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Public Transport Accessibility for SGSITS Students in Indore: A Data-Driven Analysis of Mode Share, Corridor-Level Travel Penalty, and First-/Last-Mile Friction

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***Abstract*—This study analyzes public transport accessibility for students of Shri G. S. Institute of Technology and Science (SGSITS), Indore, using the summary results of a commute survey of 642 student commuters. The data comprise mode shares for six travel modes, a five-corridor comparison of distance, transit time, two-wheeler time, daily cost, and convenience satisfaction, three first-/last-mile friction components, and nine headline indicators. Public transport and shared intermediate public transport (IPT) carry 52.3% of students (iBus BRTS 31.8%, AICTSL city bus 12.6%, shared auto/e-rickshaw 7.9%), personal two-wheelers carry 38.2%, and walking and cycling together carry 9.5%. Despite its high share, transit is slow: the median transit commute is 44 minutes against 21 minutes by two-wheeler (a ratio of 2.1), and the corridor-level transit-time penalty grows from 7 minutes near campus to 34 minutes in the outer peri-urban belt, about 2.0 additional minutes per kilometre of distance. Convenience satisfaction falls from 84.2% in the core campus vicinity to 26.4% in the outer peri-urban corridor, and it tracks median transit time ($r = -0.98$, $n = 5$) more closely than distance ($r = -0.91$). Transfer-junction waiting (13.8 minutes), home-to-first-stop walking (11.4 minutes), and terminal walking (7.2 minutes) are the reported friction components, and 68.2% of students consider subsidized transit essential while only 34.8% of transit users hold the AICTSL student pass. Because the data are published summary figures and not respondent-level records, the corridor analysis is exploratory. We present five figures and eight tables, and outline recommendations on first-/last-mile access, transfer coordination, corridor-targeted services, student fare support, and better data collection.**

***Index Terms*—Public transport accessibility, student commuting, mode share, first-/last-mile friction, iBus BRTS, Indore, transport equity, data visualization, exploratory data analysis.**

I. Introduction

Indore is one of central India's largest and fastest-growing cities, and its public transport system includes a bus rapid transit corridor (iBus BRTS), conventional city buses operated by AICTSL, and a large informal network of shared autos and e-rickshaws.

For students of a campus such as SGSITS, which draws young commuters from every part of the city, the quality of this network determines how much time and money a degree costs beyond tuition, and whether students without a personal vehicle can attend on equal terms.

Accessibility is more than the presence of a route. A student must walk to the first stop, wait, possibly transfer, ride, and walk again from the terminal to the campus gate, and every one of these stages adds time and uncertainty. Indicators such as median commute time, the time penalty relative to a private vehicle, daily cost, and reported convenience describe how well a corridor serves its riders, while the duration of first-/last-mile and transfer components describes where the journey loses time. A measure that helps a student living near the campus may do little for one living on the city's periphery, so these indicators need to be compared across origin corridors.

This study analyzes the summary data behind a student public transport survey at SGSITS, organized into the same views as the accompanying Power BI dashboard: headline indicators, commute mode share, journey friction, corridor travel time, and corridor distance and cost. We investigate: (1) what the overall commute profile of the surveyed students looks like; (2) how mode share divides between public transport, private motorized transport, and active travel; (3) how transit time, two-wheeler time, cost, and satisfaction differ across five origin corridors; (4) where in the journey time is lost through walking and waiting; and (5) what practical interventions the evidence supports.

The main contributions of this paper are: a reproducible exploratory analysis of the survey summary data using standard statistical tools; a set of baseline KPIs for student commuting; derived corridor indicators (time ratio, time penalty, effective speed, and cost per kilometre) that are not shown directly in the survey tables; a quantified description of how satisfaction declines with transit time; and a candid assessment of what summary-level data can and cannot support.

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II. Related Work

Transit quality is commonly assessed through service-level measures such as frequency, travel time, and reliability. The Transit Capacity and Quality of Service Manual [3] provides a standard framework for these measures, including the idea that the time a rider spends outside the vehicle, walking and waiting, is an integral part of service quality. Wardman [4] reviewed British evidence on public transport values of time and found that walking and waiting time are generally valued more highly by travellers than in-vehicle time, which explains why long access and transfer times weigh heavily on satisfaction.

