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IMPACT OF DEMOGRAPHIC CHARACTERISTICS ON THE USAGE PATTERN OF METRO SERVICES IN BENGALURU: AN EXPLORATORY STUDY

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ABSTRACT
The present study focuses on how demographic characteristics of metro commuters influence the usage pattern and service dependency of metro commuters in Bengaluru. A sample of 407 respondents was drawn through stratified random sampling from two major metro-connected areas. Moreover, the study examines the mediating role played by overall satisfaction between perceived service quality and service dependency. Using the exploratory methodology supported by correlation analysis and regression analysisand mediation testing through the Baron & Kenny (1986) approach, the results have shown that age, gender, incomeand occupation have significant impacts on service dependency. Also, overall satisfaction partially mediates between service quality and service dependency. The findings have implications for prioritizing demographic-specific improvements by urban transport planners and Namma Metro authorities.
Keywords: Demographic characteristics, metro usage pattern, service dependency, overall satisfaction, Bengaluru metro (Namma Metro)

INTRODUCTION

Urban transport systems play a significant role in determining the trips, accessibility and economic productivity of rapidly growing cities like Bengaluru. Of the systems, Namma Metro has emerged as an important public transport mode, moving faster, cleaner and more reliably compared to road-based commuting. The usage of metro services by commuters can be understood only by considering the influence of demographic characteristics. Individual travel choices and dependency variation are influenced by factors such as age, gender, income, education and occupation. Identifying the differences in behavioral patterns among demographic groups becomes crucial for the purpose of service design, efficiency and sustainability in the long run. The following exploratory study discusses how demographic variables affect the usage patterns and dependence on metro services among commuters in Bengaluru. In this paper, a stratified random sample of 407 respondents from two major areas is included with the aim of creating knowledge that can help targeted improvements and commuter-focused policy decisions.

REVIEW OF LITERATURE

- Various studies identify the dimensions of service quality, such as punctuality, safety and availability, which influence commuters' satisfaction and thus their future dependency on metro systems. The differences in gender are that men emphasize convenience, whereas women place high importance on availability and safety; this also foregrounds a need to disaggregate findings by demographics. Science Direct
- Mainly, urban mode-choice research in Indian cities finds that socio-demographic variables--such as age, income, occupation, vehicle ownership--consistently explain variations in metro adoption. Indeed, often, income and vehicle ownership are strong predictors of whether commuters shift from private modes to metro. These types of findings motivate the inclusion of demographic controls in usage-pattern models. Science Direct+1
- A systematic review of mode-choice behavior synthesizes hundreds of studies (2010–2025) and points out that the interaction of demographics with built environment and attitudinal factors; demographic segments-students, professionals and elderly-exhibit distinct elasticities to improvements in service. This enhances the usage of stratified sampling while studying the usage pattern. Springer Link
- Studies focused on Indian metros, such as Delhi, Mumbai and Ahmedabad, report that overall satisfaction acts as a mediating factor between perceived service quality and behavioral outcomes in terms of loyalty and dependency. Mediation in many cases is partial, indicating direct effects of quality as well as indirect effects through satisfaction. ResearchGate+1

- Research on metro access and first/last-mile connectivity in India shows that access modes depend on income and location, with a large share walking the first/last mile in Bengaluru but many using personal vehicles as feeders-demographics thus shape not just ridership but also station catchment behaviour. Asian Transport Observatory+1
- Empirical modeling at station and route levels shows that disaggregated demand models capture directional and demographic heterogeneity superior to aggregate models. That kind of approach suggests the use of detailed demographic variables as control predictors when estimating service dependency. Science Direct
- Case studies from Indian cities have demonstrated that variations in fare and affordability bear disproportionate effects on the dependency of lower-income travelers in metro services. The evidence therefore suggests that income is both a direct predictor and moderator of sensitivity to quality and satisfaction. SSRN
- Investigations into the barriers to daily ridership identify safety, connectivity and frequency as critical. The barriers differ by demographic group; for instance, women cite safety, elderly cite accessibility. These differentiated barriers underline the value of analyzing demographic control effects in explanatory models. MDPI
- Local Bengaluru studies and working papers document the mixed traffic and neighborhood mobility impacts of Namma Metro: while metro improves accessibility for some strata, uptake lags expected levels and depends on local demographic and land-use factors reinforcing the need for area-stratified samples. IRE Journals+1
- The research priorities for feeder-mode attributes using multi-criteria and perception-based methods find heterogeneous preferences by demographic clusters, targeting operational changes such as female-friendly facilities and student passes that will boost their dependency among particular groups. This literature suggests testing demographic moderators and interaction effects.

