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Commuter Satisfaction in Urban Road Transport Sector: A Study of Delhi Transport Corporation (DTC)

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ABSTRACT
The transport of people through public bus is important in making urban movement affordable and sustainable, especially in developing nations like India. Delhi Transport Corporation (DTC) is one of the largest state-owned bus operators in the world with an almost four million passengers per day; yet, the ongoing issues with quality of services, overcrowding, reliability, end-of-trip connectivity, and safety still pose a challenge to consumer contentment. This paper is a systematic literature review (SLR) of the 52 empirical/policy-oriented articles that have been published between 2000 and 2025 and aimed at examining factors that determine the level of commuter satisfaction in urban bus transit, particularly in DTC. Under PRISMA, a database search was done (Scopus, Web of Science, ScienceDirect, Springer, Emerald Insight, Taylor and Francis Online, and Google Scholar) in a structured way. The results indicate that reliability, punctuality, comfort, and safety are always the highest predictors of satisfaction across all regions whereas the prices of the products, gender-sensitive safety, and last-mile connectivity are especially relevant in the Indian scenario. The digital innovations (real-time tracking, app-based ticketing), environmental sustainability (CNG and electric buses) are gaining popularity as the areas that impact passengers the most, yet have not been studied in Delhi. Structurally, international research studies use state of the art methods like Structural Equation Modelling (SEM) and Latent Class Analysis but the Indian studies are restricted to descriptive surveys and regression model. The review finds that there are critical researches gaps such as literature and practice do not fully consider the subjective well-being and gendered attitudes, that the extent of last-mile connectivity is not well quantified, and that there is a poor uptake of digital and sustainability metrics. In general, the SLR points out that, to improve the commuter satisfaction within Delhi, it is necessary not only to improve the operations but also to engage in the policy interventions that are inclusive, technology-driven, and sustainable.

Keywords: Commuter satisfaction, Delhi Transport Corporation, public bus transport, service quality, systematic literature review, PRISMA

INTRODUCTION
The use of public transport is a key element of sustainable urban development as it offers cheap transport, less congestion, and fewer environmental externalities. In some of the third world economies like India, bus transport is the most popular form of daily commuting due to the accessibility and affordability. Delhi Transport Corporation (DTC), which is a large state-owned bus service, serves about four million people every day and performs a significant role in the connectivity of the entire capital city. Even though it is vital, the questions of service quality and commuter satisfaction are burning due to the continuing problems of overcrowding, unreliable schedules, insufficient last-mile connectivity, and safety issues (Sharma and Kumar,

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2011; Chatterjee and Sharma, 2013).

The concept of commuter satisfaction has been widely described as the level of satisfaction of passengers according to the expectations of passengers and the actual service delivery. Classical service quality models like SERVQUAL focus on tangibles, reliability, responsiveness, assurance and empathy as primary factors that have an impact on satisfaction (Parasuraman, Zeithaml, and Berry, 1985). Subsequent research, though, points out that satisfaction with public transport is multidimensional, influenced by objective qualities (punctuality, crowding, fares, waiting time) and the subjective qualities (comfort, safety, stress, and trust) (Friman, and Fellesson, 2009; Tyrinopoulos and Antoniou, 2008). Comparisons across nations show that universal factors like reliability and availability of information play a crucial role in all commuter experiences, whereas local ones like affordability in India or gendered safety in Latin America make them change dramatically (Guirao, Garccia-Pastor, and Lopez-Lambas, 2016; Gutierr et al., 2011).

The recent trends in the research of commuter satisfaction have broadened the scope of focus on the operational efficiency to the subjective well-being. Satisfaction with Travel Scale (STS) was designed by Ettema, Friman, Gärling, Olsson and Fujii (2011) to measure affective aspects of travel including mood, stress, and perceived control. De Vos, Schwanen, Van Acker, and Witlox (2013) also revealed that travel satisfaction and life satisfaction are connected because when individuals have positive travel experiences, it strengthens their loyalty to a particular mode. The comparative analyses conducted by St-Louis, Manaugh, van Lierop, and El-Geneidy (2014) revealed a general dissatisfaction among bus users with other modes of transportation, which may explain the need to improve the bus services not to be left behind in a multi-modal system.