Access to the network is a central determinant of use. Brons, Givoni, and Rietveld [5] showed that the quality of access to railway stations affects how many people choose rail, which supports the focus on first-/last-mile components here. Ewing and Cervero [6] synthesized a large body of studies and concluded that travel behaviour is related to the built environment, including distance to transit and the density and design of the surrounding area, supporting a corridor-by-corridor view of accessibility.

Finally, accessibility is an equity issue. Lucas [7] reviews how limited transport options can compound social disadvantage, since people who rely on slow or costly services have less access to education and employment. For students, the same logic suggests that the corridors with the longest, costliest, and least satisfying transit journeys deserve priority. Our data provide commute time, cost, and satisfaction together, which permits such a multi-dimensional view.

Open scientific Python tools [8]–[10] make the analysis reproducible and are used throughout this work.

III. Data And Methods

A. Dataset

The analysis uses the SGSITS Public Transport summary workbook [1], which was prepared as a Power BI import file from the figures of the submitted project report [2]. It contains four data sheets: ModeShare (6 rows), CorridorComparison (5 rows), JourneyFriction (3 rows), and HeadlineKPIs (9 rows), plus a ReadMe sheet. The workbook does not contain the 642 individual survey records; it holds published summary figures only, and it should not be treated as respondent-level data. The six mode percentages sum to exactly 100%. The five corridors are Core Campus Vicinity (under 3 km), Eastern Radial (Vijay Nagar / Sukhlia), Western Zone (Annapurna / Rajwada), Southern / AB Road (Bhanwarkuan / Rau), and Outer Peri-Urban (Bypass / Nipania / Kanadia). Because all values are aggregates, the analysis is descriptive, and every statistical association reported below is computed across five corridors.

B. Variables

The attributes fall into four groups: mode share, corridor performance, journey friction, and headline indicators. Table I lists them with their observed values.

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TABLE I
DESCRIPTION OF DATASET VARIABLES

Variable	Observed Range / Values	Interpretation
Primary Mode	6 modes	Main travel mode of a surveyed student
Share Percent	3.4 – 38.2 %	Share of surveyed commuters using the mode
Mode Group	3 groups	Public & IPT; private motorized; active non-motorized
Origin Corridor	5 corridors	Area of the city from which students commute
Estimated Distance	1.8 – 13.8 km	Estimated distance from corridor to campus
Median Transit Time	16 – 68 min	Median one-way commute time by public transport
Median Two-Wheeler Time	9 – 34 min	Median one-way commute time by two-wheeler
Daily Cost	Rs 15 – 55	Daily commuting cost reported for the corridor
Convenience Satisfaction	26.4 – 84.2 %	Share of students satisfied with convenience
Friction Component	3 components	Walking and waiting stages of a transit journey
Mean Duration	7.2 – 13.8 min	Mean time spent in each friction component

C. Preprocessing and Validation

The workbook was checked for missing values, duplicate rows, and internal consistency. No values were missing and no rows were duplicated. The three public and IPT modes sum to 52.3%, matching the headline indicator, the two-wheeler share equals the reported 38.2%, and walking and cycling sum to the reported active share of 9.5%. The corridor sheet reproduces the dashboard totals (estimated distance 38.7 km and daily cost Rs 170 summed over the five corridors). The dashboard's indicator for the AICTSL student pass (34.8%) is defined in the workbook as the share among transit users. One consistency issue was identified: the three friction components have means that add up to 32.4 minutes, while the median transit commute is 44 minutes and the friction share is reported as 57.9% of gross transit journey time. These figures probably use different aggregations (means versus medians, and different bases), so they are reported as separate metrics and no combined total is derived from them. No observations were removed.

D. Analytical Approach and KPIs

Analysis was carried out in Python using pandas [8] and SciPy [10] for aggregation and statistics, with matplotlib [9] for visualization.

