μ_2		3.65***	43.22	3.798***	51.97	3.17***	46.93
μ_3		6.04***	39.54	4.87***	50.12	4.48***	51.34
Log likelihood function		-1150.01		-1280.19		-1323.92	
Restricted log likelihood		-1239.43		-1310.69		-1337.61	
McFadden Pseudo R-squared		0.0721		0.02327		0.0102	

****99% Confidence level, **95% Confidence level, * 90% Confidence level, other coefficients are at more than 85% Confidence level*

Table 4 Summary of Marginal Effects results

Travel Satisfaction	Attributes	Marginal Effect for each Likert Scale (%)				
		1	**2**	**3**	**4**	**5**
Daily Travel Satisfaction (DTS)	Gender (M/F)	-1.12	-2.65	-0.91	3.85	0.84
	Age	-0.58	-1.37		1.95	0.42
	Sidewalk availability	-1.20	-2.80	-0.42	4.00	0.85
	Bus stop safety and security	-1.65	-3.86		5.51	1.18
	Street Congestion	-0.51	-1.20	-0.85	1.71	0.36
	Bus stop accessibility	-1.10	-2.58		3.69	0.79
	Travel mode			-1.17		
	Bus - safety	-0.48	-1.12		1.60	0.34
	Bus – work commute	2.21	4.84	-0.36	-6.37	-1.27
	Car – work commute	-1.42	-3.43			1.16
	Walking - safety	-0.81	-1.90	-0.79	5.15	0.58
	Walking - satisfaction	-1.17	-2.74		2.72	0.83
	Metro - night travel safety	-0.57	-1.33	-0.34	3.91	0.40
					1.89	
				-0.59		
				-1.47		
				-0.58		
				-0.83		
				-0.40		
Work Trip Satisfaction (WTS)	Gender (M/F)	1.12	4.05	-0.04	-2.33	-1.16
	Age	-0.47	-1.73			
	Bus stop safety and security	-1.41	-5.22	-0.12	1.00	3.49
	Street Congestion	-1.22	-4.51	-0.11	3.02	3.02
	Walking health benefits	-0.34	-1.25	-0.03	2.61	0.84
	Travel mode:				-0.72	
	Bus	1.72	5.86	-0.71		-3.56
	Private car	-1.16	-4.48		-3.31	3.22
	Walking	-2.50	-10.94	-0.20	-2.62	10.26
				-3.28	-6.46	
Other Trip Satisfaction (OTS)	Gender (M/F)	-0.16	-0.46	-0.26	0.35	0.53
	Age	0.39	1.11		-0.84	-1.26
	Vehicle ownership	0.38	1.08	-0.61		-1.24
	Street Light Condition	-0.68	-1.93	-0.60	-1.97	2.21
	Installation of GPS in buses	-0.93	-2.57		-4.77	2.81
	Travel mode:			-1.06	-1.47	
	Bus	-2.42	-7.63			11.94
	Private car	-1.29	-3.73	-1.29	1.97	8.69
	Walking	-1.89	-5.88			4.47
				-6.67	3.91	
					2.78	
				-2.23		

				-4.82		

6.1 Daily Travel Satisfaction (DTS)

Results indicate that socio-economic characteristics, namely, gender and age, statistically significantly influence DTS. A negative sign associated with Gender indicates that male commuters are relatively more satisfied than their female counterparts, which could be attributed to the lack of safety, inadequate security for female passengers, and unavailability of female seats in public transport options. Many working women are generally involved in a number of household chores, picking up and dropping off kids to school; hence, lack of unreliable public transport system could make their journey edgy, leading to less satisfactory trips (Elias et al., 2015). The marginal effects result show that for female commuters, the probability of them perceiving the quality of daily travel to be "very unsatisfactory", "unsatisfactory", and "neutral" decreases by 1.12%, 2.65%, and 0.91%, respectively, and the probability of them perceiving the quality of daily travel to be "satisfactory" and "very satisfactory" increases by 3.85% and 0.84% respectively. Age was found to positively affect daily travel satisfaction for the surveyed population. The marginal effects result shows that an increase in commuters' age increases the probability of commuters perceiving the quality of daily travel to be "satisfactory" and "very satisfactory" by 1.95% and 0.42%, respectively. The positive correlation of an increase in age with DTS could be attributed to the relatively positive attitude of elder commuters on travel perception due to experience. The young commuters may expect the commutes to be more reliable and comfortable during their daily commute. However, the actual journey condition in an Indian metropolitan in general, Delhi in specific could be quite uncomfortable due to congested roadways and unreliable public transport during peak hours. Therefore, travel during such circumstances could lead to less satisfied trip quality for the younger group of commuters.

