Role of Public Transport Quality and Friendly Public Open Spaces in Enhancing Perceived Accessibility in Urban Smart Cities

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Abstract
Perceived accessibility plays a pivotal role in shaping individuals' decisions to utilise services and access opportunities. Poor management of this factor may result in reduced participation and increased disparities, particularly affecting marginalised groups. Consequently, this study sought to examine the influence of public service quality, safety and security measures, and the availability of public open spaces on the perceived accessibility of urban public transport services within smart cities. The study adopted a quantitative cross-sectional design to evaluate the effects of public service quality, safety measures, and public open spaces on perceived accessibility. Data were gathered from 320 public transport users in urban smart cities through self-administered surveys, employing a convenience sampling approach. The multiple regression analysis revealed that dimensions of public transport quality exert a positive and significant influence on perceived accessibility within smart city public transportation systems. Similarly, safety and security measures were found to positively and significantly impact perceived accessibility. Additionally, the availability of public open spaces demonstrated a positive and significant effect on perceived accessibility in these systems. Theoretically, the findings underscore the importance of incorporating service quality, safety measures, and public open spaces into accessibility frameworks, thereby contributing to the enhancement of existing public transport models within urban smart cities. Practically, these insights offer valuable guidance for policymakers and transport authorities in prioritising improvements in these areas to promote greater accessibility and enhance user satisfaction in public transport systems. This research demonstrates originality by systematically addressing multiple dimensions of public transport quality, safety and security, and public open spaces in relation to perceived accessibility. Its novelty lies in providing empirical evidence that informs targeted improvements in public transport systems to enhance user experience.

Keywords: Public Traffic Quality, Safety and Security, Perceived Accessibility, Public Transport.

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INTRODUCTION

Perceived accessibility plays a pivotal role in urban smart cities, enhancing residents' quality of life by ensuring equitable and convenient access to essential services, infrastructure, and amenities [1]. It contributes to economic growth by attracting talent and investment while fostering inclusivity and mitigating social disparities [2]. Moreover, perceived accessibility supports sustainable urban development through eco-friendly designs and resource management. It also promotes social equity by bridging gaps among diverse groups [3].

Given its significance, perceived accessibility has become a fundamental element of sustainable urban development, encouraging resource optimisation and the integration of advanced technologies to address emerging technological challenges [4]. This adaptability not only aids cities in tackling existing urban challenges but also empowers them to anticipate future demands, such as population growth, thereby making smart cities more inclusive, sustainable, and human-centred [5]. Neglecting perceived accessibility can create significant barriers for individuals with disabilities and may result in legal repercussions for non-compliance with accessibility standards. Consequently, it has emerged as a critical area of research in the development of smart urban cities [6].

Various factors influence perceived accessibility, with public transport quality playing a crucial role by enhancing access to key destinations such as workplaces, educational institutions, and recreational areas [7]. A well-designed transportation system reduces travel barriers and improves road connectivity within urban environments [8]. For instance, integrated public transport networks supported by smart technologies, such as real-time tracking and digital ticketing systems, increase user satisfaction and reduce commuting stress [9]. Additionally, environmentally sustainable options like electric buses and bike-sharing schemes not only enhance mobility but also promote social inclusivity and environmental sustainability [10]. Effective transport systems that address the diverse needs of users, including individuals with disabilities and low-income groups, further contribute to greater accessibility [11]. Consequently, high-quality public transport fosters more cohesive and liveable urban environments [12]. Enhancing the quality of transport infrastructure is therefore essential for shaping residents' perceptions of accessibility and supporting urban development within smart city frameworks [13]. This study thus aims to examine the impact of public transport quality on perceived accessibility.

Equally, user-friendly public spaces surrounding public transport play a crucial role in shaping perceived accessibility by fostering inclusion, enhancing mobility, and promoting community engagement [14]. Well-designed spaces adjacent to transportation hubs, such as parks and pedestrian streets, create comfortable environments that cater to the diverse needs of users [15]. These spaces help reduce physical and social barriers, facilitating seamless transitions between different transport modes and fostering a sense of community belonging [16]. Moreover, ensuring smooth transport flows and enhancing connections between surrounding urban areas can significantly elevate the perceived quality of public transport and improve citywide mobility [17]. Investment in well-planned public spaces around transport hubs is therefore vital for enhancing perceived accessibility. In line with this, the present study seeks to examine the impact of user-friendly public open spaces on perceived accessibility.

