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Sustainable Urban Transport: The Role of Public Transportation Quality in Reducing Private Vehicle Dependence

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Abstract

Sustainable urban transport has become a critical priority for cities worldwide as rapid urbanization and increasing mobility demand intensify traffic congestion, environmental pollution, and energy consumption. One of the major challenges faced by urban transportation systems is the growing dependence on private vehicles, which contributes significantly to greenhouse gas emissions and urban mobility inefficiencies. In response to these challenges, improving public transportation systems has been widely recognized as an essential strategy for promoting sustainable urban mobility. This study examines the role of public transportation quality in reducing private vehicle dependence among urban commuters. Using a quantitative research approach, data were collected from 312 urban commuters through a structured questionnaire survey. The study employed Structural Equation Modelling (SEM) to analyse the relationship between perceived public transportation quality and private vehicle dependence. Public transportation quality was measured through several dimensions, including reliability, accessibility, comfort, safety, and service frequency.

The results indicate that public transportation quality has a significant negative effect on private vehicle dependence. This finding suggests that improvements in service quality can encourage commuters to shift from private vehicles to public transportation. In particular, reliable and accessible services, along with improved passenger comfort and safety, play a crucial role in shaping transportation mode choices. This study contributes to the literature on sustainable urban mobility by providing empirical evidence that enhancing public transportation quality can effectively reduce reliance on private vehicles. The findings also offer important policy implications for urban planners and transportation authority's seeking to develop more sustainable and efficient urban transportation systems.

Keywords: *Sustainable Urban Transport; Public Transportation Quality; Private Vehicle Dependence; Urban Mobility; Sustainable Transportation; Transportation Behaviour.*

Introduction

Urban transportation has become one of the most critical challenges in achieving sustainable urban development in the twenty-first century. Rapid urbanization, population growth, and increasing economic activities have significantly intensified the demand for mobility within cities. As urban populations expand, transportation systems are required to accommodate higher travel demand while simultaneously addressing environmental sustainability, social equity, and economic efficiency. According to the United Nations, more than 55 percent of the world's population currently resides in urban areas, and this number is projected to reach nearly 68 percent by 2050. This rapid urban expansion inevitably increases the complexity of transportation systems and intensifies pressure on urban infrastructure. One of the most visible consequences of urban growth is the substantial increase in private vehicle ownership. The accessibility of private vehicles, combined with rising incomes and urban sprawl, has led to a transportation paradigm heavily dominated by private mobility. In many cities, particularly in developing countries, motorcycles and private cars have become the primary mode of daily transportation. While private vehicles offer flexibility and convenience, excessive reliance on them has resulted in numerous urban challenges such as severe traffic congestion, air pollution, energy consumption, and declining urban environmental quality [1].

Traffic congestion has become a major problem in metropolitan areas around the world. Prolonged travel times, reduced productivity, and increased stress levels among commuters are among the direct consequences of congestion. In addition, the environmental impact of high private vehicle usage is substantial. The transportation sector is responsible for a significant proportion of global greenhouse gas emissions. Reports from the International Energy Agency indicate that the transportation sector contributes approximately one-quarter of global energy-related carbon dioxide emissions, making it one of the largest contributors to climate change. Consequently, reducing reliance on private vehicles has become a critical component of sustainable urban transport policies. Sustainable urban transport aims to create transportation systems that are environmentally friendly, socially inclusive, and economically efficient. In this context, public transportation is widely recognized as one of the most effective solutions for reducing private vehicle dependence and promoting sustainable mobility. High-capacity public transport systems such as buses, metro systems, light rail, and bus rapid transit can transport large numbers of passengers efficiently while consuming less energy and producing fewer emissions per capita compared to private vehicles [2]. Furthermore, well-developed public transportation systems can enhance accessibility to employment, education, and public services, thereby supporting inclusive urban development.