Factors such as sidewalk availability, bus-stop safety and security, and bus-stop accessibility have a significant favourable influence on DTS; an increase in the satisfaction level of sidewalk availability, bus-stop safety and security, and bus-stop accessibility (coefficient estimates: +0.2281, +0.3144 and +0.2002, respectively) was likely to increase the DTS for commuters. The marginal effects result shows that a unit increase in perception of satisfaction towards these independent variables increases users' probability of perceiving the quality of daily travel to be "very satisfactory" by 0.85%, 1.18%, and 0.79%, respectively. Sidewalk availability promotes walking, which improves daily travel satisfaction; this is in line with the findings by Lee & Sener (2016). Providing good quality sidewalks along the road and improving existing ones can help promote active transport (Mitra & Buliung, 2014), thereby improving the user's perception of satisfaction while undertaking their daily travel. Bus-stop safety and security is another factor that was found to influence DTS positively; therefore, enhancing the safety at bus stop premises and within the bus can improve the perceived safety of travel, which would enhance DTS of travellers, especially for women and elderly commuters. Bus stop accessibility is also positively associated with DTS, which shows that ease in accessibility of bus stops can improve commuters' daily travel satisfaction. Placing bus stops at strategic locations such that commuters can easily access them by walking or by two-wheelers can help improve the perception of DTS.

Reduction in street congestion was found to positively influence DTS with a significant positive co-efficient estimate (+0.0973), indicating that the reduction of street congestion is most likely to improve commuter satisfaction. Delhi is one of the Indian cities that report very high congestion, especially during peak hours. Improvements in travel time during the congested condition (Higgins et al., 2018) plays a key role towards improving commuter’s trip satisfaction level. The coefficient shows that reduction in congestion was likely to improve the daily travel satisfaction of urban commuters. Similarly, the results from marginal effects show that a unit decrease in street congestion decreases the probability of user perceiving the quality of daily travel to be "very unsatisfactory", "unsatisfactory", and "neutral" by 0.51%, 1.20%, and 0.36% respectively and increases the probability of user perceiving the quality of daily travel to be "satisfactory" and "very satisfactory" by 1.71% and 0.36% respectively. In this regard, the introduction of congestion management techniques is essential for improving the street congestion level, leading to improved trip satisfaction.

Analysis results indicate a significant influence of mode of commute on DTS as perceived by the commuters. Results also indicate that work commute by bus has a negative coefficient estimate (-0.3779), which could be attributed to the poor quality of existing bus service concerning safety, unreliability, and lack of comfort while travelling (Kumar et al. 2016). This observation could also be linked to the crowdedness on the bus during the office/peak hours of travel in Indian cities, reducing travel satisfaction (Börjesson & Rubensson, 2019). Increased crowdedness in public transport may improve the chance of theft during commutes, which creates an insecure situation while travelling. The variable "Bus-safety" had a positive effect on DTS, which shows that an improvement in the perception of travel safety is likely to increase the travel satisfaction of commuters. The marginal effect analysis was also conducted to understand the effect of change in the perception of the independent variables on each level of commuter perceived DTS. The marginal effect shows that a unit increase in user perception towards safer bus travel increases users' probability of perceiving the quality of daily travel to be "satisfactory" and "very satisfactory" by 1.60% and 0.34%, respectively. Among other modes, travel by private car had a positive impact (+0.2890) which could be attributed to the privacy, safety, and comfort experienced while travelling in cars. Marginal effects results (see Table 4) suggest that a unit increase in user perception towards travel by car in terms would improve the probability of user perceiving DTS to be "satisfactory" and "very satisfactory" by 5.15% and 1.16%, respectively, which highlights the contribution of car travel in improving DTS. Interestingly, the "safety" and "satisfaction" associated with walking were found to positively influence DTS with statistically significant coefficient estimates of +0.1549 and +0.2231, respectively. Transportation and physical wellbeing (fitness, energy, absence of illness, or physical dysfunction) are closely related to each other, and walking is the best and the easiest way to improve health. Active transport has been connected to lower body mass index (BMI) and decreased odds of hypertension, diabetes, and cardiovascular diseases (Lee & Sener, 2016). Walking or bicycling is associated with greater levels of mental health because physical activity engagement has mentally therapeutic effects (Fox, 1999; Lee & Sener, 2016). The findings from marginal effects (see Table 4) suggest that a unit increase in user perception towards walking quality in terms of "safety" and "satisfaction" would improve the probability of users perceiving DTS to be "very satisfactory" by 0.58% and 0.83% respectively. It can be inferred that providing better-walking facilities would substantially increase the DTS by improving people's physical, mental and social wellbeing. Among other public transport modes, perception towards night-time travel is positively associated with improved DTS while travelling in Metro rail with a significant positive coefficient estimate. Marginal effects show that a unit increase in user perception towards night-travel safety will improve the probability of users perceiving DTS to be "satisfactory" by 1.89%, highlighting the need to improve the security level, especially during the night time may significantly improve the overall travel satisfaction level.

