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Assessing Last-Mile Connectivity in Dhaka City

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Abstract

Dhaka's MRT Line-6 and elevated expressways represent significant transit investments, yet first- and last-mile connectivity (LMC) challenges continue to undermine their effectiveness. Existing literature in Bangladesh has focused on trunk infrastructure rather than station-level catchment areas, a gap this study addresses. This study assesses last-mile connectivity and commuter satisfaction across three functionally distinct metro stations — Uttara North, Mirpur 10, and Motijheel — representing a transit hub, a mixed residential-commercial corridor, and a central business district, respectively. Using a structured questionnaire survey of 164 commuters through proportional stratified sampling, the study measured last-mile mode choice, travel distance, time, cost, and satisfaction across six dimensions: accessibility, affordability, comfort, convenience, safety, and infrastructure quality. Data were analysed using descriptive statistics, one-way ANOVA with Tukey post-hoc comparisons, Pearson correlation, and multiple linear regression. Walking (44.5%) and rickshaws (42.7%) dominate as primary last-mile modes, with more than half of commuters travelling over 500 metres and nearly a quarter spending more than 20 minutes on the last-mile leg. Overall satisfaction was moderate (mean = 2.98/5) and varied significantly across stations ($F = 3.31$, $p = 0.039$), with Uttara North recording the highest and Mirpur 10 the lowest satisfaction. Infrastructure quality ($\beta = 0.262$, $p < 0.001$) and affordability ($\beta = 0.187$, $p = 0.001$) were the strongest predictors of overall satisfaction, with the model explaining 52.2% of variance. Traffic congestion, poor road conditions, and safety concerns were the most cited barriers. The study offers a station-catchment diagnostic framework and area-differentiated recommendations to guide last-mile investment as Dhaka's MRT network continues to expand.

KEYWORDS

last-mile connectivity; metro rail; commuter satisfaction; transit-oriented development; dhaka; urban mobility

Introduction

Dhaka, the capital of Bangladesh, is among the most densely populated cities in the world and continues to grapple with severe transportation challenges, including chronic traffic congestion and inadequate public transport coverage. According to World Bank estimates ([Bird et al., 2018](#)), average vehicular speed in Dhaka has fallen from 21 km/h to below 7 km/h in recent years, with an estimated 3.2 million working hours lost daily to congestion, compounded by road-traffic safety outcomes: behavioural and demographic factors substantially elevate crash severity for pedestrians and non-motorized road users, who make up a large share of last-mile trips ([Islam et al., \(2026\)](#)). In response, the Government of Bangladesh has invested heavily in mass transit infrastructure, notably the Dhaka MRT system and a network of elevated expressways, intended to shift travel demand toward higher-capacity public transport.

However, the effectiveness of any high-capacity transit investment depends on how easily commuters can reach stations and complete their journey to their final

destination first- and last-mile connectivity (LMC). This link is theorised through accessibility theory, which treats ease of reaching a destination not merely the existence of a service as the determinant of effective mobility (Tight et al., 2016), and through service-quality frameworks, which hold that rider satisfaction reflects the gap between perceived and expected service at every stage of a trip (Venter, 2020). Where this link is weak, ridership, equity of access, and the return on transit investment are compromised, regardless of the trunk system's own efficiency (Park et al., 2021; M. Rahman et al., 2022).

Three interlinked structural issues shape last-mile conditions in Dhaka: traffic congestion from a growing private-vehicle fleet and unregulated paratransit such as leguna; constrained formal paratransit availability with unpredictable waiting times; and safety risks from heavy, speeding traffic on roads lacking adequate pedestrian infrastructure. A recent walkability audit found Motijheel's footpaths compromised by garbage dumping, illegal parking, and hawkers encroachment, with comparable deficits in Mirpur (F. A. Khan & Tabassum, 2024), echoing accounts of older pedestrians navigating obstructed footpaths across Dhaka (Bailey et al., 2026). Because a transit hub, a mixed residential-commercial corridor, and a CBD differ systematically in density, land use, and paratransit supply, this study's starting hypothesis is that their last-mile experiences diverge accordingly, which the comparative design below is built to test.

Conceptual Framework

This study situates its variables within three complementary theoretical strands. Accessibility theory frames last-mile mode, distance, time, and cost as the practical determinants of whether a transit trip is genuinely usable, independent of the trunk service's own performance (Kåresdotter et al., 2022). Transit-oriented development (TOD) theory explains why station-area built form density, footpath continuity, mixed land use conditions last-mile outcomes, predicting that purpose-built, pedestrian-oriented stations (such as Uttara North) will outperform organically developed catchments (Mirpur 10, Motijheel) on comfort and safety (Calthorpe, 1993; Cervero, 2013). Service-quality theory supplies the outcome construct: overall satisfaction as a function of perceived performance across the six discrete service dimensions. Figure 1 summarises how these three strands jointly motivate the study's variables: the station catchment context (informed by accessibility theory and TOD) shapes both the last-mile connectivity attributes and the six satisfaction dimensions, which combine, per service-quality theory, into overall commuter satisfaction with downstream implications for ridership, equity, and station-area policy. This framework directly informs the survey instrument (Section 3.2) and structures the interpretation of results in Sections 4 and 5.

Problem Statement

Despite the operational success of MRT Line-6, empirical, commuter-level evidence on how well the 'first and last mile' of these journeys is served remains limited. This can be substantiated against the small set of Dhaka-specific studies that exist: Rahman et al. (2022) examined access-egress mode choice among suburban commuters, but at the scale of the wider suburban catchment; Rahman et al., (2021) and Pramanik et al. (2024) examined socio-demographic correlates of ride-sourcing and e-rickshaw use, but not

satisfaction with the station catchment itself; and Khan and Tabassum (2024) audited footpath conditions in Dhaka's CBDs from an infrastructure standpoint, without capturing commuter-reported satisfaction or mode choice. None combines commuter-level satisfaction measurement with a cross-station comparative design at the immediate catchment scale the gap this study fills. Existing assessments have focused on trunk infrastructure road capacity, transit corridors, vehicle fleets while pedestrian- and paratransit-level experience near stations has received little attention, yet trunk investments alone cannot resolve accessibility gaps if footpaths, paratransit supply, and safety conditions remain inadequate (Mo et al., 2018; Roy & Basu, 2019). This study addresses this gap by empirically assessing infrastructure conditions and commuter satisfaction at three distinct nodes of Dhaka's transit network.

Research Objectives

The study is guided by the following objectives:

1. To assess the current state of last-mile connectivity including dominant travel modes, distance, time, and cost at three strategically selected locations in Dhaka City.
2. To evaluate the satisfaction levels of pedestrians and daily commuters with respect to accessibility, affordability, comfort, convenience, safety, and infrastructure quality of last-mile connectivity.
3. To statistically examine variation in last-mile connectivity outcomes across the three study areas and identify the key determinants of overall commuter satisfaction.
4. To identify the principal challenges faced by commuters and their preferred improvement measures, in order to inform area-specific policy recommendations.