We computed approximate respondent counts from mode shares (share multiplied by 642 and rounded), four derived corridor indicators, and Pearson and Spearman correlations and simple linear fits between corridor indicators and satisfaction. The derived indicators are: the time ratio (median transit time divided by median two-wheeler time), the time penalty (transit minus two-wheeler minutes), effective speed (estimated distance divided by median time, in km/h), and cost per kilometre (daily cost divided by estimated distance). Five primary Key Performance Indicators (KPIs) were established: Public & IPT Mode Share, Median Transit Commute Time, Transit-to-Two-Wheeler Time Ratio, Convenience Satisfaction by corridor, and Mean First-/Last-Mile and Transfer Time. With only five corridors, p-values are indicative only.

IV. RESULTS

A. Overall Commute Profile

The survey covers 642 student commuters. Public transport and shared IPT together carry 52.3% of them, personal two-wheelers carry 38.2%, and walking and cycling carry 9.5%. The median one-way transit commute is 44 minutes door to door, against a median of 21 minutes for a motorized two-wheeler, so a transit commuter spends 23 minutes more, or 2.1 times as long.

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The reported first-/last-mile friction share is 57.9% of the gross transit journey time. Only 34.8% of transit users hold the AICTSL student pass, whereas 68.2% of students consider subsidized transit essential.

If the sample were a simple random sample, the 95% margin of error on a share near 50% would be about ±3.9 percentage points; the actual sampling design is not documented. Table II summarizes the primary KPIs.

TABLE II
HEADLINE STUDENT COMMUTE KPIS

Dashboard KPI / Metric	Value	Baseline Context (SGSITS Survey, N=642)
Surveyed Student Commuters	642	Summary results only; no respondent-level records
Public & IPT Mode Share	52.3%	iBus BRTS 31.8%; city bus 12.6%; shared IPT 7.9%
Personal Two-Wheeler Share	38.2%	Motorcycles and scooters
Active Commute Share	9.5%	Walking 6.1%; bicycle 3.4%
Median Transit Commute Time	44 min	One-way, door to door
Median Two-Wheeler Commute Time	21 min	One-way, motorized two-wheeler
First/Last-Mile Friction Share	57.9%	Reported share of gross transit journey time
AICTSL Student Pass Adoption	34.8%	Among transit users
Subsidized Transit Seen as Essential	68.2%	Share of surveyed students

B. Commute Mode Share

Personal two-wheelers are the single most used mode (38.2%, about 245 students), followed closely by the iBus BRTS (31.8%, about 204 students). The AICTSL city bus (12.6%) and shared autos and e-rickshaws (7.9%) bring the public and IPT group to 52.3%, so public modes are used by a majority but are concentrated in one service: the iBus BRTS alone accounts for 61% of public and IPT users (31.8 of 52.3). Walking (6.1%) and cycling (3.4%) are marginal, together carrying fewer students than the city bus alone. Table III details the comparison and Fig. 1 visualizes the shares.

TABLE III
COMMUTE MODE SHARE OF SURVEYED STUDENTS (SORTED BY SHARE)

Primary Mode	Mode Group	Share	Approx. Students (of 642)
Personal two-wheeler	Private motorized	38.2%	245
iBus BRTS	Public & IPT	31.8%	204
AICTSL city bus	Public & IPT	12.6%	81
Shared auto/e-rickshaw (IPT)	Public & IPT	7.9%	51
Walking	Active non-motorized	6.1%	39
Bicycle	Active non-motorized	3.4%	22

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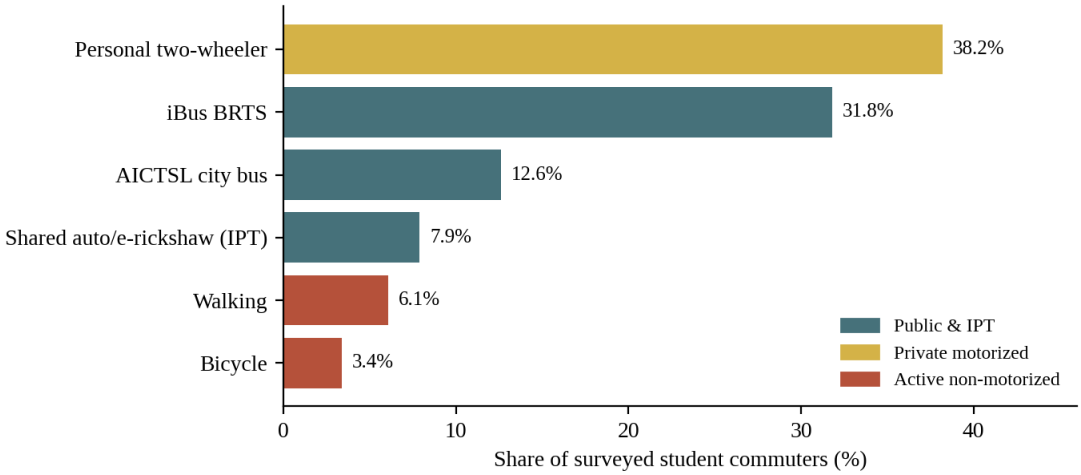