6.2 Work Trip Satisfaction (WTS)

Work trip refers to the trips that are revenue-generating for the individuals; hence user perception towards the overall quality of a work-trip remains crucial as it may directly affect the economic wellbeing of the commuters. Among socio-economic factors, gender and age were observed to be significantly influencing WTS. The results showed that gender had a negative effect (-0.2368) on WTS, implying that women had lower WTS than men, which could be due to the increased travel times that negatively affect women more than men due to their increased family and household responsibilities. This finding is in line with the existing literature by Roberts et al. (2011). The marginal effects analysis shows that for female commuters perceiving the quality of work trips to be "very unsatisfactory" and "unsatisfactory" increases by 1.12% and 4.05%, respectively, while female commuters perceived the quality of work trips to be "satisfactory" and "very satisfactory" decreases by 2.33% and 2.65% respectively. It was found that age has a positive effect (+0.1016) on WTS, indicating that older adults are likely to have higher satisfaction than younger commuters. This observation is similar to that of DTS. Marginal effects analysis on different levels of WTS show that an increase in age would result in the decrease in the probability of user perception of work trip satisfaction as "very unsatisfactory" and "unsatisfactory" by 0.47% and 1.73%, respectively, and an increase in the probability of user perception of work trip satisfaction as "neutral", "satisfactory" and "very satisfactory" by 0.04%, 1%, and 1.16% respectively. This finding could be attributed to the fact that younger commuters expect the trip quality to be much better than their elder counterparts.

Among built environment factors, Bus stop safety and security (+0.3064) are found to positively affect work trips. Providing adequate lighting facilities and police patrol near bus stops and other isolated areas - considering that the crime rate in Delhi per lakh population was nearly four times other metropolitan cities in India in 2018 (ToI, 2020), will substantially increase the sense of security for public transport commuters travelling during the night leading to increased trip satisfaction level. Marginal effects (see Table 4) show that a unit increase in the perception of bus stop safety and security will increase the probability of users perceiving WTS to be very satisfactory by 3.49%. The finding further strengthens the need to improve the existing conditions regarding safety and security in bus stops. Among other factors, congestion, especially during peak hours, significantly reduces the perceived trip satisfaction associated with work trips in particular (Evans & Wener, 2006). These study findings also indicate that a decrease in congestion is likely to increase the work trip satisfaction of commuters (+0.2649). Marginal effects (see Table 4) show that a unit increase in the level of perception of street congestion (as street congestion increases) will increase the probability of users perceiving WTS to be "unsatisfactory" by 4.51%.