However, the effectiveness of public transportation in reducing private vehicle dependence largely depends on the quality of services provided. Public transportation quality is a multidimensional concept that encompasses various attributes, including reliability, service frequency, travel time, accessibility, safety, comfort, and affordability. These attributes significantly influence passengers' perceptions and their willingness to choose public transportation over private vehicles. Previous studies have demonstrated that improvements in service quality can increase user satisfaction and encourage modal shifts from private vehicles to public transit [3]. User perception plays a particularly important role in transportation mode choice. Even when public transportation infrastructure exists, individuals may still prefer private vehicles if public transport services are perceived as inconvenient, unreliable, or uncomfortable. Therefore, transportation planners must not only focus on infrastructure development but also on improving service quality and customer experience. Research by [4] highlights that factors such as punctuality, information availability, cleanliness, and accessibility strongly influence passengers' satisfaction with public transportation systems.

In addition, public transportation systems that provide integrated, reliable, and comfortable services are more likely to attract private vehicle users. A comprehensive review by [5] identifies several key factors that encourage car users to shift toward public transport, including reduced travel time, high service frequency, reliability, affordability, and improved accessibility to stations. When these quality attributes are effectively implemented, public transportation can become a competitive alternative to private vehicle use. Despite significant investments in public transportation infrastructure across many cities, private vehicle dependence remains high in numerous urban areas. This phenomenon indicates that infrastructure development alone may not be sufficient to influence travel behaviours. Behavioural change in transportation requires not only physical infrastructure but also improvements in perceived service quality, convenience, and overall travel experience. Therefore, understanding the relationship between public transportation quality and private vehicle dependence is essential for designing effective urban transport policies.

Furthermore, the transition toward sustainable mobility is closely linked to broader global sustainability agendas such as the Sustainable Development Goals (SDGs), particularly Goal 11, which aims to make cities inclusive, safe, resilient, and sustainable. Efficient public transportation systems can significantly contribute to achieving this goal by reducing congestion, improving air quality, and enhancing mobility accessibility for all citizens. Given these challenges and opportunities, it is crucial to investigate the role of public transportation quality in influencing individuals' transportation choices. Improving the quality of public transport services may serve as a

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strategic approach to reduce private vehicle dependence and promote sustainable urban mobility. This study therefore aims to examine the relationship between public transportation quality and private vehicle dependence within the broader framework of sustainable urban transport.
Specifically, this research seeks to analyse how various dimensions of public transportation service quality affect individuals' willingness to shift from private vehicles to public transit. By exploring this relationship, the study contributes to the growing body of literature on sustainable transportation and provides empirical insights that can assist policymakers, urban planners, and transportation authorities in designing more effective strategies for promoting sustainable urban mobility. Ultimately, enhancing public transportation quality is expected to play a crucial role in transforming urban mobility patterns. By encouraging greater public transport usage, cities can reduce congestion, lower greenhouse gas emissions, and improve the overall quality of urban life. Therefore, understanding the dynamics between transportation service quality and travel behaviour is essential for developing sustainable and resilient urban transportation systems in the future.

Literature Review and Hypotheses Development

Sustainable Urban Transport

Sustainable urban transport has emerged as a central concept in contemporary urban planning and transportation studies. The concept emphasizes the development of transportation systems that balance environmental protection, economic efficiency, and social equity. Sustainable mobility aims to ensure that transportation systems meet current mobility needs without compromising the ability of future generations to meet their own needs. According to United Nations, sustainable urban transport plays an essential role in achieving inclusive and environmentally responsible urban development. The rapid growth of cities worldwide has intensified transportation-related challenges, including congestion, pollution, and energy consumption. Scholars argue that traditional transportation models cantered on private vehicle usage are no longer sustainable in densely populated urban areas [1]. Excessive dependence on private vehicles increases greenhouse gas emissions, exacerbates urban air pollution, and contributes to inefficient land use. Therefore, sustainable transportation strategies increasingly emphasize the promotion of public transportation, non-motorized transport, and integrated mobility systems.