Fig. 1. Mode share of surveyed student commuters, coloured by mode group.

C. Corridor-Level Travel Time, Cost, and Satisfaction

Travel conditions deteriorate steadily with distance from campus (Table IV, Fig. 2). Near the campus, the median transit commute is 16 minutes, the two-wheeler commute is 9 minutes, the daily cost is Rs 15, and 84.2% of students are satisfied with convenience. In the outer peri-urban corridor, the corresponding values are 68 minutes, 34 minutes, Rs 55, and 26.4%.

The transit time rises by roughly 3.9 minutes per kilometre across corridors ($r^2 = 0.94$ against distance), and daily cost by about Rs 3.1 per kilometre ($r^2 = 0.98$). Satisfaction is above 60% only in the Core Campus and Eastern Radial corridors, and in all three remaining corridors, which together cover the western, southern, and outer areas, fewer than half of students are satisfied.

TABLE IV
TRAVEL TIME, COST, AND SATISFACTION BY ORIGIN CORRIDOR

Origin Corridor	Distance (km)	Median Transit (min)	Median Two-Wheeler (min)	Daily Cost (Rs)	Satisfaction (%)
Core Campus	1.8	16	9	15	84.2
Eastern Radial	6.5	38	20	30	62.5
Western Zone	5.2	42	19	28	48.1
Southern / AB Road	11.4	56	27	42	41.6
Outer Peri-Urban	13.8	68	34	55	26.4

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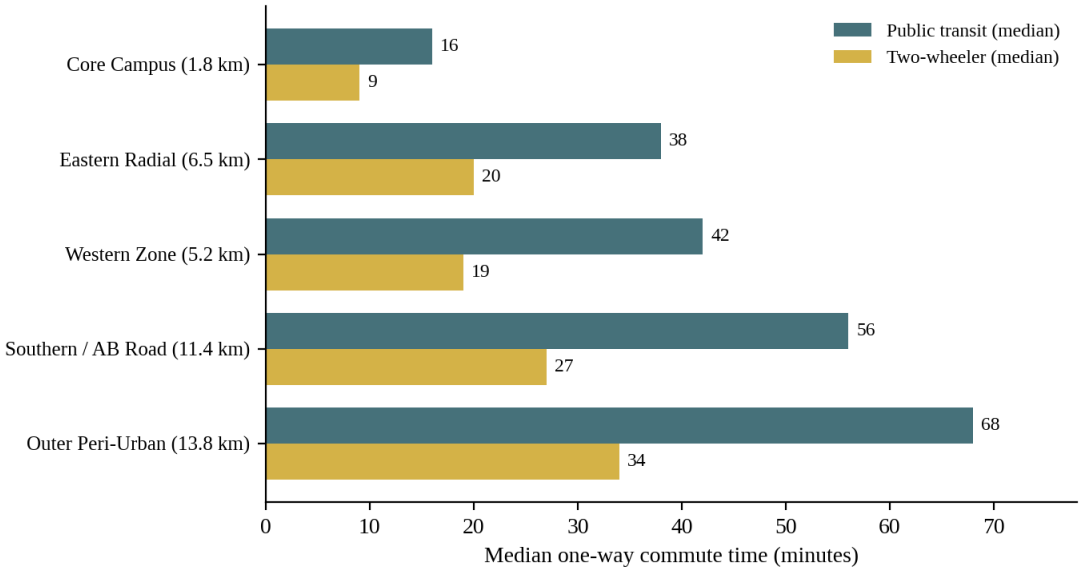


Fig. 2. Median one-way commute time by public transit and two-wheeler, by corridor.