Significance of the Study

As Dhaka expands its metro rail network, how effectively commuters can access stations will increasingly determine ridership outcomes and equity of transit benefits. This study contributes location-specific, quantitative evidence that can directly inform station-area planning, NMT investment, and paratransit regulation, with findings most directly transferable to station catchments sharing comparable land-use and planning characteristics rather than to Dhaka's transit network as a whole. Strengthening walking and non-motorised access to metro stations also aligns with the wider transport-decarbonisation agenda identified for cities in the Global South (Emodi et al., 2022).

Literature Review

The first/last-mile (FM/LM) conundrum refers to the distance between an individual's origin or destination and the nearest public transport node, closely linked to whether individuals perceive public transport as accessible (Tight et al., 2016, as cited in Umair et al., 2025). Where this connection is poorly served, the utility of even a well-designed trunk system is diminished (Kåresdotter et al., 2022, as cited in Umair et al., 2025), and Venter (2020) frames connection quality as a determinant of overall transport quality. Built-environment research reinforces this: Mo et al. (2018), Park et al. (2021), and Roy and Basu (2019) find footpath continuity and perceived safety predict last-mile mode choice and satisfaction independently of trip distance. In South Asian metro systems, Goel & Tiwari, (2016) and Sadhukhan et al., (2015) find access-egress trips heavily dependent on

non-motorized and paratransit modes, while Chidambara and Gupta (2018) show walkability, not mode availability, primarily determines whether Delhi Metro users walk the last mile. International evidence corroborates this pattern (Liu et al., 2022; Zeng et al., 2022; Zhao et al., 2018).

A substantial body of literature identifies intermediate para-transit (IPT) auto-rickshaws, cycle-rickshaws, and e-rickshaws as the dominant last-mile mode in South Asian cities. Umair et al. (2025), assessing Dwarka Sub-city metro stations in New Delhi, found e-rickshaws and app-based cabs dominate modal share alongside a 9–25% oversupply of e-rickshaw fleet, and that comfort (62%) rather than fare (5%) was the primary reason commuters preferred app-based cabs over the metro. In Bangladesh, Hossain et al., (2022) and Pramanik et al. (2024) similarly find e-rickshaw users prioritize service quality over cost, though informal, unregulated operation (Khan & Quaddus, 2021) constrains reliability; comparable dynamics, in which informally organised services fill the gaps left by formal networks, have long been documented elsewhere in Asia (Loo, 2007). Complementing this, TOD literature holds that compact, pedestrian-oriented station-area development is a more durable solution than feeder-mode interventions alone (Dittmar & Ohland, 2003; Singh et al., 2017), reinforced by technology-enabled mobility research (Kanuri et al., 2019; Shaheen & Chan, 2016) and interchange-design evidence from Germany and India (Sil et al., 2022).

Within the Dhaka context specifically, Niger, (2013) proposed an integrated hierarchical transport network combining trunk transit with feeder and paratransit tiers, directly relevant to MRT Line-6 and its successors. Rahman et al. (2022), the most directly comparable Dhaka-based study, found a strong dependence on non-motorized and human-hauled transport for suburban access-egress trips a pattern this study's mode-share findings echo while Khan and Tabassum (2024) document footpath discontinuity and

encroachment across Dhaka's CBDs. Equity dimensions are also well established: Bailey et al. (2026) document how obstructed footpaths constrain older men's mobility in Dhaka, Chowdhury and van Wee (2020) find perceived safety a major deterrent to women's transit use, and Ahmed et al. (2019) identify similar safety barriers for older persons in urban Pakistan patterns corroborated regionally by Dhurai et al. (2023), Dube et al. (2023), and Pucher et al. (2004). At the level of travel behaviour, Lu et al., (2023, 2024) show that mode choice is shaped by household modality style as much as by trip-level circumstances.

Taken together, the literature converges on five recurring findings: paratransit and walking dominate last-mile mode share but supply is frequently oversupplied and informally regulated (E. A. Khan & Quaddus, 2021; Pramanik et al., 2024; Umair et al., 2025) comfort and safety often outweigh cost in mode choice, even among lower-income users (Chidambara & Gupta, 2018) TOD-oriented station design offers a more durable solution than feeder-mode interventions alone (Cervero, 2013; Singh et al., 2017); safety and infrastructure burdens fall disproportionately on women and older adults (Ahmed et al., 2019; Chowdhury & van Wee, 2020); and station-level survey assessment, not city-wide audits alone, is necessary for actionable recommendations (Rahman et al., 2022; Khan & Tabassum, 2024). Read critically, three issues remain unresolved. First, the South Asian mode-choice literature is drawn almost entirely from Indian metro systems where paratransit is increasingly formalised; whether the same comfort-over-cost ordering holds where paratransit remains human-hauled and unregulated, as in Dhaka, has not been directly tested. Second, the TOD literature is largely normative or audit-based (Cervero, 2013; Khan & Tabassum, 2024) rather than grounded in commuter-reported satisfaction, leaving open whether a purpose-built TOD station such as Uttara North actually delivers measurably higher satisfaction than organically developed catchments.

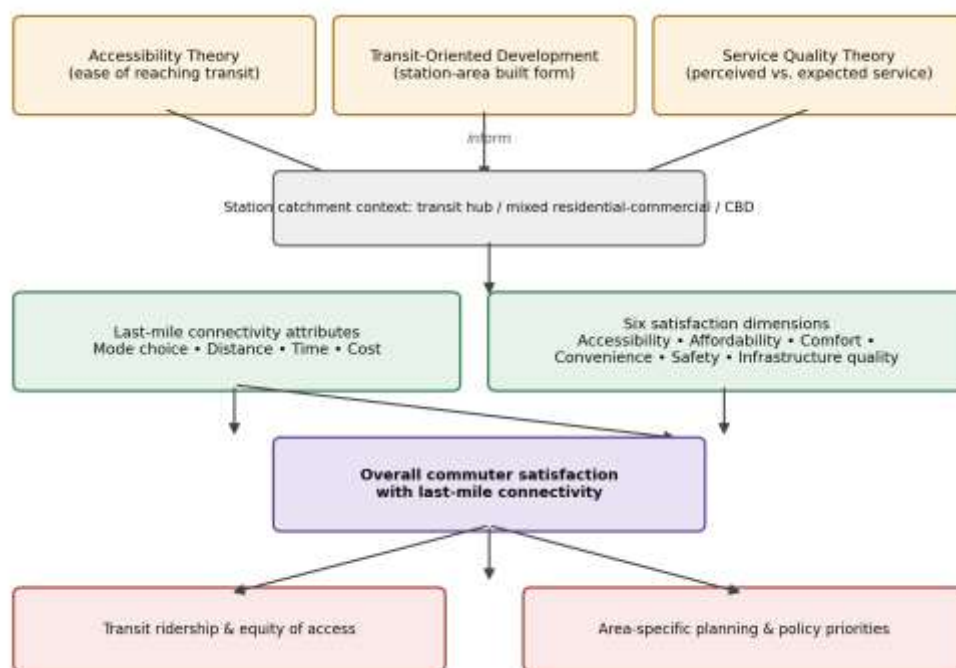


Figure 1. Conceptual framework linking accessibility theory, transit-oriented development, and service-quality theory to the study's last-mile connectivity and satisfaction variables

Third, no existing Dhaka study jointly models all six satisfaction dimensions to identify their relative predictive weight, so it remains unknown which dimension Dhaka policymakers should prioritise first. This study builds directly on this body of work, applying a comparable survey-based methodology to three functionally distinct station catchments in Dhaka, situating its findings against the Dwarka case study (Umair et al., 2025) as a regional benchmark, and extending the Dhaka-specific evidence base of Rahman et al. (2022) and Khan and Tabassum (2024) to a commuter-satisfaction framework not previously applied to Dhaka's Metro Rail network.