Numerous studies have explored the impact of public transport quality, safety and security, and user-friendly public open spaces on various factors [10,14,15,18-20]. However, limited attention has been paid to their influence on perceived accessibility. This study addresses this gap by investigating the impact of these factors on perceived accessibility. While prior research has extensively examined service quality, limited studies have specifically contextualised it within public transport quality [21]. This study contributes to the literature by focusing on public transport quality within urban environments. Moreover, previous research has reported inconsistent findings [22,23], potentially due to the fragmented analysis of public transport quality, safety and security, and public open spaces, without considering their combined impact within a single model. This study addresses this limitation by simultaneously evaluating the effects of these factors on perceived accessibility. Furthermore, existing studies often focus on specific countries or sectors, overlooking a broader examination of public transport systems in urban smart cities. This research contributes by adopting a general perspective, offering an empirical analysis of public transport systems in urban smart city contexts. To address these gaps, the study aims to examine the impact of public service quality, safety and security, and public open spaces on the perceived accessibility of public services in smart cities.

The remainder of the research paper was structured into four key sections. The Literature Review examines existing studies and theoretical frameworks related to perceived accessibility and its determinants within urban smart

cities. The Research Methodology outlines the research design, data collection methods, and analytical techniques employed to investigate perceived accessibility. The Data Analysis and Results section presents the study's findings, supported by statistical analyses and interpretations of the collected data. Finally, the Discussion and Limitations section explores the implications of the findings, underscores their significance, addresses the study's limitations, and proposes recommendations for future research.

LITERATURE REVIEW

Public Transport Quality and Perceived Accessibility

Public transport quality reflects the overall effectiveness of a transport system in meeting users' expectations, significantly contributing to their reliability and satisfaction [24]. Lättman, *et al.*[25]concluded that public transport quality comprises various factors related to service reliability, transportation efficiency, and user satisfaction, all of which significantly enhance perceived accessibility. Practically, the quality of public transport is often understood through specific, measurable parameters that influence users' perceptions and the accessibility of transport systems. This study conceptualises the quality of public transport as encompassing four key dimensions: functionality, information, convenience, and cost. Research has shown that these dimensions play a crucial role in improving perceived accessibility [26]. These factors are essential in increasing the perceived accessibility of transportation systems.

Among these dimensions, functionality refers to the operational efficiency of the transport system, including service frequency, network coverage, and reliability [27]. A functional transport system enables users to depend on timely services, supporting continuous travel in both rural and urban areas [28]. Functionality is the backbone of public transport quality, directly affecting its feasibility for daily and long-distance travel [27]. Information involves the availability, accuracy, and accessibility of transport-related details such as schedules, routes, delays, and ticketing options [29]. The integration of digital tools like mobile apps and real-time displays has significantly improved this dimension, helping users plan trips and enhancing perceptions of public transport services [30].

Moreover, comfort encompasses both physical and psychological aspects, including seat availability, cleanliness, air quality, safety, and noise levels [31]. A comfortable transport system attracts and retains users, while lack of comfort can push them toward private transport options. Finally, cost refers to the price of public transport services, including tickets, concessions, and discounts [32]. Affordability is key to encouraging usage, especially in urban smart cities where transportation costs can significantly impact household finances [33]. Comfort also plays a significant role in increasing perceived accessibility [30].

Further empirical research has highlighted the significant role of public transport quality in enhancing perceived accessibility for individuals [34]. These studies also concluded that rural areas are often transformed into urban settings as a result of improved service quality. The research emphasised that functionality and comfort are key drivers in enhancing perceived accessibility, noting that improvements in factors such as punctuality, reliability, and physical conditions—such as seat availability—can considerably increase the attractiveness of public transport [35]. Additionally, the study found that functionality has a positive and significant effect on the perceived accessibility of individuals, particularly with regard to the public transport system. The research further revealed that the availability of accurate, real-time information helps reduce anxiety and uncertainty for users, thereby improving perceived accessibility. Moreover, the study indicated that comfort plays a crucial role in enhancing the perceived accessibility of transport systems [36]. The authors suggested that future studies should explore these factors in other countries and use diverse samples to increase the variation in results.

The study by Nguyen-Phuoc, *et al.*[35] also found that comfort, which includes cleanliness and safety, positively enhances perceived accessibility. They further concluded that affordable services contribute to increased perceived accessibility by providing optimal physical conditions that offer the best value for money. Similarly, Fu, *et al.*[37]et al. identified affordability as a key factor for improving accessibility, particularly in low-income regions, and noted that reliable and frequent services positively impact accessibility for older women. Mehdizadeh, and Kroesen[38] also observed that public service quality significantly and positively influences perceived accessibility, and suggested that future research should be conducted in other countries to explore variations in the results. These findings highlight the multifaceted nature of public transport quality and its substantial impact on perceived accessibility. Additional studies, such as those by Gayatri, and Prasilowati[24], also found that cost significantly increases perceived accessibility.