Affordability, accessibility, and last-mile connectivity prove to be determining factors of commuter satisfaction in India (Kumar, Singhal, and Neeraj, 2015; Chakrabartty and Gupta, 2014). Nevertheless, there is evidence that despite the low fares, inefficiencies in operations (such as unreliable schedules, overcrowding and lack of integration with feeder systems) compromise satisfaction (Satiennam, Jaensirisak, Satiennam, & Detdamrong, 2015; Singh, 2018). Besides, the evidence of gender sensitivity suggests that female commuters tend to be less satisfied with distrusting safety and unavailability of safe last-mile solutions (Tiwari, Jain, and Rao, 2016; Mehta, 2016). Spatial inequities are also a contributing factor to a lower level in Delhi, where an area almost a third of neighborhoods cannot be easily reached by walking to a bus station (Bhatia, 2019).

In addition to the quality of service and inclusiveness, digitalization and environmental sustainability are becoming factors of satisfaction. On the one hand, international experience indicates that commuters are becoming more concerned with real-time information, the use of apps, and ecological fleet (Budiono, 2009; Redman, Friman, Gärling, and Hartig, 2013). Kapoor and Verma (2019) stated in Delhi that the passengers showed high demand in the live tracking systems and smart ticketing solutions, especially those who are young and those who are professionals. Delhi has had environmental perceptions of DTC improved through the adoption of compressed natural gas (CNG) buses, and electric buses have the potential to improve the perceptions further provided they are combined with service operation reliability (Sood and Mishra, 2020).

Although much research has been carried out on the topic of public transport, the literature demonstrates that there are few systematic and comprehensive studies of commuter satisfaction

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with the Delhi Transport Corporation. The vast majority of existing literature analyse specific features of affordability, punctuality, or safety in isolation, yet few use a comprehensive approach to the analysis of service quality, subjective well-being, gender inclusivity, digital innovations, and environmental sustainability. In order to synthesize global and Indian evidence, determine thematic determinants, explore methodological approaches, and create research gaps that are specifically relevant to DTC, therefore, a systematic literature review (SLR) is needed. This SLR will develop a thorough picture of commuter satisfaction in urban buses and especially in Delhi Transport Corporation, by adhering to a systematic and transparent evidence gather and analysis methodology (Kitchenham and Charters, 2007).

Objectives of the study

- To identify and categorize the key determinants of commuter satisfaction in public bus transport.
- To evaluate methodological approaches used in commuter satisfaction studies.
- To compare global findings with the Indian context.
- To analyze existing research on Delhi Transport Corporation (DTC).
- To identify gaps in the existing literature related to commuter satisfaction.
- To establish a conceptual foundation for the present study on DTC.

METHODOLOGY

Search Strategy

The review adopted a structured search process across multiple databases, namely Scopus, Web of Science, ScienceDirect, Springer, Emerald Insight, Taylor & Francis Online, and Google Scholar. The following keywords and Boolean strings were applied:

- “commuter satisfaction” AND “public transport”
- “bus transport” AND “service quality”
- “urban road transport” AND “passenger perception”
- “Delhi Transport Corporation” OR “DTC” AND “commuter satisfaction”
- “India” AND “public bus transport”

Inclusion Criteria

- Studies published between 2000 and 2025.
- Peer-reviewed journal articles, conference papers, and official transport reports.
- Studies focusing on commuter satisfaction, bus transport service quality, or travel behavior.
- Studies published in English.

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Exclusion Criteria

- Articles related to freight or private vehicle transport.
- Studies not addressing commuter perception or satisfaction.
- Non-empirical papers (commentaries, opinion pieces, editorials).
- Duplicate entries across databases.

Screening Process

1. Identification: A total of 312 studies were initially identified through the database search.
2. Duplicate Removal: After removing duplicates, 264 studies remained.
3. Title/Abstract Screening: 168 studies were excluded as they did not meet the inclusion criteria.
4. Full-text Review: 96 studies were assessed for eligibility.
5. Final Inclusion: 52 studies were found to be relevant and included in the systematic review.