Methods

Study Area and Sampling

The study was conducted at three strategically selected locations in Dhaka City: Uttara North Metro Station, Mirpur 10, and Motijheel. The three sites were purposively selected to maximise contrast on dimensions that TOD and accessibility theory identify as consequential for last-mile outcomes: station-area planning status, density, and dominant land use rather than to represent Dhaka's transit network in general. Uttara North serves as a dedicated transit hub for MRT Line-6 users, with station-area infrastructure planned concurrently with the metro line itself; Mirpur 10 is a dense, organically developed residential-commercial corridor where paratransit and pedestrian infrastructure evolved without a coordinated station-area plan; and Motijheel is Dhaka's central business district (CBD), with high daytime employment density, mixed heavy traffic, and a legacy footpath network predating any transit-oriented design standard. This contrast planned transit hub versus unplanned residential-commercial corridor versus legacy CBD constitutes the study's core comparative treatment: differences in satisfaction across the three sites are consistent with, though cannot definitively isolate, an effect of station-area planning quality itself, given that other unmeasured site differences were not statistically controlled. This selection mirrors the comparative logic used by Umair et al. (2025) in their study of Dwarka, where stations were purposively chosen to represent distinct land-use and connectivity profiles.

A stratified sampling framework was used to ensure coverage of pedestrians and daily commuters across the three areas. The required minimum sample size was determined using Cochran's formula for an unknown population, $n_0 = Z^2pq / e^2$, with a 95% confidence level ($Z = 1.96$), maximum variability ($p = q = 0.5$), and a margin of error of $e = 7.65\%$, yielding a minimum required sample of approximately 164 respondents the sample achieved in this study. The sample was allocated across the three catchments in approximate proportion to average daily pedestrian and paratransit footfall recorded during a one-week preliminary field observation at each site, so busier catchments (Mirpur 10 and Motijheel) received proportionally larger allocations than lower-footfall Uttara North. A total of 164 valid responses were collected: 60 from Mirpur 10 (36.6%), 57 from Motijheel (34.8%), and 47 from Uttara North Metro Station (28.7%). Because a complete list-based sampling frame was not available, individual respondents within each stratum were selected via systematic intercept sampling approaching every n -th eligible pedestrian or commuter passing each survey point during each shift rather than simple random sampling from a full population list. The sample is therefore best

characterised as representative by proportional stratified allocation, not by individual-level random selection, and this distinction should be borne in mind when generalising the findings. Respondents were approached at station entrances, footpaths, and paratransit boarding points during peak and off-peak hours to capture a broad, time-diverse cross-section of daily travel behaviour.

Data Collection Instrument

Primary data were collected through a structured questionnaire survey administered via face-to-face interviews, capturing three categories of information: (i) socio-demographic characteristics (age, gender, occupation, monthly household income); (ii) last-mile travel characteristics, including primary mode, distance to the final destination, travel time, and typical one-way cost; and (iii) satisfaction ratings across six dimensions: accessibility, affordability, comfort, convenience, safety, and infrastructure quality each on a five-point Likert scale (1 = Very Poor to 5 = Very Good), plus an overall rating. Two open-ended, multi-select items captured respondents' main challenges and top three preferred improvements. The instrument operationalizes the five satisfaction dimensions of the original study design, with infrastructure quality added as a sixth dimension to separately capture footpath, signage, and lighting conditions distinct from vehicle/service comfort.

Content and face validity were established through a two-stage expert review: the draft questionnaire was reviewed by three faculty members in the Department of Urban and Regional Planning, Jahangirnagar University, for construct relevance and item clarity, then piloted with 20 commuters at Mirpur 10 whose feedback simplified item wording and section order before full-scale administration; pilot responses were excluded from the final sample. Internal consistency of the six-item satisfaction scale, assessed via Cronbach's alpha ($N = 164$), was $\alpha = 0.83$, indicating good reliability; item-total correlations for all six dimensions exceeded 0.40, and no item's removal would have raised alpha above 0.83, supporting retention of all six dimensions.

Data Analysis Techniques

Data were analysed using a combination of descriptive and inferential statistical techniques appropriate for a predominantly quantitative research design:

1. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to characterize the socio-demographic profile, mode share, and travel characteristics of respondents.
2. One-way Analysis of Variance (ANOVA), with Tukey's Honestly Significant Difference (HSD) post-hoc test, was used to test whether satisfaction scores differed significantly across the three study areas for each of the six satisfaction dimensions and the overall satisfaction score.
3. Pearson correlation analysis was used to examine the strength and direction of association among the six satisfaction dimensions and overall satisfaction.
4. Multiple linear regression was used to model overall satisfaction as a function of the six satisfaction dimensions, in order to identify which dimensions most strongly predict overall commuter satisfaction with last-mile connectivity.
5. Chi-square test of independence was used to examine whether primary mode choice is significantly associated with study area.

All statistical analyses were performed using Python (pandas, SciPy, and statsmodels), with a significance threshold of $\alpha = 0.05$. Four responses had missing values

for the safety dimension and were excluded listwise from analyses involving that variable.

Prior to interpreting the inferential results, standard assumption checks were performed. Levene's test confirmed homogeneity of variance across the three areas for all dimensions except comfort and safety ($p < .05$); Welch-adjusted ANOVA for these two was consistent with the standard ANOVA in Table 2. Regression residuals approximated normality with no evidence of heteroscedasticity on visual inspection. Multicollinearity among the six predictors, assessed via variance inflation factors (VIF), ranged from 1.08 to 1.74 well below the threshold of 5 indicating multicollinearity is not a material concern.

Result and Discussion

Socio-Demographic Profile of Respondents

A total of 164 valid responses were analysed. Figure 2 shows the distribution of respondents across the three study areas, and Figure 3 summarizes the socio-demographic profile of the sample. The sample was 70.1% male ($n = 115$) and 29.9% female ($n = 49$), with a mean age of 30.7 years ($SD = 10.5$, range 18–60). Students constituted the largest occupational group (47.0%), followed by service holders (32.3%) and business owners (18.3%). In terms of monthly household income, 40.9% of respondents reported earnings below BDT 10,000, indicating that a substantial share of the sample belongs to lower-income groups for whom the affordability of last-mile travel is likely to be especially consequential.