D. Derived Corridor Indicators

Derived indicators (Table V) show that distance alone does not explain transit disadvantage. Transit takes between 1.78 and 2.21 times as long as a two-wheeler in every corridor; the ratio is lowest in the Core Campus Vicinity (1.78) and highest in the Western Zone (2.21), which is only 5.2 km from campus but has a 23-minute penalty, comparable to the Eastern Radial corridor's 18 minutes at 6.5 km.

The time penalty itself rises from 7 minutes (Core Campus) to 34 minutes (Outer Peri-Urban), about 2.0 minutes for each additional kilometre. Effective door-to-door transit speed is low everywhere, between 6.8 km/h (Core Campus, where walking and waiting dominate a short ride) and 12.2 km/h (Southern and Outer corridors), whereas two-wheelers average 12.0 to 25.3 km/h (Fig. 3). Cost per kilometre falls with distance, from Rs 8.33 near campus to Rs 3.68–3.99 on the two longest corridors, although the total daily cost still rises from Rs 15 to Rs 55.

TABLE V
DERIVED CORRIDOR INDICATORS

Origin Corridor	Time Ratio (Transit ÷ 2W)	Time Penalty (min)	Transit Speed (km/h)	Two-Wheeler Speed (km/h)	Cost per km (Rs)
Core Campus	1.78	7	6.8	12.0	8.33
Eastern Radial	1.90	18	10.3	19.5	4.62
Western Zone	2.21	23	7.4	16.4	5.38
Southern / AB Road	2.07	29	12.2	25.3	3.68
Outer Peri-Urban	2.00	34	12.2	24.4	3.99

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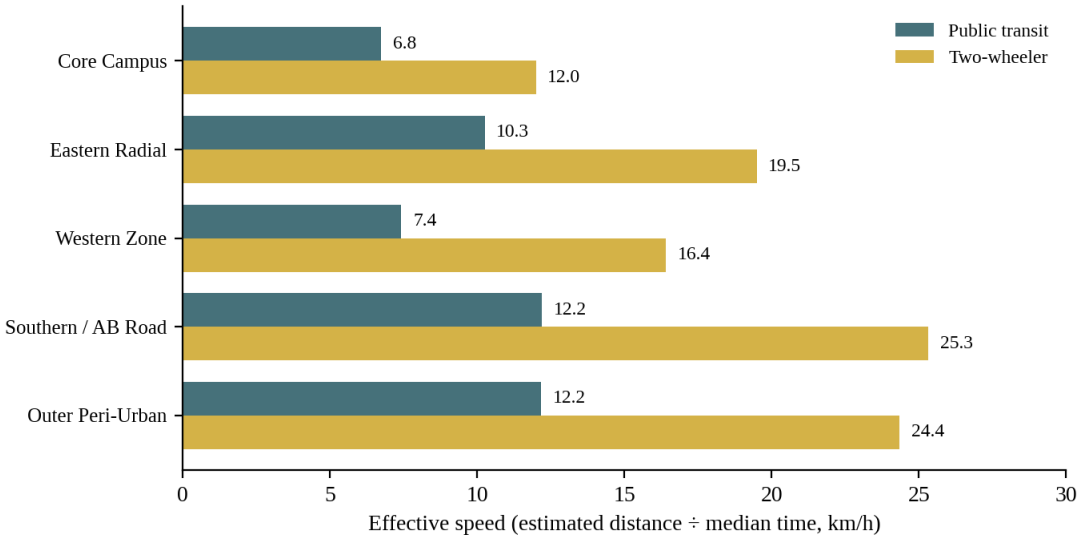


Fig. 3. Effective door-to-door speed by public transit and two-wheeler, by corridor.

E. First-/Last-Mile and Transfer Friction

Three components of the transit journey are reported. Waiting at transfer junctions is the longest (mean 13.8 minutes), followed by walking from home to the first stop (11.4 minutes) and walking from the terminal stop to the campus (7.2 minutes). Together the three components account for 32.4 minutes, of which transfer waiting is 42.6%, home-side walking 35.2%, and campus-side walking 22.2%.