Likewise, DTS, the various modes of travel also influence the WTS of the commuters. Results showed that the use of bus (-0.3383) had a negative effect, whereas the use of the private car (+0.2679) or walking (+0.7169) as a mode of travel to work location had a positive effect on WTS. Bus travel is often unreliable in the context of a busy and congested city like Delhi, hence less attractive compared to other alternatives. If the work locations are located close to the home location, walking will prove to be a better option as it would add to the physical exercise to the otherwise inactive lifestyle of the office workers. Hence, there is an increase in work trip satisfaction when walking to the work location. User's positive attitude towards walking could be observed in the 6.46% and 10.26% (Table 4) increase in the probability of user perception of WTS as "satisfactory" and "very satisfactory", with a unit increase in user's perception of walking to work. Using a car as a travel mode improves the perception of WTS as "very satisfactory" by 3.22%, while the use of bus lowers this by 3.56%. Similarly, the effect of all other aspects on user-perception of WTS could be identified by the marginal analysis results. Ordered regression models show that users attach walking with high benefits due to the perception that incorporating walking will act as a source of physical activity and relaxation in their otherwise busy lives, which would help reduce mental stress and promote wellbeing to a greater extent (Fox, 1999; Lee & Sener, 2016). Results show that the health benefits associated with walking are likely to improve the perception of WTS (+0.0734). The findings from marginal effects show that a unit increase in user perception towards health benefits associated with walking would improve users' probability of perceiving WTS to be "very satisfactory" by 0.84%. Such findings indicate that transit-oriented development such that walking or use of bicycle use to workplaces could be promoted to improve the perceived trip satisfaction.

6.3 Other than work Trip Satisfaction (OTS)

The estimated ordered-logit model with OTS as dependent and other socio-economic, built environment, mode-specific variables as independent variables indicate that gender was found to be an insignificant variable. The negative sign of the coefficient associated with age (-0.0849) could be attributed to the fact that elderly people become more physically restricted due to health conditions with the increase in age and prefer a non-revenue generating or leisure trip to be more satisfactory compared to work trips. Marginal effects show that with an increase in age, the commuter's perception of OTS to be "very satisfactory" decreases by 1.26%.

Vehicle-ownership has a negative effect on OTS, which could be attributed to the fact that users become more conscious about the safety of the vehicle while travelling in their vehicle through congested streets, reducing the overall trip quality, a unique finding that could be observed in this study. In general, Indian commuters prefer to use hired cab-service or app-based cap service for trips other than work. Marginal effects analysis also shows that with vehicle ownership, the commuter's perception of OTS to be "very satisfactory" decreases by 1.24%. On the other hand, using a car for trips other than work trips were observed to be associated with a positive coefficient estimate (+0.2920). This could be attributed to the fact that users will have a sense of personal freedom, flexibility, and control by allowing them to travel wherever they want, at any time convenient for them, without having to wait for public transport.

Interestingly, Street light condition (+0.1485) and the installation of a GPS tracking system in the bus (+0.1942) and other public transit modes positively influenced OTS as it adds to the safety of commuters during their commutes. Ensuring street lights in working conditions will make night-time travel or walking safer for commuters, especially women. Installation of GPS tracker on public transport helps in real-time tracking, which would be beneficial to passengers. One of the other benefits of installing a GPS tracker is that it will help monitor the activities and whereabouts of the public transit unit as it provides the location data and route history of the unit efficiently. This helps track any possible driver misbehaviour or misuse of vehicles and allows for a faster response during accidents. Marginal effects analysis reveals that a unit increase in the positive perception of the street light condition and GPS installation improves the commuter's perception of OTS to be "very satisfactory" by 2.21% and 2.81%. Such results indicate that if appropriate improvements such as installing a GPS device in bus could lead commuters to choose public transport more for trips other than work and increase OTS.

OTS was also found to be significantly influenced by different modes. Like DTS and WTS, walking (+0.5066) was found to positively affect OTS, as it is likely to improve a person's physical health. Hence, incorporating walking helps improve satisfaction by enhancing the physical health and wellbeing of the commuters. Results also indicate that the perception of walking would increase the probability of users perceiving OTS-5 ("very satisfactory") by 4.47%. Contrary to the results on DTS and WTS, travel by public buses was showing a positive effect (+0.6765), which could be due to the reason that casual and leisure trips are not bound to strict time frame, and the lower spending associated with the use of public buses makes buses more attractive in terms of its affordability. Marginal effects analysis reveals that a unit increase in the positive perception of using bus improves the commuter's perception of OTS to be "very satisfactory" by 11.94%. Commuter's perception of OTS was positively influenced by travel in private cars, similar to DTS and OTS. Marginal effects showed that for a one-unit increase in the user perception on leisure travel using private-vehicle, the probability of users perceiving OTS-1("very unsatisfactory") OTS-2 ("unsatisfactory") and OTS-3 ("neutral") decreases by 1.29%, 3.73%, and 2.23% respectively. In contrast, the one-unit increase would lead to an increase in the probability of user's perception of OTS-4 ("satisfactory") and OTS-5 ("very satisfactory") by 3.91% and 8.69%, respectively. Similarly, the marginal effect of all other variables on different levels of OTS could be interpreted.