Last-Mile Mode Choice and Travel Characteristics

Walking (44.5%) and rickshaws (42.7%) together account for the vast majority of primary last-mile trips, with leguna (4.9%), shuttle services (4.3%), and auto-rickshaws (3.7%) serving smaller shares (Figure 4). When multi-modal responses are considered, rickshaws were mentioned by 90 respondents and walking by 73, confirming that these two modes anchor last-mile travel across all three areas. However, mode share differs meaningfully by location (Figure 4): shuttle services were used exclusively by Mirpur 10 respondents (7 of 60), leguna appeared almost entirely in Motijheel (6 of 57) and marginally in Uttara North (2 of 47), while auto-rickshaws were most common in Mirpur 10. A chi-square test of independence confirmed that primary mode choice is significantly associated with study area ($\chi^2 = 25.68$, $df = 8$, $p = 0.001$), indicating that local land-use and paratransit supply conditions rather than uniform city-wide patterns shape last-mile mode choice.

Distance, time, and cost profiles further illustrate the burden of the last-mile leg (Figure 5). Over half of respondents (58.5%) must travel more than 500 metres to reach their final destination, including 33.5% travelling more than 2 km a distance that exceeds comfortable walking range and necessitates paratransit use. Correspondingly, only 10.4% of respondents complete their last-mile trip in under 5 minutes, while 23.2% require more than 20 minutes. Cost data show a bimodal pattern: 31.1% of respondents travel for free (walking), while an equal share (31.1%) pay between BDT 20–50 per one-way trip, and 8.5% pay more than BDT 100 a cost burden that is likely to be regressive given that over 40% of the sample reports monthly household income below BDT 10,000.

Table 1. Mean satisfaction scores (1 = Very Poor, 5 = Very Good) by dimension and study area

Study Area	Access.	Afford.	Comfort	Conven.	Safety	Infra.	Overall
Uttara North Metro Station	3.13	3.00	3.23	2.85	3.51	2.53	3.23
Mirpur 10	2.90	2.90	2.57	2.57	2.62	2.43	2.87
Motijheel	3.26	3.04	2.98	2.88	2.53	2.89	2.89
Full Sample ($N = 164$)	3.09	2.98	2.90	2.76	2.82	2.62	2.98

Table 2. One-way ANOVA results comparing satisfaction dimensions across the three study areas

Dimension	F-statistic	p-value	Significance
Accessibility	3.120	0.047	Significant ($p < 0.05$)
Affordability	0.346	0.708	Not significant
Comfort	8.524	<0.001	Significant ($p < 0.001$)
Convenience	2.068	0.130	Not significant
Safety	10.913	<0.001	Significant ($p < 0.001$)
Infrastructure	2.669	0.072	Marginal
Overall Satisfaction	3.305	0.039	Significant ($p < 0.05$)

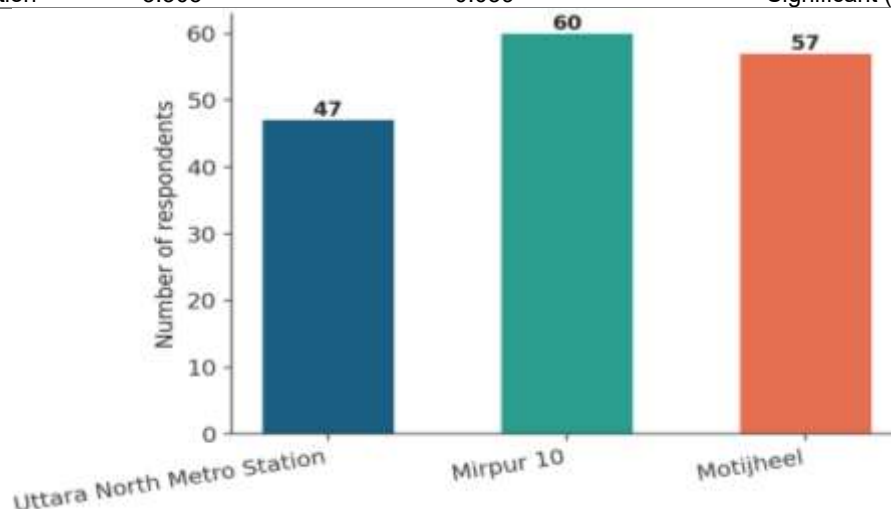


Figure 2. Distribution of survey respondents by study area ($N = 164$)

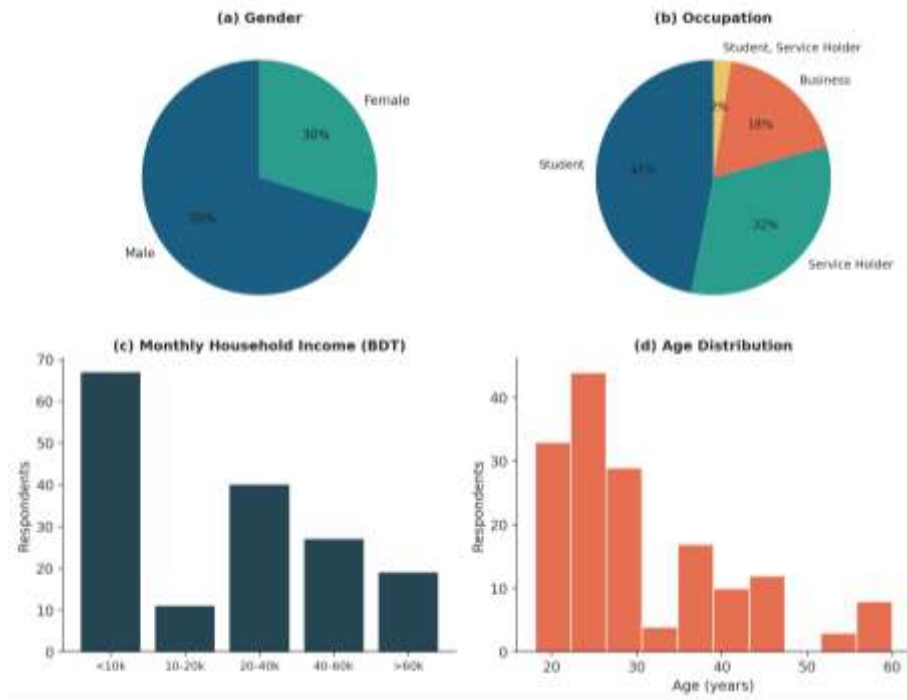


Figure 3. Socio-demographic profile of survey respondents: (a) gender, (b) occupation, (c) monthly household income, (d) age distribution