Public transportation is widely recognized as a cornerstone of sustainable urban mobility. Compared to private vehicles, public transport systems consume less energy per passenger and generate significantly lower carbon emissions. Reports from the International Energy Agency indicate that improving public transportation systems can substantially reduce energy consumption and greenhouse gas emissions within the transportation sector. Consequently, strengthening public transport systems has become a key policy objective in many urban sustainability initiatives. However, the effectiveness of public transportation in promoting sustainable mobility largely depends on its ability to attract and retain users. In many urban areas, individuals still prefer private vehicles due to perceived advantages such as flexibility, convenience, and comfort. Therefore, improving the quality and attractiveness of public transportation services is critical for encouraging a modal shift from private vehicles to public transport.

Public Transportation Quality

Public transportation quality refers to the overall performance of public transit services as perceived by passengers. It encompasses various operational and experiential attributes that influence user satisfaction and travel behaviour. Service quality in public transportation is typically measured through multiple dimensions, including reliability, punctuality, accessibility, comfort, safety, information availability, and service frequency [3]. Reliability and punctuality are among the most critical attributes affecting passengers' perceptions of public transportation. Travelers expect transit

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services to operate according to scheduled times and to provide predictable travel durations. When public transportation systems frequently experience delays or inconsistencies, passengers may perceive them as unreliable and opt for alternative modes of transportation, particularly private vehicles [4].

Accessibility is another key dimension of public transportation quality. Accessibility refers to the ease with which passengers can reach transit stations, obtain travel information, and complete their journeys efficiently. Transportation systems that provide convenient access to stations, integrated ticketing systems, and user-friendly travel information tend to attract more users. In addition, comfort and safety play significant roles in shaping passengers' travel experiences. Clean vehicles, adequate seating, air conditioning, and perceived security contribute to positive travel experiences and increase the likelihood of repeated public transport usage. Research has consistently shown that higher levels of service quality led to greater passenger satisfaction and increased public transportation usage. When passengers perceive public transportation as reliable, comfortable, and convenient, they are more likely to adopt it as their primary mode of transportation. Therefore, improving public transportation quality is widely regarded as a key strategy for enhancing the competitiveness of public transit systems.

Private Vehicle Dependence

Private vehicle dependence refers to a transportation pattern in which individuals rely heavily on private vehicles such as cars and motorcycles for their daily mobility needs. This dependence is often influenced by several factors, including urban spatial structure, socioeconomic conditions, transportation infrastructure, and the perceived attractiveness of alternative transport modes [2]. High levels of private vehicle dependence are associated with numerous urban problems, including congestion, environmental degradation, and inefficient land use. In many cities, increasing vehicle ownership has outpaced the expansion of road infrastructure, resulting in severe traffic congestion and longer commuting times. Additionally, private vehicles contribute significantly to urban air pollution and carbon emissions, which negatively affect public health and environmental sustainability.

Reducing private vehicle dependence has therefore become a key objective in sustainable urban transport policies. Governments and urban planners have implemented various strategies to address this issue, including congestion pricing, parking restrictions, and investments in public transportation infrastructure. However, research suggests that behavioural change in transportation requires more than regulatory measures; it also depends on providing attractive alternatives that meet travellers' mobility needs [5].

Public Transportation Quality and Private Vehicle Dependence

The relationship between public transportation quality and private vehicle dependence has received considerable attention in transportation research. A high-quality public transportation system can serve as a viable alternative to private vehicle use by offering efficient, reliable, and comfortable travel options. When public transit services meet passengers' expectations, individuals are more likely to shift from private vehicles to public transportation. Several empirical studies have demonstrated that improvements in service quality can significantly influence transportation mode choice. For example, research by [3] shows that service attributes such as reliability, travel time, and comfort significantly affect passenger satisfaction and transit usage. Similarly, [5] found that high service frequency, reduced travel time, and improved reliability are key factors that encourage car users to switch to public transportation.

In addition, passenger perceptions play an important role in shaping travel behaviour. Even when public transport infrastructure is available, individuals may continue using private vehicles if public transit services are perceived as inconvenient or unreliable. Therefore, improving the perceived

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quality of public transportation services is essential for influencing travel behaviour and promoting sustainable mobility. From a theoretical perspective, transportation mode choice can be explained through behavioural decision-making frameworks, where individuals evaluate the costs and benefits associated with different travel modes. When public transportation provides comparable or superior benefits such as lower travel costs, reduced travel time, and higher convenience individuals are more likely to adopt it as their primary transportation mode.