They, too, recommended further investigation into the effects of public transportation systems in different countries to enhance result diversity. Collectively, these studies underline the importance of public transport quality dimensions in improving the perceived accessibility of smart cities. Addressing these dimensions could enhance the usability of public transport systems, attract more users, and contribute to sustainable urban mobility solutions. Based on these findings, the study has formulated the following research hypothesis.

H1: Functionality significantly influences perceived accessibility.
H2: Information significantly influences perceived accessibility.
H3: Comfort significantly influences perceived accessibility.
H4: Cost significantly influences perceived accessibility.

Safety and Security

Safety and security are crucial components of perceived accessibility, playing a key role in protecting individuals from accidental harm while travelling [39]. Additionally, safety contributes to reducing traffic-related losses that affect public transportation [40]. Safety and security are particularly important for various user groups, as they enhance users' confidence when using public transport services and facilities [41]. Once individuals feel secure in their environment, they are more likely to engage with urban resources, utilise the urban environment, and access public spaces. Further research has also confirmed that security is a critical factor in enhancing perceived accessibility in public transportation systems [42]. Nguyen-Phuoc*, et al.*[35] conducted a study to examine the impact of safety and security on perceived accessibility, finding that passengers who feel unsafe perceive a higher risk, which reduces their willingness to use public transport. Their study concluded that further research should be conducted in other countries to explore variations in results.

Liu*, et al.*[43]et al. emphasised that improving physical security features such as lighting, emergency alarms, and the presence of security personnel can significantly enhance passengers' perceptions of accessibility, particularly among women and elderly users. Kalyanaraman, and Prabakar[44], along with Nguyen-Phuoc*, et al.*[35], studied the role of crime prevention measures in improving public transport accessibility. Their findings revealed that the introduction of security measures, such as surveillance cameras and trained security staff, notably improved perceived accessibility among passengers. These studies collectively highlight the importance of safety and security in enhancing the perceived accessibility of public transport systems. Based on these findings, the study has formulated the following research hypothesis.

H5: Safety and security significantly influence perceived accessibility.

Friendly Public Open Space

Friendly open spaces play a crucial role in enhancing the perceived accessibility of public transport systems by providing better outdoor areas [45]. These spaces include pedestrian crossings and other public areas designed to support diverse users in increasing accessibility [46]. In the context of perceived accessibility, friendly public open spaces are vital in improving mobility and creating a positive user experience. Perceived accessibility encompasses not only the physical ability to reach a location but also psychological and emotional factors, such as how welcoming and inclusive a space feels [15]. For example, public open spaces that are free from physical barriers, well-connected to transport networks, and clearly signposted enhance users' ability to navigate and enjoy these areas. Such spaces also promote social equity by offering opportunities for recreation and relaxation without financial barriers, significantly contributing to perceived accessibility for individuals in various areas [45]. Additionally, user-friendly parks cater to specific needs, providing wheelchair-accessible pathways or play areas for children, further enhancing the inclusivity and accessibility of public spaces [47]. Another study reinforced that friendly public spaces positively and significantly increase the perceived accessibility of public transport systems [45].

Rahmawati*, et al.*[14] highlighted that well-maintained, friendly spaces create an environment conducive to social interaction, which enhances perceived accessibility. Their study found that such spaces significantly influence accessibility. Zeng, and Chen[15] further demonstrated that poorly maintained or unsafe spaces hinder perceptions of accessibility, while user-friendly designs foster feelings of inclusion and accessibility. Liao[48] noted that in developing countries, challenges such as overcrowding and lack of basic amenities can restrict accessibility. Bhadragoudar Shivanagouda[49] observed that well-designed public spaces connected to active transport routes enhance accessibility by encouraging frequent use.

These studies underscore the crucial role of friendly public open spaces in improving perceived accessibility. They emphasise the importance of thoughtful planning, inclusive designs, and regular maintenance in creating equitable and accessible environments. Another study also found that friendly public spaces increase individuals' accessibility to public transport systems, suggesting that further research in different countries could increase the variation in findings. These previous studies, along with existing literature, highlight that friendly public spaces are integral to improving perceived accessibility in public transport systems. Based on these insights, the following hypothesis is formulated.

H6: Friendly public open space significantly influences perceived accessibility.

METHODS AND OBJECTS

The study aimed to examine the impact of public service quality, safety and security, and public open spaces on the perceived accessibility of public services in urban smart cities. To achieve this, a quantitative deductive approach was employed. The strength of quantitative research lies in its ability to provide objective, measurable data that can be statistically analysed to identify patterns and relationships [50]. Data were collected using a self-administered survey instrument. Self-administered questionnaires in cross-sectional research designs offer several advantages, including efficient data collection from large samples, minimisation of interviewer bias, and cost reduction. Additionally, they allow respondents to answer at their own pace, which can enhance the accuracy and honesty of responses [51]. As such, the study adopted a cross-sectional research design, collecting data within a single time frame. Since the study aimed to test existing research by incorporating additional variables, explanatory research was considered the most suitable approach.