The access walk at the home end is therefore 1.6 times as long as the walk at the campus end, and the single longest component is the one students can least control: time waiting for a connection. The reported friction share of 57.9% of gross journey time confirms that most of the transit journey is spent outside the vehicle, but, as noted in Section III-C, the component means are not directly additive with the 44-minute median. Table VI and Fig. 4 present the components.

TABLE VI
FIRST-/LAST-MILE AND TRANSFER FRICTION COMPONENTS

Friction Component	Mean Duration (min)	Share of Three Components	Where It Occurs
Transfer junction waiting	13.8	42.6%	Between routes or modes
Home to first stop walking	11.4	35.2%	Origin end of the journey
Terminal walking to campus	7.2	22.2%	Campus end of the journey

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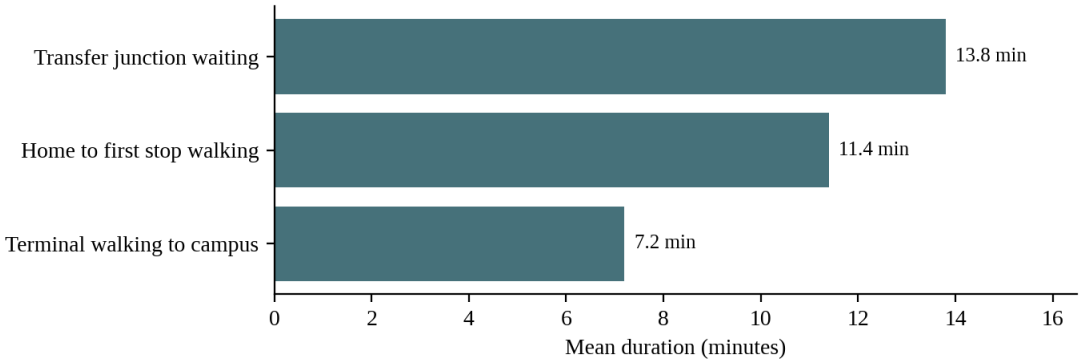


Fig. 4. Mean duration of first-/last-mile and transfer friction components.

F. Satisfaction and Its Correlates

Satisfaction falls consistently along every dimension of travel burden (Table VII, Fig. 5). Across the five corridors, convenience satisfaction is strongly and negatively correlated with median transit time ($r = -0.98$), the transit time penalty ($r = -0.99$), daily cost ($r = -0.94$), and estimated distance ($r = -0.91$). Satisfaction ranks perfectly in reverse order of transit time, but not of distance: the Western Zone is closer than the Eastern Radial corridor yet has a 14-point lower satisfaction (48.1% against 62.5%) because its transit time is longer (42 against 38 minutes).

A simple linear fit explains 96.8% of the variation in satisfaction by transit time but 83.6% by distance, with each additional minute of median transit time associated with a drop of about 1.1 percentage points in satisfaction. The time ratio ($r = -0.68$) and effective transit speed ($r = -0.75$) are weaker predictors, and cost per kilometre is positively associated with satisfaction ($r = 0.86$), simply because short, expensive-per-km trips are concentrated near the campus. With five observations these coefficients describe the corridors in this sample and should not be generalized.

TABLE VII
ASSOCIATION OF CORRIDOR INDICATORS WITH CONVENIENCE SATISFACTION (n = 5)

Corridor Indicator	Pearson r	Spearman ρ	p-value (indicative)
Estimated distance (km)	-0.91	-0.90	0.030
Median transit time (min)	-0.98	-1.00	0.002
Transit time penalty (min)	-0.99	-1.00	0.001
Daily cost (Rs)	-0.94	-0.90	0.017
Transit/two-wheeler time ratio	-0.68	-0.60	0.211
Cost per km (Rs)	0.86	0.80	0.062
Effective transit speed (km/h)	-0.75	-0.80	0.143