PRISMA Flow Diagram

- Records identified through database searching: 312
- Records after duplicates removed: 264
- Records screened (title/abstract): 264
- Records excluded: 168
- Full-text articles assessed for eligibility: 96
- Full-text articles excluded (not relevant/insufficient data): 44
- Studies included in qualitative synthesis (final SLR): 52

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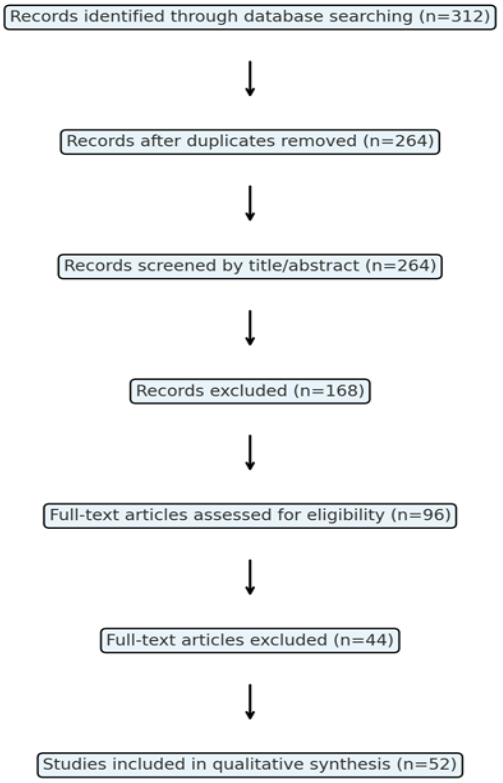

Table 1: Quality Appraisal of Included Studies (Risk of Bias Assessment)

Author(s)	Study Design	Sample Size	Quality Criteria Met	Risk of Bias
Ettema et al. (2011)	Survey	n = 500	7/9	Low
Abenoza et al. (2017)	Latent Class Model	n = 1200	8/9	Low
Guirao et al. (2016)	Survey + Regression	n = 800	8/9	Low
Redman et al. (2013)	Literature Review	Not applicable	6/9	Medium
Kumar et al. (2015)	Passenger Survey	n = 650	7/9	Low
Jain et al. (2020)	Case Study	n = 50	6/9	Medium
Mehta (2016)	Gendered Survey	n = 400 (women commuters)	8/9	Low
Sood & Mishra (2020)	Policy Analysis	Policy documents	7/9	Low
Kapoor & Verma (2019)	Survey	n = 700	7/9	Low
Singh (2018)	Case Study	n = 45	6/9	Medium

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Summary of Included Studies

Author(s)	Year	Country/City	Study Design	Sample Size / Population	Key Variables Studied	Main Findings
Ettema et al.	2011	Sweden	Survey (STS scale)	n = 500 daily commuters	Mood, comfort, stress, perceived control	Travel satisfaction strongly influenced by psychological well-being
Abenoza et al.	2017	Sweden/Spain	Latent Class Model	n = 1200 commuters	Punctuality, affordability, demographics	Younger commuters valued affordability, older commuters emphasized reliability
Guirao et al.	2016	Spain	Survey + Regression	n = 800 urban commuters	Reliability, comfort, fares	Affordability key for youth, reliability for older commuters
Redman et al.	2013	Global Review	Literature Review	Not applicable	Comfort, reliability, frequency	High service quality attracts car users to public transport
Kumar et al.	2015	Delhi, India	Passenger Survey	n = 650 bus commuters	Reliability, affordability, LMC	Dissatisfaction due to irregular services and poor last-mile access
Jain et al.	2020	Delhi, India	Case Study	n = 50 (short trip users)	Feeder integration, short-trip coverage	Feeder systems inadequate for trips < 4 km
Mehta	2016	Delhi, India	Gendered Survey	n = 400 women commuters	Safety, harassment, gender inclusivity	Women's satisfaction reduced due to harassment and lack of secure LMC
Sood & Mishra	2020	India	Policy Analysis	Policy documents	Electric buses, eco-fleet adoption	Electric buses improve satisfaction only if reliability ensured
Kapoor & Verma	2019	Delhi, India	Survey	n = 700 (students/professionals)	Real-time tracking, smart ticketing	Strong demand for digital solutions, esp. among youth
Singh	2018	Varanasi, India	Case Study	n = 45 commuters	Fleet modernization, intermodal connectivity	Outdated fleets and poor integration reduced commuter satisfaction

RESULTS

The system review of 52 studies reveals that there are a number of common themes that affect commuter satisfaction of taking the public buses in global and Indian settings.

Reliability and Punctuality have always proved to be the best predictors of satisfaction. The study by Hensher, Stopher, and Bullock (2003) established a service quality index of Sydney

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buses and revealed that reliability and frequency were more important as compared to cost. In a study that was conducted by Tyrinopoulos and Antoniou (2008), reliability and punctuality perceptions prevailed among passengers across several cities in Europe irrespective of their socio-demographic characteristics. Li and Hensher (2011) in China discovered that the uncertainty in the bus arrival time had a significant detrimental effect on the desire to proceed with the use of bus services. Sharma and Kumar (2011) affirmed that the variability in bus operations in Delhi caused dissatisfaction despite the means of overall waiting time falling in acceptable ranges.