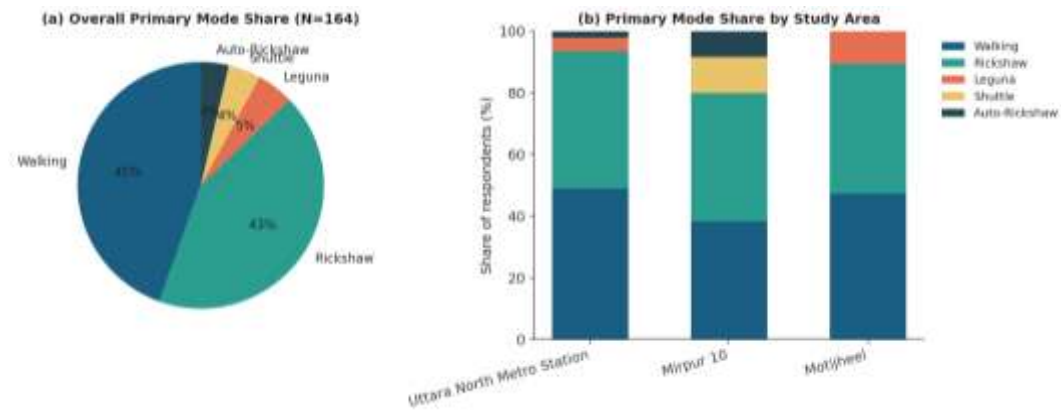


Figure 4. Primary mode used for last-mile connectivity: (a) overall mode share, (b) mode share by study area

Satisfaction with Last-Mile Connectivity

Table 1 presents mean satisfaction scores (on a 1–5 scale) across the six dimensions and overall satisfaction, disaggregated by study area. Across the full sample, infrastructure quality received the lowest mean rating (2.62), followed by convenience (2.76) and safety (2.82), while accessibility (3.09) and affordability (2.98) were rated comparatively more favourably. Overall satisfaction averaged 2.98 just below the scale midpoint indicating that, on balance, commuters across all three areas regard last-mile connectivity as no better than marginally adequate.

Clear differences emerge across the three areas. Uttara North Metro Station recorded the highest scores for comfort (3.23), safety (3.51), and overall satisfaction (3.23), consistent with its function as a purpose-built transit hub with more structured station-area infrastructure. Motijheel scored highest on accessibility (3.26) and infrastructure (2.89), reflecting its dense CBD footpath network, but recorded the lowest safety score (2.53) of the three areas plausibly linked to heavy mixed traffic in the central business district. Mirpur 10 recorded the lowest scores on four of the six dimensions (affordability, comfort,

convenience, and infrastructure) and the lowest overall satisfaction (2.87), suggesting that this dense residential-commercial corridor faces the most acute last-mile deficiencies among the three areas studied. (See Figure 6).

Inferential Analysis

One-Way ANOVA across Study Areas

One-way ANOVA tests were conducted to determine whether mean satisfaction scores differ significantly across the three study areas for each dimension (Table 2). Statistically significant differences were found for accessibility ($F = 3.12$, $p = 0.047$), comfort ($F = 8.52$, $p < 0.001$), safety ($F = 10.91$, $p < 0.001$), and overall satisfaction ($F = 3.31$, $p = 0.039$). Differences in affordability ($F = 0.35$, $p = 0.708$) and convenience ($F = 2.07$, $p = 0.130$) were not statistically significant, while infrastructure showed a marginal trend ($F = 2.67$, $p = 0.072$).

Tukey HSD post-hoc comparisons clarify where these differences lie. For accessibility, Mirpur 10 scored significantly lower than Motijheel (mean difference = -0.363 , $p = 0.038$). For comfort, Mirpur 10 scored significantly lower than both Motijheel (mean difference = -0.416 , $p = 0.024$)

and Uttara North (mean difference = -0.667 , $p < 0.001$). The safety dimension showed the sharpest divergence: Uttara North scored significantly higher than both Mirpur 10 (mean difference = 0.895 , $p < 0.001$) and Motijheel (mean difference = 0.985 , $p < 0.001$), while Mirpur 10 and Motijheel did not differ significantly from each other. For overall satisfaction, the difference between Mirpur 10 and Uttara North approached but did not reach conventional significance (mean difference = 0.367 , $p = 0.051$), suggesting a consistent, if not always statistically decisive, pattern of Uttara North outperforming Mirpur 10 across dimensions.

Correlation among Satisfaction Dimensions

Pearson correlation coefficients among the six satisfaction dimensions and overall satisfaction are presented in Table 3 and visualised in Figure 7. Overall satisfaction correlated most strongly with infrastructure quality ($r = 0.51$), comfort ($r = 0.51$), and safety ($r = 0.50$), followed by convenience ($r = 0.46$) and affordability ($r = 0.33$), with accessibility showing the weakest association ($r = 0.23$). Among the predictor dimensions themselves, comfort and convenience were most strongly correlated ($r = 0.58$), and comfort and safety were also moderately associated ($r = 0.48$), suggesting that these experiential dimensions of the last-mile journey tend to move together. Notably, infrastructure quality was essentially uncorrelated with accessibility ($r = -0.01$) and affordability ($r = 0.01$), indicating that the physical condition of footpaths, signage, and lighting operates as a largely independent dimension

of the last-mile experience, distinct from how easily or cheaply a mode can be accessed.

Multiple Linear Regression: Predictors of Overall Satisfaction

A multiple linear regression model was estimated with overall satisfaction as the dependent variable and the six satisfaction dimensions as independent variables (Table 4). As reported in Section 3.3, variance inflation factors for the six predictors ranged from 1.08 to 1.74 and residual diagnostics indicated approximate normality with no evidence of heteroscedasticity, confirming that the ordinary least squares assumptions are met. The model was statistically significant ($F(6,153) = 27.83$, $p < 0.001$) and explained 52.2% of the variance in overall satisfaction ($R^2 = 0.522$, Adjusted $R^2 = 0.503$).

Infrastructure quality emerged as the strongest predictor of overall satisfaction ($\beta = 0.262$, $p < 0.001$), followed by affordability ($\beta = 0.187$, $p = 0.001$) and safety ($\beta = 0.123$, $p = 0.007$). Comfort and convenience were also significant, positive predictors, while accessibility was not a statistically significant predictor once the other five dimensions were controlled for ($p = 0.183$) despite showing a positive bivariate correlation with overall satisfaction. This suggests that, although commuters can generally access some form of last-mile transport, the quality of the physical infrastructure they must navigate and the affordability of the options available exert the strongest independent influence on how satisfied they are with the journey overall.