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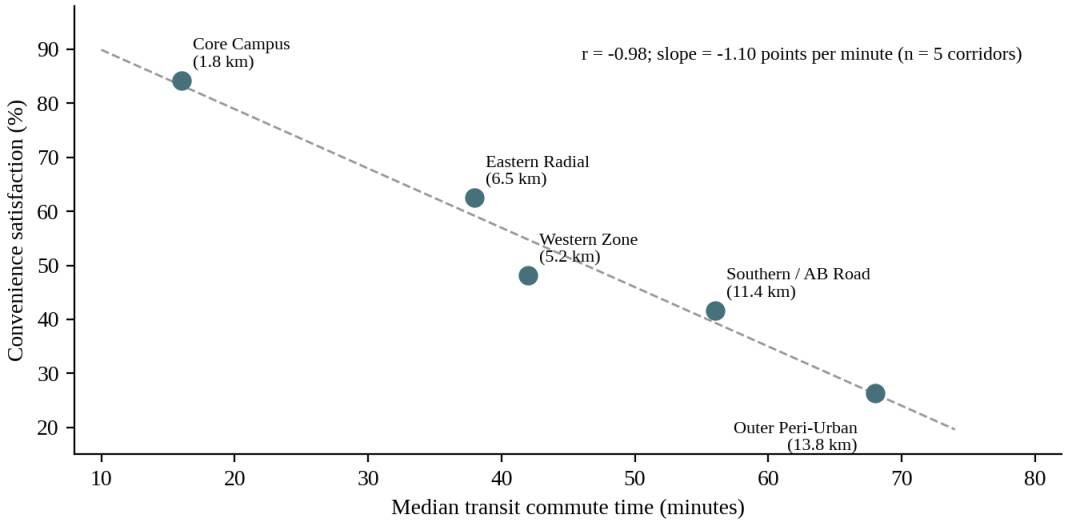


Fig. 5. Convenience satisfaction versus median transit commute time, by corridor.

V. Discussion

A. A Majority Mode That Is Slow

Public transport is already the choice of most surveyed students (52.3%), and the iBus BRTS alone carries almost a third. The problem is therefore not a lack of use but the quality of the journey: a transit commute takes about twice as long as the two-wheeler alternative in every corridor, and the 23-minute median penalty is a daily cost in time that students without a vehicle must bear. The fact that 38.2% still choose a two-wheeler suggests that students with access to one are willing to pay for the time saving, which is consistent with the finding that walking and waiting are weighted heavily by travellers [4].

B. Travel Burden Grows Faster Than Distance

Each additional kilometre adds about 3.9 minutes of transit time but only about 1.9 minutes of two-wheeler time (derived from the fit of two-wheeler time on distance), so the penalty widens with distance. At the same time, daily cost rises from Rs 15 to Rs 55 and satisfaction falls from 84.2% to 26.4%. The students who commute furthest therefore face the longest, most expensive, and least satisfying journeys, a combination that matches the pattern of compounding disadvantage described in the transport equity literature [7].

C. Why Transit Time Matters More Than Distance

Satisfaction tracks transit time ($r = -0.98$) more closely than distance ($r = -0.91$), and the Western Zone is the clearest example: it is nearer than the Eastern Radial and Southern corridors but is the slowest relative to a two-wheeler (time ratio 2.21). This suggests that route coverage and transfers, not distance as such, are the main source of dissatisfaction in that area. This is consistent with studies that find the quality of access and the built environment affects transit use [5], [6], and it points toward route-level review in the Western Zone as a priority independent of the long-distance corridors.

D. Friction Is Concentrated in Waiting and Access

The friction components identify where time is lost. Transfer waiting (13.8 minutes) is the longest single component, so timetable coordination and transfer design offer potentially the largest reduction per intervention, whereas the 11.4-minute walk to the first stop points to gaps in route coverage at the origin end. The reported 57.9% friction share supports the conclusion that out-of-vehicle time is the dominant part of the transit journey. The apparent difference between the 32.4 minutes of component means and the 44-minute median should be resolved in future data collection rather than interpreted here.

E. Implications for Practice

The most reliable signals in the data are the roughly twofold transit time penalty, the steady decline in satisfaction with transit time, and the weight of waiting and access time. Planners with limited resources should address transfers and first-mile access before adding capacity, and should target the Southern / AB Road, Outer Peri-Urban, and Western Zone corridors, where fewer than half of students are satisfied.