7. Policy Implications

Based on the model estimation results for DTS, WTS, and OTS, a set of policy-level interventions and recommendations are discussed below. These specific policy-level considerations can be instrumental in improving travel satisfaction in particular, and quality of life, in general.

It is discernible that socio-economic, built environment, and accessibility-related characteristics significantly affect the user's overall trip satisfaction. Gender and age play a crucial role in influencing trip satisfaction for daily travel and work trips. Women were found to have lesser travel satisfaction than men, which could be attributed to the unsafe travel conditions persisting in Delhi. Women's travel can be made safer by many methods such as the deployment of marshals in public transit units, installing panic buttons in all public transit for emergencies, and provision of GPS tracking systems for improved safety. This will improve safety and can also be beneficial in enhancing the perception of safety. Policies can be implemented to encourage more women to work in the transport sector as service providers, which will improve the perception of comfort and safety among the women public bus users.

Elderly users perceive better DTS and WTS than their counterparts; this could be attributed to relatively more experience with the travel conditions. Fare revision of public transport and para-transit modes with careful consideration of different socio-economic groups could be an effective policy measure to attract young commuters with relatively less income. Similarly, to maintain the level of trip satisfaction perceived by the elderly users, policies such as the provision of ramps on buses, popularising low floor buses, increasing the number of reserved seats for senior citizen, provision of toilets in bus and metro stations could be adopted.

It was observed that vehicular emmission contribute to almost 60% of the air pollution in major Indian cities (Sudarshan et al., 2020). Emitted hydrocarbons and nitrogen oxides react during daylight and develop ground-level ozone, which leads to several respiratory problems among the population (DTMR, 2017). In recent years, efforts have been made to promote active modes such as walk and bicycle to improve air quality and consequently improve the urban Delhi commuters' quality of life. This research findings show that walking contributes to improved commuter wellbeing, an observation well supported by the previous research literature (Clark et al., 2020; Handy & Thigpen, 2019; Olsson et al., 2013). Based on the visual observations, the existence of the poor state of pedestrian facilities in terms of poor surface condition (Figure 2 (a)), absence of physical separation from moving motorized traffic (Figure 2 (b)), lack of pedestrian holding space and lack of sidewalk amenities can be seen in Delhi. The existing pedestrian infrastructure in Indian cities in general, Delhi in particular (Figure 2 (c)), is unsafe and unsuitable for safe pedestrian movement. Policy measures such as the provision of sidewalk amenities, clean and obstruction-free smooth pedestrian walkway, etc., could be taken up to promote walking. Walking leads to a reduced rate of cardiovascular diseases, lung inflammation (COPD), obesity, and other health-related issues among adults and keeps children healthy, thus improving their overall quality of life. Provision for separate walkways and cycling tracks will attract commuters to use non-motorized modes of transportation, which could help achieve the goal. Implementing bi-cycle hiring (renting) can also be a phenomenal method in such conditions that will improve the quality of life by contributing to health-related benefits, environmental quality and act as a revenue-generator. The funds raised through this method can be used for improving the fixed facilities of the network. Appropriate measures such as awareness campaigns can also be implemented to promote cognizance regarding the benefits of active transportation (walking and cycling) on health and the environment, improving the quality of life. Hence, improved trip satisfaction based on reducing carbon footprint could be an effective measure to improve urban commuters' overall quality of life in a developing country such as India.

Further, improving safety in the neighbourhood is also another means of boosting the travel-satisfaction of the people. Thus, regular patrolling and continuous surveillance, which law enforcement agencies can carry out, can also play an essential part in improving satisfaction. Results also indicate that that route visibility plays a vital role in trip satisfaction. Poor route visibility due to inadequate and insufficient on-street illumination is a significant deterrent to trip satisfaction in Delhi. Providing adequate street lights will improve route visibility on the existing segments and improve the trip's quality.