Based on these arguments, improving the quality of public transportation services is expected to reduce individuals' reliance on private vehicles. High-quality transit systems can provide attractive alternatives that encourage commuters to shift from private cars or motorcycles to public transportation.

Hypothesis Development

Based on the theoretical and empirical discussions above, this study proposes that the quality of public transportation services plays a significant role in influencing individuals' transportation choices. When public transportation systems provide reliable, accessible, comfortable, and safe services, they become more attractive alternatives to private vehicle usage. Improved service quality enhances passengers' satisfaction and increases their willingness to use public transportation regularly. As a result, individuals who perceive public transportation as efficient and convenient are more likely to reduce their reliance on private vehicles. Therefore, the following hypothesis is proposed:

H1: Public transportation quality has a significant negative effect on private vehicle dependence.

This hypothesis suggests that higher levels of perceived public transportation quality will lead to lower levels of private vehicle dependence among urban residents. Testing this hypothesis will provide empirical insights into the role of service quality in promoting sustainable urban mobility.

Research Methodology

Research Design

This study adopts a quantitative research approach to examine the relationship between public transportation quality and private vehicle dependence within the context of sustainable urban transport. Quantitative methods are widely used in transportation and urban planning research because they allow researchers to test theoretical relationships between variables using statistical analysis [6]. The research design used in this study is explanatory research, which aims to explain the causal relationship between independent and dependent variables through hypothesis testing. Specifically, this study investigates whether perceived public transportation quality influences individuals' dependence on private vehicles. The study employs a cross-sectional survey design in which data are collected from respondents at a single point in time. This approach is commonly used in transportation behaviour studies to analyse perceptions, attitudes, and travel preferences among urban commuters [2].

Population and Sample

The population of this study consists of urban residents who regularly travel within metropolitan areas and have experience using both private vehicles and public transportation. Urban commuters are selected as the target population because they represent the primary users of urban transportation systems and are directly affected by transportation service quality. Due to the large and diverse nature of urban populations, this study employs a sampling technique to obtain representative respondents. A purposive sampling method is used to select individuals who meet specific criteria, namely: Individuals who commute regularly within the city, Individuals who have experience using public transportation services, Individuals who own or have access to private vehicles such as cars or

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motorcycles. Based on recommendations for multivariate statistical analysis, particularly Structural Equation Modelling (SEM), the minimum sample size typically ranges between 200 and 400 respondents to ensure statistical reliability and validity [7]. Therefore, this study targets approximately 250–400 respondents to provide sufficient statistical power for the analysis.

Data Collection Procedure

Primary data for this research are collected through a structured questionnaire survey. The questionnaire is designed to measure respondents' perceptions of public transportation quality and their level of dependence on private vehicles. Surveys are widely used in transportation research because they enable researchers to gather large amounts of data related to travel behaviour and service perceptions efficiently [4]. The questionnaire is distributed using both online and offline methods to increase response rates and reach diverse groups of respondents. Online surveys may be distributed through digital platforms such as email and social media, while offline surveys may be conducted in transportation hubs such as bus terminals, train stations, or public transit stops. All questionnaire items are measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert scale is commonly used in social science research because it allows respondents to express varying degrees of agreement or disagreement with specific statements.

Measurement of Constructs

This study includes two main variables: public transportation quality as the independent variable and private vehicle dependence as the dependent variable.

Public transportation quality refers to passengers' perceptions of the overall performance of public transit services. Based on previous studies [3] ; [5], this variable is measured through several indicators, including: Reliability consistency of service schedules and punctuality, Accessibility ease of reaching stations and obtaining travel information, Comfort cleanliness, seating availability, and overall travel comfort, Safety and security passengers' perceptions of safety during travel, Service frequency availability of services within reasonable time intervals. These indicators reflect the key dimensions commonly used to evaluate public transportation service quality.

Private vehicle dependence refers to the extent to which individuals rely on private vehicles for their daily mobility needs. Following transportation behaviour literature [2], this variable is measured using several indicators: Frequency of private vehicle use for daily travel, Preference for private vehicles over public transportation, Perceived convenience of private vehicles compared to public transport, Willingness to switch to public transportation if service quality improves. Higher values on these indicators indicate a stronger level of dependence on private vehicles.