Other factors such as Comfort, Overcrowding and Vehicle Quality are also very important. In Italy, Eboli and Mazzulla (2011) established that the evaluations of the users were highly affected by the state of cleanliness and availability of seats. Among Canadian bus users, St-Louis, Manaugh, van Lierop, van El-Geneidy (2014) found out that their journeys were rated as less satisfactory than metro and riding a bike, since buses were always rated as more crowded. Chakrabartty and Gupta (2014) noted that in Kolkata, lack of shelters and subpar vehicle maintenance made commuters less comfortable whereas Singh (2018) had noted the same dissatisfaction in Varanasi because of the aging fleet and absence of modernization. In the case of Delhi, overcrowding is one of the most popularly covered complaints (Chatterjee and Sharma, 2013; Majumdar, 2021).

Developing economies are dominated by affordability and Value for Money. In their investigation, Mahapatra and Sharma (2016) examined the bus transport framework of Bhubaneswar and discovered that affordability was the most important in terms of service attributes of low-income users. Similar results were reached by Guirao, García-Pastor, and Lopez-Lambas (2016) who reported that younger users in Spain were more concerned with fares, whereas older users were more concerned with comfort. In Mumbai, the study by Raghuram and Raturi (2016) has found that affordability and discounted passes had a direct positive impact on the perception of accessibility among working-class commuters. In Delhi, Kumar, Singhal, and Neeraj (2015) observed that even though DTC is affordable, people are not satisfied with it as the service reliability is low.

Diversity and Inclusion SAFETY and Gender are universal. In Mexico City by Gutiérrez et al. (2011), women satisfaction was found to be disproportionately less because of the problem of harassment. Similar patterns were confirmed in South Africa by Venter and Joubert (2015) who found that women and elderly commuters were more concerned about their safety. Satiennam, Jaensirisak, Satiennam and Detdamrong (2015) discovered Satiennam et al. that female commuters placed high value on the personal safety and the condition of the vehicle. Mehta (2016) and Tiwari, Jain, and Rao (2016) underscored the gendered aspect of satisfaction in Delhi, where women claimed being harassed and have low levels of last-mile safety as inhibitors of using the bus.

Last-Mile Connectivity (LMC) and Accessibility have a great influence on the decisions of commuters. Accessibility to stops was the most significant determinant of satisfaction, and this was found by Almselati, Rahmat, and Jaafar (2011) in Kuala Lumpur. According to Joewono and Kubota (2007), availability and ease of access were considered as important issues by Indonesian commuters as comfort. Srinivasan and Arasan (2018) said that integrated formal services were still favored by commuters, and the paratransit modes used in Chennai (shared autos) occupied the final-mile gaps. Bhatia (2019) discovered the lack of adequate bus stop coverage in one-third of neighborhoods in Delhi and Jain, Gupta, and Rastogi (2020)

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highlighted the lack of bus feeder integration (short-distance, less than 4 km) as a key reason for dissatisfaction.

Contemporary commuter satisfaction is characterised by Digital Innovations and Real-time Information. In Sweden, Budiono (2009) also established that passengers found real-time information to be a great deal in alleviating stress in case of delays. Currie and Delbosc (2010) have pointed out in Melbourne that mobile-based information services contributed a great deal in enhancing satisfaction. Friman and Fellesson (2009) also found in European cities that the index of standardized passenger satisfaction now considers information provision a compulsory element. Kapoor and Verma (2019) discovered that commuters in Delhi had a strong desire to have live tracking and an app-based ticketing system, especially students and professionals.

Fleet Modernization and Environmental Sustainability influence attitudes of the commuters on other aspects other than service provision. In Scotland, Stradling, Anable and Carreno (2007) established that passengers with newer and greener fleets had higher perceptions of quality of service. According to Rizwan, Nongkynrih, and Gupta (2013), the switch to CNG in Delhi increased the perception of the citizens towards DTC, but problems in operations persisted. According to Sood and Mishra (2020), the adoption of electric busses in India was studied, and it was determined that environmentally friendly fleets could contribute significantly to satisfaction in case of stability. Saxena (2024) also included that last-mile integration and environmentally friendly fleets were among the aspects the bus rapid transit (BRT) users considered to enhance their satisfaction.