Roadway congestion is one of the commuters' most significant problems, especially during peak hours in India (Figure 2 (d)). In this regard, congestion pricing can be implemented by charging the users of a particular road network where there is very high traffic to reduce congestion. Congestion pricing schemes could significantly reduce congestion during peak hours in the charged area/cordon/road, reduce delay, improve journey speed, and increase productivity. It could increase the number of passengers entering the congestion charging zone using public transport rather than private modes, thereby reducing greenhouse gas emissions. Such schemes would also generate revenue, which could be utilized for roadway infrastructure improvement to enhance commuters' quality of life and as funding to accelerate research programs. Moreover, there are areas in Delhi where the road stretch suddenly narrows down, which hinders the smooth flow of traffic, especially near junctions. Such narrow stretches can be widened to avoid congestion and ensure the smooth flow of vehicles. Channelising islands can be provided in areas to streamline the traffic flow. Grade separated interchanges can be provided at critical locations where other means to control traffic movements are ineffective.

Primary trip stages have a significant impact on the overall trip satisfaction. Thus, ensuring the proper location of bus stops that are easily accessible to the public, which minimizes the first and last mile connectivity issues, could significantly impact the commuter's satisfaction with the quality of the trip. Suitable bus stops with frequent bus operation, ease of transfer, adequate lighting, and coordination with the nearest emergency dealing station such as fire bigrade and hospitals can add to commuters' trip satisfaction. Providing adequate areas for private vehicle parking near bus terminals and metro stations can also promote public transport ridership and should be considered during policy formulation. In the present emergent cities, access to public transport for all user groups is a critical determinant of mobility and social inclusion. The public transport sector has a vital role in ensuring that all citizens travel

seamlessly and commuters with special needs to travel comfortably. Hence, policies aimed at ensuring the accessibility of urban transport needs to be formulated by the concerned authority for achieving improved commute quality. Transport facilities should be designed to cater to the needs of the differently-abled sections of the society to access these facilities quickly. Giving priority to public transport at traffic signals is another method that can be adopted to ensure their smooth movement, potentially making the commuters satisfied.

A significant portion of trips in Delhi are made using the Delhi Metro rail; therefore, employing various schemes to increase public transport ridership can also reduce the private car share on the city roads. Moreover, fair concession or any tax benefits for daily commuters can attract the public towards the mass transit modes. Deployment of the low floor and electric bus fleet can also reduce the congestion and improve the overall environment. Results indicate that with improved quality of public transport infrastructures such as buses and metro-rails, better commute quality could be achieved, especially in a city like Delhi, where pollution is a significant deterrent towards using private vehicles on-route. In this regard, the metro authority can prioritize metro service-related attributes to improve the metro system's travel quality. Strategies and solution concepts need to be drafted for a rational increase in fare, integration of feeder system, lower operational headway, etc., to mitigate the discussed concerns, which will eventually increase the metro riders' trip satisfaction. The general public should visualize the benefits and the goals that will be achieved from the policy interventions for a better quality of life; various programmes other than awareness programmes like implementing the odd-even car using scheme should be conducted. Above all, awareness programmes should be conducted to instill a sense of responsibility and thoughtfulness among the general public to follow the implemented policies, so that their quality of travel and quality of life can be improved.

(a)

(b)

(c)

(d)

Figure 2 Sample illustrations of roadway sections at Green Park Extension, New Delhi (images by authors): **a)** Pedestrian infrastructure unsuitable for walking; **b)** Lack of maintenance of sidewalk; **c)** Safety hazard due to negligence in maintaining pedestrian facilities; **d)**Traffic Congestion at peak hour.

8. Conclusions

This study carried out a detailed investigation to ascertain the main factors affecting travel satisfaction, thereby improving the transportation-related quality of life of the people of Delhi. Ordered logit models were used to model travel satisfaction with respect to various attributes contributing to overall variation. The models were analyzed, and the obtained results were interpreted for better understanding and policy suggestions. Based on the results, the following conclusions can be made.

Firstly, socio-economic characteristics such as age, gender, and vehicle ownership are factors are some of the main factors affecting the travel satisfaction of users. Authorities should lay importance on the users' socio-economic profile while designing and improving the existing public transit services, such as by reforming the fare structure and introducing better feeder systems that can add to the satisfaction of users with varying socio-economic characteristics.