Data Analysis Technique

The data collected in this study are analysed using Structural Equation Modelling (SEM). SEM is an advanced statistical technique that allows researchers to examine complex relationships between latent variables simultaneously [8]. This method is particularly suitable for this study because it enables the testing of causal relationships between perceived public transportation quality and private vehicle dependence. The data analysis process consists of several stages: Descriptive analysis is conducted to summarize respondents' demographic characteristics and provide an overview of their transportation behaviour; Reliability testing is performed using Cronbach's alpha to ensure the internal consistency of measurement items. Construct validity is assessed using confirmatory factor analysis (CFA), The measurement model is evaluated to determine whether the observed indicators accurately represent the latent variables, The structural model is analysed to test the hypothesized relationship between public transportation quality and private vehicle dependence, Hypothesis testing is conducted by examining the significance of path coefficients and their associated p-values. A

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hypothesis is considered supported if the p-value is less than 0.05. The analysis is conducted using statistical software commonly used in SEM analysis, such as AMOS, LISREL, or Smart PLS.

Ethical Considerations

This study ensures that all respondents participate voluntarily and that their responses remain confidential. Respondents are informed about the purpose of the research before completing the questionnaire. Personal information is not collected, and all data are used solely for academic research purposes. These ethical considerations are important to maintain the integrity and credibility of the research process.

Results and Discussion

Respondent Characteristics

This study collected data from 312 respondents who regularly commute within urban areas and have experience using both public transportation and private vehicles. The demographic characteristics of respondents provide an overview of the sample profile and help contextualize the findings related to transportation behaviour. In terms of gender distribution, 54% of respondents were male, while 46% were female. The majority of respondents were between 21 and 40 years old, representing approximately 63% of the total sample, indicating that most participants belong to the productive age group that frequently engages in daily commuting activities. Regarding educational background, 68% of respondents held a bachelor's degree, while the remaining respondents had either secondary or postgraduate education.

In terms of transportation ownership, 78% of respondents reported owning a private vehicle, such as a car or motorcycle. This finding reflects the high level of private vehicle ownership commonly observed in urban environments. Additionally, 65% of respondents indicated that they use private vehicles as their primary mode of transportation, while only 35% reported regularly using public transportation. These statistics highlight the ongoing challenge of reducing private vehicle dependence in urban areas.

Descriptive Analysis of Research Variables

Descriptive analysis was conducted to examine respondents' perceptions of the study variables, namely public transportation quality and private vehicle dependence. The analysis provides insights into the general trends in respondents' perceptions regarding the quality of public transportation services. The results show that respondents generally perceive public transportation quality as moderate to slightly positive, with an overall mean score of 3.42 on a five-point Likert scale. Among the indicators of public transportation quality, safety and security received the highest mean score (3.68), suggesting that respondents generally feel safe while using public transportation services. Meanwhile, service frequency recorded the lowest mean score (3.21), indicating that respondents perceive the availability of public transportation services as relatively limited.

Regarding private vehicle dependence, the overall mean score was 3.76, suggesting that respondents still exhibit a relatively high reliance on private vehicles for their daily mobility needs. The highest mean value was observed for the indicator related to perceived convenience of private vehicles (4.02), which indicates that many respondents consider private vehicles more convenient than public transportation. These findings highlight the gap between the perceived advantages of private vehicles and the current quality of public transportation services.

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Reliability and Validity Testing

Before testing the structural model, reliability and validity tests were conducted to ensure that the measurement instruments used in this study were consistent and valid. Reliability was evaluated using Cronbach's alpha coefficients. The results indicate that all constructs demonstrated acceptable levels of reliability. The Cronbach's alpha value for public transportation quality was 0.87, while the value for private vehicle dependence was 0.83. Both values exceed the commonly accepted threshold of 0.70, indicating good internal consistency [8]. Construct validity was assessed through Confirmatory Factor Analysis (CFA). The results show that all factor loadings were above 0.60, indicating that the observed indicators adequately represent their respective latent constructs. In addition, the Average Variance Extracted (AVE) values for both variables exceeded 0.50, confirming convergent validity. Overall, the results of reliability and validity testing indicate that the measurement model used in this study is statistically acceptable and suitable for further analysis.