Table 3. Pearson correlation matrix among last-mile connectivity satisfaction dimensions (N = 160)

Dimension	Access.	Afford.	Comfort	Conven.	Safety	Infra.	Overall
Accessibility	1.00	0.26	0.20	0.29	0.11	-0.01	0.23
Affordability	0.26	1.00	0.24	0.26	0.21	0.01	0.33
Comfort	0.20	0.24	1.00	0.58	0.48	0.23	0.51
Convenience	0.29	0.26	0.58	1.00	0.35	0.15	0.46
Safety	0.11	0.21	0.48	0.35	1.00	0.34	0.50
Infrastructure	-0.01	0.01	0.23	0.15	0.34	1.00	0.51
Overall	0.23	0.33	0.51	0.46	0.50	0.51	1.00

Table 4. Multiple linear regression predicting overall satisfaction ($R^2 = 0.522$, Adj. $R^2 = 0.503$, N = 160)

Predictor	Coefficient (β)	Std. Error	t-value	p-value
Constant	0.333	0.243	1.37	0.172
Accessibility	0.079	0.059	1.34	0.183
Affordability	0.187	0.054	3.48	0.001 **
Comfort	0.153	0.067	2.30	0.023 *
Convenience	0.138	0.062	2.23	0.027 *
Safety	0.123	0.045	2.75	0.007 **
Infrastructure	0.262	0.043	6.12	<0.001 ***

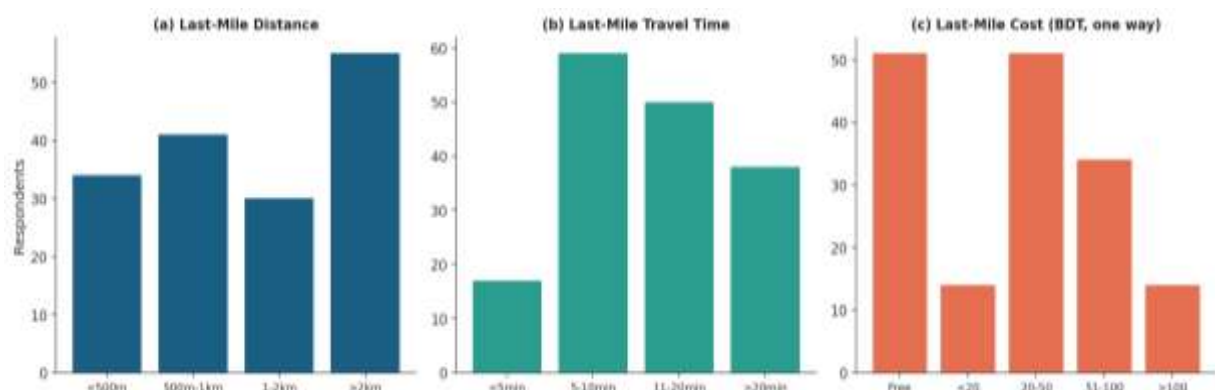


Figure 5. Distance, travel time, and cost of the last-mile trip: (a) distance to final destination, (b) last-mile travel time, (c) last-mile cost (BDT, one way)

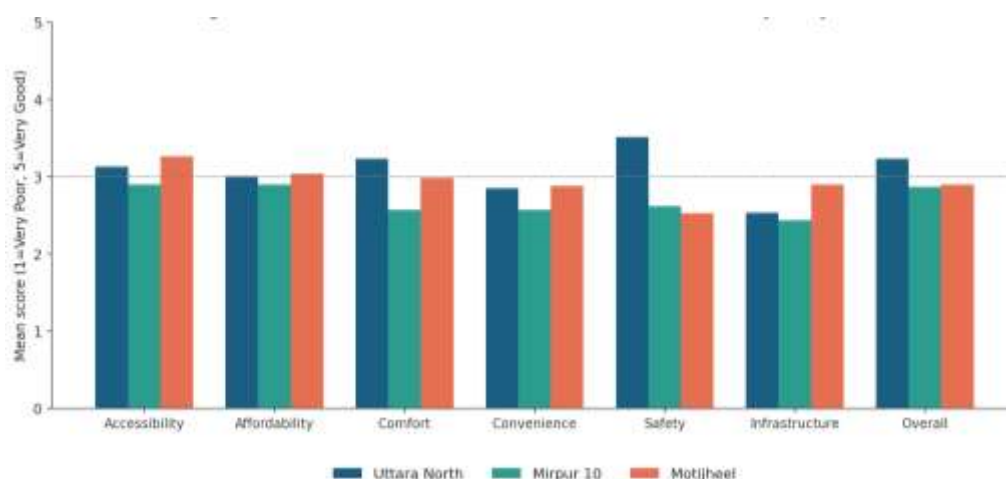


Figure 6. Mean satisfaction scores across six last-mile connectivity dimensions by study area

Challenges and Preferred Improvements

Respondents identified traffic congestion (59.1%), poor road conditions (48.2%), and unsafe areas (31.7%) as the three most commonly experienced challenges, followed by high travel cost (28.0%), absence of sidewalks/footpaths (23.8%), lack of public transport (22.0%), and unavailability of vehicles (18.9%) (Figure 8). These findings are broadly consistent with the safety and infrastructure deficits identified in the quantitative satisfaction analysis (Section 4.4), where these two dimensions recorded the lowest mean scores and the most significant inter-area variation.

When asked to select up to three preferred improvements, respondents overwhelmingly favoured better traffic management (88.4%), followed by enhanced safety measures such as policing and CCTV (45.7%), and improved walkways/footpaths (42.7%) (Figure 8). More street lighting (26.2%) and lower transport costs (25.6%) were also frequently selected, while digital solutions such as ride-sharing applications (23.2%) and integrated transport stops (23.8%) were comparatively less prioritized suggesting that respondents place greater immediate value on basic physical safety and infrastructure improvements than on technology-enabled service enhancements.

The findings of this study reinforce and extend the broader South Asian literature on last-mile connectivity while revealing patterns specific to Dhaka's evolving transit network. Consistent with Umair et al. (2025) in Dwarka Sub-city, New Delhi, this study finds that informal paratransit rickshaws, functioning analogously to Dwarka's e-rickshaws dominate last-mile mode share alongside walking. However, an important divergence emerges: whereas the Dwarka study found comfort, not fare, was the primary reason commuters avoided formal transit, the Dhaka sample places comparatively greater weight on cost (28.0% cite high travel cost as a challenge), likely reflecting the lower income profile of respondents, over 40% of whom report monthly household income below BDT 10,000. This suggests the comfort-over-cost ordering documented in Dwarka is conditional on income and paratransit formalisation: Dwarka's formalised e-rickshaw/app-cab market compresses fare differences enough for comfort to dominate choice, whereas Dhaka's informally priced, human-hauled rickshaw market leaves fare a binding constraint for lower-income riders, so affordability-sensitive interventions may carry greater importance in Dhaka than in wealthier catchments such as Dwarka.