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The gap between student pass adoption (34.8% of transit users) and perceived need for subsidized transit (68.2%) indicates that fare support does not yet reach many of the students who want it.

VI. Limitations

This study has several limitations. First, the workbook contains published summary figures transcribed from a project report [2] and not the 642 individual responses, so no respondent-level analysis, confidence intervals, or significance tests for mode share are possible, and the corridor statistics are based on only five data points. Second, the sampling design of the survey is not documented, so the representativeness of the 642 students for the whole student body is unknown. Third, the metrics mix medians (commute times), means (friction components), and a share of gross journey time (57.9%); the components sum to 32.4 minutes against a 44-minute median, so they cannot be combined and the apparent discrepancy remains unresolved.

Fourth, corridor distances are estimates, and it is not stated whether they are straight-line or route distances, so derived speeds and cost per kilometre are approximate. Fifth, the basis of the daily cost (one-way or round trip, fare only or including access) and the exact wording of the satisfaction question are not documented. Sixth, the data have no route, stop, or time-of-day information and no geocoded origins, so spatial coverage, service frequency, and peak-hour effects cannot be analyzed; corridor comparison is used in place of a precise origin map. Finally, the analysis is correlational, self-reported, and cross-sectional, and it does not establish the causes of dissatisfaction.

Recommendations

Based on the evidence, we propose five actionable interventions for the city transport authority, the transit operators, and the institute:

1) Coordinate Transfers: Reduce the 13.8-minute mean wait at transfer junctions through synchronized timetables between the iBus BRTS and city bus routes, real-time arrival information at transfer points, and, where possible, direct services that avoid a transfer.

2) Improve First-Mile Access: Address the 11.4-minute walk to the first stop with feeder services or shared-IPT links into the main corridor, and with safe, shaded pedestrian routes to stops. Improve the 7.2-minute terminal walk to the campus with a stop or shuttle closer to the main gate.

3) Target the Low-Satisfaction Corridors: Prioritize direct or express services for the Outer Peri-Urban and Southern / AB Road corridors (68 and 56 minutes, 26.4% and 41.6% satisfaction), and review route coverage in the Western Zone, where transit takes 2.21 times as long as a two-wheeler over only 5.2 km.

4) Expand Student Fare Support: Raise awareness and coverage of the AICTSL student pass and consider an integrated student pass valid on the iBus BRTS, city buses, and partner IPT, since only 34.8% of transit users hold the pass while 68.2% of students consider subsidized transit essential.

5) Collect Better Data: Record respondent-level, geocoded origin data, stop and route files, time-of-day information, and consistent definitions of journey time, so that future analyses can model commute time and satisfaction at the individual level and evaluate interventions with before-and-after designs.

Table VIII Groups These Measures By Implementation Horizon.

TABLE VIII
SUGGESTED IMPLEMENTATION ROADMAP

Horizon	Measures	Target Indicator
Short term (0–1 year)	Transfer timetable coordination; real-time information; student pass awareness; improved survey design	Transfer waiting time; student pass adoption
Medium term (1–3 years)	Feeder links and pedestrian access; campus-gate stop or shuttle; Western Zone route review	Home-to-stop and terminal walking time; time ratio
Long term (3+ years)	Direct or express services on outer corridors; integrated student fare across modes	Median transit time; corridor satisfaction

VII. Conclusion

Public transport already serves most SGSITS students in the survey (52.3% use public or shared IPT modes), but the journey is slow, costly for those who live farthest away, and largely spent outside the vehicle. The median transit commute is 44 minutes against 21 minutes by two-wheeler, the penalty grows from 7 to 34 minutes across corridors, and convenience satisfaction falls from 84.2% near campus to 26.4% in the outer peri-urban belt, tracking transit time more closely than distance. Transfer waiting, first-mile walking, and terminal walking are the main friction components, and student fare support reaches only a minority of transit users. Transfer coordination, first-mile access, corridor-targeted services, and better fare support are therefore the most evidence-supported directions.

Future work should combine this survey with respondent-level geocoded origins, stop and route data, and time-of-day service information to build models of commute time and satisfaction and to measure route coverage directly. The KPI baselines established here provide a repeatable framework for monitoring future progress.

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