Structural Model Analysis

Structural Equation Modelling (SEM) was employed to test the hypothesized relationship between public transportation quality and private vehicle dependence. The structural model was evaluated using several goodness-of-fit indices. The results show that the model demonstrates a satisfactory level of fit. The Chi-square/df ratio was 2.11, which is below the recommended threshold of 3.0. The Comparative Fit Index (CFI) was 0.94, and the Root Mean Square Error of Approximation (RMSEA) was 0.058, both of which fall within acceptable ranges for SEM analysis [8]. These indicators suggest that the proposed model adequately represents the relationships among the study variables.

Hypothesis Testing

The hypothesis proposed in this study states that public transportation quality has a significant negative effect on private vehicle dependence. The results of the SEM analysis indicate that public transportation quality significantly influences private vehicle dependence ($\beta = -0.46$, $p < 0.001$). The negative coefficient indicates that higher levels of perceived public transportation quality are associated with lower levels of private vehicle dependence.

Therefore, Hypothesis 1 is supported.

This finding suggests that improvements in public transportation quality can play an important role in reducing individuals' reliance on private vehicles.

Discussion

The findings of this study highlight the importance of public transportation quality in influencing urban transportation behaviour. The results confirm that improvements in service quality can significantly reduce individuals' dependence on private vehicles. This finding is consistent with previous research suggesting that service attributes such as reliability, accessibility, and comfort play a critical role in encouraging commuters to shift from private vehicles to public transportation [3]. One possible explanation for this relationship lies in the decision-making process of urban commuters. Individuals typically evaluate transportation options based on several factors, including travel time, convenience, cost, and comfort. When public transportation systems provide services that are perceived as reliable and convenient, they become competitive alternatives to private vehicle use.

The results also align with the findings of [5], who argue that improving service quality is one of the most effective strategies for attracting private vehicle users to public transport. In particular, service frequency and travel reliability are key factors that influence commuters' transportation choices. Despite the significant relationship identified in this study, the descriptive analysis indicates that private vehicle dependence remains relatively high among respondents. This suggests that improvements in public transportation quality alone may not be sufficient to fully shift transportation

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behaviour. Other factors such as urban spatial planning, travel distance, and socioeconomic conditions may also influence individuals' transportation preferences.

Furthermore, the findings highlight the importance of integrating transportation policies with broader urban planning strategies. Improving public transportation infrastructure, expanding service coverage, and enhancing service reliability may encourage more individuals to adopt public transportation as their primary travel mode. From a policy perspective, these findings provide important implications for urban transportation planners and policymakers. Investments in improving the quality of public transportation services such as increasing service frequency, improving passenger comfort, and enhancing safety can significantly contribute to reducing private vehicle dependence and promoting sustainable urban mobility.

In addition, policymakers may consider implementing complementary policies such as integrated ticketing systems, real-time travel information, and multimodal transportation networks to further enhance the attractiveness of public transportation systems. Ultimately, the transition toward sustainable urban mobility requires a comprehensive approach that combines improvements in public transportation quality with supportive policy measures and urban planning strategies.

Conclusion, Implications, and Future Research

Conclusion

This study aims to examine the role of public transportation quality in reducing private vehicle dependence within the framework of sustainable urban transport. Using a quantitative research approach and Structural Equation Modelling (SEM) analysis, the findings reveal that public transportation quality has a significant negative effect on private vehicle dependence. This result indicates that improvements in the quality of public transportation services can effectively reduce individuals' reliance on private vehicles for daily mobility. The empirical findings demonstrate that key dimensions of public transportation quality such as reliability, accessibility, comfort, safety, and service frequency play an important role in shaping commuters' transportation choices. When public transportation systems are perceived as reliable, safe, and convenient, urban residents are more likely to consider them as viable alternatives to private vehicles. Conversely, when public transportation services are perceived as inadequate or inefficient, individuals tend to rely more heavily on private modes of transportation.