The significant variation in satisfaction across the three study areas particularly for comfort, safety, and overall satisfaction underscores that last-mile connectivity in

Dhaka cannot be addressed through a single, city-wide policy. Uttara North's comparatively strong performance is consistent with its status as a purpose-built MRT station, echoing the TOD literature's emphasis on planned, mixed-use development around transit nodes. Read against the conceptual framework in Figure 1, this result is consistent with the TOD strand specifically: planning status, not merely density or footfall, may be an important contributing factor though, absent experimental manipulation or statistical control for other site differences, it cannot be isolated as the sole cause since Motijheel despite comparable or higher density and footfall than Mirpur 10 does not share Mirpur 10's uniformly low scores, while Uttara North, the only site with coordinated station-area design, is the only site outperforming on both comfort and safety simultaneously.

By contrast, Mirpur 10's consistently lower scores across comfort, convenience, and infrastructure point to high commuter density operating over inadequate, unplanned infrastructure a pattern also observed by Niger (2013) and corroborated by Khan and Tabassum's (2024) audit, which identified Mirpur's footpaths as narrow, discontinuous, and barrier-encumbered. Motijheel's distinctly low safety score, despite strong accessibility and infrastructure ratings, suggests footpath quality alone cannot ensure a safe last-mile experience in a CBD with heavy mixed traffic, consistent with Khan and Tabassum's (2024) finding of illegal parking and hawker encroachment there, and with Chowdhury and van Wee's (2020) finding that perceived safety, not just footpath condition, is often the binding constraint for vulnerable users.

The regression results carry direct planning implications: infrastructure quality and affordability rather than accessibility per se emerged as the strongest predictors, suggesting that simply ensuring some last-mile mode is available is not sufficient; walking-environment quality and cost-effectiveness ultimately determine whether commuters regard their journey favourably. This is the distinction service-quality theory predicts (Section 1.2): accessibility captures whether a service exists, while infrastructure quality and affordability capture the perceived-versus-expected performance gap identified as the true driver of satisfaction explaining why accessibility's positive bivariate correlation ($r = 0.23$) collapses to non-significance once experiential dimensions are controlled for. This aligns with Venter's (2020) argument that connection quality drives perceived transport quality, and supports Kanuri et al.'s (2019) call for treating last-mile infrastructure as a core transit-investment component.

The strong preference for traffic management and safety interventions over digital solutions (Section 4.5) suggests a

sequencing implication: while ride-sharing apps and digital ticketing are frequently proposed in the LMC literature (Pucher et al., 2004), Dhaka commuters prioritize foundational safety and infrastructure improvements first, likely generating larger short-term gains than technology-driven interventions better positioned as second-stage measures reinforced by regional feeder-mode research (Dhurai et al., 2023; Dube et al., 2023) and the safety-first pattern documented by Chowdhury and van Wee (2020) and Ahmed et al. (2019).

The road-safety dimension also merits attention. Islam et al. (2026) found behavioural and demographic factors strongly associated with road-crash severity in Dhaka, a risk falling disproportionately on pedestrians and non-motorized road users who dominate last-mile trips here. Read alongside Bailey et al. (2026) and Chowdhury and

van Wee (2020), the finding that safety was the most differentiated dimension across areas ($F = 10.91, p < .001$) suggests last-mile safety in Dhaka is grounded in demonstrable risk factors warranting targeted engineering and enforcement responses rather than awareness campaigns alone.

Some limitations should be acknowledged. The sample size ($N = 164$), though consistent with the minimum indicated by Cochran's formula (Section 3.1), is modest relative to the daily commuter population at each station, and the cross-sectional design captures a single point in time rather than seasonal variation. The study also relies on self-reported ratings and no parallel infrastructure audit, which future research combining this approach with Khan and Tabassum's (2024) audit methodology would usefully complement.

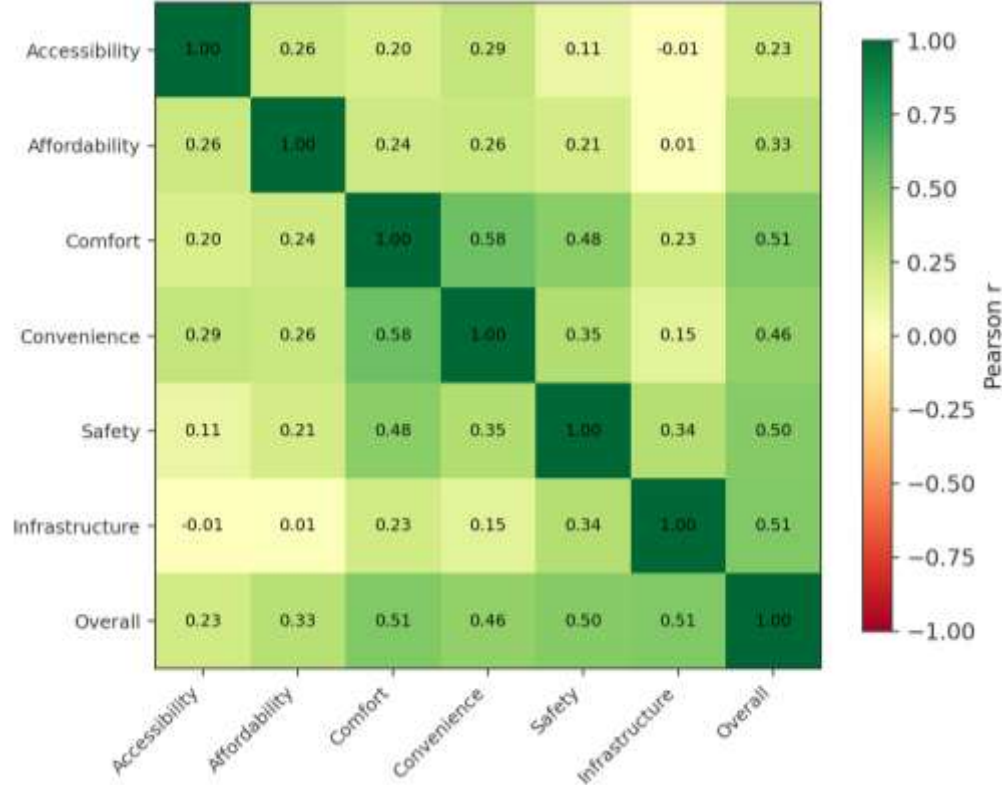


Figure 7. Correlation matrix among last-mile connectivity satisfaction dimensions