Secondly, the built environment and accessibility-related factors such as street lighting, sidewalk availability, street congestion, bus stop accessibility, safety, and security influence commuters' quality of life. Maintaining and improving the transport infrastructure and promoting the use of public transit can help create a positive impact on the users and the environment, thereby enhancing the overall quality of travel.

Thirdly, the travel mode used by the people for their trips and associated characteristics like safety benefits and satisfaction influence the trip satisfaction. Providing better quality of service in terms of accessibility, efficiency, and security will help create a better outlook about various modes of travel and promote more usage of public vehicles like buses and metro. Enhancing the infrastructure for active transport will also contribute to the added well-being of the people.

Fourthly, the results obtained could be an important decision-making tool for long-term urban-infrastructure development in a city such as Delhi. Presently, Delhi is one of the most polluted city in the world with an air quality index of 319 in February 2020 as per the report by ‘India Today’ and is one of the most unsafe city to travel, especially for women, as reported by The Times of India in January 2020. Hence developing policy measures to improve the overall quality of life of urban residents is of high priority. The government and local planning agencies could adopt the results to prioritize the specific areas of interventions for improvement of overall trip quality. These planning decisions will be a key input for drafting improvement strategies and designing programs to enhance urban environment travel quality.

Before closing, we understand that satisfaction associated with a trip purpose may vary due to socio-economic differences across the survey participants. Henceforth, the observations obtained for Delhi may not be illustrative for several other cities across the world. Therefore, the authors would like to continue this work across different Indian and international cities and compare the results for a better understanding of the interaction of transportation and quality of life. However the methodology presented and the developed survey formats are generic, which could be used as initial guidelines for cities aiming to improve trip-quality of residents through policy interventions.

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Appendix – 1: Description of Questionnaire Elements

Measure	**Statement**	**Measurement**
Daily Travel Satisfaction (DTS)	How satisfied are you based on your daily travel experience?	1 – Least Satisfied 2 – Less satisfied 3 – Neutral 4 – Satisfied 5 – Highly satisfied
Work Trip Satisfaction (WTS)	How satisfied are you based on your work-trip experience?	
Other Than Work Trip Satisfaction (OTS)	How satisfied are you based on your other / non-work trips (leisure, shopping)	
Gender (M/F)		0 – Male 1 – Female
Age		0 – 18-24 1 – 25-34 2 – 35-44 3 – 44-54 4 – 55 and above
Vehicle ownership		0 – No 1 – Two-Wheeler 2 – Car 3 – Both
Sidewalk availability	How satisfied are you with the sidewalk availability in your locality?	1 – Least Satisfied 2 – Less satisfied 3 - Neutral 4 -Satisfied 5 –Highly satisfied
Street Light Condition	How satisfied are you with the street-light condition in your locality?	
Bus stop safety and security	Are the bus-stops safe and secure in your opinion?	1 – Very much unsafe and insecure 2 – Unsafe and insecure 3 – Neutral 4 – Safe and secure 5 – Very much safe and secure
Bus stop accessibility	Is the bus stop at an accessible distance from your residence?	1 – Highly inaccessible 2 – Inaccessible 3 – Neutral 4 – Accessible 5 – Highly accessible
Street Congestion	Was the street congested?	1 – Street was not at all congested 2 – Street was little congested 3 – Street was neither congested nor free 4 – Street was congested 5 – Street was very congested
Walking health benefits	Do you think there are health benefits associated with walking?	1 – There is no health benefit 2 – There is a little health benefit 3 – Neutral

		4 – There is some health benefit 5 – There is a significant health benefit
Installation of GPS in buses	Do you think the installation of a GPS tracking system on a bus is beneficial?	0 – No 1 – Yes
Bus – safety	Do you think your travel by bus is safe?	1 – Very unsafe 2 – Unsafe 3 – Neutral 4 – Safe 5 – Very much safe
Walking – safety	Do you think your travel by walking is safe?	
Metro - night travel safety	Do you think your travel by metro at night is safe?	
Walking – satisfaction	Do you think your travel by walk is satisfying?	1 – Least Satisfied 2 – Less satisfied 3 – Neutral 4 – Satisfied 5 – Highly satisfied