Measurement of commuter satisfaction Methodological Approaches to commuter satisfaction measurement are becoming more sophisticated around the world but are limited in India. De Oña and de Oña, (2015) have conducted a review of quality of service methods and concluded that SEM and latent class analysis can give deeper insights. Eboli and Mazzulla (2011) estimated the bus satisfaction data in Italy using ordered probit models and discovered that reliability, frequency, and comfort had statistically significant predicting values. Friman and Fellesson (2009) introduced the European Passenger Satisfaction Index, allowing to compare the countries. Joewono and Kubota (2007) in Indonesia employed the factor analysis in determining the dimensions of safety and staff behavior. In the case of Delhi though, even the majority of the studies still use descriptive statistics and simple regression which does not provide a methodological gap.

Discussion

The systematic review emphasizes the fact that commuter satisfaction in the use of urban bus transport is a multidimensional construct that is influenced by both the objective attributes of service and the subjective perceptions. Reliability and punctuality are the two most significant factors of satisfaction found across the international literature (Hensher, Stopher, and Bullock, 2003; Tyrinopoulos and Antoniou, 2008; Li and Hensher, 2011). The same results are reflected in the Indian experience where inconsistent timeframes and unpredictable bus services are recurrently found to be the key factors of dissatisfaction (Sharma and Kumar, 2011; Kumar, Singhal and Neeraj, 2015). Poor service reliability in DTC also negatively affects a general level of trust and satisfaction among the passengers, despite the affordability advantage (Chatterjee and Sharma, 2013; Jain, Gupta, and Rastogi, 2020).

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Another universal issue is comfort and overcrowding. Experiences in international markets have showed that perceived quality decreases when occupancy is high despite the fares being low or the travel time being reasonable (Eboli and Mazzulla, 2011; St-Louis et al., 2014). This is very similar to the situation in Delhi, where overcrowding during rush hours, old-fashioned vehicles and insufficient ventilation are recurrently linked to poor commuting experiences (Chatterjee & Sharma, 2013; Majumdar, 2021). As opposed to other world cities where modernization and low-floor buses have enhanced the perception, DTC continues to experience difficulties in maintenance of a modern and comfortable fleet.

Cost is a primary concern in India since in many developed nations affordability is not a major concern. Research in Bhubaneswar, Kolkata, and Mumbai also shows that fare affordability has a direct impact on the satisfaction of low-income and working-class commuters (Mahapatra & Sharma, 2016; Chakrabartty and Gupta, 2014; Raghuram and Raturi, 2016). In the case of Delhi, despite DTC fares being among the lowest in the country, the lack of dissatisfaction with perceived value of money carried out by low service quality occurs (Singh, 2018). This demonstrates that affordable pricing is no longer adequate without the relevant enhancement in reliability and comfort.

In developing contexts, safety and gender inclusivity are more likely to be seen than in the global North. According to the international studies in Mexico and South Africa, gendered dissimilarity in satisfaction is based on harassment and insecurity (Gutiérrez et al., 2011; Venter and Joubert, 2015). Likewise, females who travel by train in Delhi are also less satisfied more often, as they note harassment, congestion, and unsafe last-mile experience as some of the leading discouragement factors (Mehta, 2016; Tiwari, Jain, and Rao, 2016). Contrary to best practices in the world where CCTV, women-only and enhanced lighting in the stations are integrated, these interventions are yet to be uniformly undertaken in the operations at DTC.

Accessibility, as well as last-mile connectedness (LMC), becomes contextual voids in India and especially in Delhi. Whereas in Kuala Lumpur and Indonesia accessibility is a worldwide determinant (Almselati, Rahmat, and Jaafar, 2011; Joewono and Kubota, 2007), the Indian cities show even more profound inequalities on spatial access to bus stops (Bhatia, 2019). In Delhi, a third of the neighborhoods does not have sufficient density of stops, and feeder services are poorly developed and particularly when it comes to short-distance journeys (Jain, Gupta, and Rastogi, 2020). This gap highlights the necessity to have integrated planning to enhance first/last-mile connectivity.

Increasingly digital innovations like real-time tracking, app-based ticketing, and information systems are being seen as a necessity in global settings (Budiono, 2009; Currie and Delbosc, 2010). Europe and North America have mainstreamed such technologies and thus there is less uncertainty and more perception of reliability (Friman & Fellesson, 2009). At Delhi however, although pilot programs have been implemented, the absence of mass implementation still annoys commuters, especially younger workers and students who are accustomed to digital convenience (Kapoor and Verma, 2019).