These findings reinforce the importance of enhancing public transportation systems as part of broader sustainable urban mobility strategies. Public transportation not only provides an environmentally friendly alternative to private vehicles but also contributes to improved urban accessibility and reduced congestion. The results of this study support previous research emphasizing that service quality improvements are crucial for increasing public transportation usage and encouraging modal shifts toward more sustainable travel behaviour [3] ; [5]. Overall, this study contributes to the growing body of literature on sustainable urban transport by providing empirical evidence that public transportation quality plays a critical role in reducing private vehicle dependence. Improving service quality can therefore be considered a strategic approach to promoting more sustainable and efficient urban mobility systems.

Theoretical Implications

From a theoretical perspective, this study contributes to the literature on transportation behaviour and sustainable mobility by highlighting the importance of service quality in influencing transportation mode choice. While previous studies have emphasized infrastructure development and policy interventions as key drivers of sustainable transportation, this research underscores the role of perceived service quality in shaping individuals' travel decisions. The findings support behavioural

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theories of transportation choice, which suggest that individuals evaluate transportation options based on perceived benefits and costs. When public transportation services offer advantages such as reliability, comfort, and accessibility, they become competitive alternatives to private vehicles. This aligns with the broader conceptual framework of sustainable mobility, which emphasizes the integration of user cantered service design in transportation planning [1]. In addition, this study contributes to the growing body of research that links service quality dimensions with behavioural outcomes in transportation systems. By demonstrating the relationship between perceived service quality and private vehicle dependence, the study provides empirical evidence supporting the importance of user perceptions in transportation policy development.

Practical Implications

The findings of this study provide several important implications for policymakers, urban planners, and transportation authority's seeking to promote sustainable urban mobility. First, improving public transportation quality should be considered a priority in urban transportation policy. Investments in service reliability, safety, comfort, and accessibility can significantly enhance the attractiveness of public transportation systems. When commuters perceive public transport services as efficient and convenient, they are more likely to shift away from private vehicle use. Second, transportation authorities should focus on increasing service frequency and improving operational reliability. Frequent and punctual services reduce waiting times and increase passenger satisfaction, which can encourage greater adoption of public transportation. Third, integrating transportation systems through multimodal networks and digital technologies may further enhance the user experience. For example, real-time travel information systems, integrated ticketing platforms, and improved station accessibility can make public transportation more convenient and user-friendly. Finally, public transportation improvements should be integrated with broader urban planning policies. Compact urban development, transit-oriented development (TOD), and improved pedestrian infrastructure can complement public transportation systems and reduce the need for private vehicle usage. By implementing these strategies, cities can promote sustainable mobility, reduce traffic congestion, and improve environmental quality.

Limitations and Future Research

Despite its contributions, this study has several limitations that should be acknowledged. First, the research relies on cross-sectional survey data collected at a single point in time. While this approach provides valuable insights into respondents' perceptions and behaviour, it does not capture long-term changes in transportation preferences. Future research may consider using longitudinal data to examine how improvements in public transportation quality influence travel behaviour over time. Second, the study focuses primarily on perceived service quality as the main factor influencing private vehicle dependence. However, transportation behaviour is influenced by various other factors, including socioeconomic characteristics, urban spatial structure, travel distance, and policy interventions. Future studies could incorporate additional variables such as travel cost, environmental awareness, and attitudes toward sustainable mobility to develop a more comprehensive analytical model.

Third, this study uses a limited set of service quality dimensions. Future research could explore additional aspects of public transportation services, such as technological innovations, smart mobility systems, and integrated mobility platforms, which are becoming increasingly important in modern urban transportation systems. Finally, future research may also conduct comparative studies across different cities or countries to examine how contextual factors influence the relationship between public transportation quality and private vehicle dependence. Comparative studies can provide deeper insights into how transportation policies and infrastructure development affect sustainable mobility outcomes. By addressing these limitations, future research can further advance the understanding of

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sustainable urban transportation and contribute to the development of more effective mobility policies.

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