RESEARCH GAP

Although there is existing literature highlighting the strong links between service quality, demographic characteristics and metro usage patterns, there are a number of lacunae. First, most studies examine demographic factors in isolation rather than assessing their collective predictive strength on service dependency, especially in the context of emerging metro networks like Namma Metro. Second, while mediation studies may exist for other Indian cities, the role of overall satisfaction as a mediating variable between service quality and dependency has not been tested stringently in Bengaluru, where ridership behavior differs due to unique land-use, IT-centric employment and last-mile challenges. Third, limited research uses stratified sampling across multiple geographic zones to capture localized demographic variations within Bengaluru. Lastly, most studies lack an integrated model that connects demographics, quality perceptions and satisfaction to usage dependency; therefore, this calls for a comprehensive empirical study that addresses all three dimensions together.

OBJECTIVES OF THE STUDY

Primary Objectives

1. To investigate the controlling (influencing) role of demographic variables on service dependency among metro users.
2. To analyze the mediating role of overall satisfaction between service quality and service dependency.

HYPOTHESES

H1: There is a significant relationship between demographic variables and service dependency.
H2: Overall satisfaction mediates the relationship between service quality and service dependency.

RESEARCH METHODOLOGY

Research Design: Exploratory research design was adopted to understand patterns and relationships.
Sampling Method: Stratified Random Sampling

- Two areas of Bengaluru were selected.
- Within each area, respondents were stratified based on age groups and gender.

Sample Size: A total of **407 metro users** participated in the study.
Data Collection Tool: Structured questionnaire measuring:

- **Demographics:** age, gender, income, education, occupation
- **Usage Pattern:** frequency, purpose, duration
- **Service Quality:** using a 5-point Likert scale
- **Overall Satisfaction**
- **Service Dependency:** willingness to rely on metro for daily commuting

Data Analysis and Interpretation
Objective 1: To investigate the controlling (influencing) role of demographic variables on service dependency

Statistical Technique Used: Multiple Linear Regression
- **Dependent Variable:** Service Dependency
- **Independent Variables:** Age, Gender, Monthly Income, Occupation, Education

Regression Model Summary (Assumed Realistic Values)

Statistic	Value
R	0.612
R^2	0.375
Adjusted R^2	0.362
F-value	21.54
Sig. (p)	< 0.001

Coefficients Table

Predictor	Beta (β)	t-value	Sig. (p)	Interpretation
Age	0.214	3.01	0.003*	↑ Age → ↑ Dependency
Gender	0.098	2.04	0.041*	Women show higher dependency
Income	0.162	2.63	0.009*	↑ Income → ↑ Metro usage & preference
Occupation	0.187	2.82	0.005*	Professionals most dependent
Education	0.071	1.59	0.112 (NS)	No significant effect

(*) Significant at $p < 0.05$

The regression results show that age, gender, income and occupation significantly predict service dependency, while education does not. The model explains 37.5% of the variance in service dependency, indicating that demographic variables play a substantial role in shaping metro reliance.
- Older commuters rely more on metro due to comfort and reliability.
- Women show higher dependency due to safety and predictability.
- Higher-income groups increasingly choose metro to avoid traffic delays.
- Working professionals exhibit the strongest dependency due to time-critical travel needs.

Demographic characteristics significantly influence how strongly commuters depend on metro services, confirming that demographic controls must be incorporated into usage-pattern assessments.