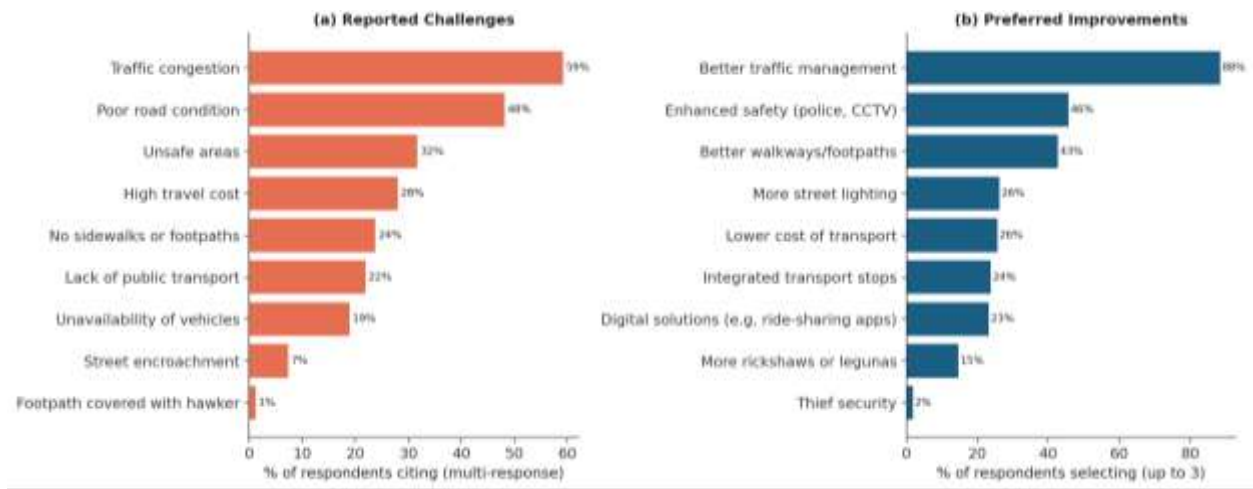


Figure 8. Commuter-reported challenges (a) and preferred improvements (b) for last-mile connectivity (multi-response, % of $N = 164$)

Conclusion

This study makes two contributions beyond its empirical findings. Methodologically, it is the first study of Dhaka's transit network to jointly measure commuter satisfaction across six last-mile dimensions at the immediate station-catchment scale rather than the suburban or infrastructure-audit scales used in prior Dhaka research and to model their relative predictive weight through regression, identifying infrastructure quality and affordability, rather than mode availability, as the dimensions Dhaka policymakers should prioritise first. Conceptually, by testing the TOD, accessibility, and service-quality frameworks (Section 1.2) against three catchments differing in planning status, the study provides comparative evidence consistent with an association between planned, TOD-aligned station environments (Uttara North) and higher commuter satisfaction relative to organically developed catchments (Mirpur 10, Motijheel). Because planning status was not experimentally manipulated and other site differences were not statistically controlled, this pattern should be read as an association rather than evidence that TOD-aligned design causally produces the satisfaction difference an association that, to date, existed only as audit-based or normative argument in the regional literature. Because the three sites were purposively selected to maximise contrast in planning status rather than to statistically represent Dhaka's transit network as a whole, city-wide generalizability is limited; findings are most directly transferable to station catchments in Dhaka and other South Asian megacities sharing comparable land-use and planning characteristics.

Empirically, using a structured survey of 164 commuters across Uttara North Metro Station, Mirpur 10, and Motijheel, the study finds that walking and rickshaws dominate last-mile mode choice, that a majority travel more than 500 metres and often more than 20 minutes to complete their last-mile journey, and that overall satisfaction remains moderate at best (mean = 2.98 of 5). Satisfaction varies significantly across the three areas, with Uttara North Dhaka's purpose-built metro hub outperforming Mirpur 10 and Motijheel on comfort and safety. Regression analysis identifies infrastructure quality and affordability as the strongest predictors, while traffic congestion, poor road conditions, and safety concerns are the most frequently cited barriers.

These findings confirm that Dhaka's continued investment in trunk transit infrastructure must be matched by station-specific last-mile infrastructure and paratransit regulation if ridership and equity goals are to be realized. A uniform, city-wide strategy is unlikely to be effective; interventions should instead be calibrated to each station catchment's land-use and infrastructure conditions.

Recommendations

Based on the empirical findings, the following area-differentiated recommendations are proposed. First, footpath and infrastructure rehabilitation should be prioritized in Mirpur 10 and Motijheel. Given that infrastructure quality was the strongest predictor of overall satisfaction and scored lowest in Mirpur 10 (2.43) and marginally low in Motijheel (2.89), continuous, well-lit, and obstruction-free footpaths should be developed in these corridors, alongside enforcement against street encroachment identified by 7% of respondents.

Second, targeted safety measures should be introduced in Motijheel and Mirpur 10. Given the significantly lower safety scores in these areas relative to Uttara North (safety mean 2.53–2.62 vs. 3.51), visible safety interventions including improved street lighting, designated pedestrian crossings, and traffic-calming measures at high-conflict intersections should be prioritized, consistent with the 45.7% of respondents who identified enhanced safety measures as a preferred improvement.

Third, traffic congestion should be addressed through demand and supply management. As the single most cited challenge (59.1%) and top preferred improvement (88.4%), traffic management interventions such as dedicated paratransit lanes, staggered signal timing near station entrances, and regulation of leguna and other informal vehicles should be prioritized at all three locations.

Fourth, fare-sensitive interventions merit consideration given the lower-income profile of the Dhaka sample. With over 40% of respondents reporting household income below BDT 10,000 and 28% citing high travel cost as a barrier, fare harmonization or subsidized paratransit passes for last-mile trips, particularly rickshaw fares in Mirpur 10 where affordability scored lowest (2.90), should be explored.

Fifth, Uttara North's transit-oriented design principles should be replicated at future MRT stations. Its comparatively strong performance across comfort, safety, and overall satisfaction suggests that purpose-built, TOD-aligned station-area design is associated with more favourable last-mile outcomes, although this association cannot be interpreted causally from the present comparative design. Design principles such as dedicated pedestrian zones, regulated paratransit bays, and integrated station facilities should inform planning for forthcoming MRT lines and stations.

Sixth, technology-enabled solutions should be sequenced after foundational infrastructure investment. Given that digital solutions and integrated transport stops were comparatively lower priorities for respondents than physical safety and infrastructure improvements, technology-driven interventions such as route information apps and digital ticketing should be treated as complementary, second-stage measures rather than substitutes for foundational infrastructure investment.

Finally, this survey methodology should be extended to future MRT stations. As Dhaka's metro network expands, replicating this station-level, commuter-survey approach combined with a parallel infrastructure audit would enable systematic, comparative monitoring of last-mile connectivity across the network and support evidence-based prioritization of station-area investment.

Author contributions

Shafiqul Hassan Shawon (Corresponding Author): conceived and designed the study, developed the survey instrument in consultation with the co-authors, performed all statistical analyses (descriptive statistics, one-way ANOVA with Tukey post-hoc tests, Pearson correlation, multiple linear regression, and the associated assumption diagnostics), interpreted the results, and drafted the original manuscript. Shormila Islam Peu: conducted the literature review and desk study underpinning the conceptual framework and Discussion, and contributed to structuring

the manuscript's theoretical grounding. Jawhar Jajrive and Nafis Hasnat Nibir: carried out the field data collection at the three study sites, including respondent recruitment and questionnaire administration, and reviewed the manuscript for accuracy and completeness. All four authors jointly contributed to writing, reviewing, and revising the manuscript, and have read and approved the final version submitted for publication.

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