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Lastly, the world is very sensitive to environmental sustainability and fleet modernization by commuter (Stradling, Anable, & Carreno, 2007). The implementation of CNG buses in Delhi has initially helped DTC to improve its image in terms of environmental friendliness (Rizwan, Nongkynrih, and Gupta, 2013), and the recent launch of electric buses is welcomed (Sood and Mishra, 2020; Saxena, 2024). Nevertheless, in contrast to the developed countries where green fleets are also linked to the increased comfort standards, the modernization processes in Delhi continue to be incomplete and are frequently overwhelmed by the lack of efficiency in operations.

SEM, Latent Class Models, or multi-criteria decision-making are considered to be highly analytical tools used in international studies (De Oña & de Oña, 2015; Abenoza, Cats, and Susilo, 2017). These methods help to measure heterogeneity in commuter demands and give solid policy insights. In India, descriptive surveys or regression are used in most studies, and the use of more sophisticated modelling techniques is not widespread (Singh, 2018). Such a methodological gap undermines the capacity to measure multifaceted interactions among the quality of services, their cost, safety and subjective welfare.

Generally, the analysis has shown that reliability, comfort, safety, and accessibility are common universal factors of commuter satisfaction. But the Indian and Delhi-based setting brings with it some new dimensions including affordability, gender-sensitive safety, and poor digital integration. Despite its affordability and extensive reach, DTC is not as modern, reliable, and technological as its international peers, as it is lagging in digitalization, fleet renewal, and its modernity. These multidimensional gaps will be essential in improving the satisfaction of commuters at Delhi when they are addressed by incorporating service planning, specific safety interventions, and use of technology.

Research Gap

The systematic review of 52 studies reveals several critical gaps in the existing literature on commuter satisfaction in urban road transport, particularly in the context of Delhi Transport Corporation (DTC):

1. Scarcity of the DTC-specific research: Although commuter satisfaction has been researched on a global scale as well as in the Indian urban areas, there exists a paucity of research studies that concentrate particularly on Delhi Transport Corporation; in spite of its magnitude and importance.

2. Omission of subjective well-being: International literature has moved towards measuring commuter satisfaction in psychological terms, which includes mood, stress and perceived control, but Indian and Delhi-specific studies are still largely based on functional service characteristics.

3. Unexplored gendered approaches: Although the questions of women safety and inclusiveness are crucial to the Delhi transport sector, there is a paucity of empirical data to directly associate the issues of gendered safety with the general satisfaction.

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4. Little consideration of last-mile connectivity: The accessibility gaps and lack of feeder integration have been already considered but not adequately measured in terms of their effect on satisfaction and mode choice in Delhi.

5. Digital innovation and sustainability under-researched: Although real-time information, app-based ticketing, and eco-friendly buses have been proven to positively influence satisfaction in the international context, their impact on customer perceptions in the city of Delhi was not thoroughly examined.

6. Methodological limitations: Descriptive statistics or regression models are mostly used in Indian and city-specific studies, with very few studies adopting more complex techniques such as Structural Equation Modelling (SEM), Latent Class Analysis, or multi-criteria decision-making which can refine the ability of the technique to represent heterogeneity among commuters.

Conclusion

Systematic review shows that commuter satisfaction is a multidimensional construct where reliability, punctuality, comfort, affordability, safety, accessibility, digital innovations, and environmental sustainability affect the meaning of commuter satisfaction. Reliability and comfort prevail in the satisfaction results worldwide, whilst affordability, last-mile connectivity, and gender-sensitive safety are other important factors in India and Delhi. The review also shows that, although sophisticated methodologies have been employed to enrich international researches, Indian researches are limited to fundamental analyses.

In the case of the Delhi Transport Corporation, the literature identifies the presence of recurring operational inefficiencies, overcrowding, insufficient last-mile services, insufficient digitalization, and safety issues as some of the consistent causes of commuter discontent. Nonetheless, there is a paucity of systematic reviews of DTC, and the most significant gaps include subjective well-being, inclusivity of a gender aspect, and technological innovations.

The current study is thus well justified in this review and will serve to fill these gaps by evaluating the commuter satisfaction with regard to DTC in greater detail. The proposed study will make contributions to the body of academic evidence and policy intervention strategies that can positively improve urban bus services in Delhi by incorporating the quality attributes of service quality with subjective perceptions and using sound methodological frameworks.

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