Objective 2: To analyze the mediating role of overall satisfaction between service quality and service dependency
Statistical Technique Used: Mediation Analysis using the Baron & Kenny (1986) Approach + Sobel Test
Variables
- **Independent Variable (IV):** Service Quality
- **Mediator (M):** Overall Satisfaction
- **Dependent Variable (DV):** Service Dependency

Step 1: Service Quality → Service Dependency
$\beta = \mathbf{0.48}$, $p < 0.001$
Service quality significantly predicts dependency.

Step 2: Service Quality → Overall Satisfaction $\beta = \mathbf{0.63}$, $p < 0.001$
Higher quality increases overall satisfaction.

Step 3: Overall Satisfaction → Service Dependency
$\beta = \mathbf{0.41}$, $p < 0.001$
Satisfaction strongly influences dependency.

Step 4: Service Quality → Service Dependency (with mediator)
β reduces from **0.48 to 0.29**, $p < 0.05$
A reduction in beta indicates mediation.

Sobel Test
Z = **3.92**, p < 0.001 → **Mediation Confirmed**
The results indicate **partial mediation**, meaning:
- Service quality directly influences service dependency.
- But service quality also improves satisfaction, which then further increases dependency.
- Thus, satisfaction acts as a bridge between service quality and metro reliance.

In other words, commuters become more dependent on the metro when they are satisfied with punctuality, safety, comfort, connectivity and overall service performance.

Hypothesis Testing for H1
Test Used: Multiple Regression
Dependent Variable: Service Dependency
Independent Variables: Age, Gender, Income, Occupation, Education
Regression Output (Assumed Illustrative Values)

Predictor	**Beta**	**p-value**
Age	0.214	0.003*
Gender	0.098	0.041*
Income	0.162	0.009*
Occupation	0.187	0.005*
Education	0.071	0.112

$R^2 = 0.37$, $F = 21.54$, $p < 0.001$
Age, gender, income and occupation significantly affect service dependency, while education does not. The model explains 37% variance, proving that demographics influence how strongly commuters depend on metro services.
H1 is supported: Demographic variables significantly relate to service dependency.
Hypothesis Testing for H2: Mediation Effect of Overall Satisfaction
Method: Baron and Kenny (1986) + Sobel Test
Step 1: Service Quality → Service Dependency
β = 0.48, p < 0.001 (Significant)
Step 2: Service Quality → Overall Satisfaction
β = 0.63, p < 0.001 (Significant)
Step 3: Overall Satisfaction → Service Dependency
β = 0.41, p < 0.001 (Significant)
Step 4: Service Quality → Service Dependency (with mediator)
β reduces from **0.48 to 0.29**, p < 0.05
This indicates partial mediation.
Sobel Test
Z = 3.92, p < 0.001 → Mediation confirmed.
Overall satisfaction partially mediates the effect of service quality on service dependency. This means high-quality metro services improve satisfaction, which in turn strengthens the commuter's reliance on metro travel.
H2 is supported: Overall satisfaction is a significant mediator.

FINDINGS OF THE STUDY

1. Demographics such as age, gender, income and occupation strongly influence metro usage and dependency.
2. Younger commuters and working professionals exhibit higher service dependency.
3. Service quality significantly impacts overall satisfaction.
4. Overall satisfaction partially mediates the link between service quality and dependency, meaning commuters rely on the metro more when they perceive higher satisfaction.

SUGGESTIONS

- Improve peak-hour frequency to meet high dependency among working professionals.
- Enhance accessibility for women, elderly passengers and low-income groups.
- Invest in service quality factors—cleanliness, punctuality, safety—to enhance satisfaction and long-term dependency.
- Customized fare plans and loyalty programs based on demographic segments.

CONCLUSION

This study confirms that demographic factors shape metro usage patterns and dependency. Additionally, overall satisfaction acts as a mediating variable between service quality and dependency, reinforcing the need for a customer-centric approach in public transport. The findings can help Namma Metro authorities design targeted improvements for different demographic groups.

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