Research Instrument

The survey instrument was adapted from existing studies where the relevant variables had already been measured. Public transport quality was assessed using four dimensions: functionality, information, cost, and comfort. The functionality dimension included five items, the information dimension consisted of two items, the comfort dimension was measured by four items, and the cost dimension comprised two items. These items were adapted from Chau, *et al.*[52]. The perceived accessibility dimension included three items, as sourced from Ismael, and Duleba[53]. Safety and security were measured by four items, also based on the work of Ismael, and Duleba[53]. Finally, the friendly public open spaces dimension was assessed using four items from Lak, *et al.*[54]. Each item was rated on a five-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree). The constructed variables are illustrated in Figure 1.

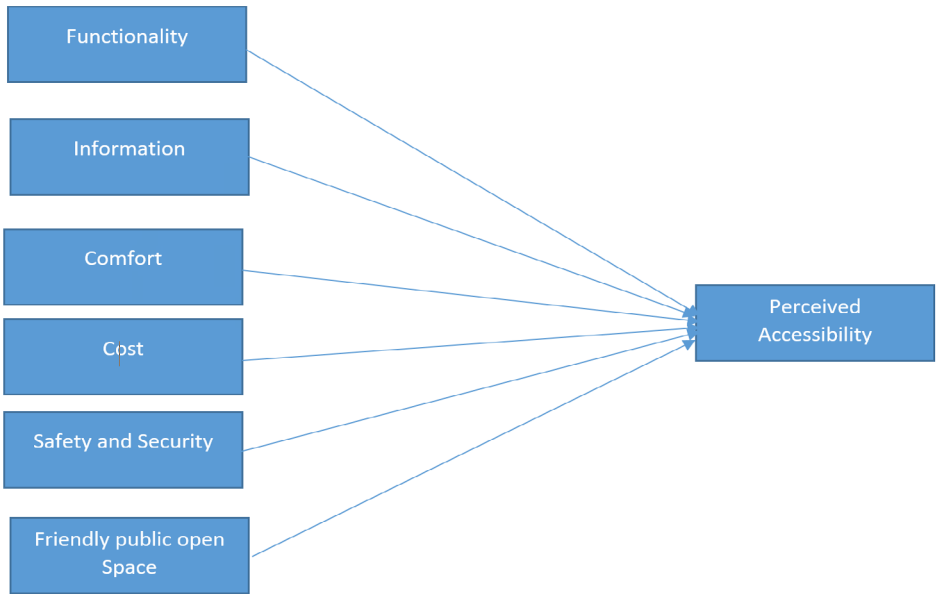

Figure 1: Research Framework

Sampling and Data Collection Procedures

The study gathered data from individuals who use public transport services to assess perceived accessibility and service quality. The advantage of focusing on public transport users lies in their direct experience, offering valuable, real-world insights into the factors influencing perceived accessibility and service quality [55]. A total of 405 individuals participated, selected using a convenient sampling technique. For non-probability sampling, a sample size of over 200 is considered effective [56]. The data collection was carried out in collaboration with a market research organisation adhering to international quality standards. The survey instrument ensured diverse representation across sociodemographic characteristics in Section A, including age, gender, and employment status. Section B focused on questions related to the study variables. Participants were apprised of their anonymity, their right to withdraw at any moment, and granted agreement to participate. Participants were incentivised with a little prize, such as a lottery ticket or the opportunity to contribute to charity upon completing the questionnaire. Data collection was carefully monitored to ensure quality and integrity. A total of 330 questionnaires were returned, with 320 being valid for analysis, reflecting a 79% response rate, which is deemed sufficient for social science studies [33].

DATA ANALYSIS AND RESULTS

The data were analysed from both demographic and inferential perspectives. SPSS and Smart PLS software were utilised for the analysis of the study.

Demographic Analysis

Table 1 presents the demographic characteristics of the 320 respondents across various categories. In terms of gender, there was a slight female majority, with 170 females (53.13%) compared to 150 males (46.88%). The age distribution revealed that the largest group of respondents were between 18-22 years old (31.25%), followed by those in the 23-27 years range (28.13%). The age group of 28-32 years made up 23.44% of respondents, while the least represented group was those aged 33 years and above, accounting for 17.19%. This suggests that the respondents were predominantly younger individuals, with a substantial proportion in their early twenties.

Regarding the frequency of usage, the most common frequency was daily use, reported by 37.5% of respondents. A significant portion of respondents used the service weekly (29.69%), while 18.75% used it every month, and 14.06% used it occasionally. In terms of transportation modes, buses were the most frequently used, with 31.25% of respondents indicating they used buses. Trains followed closely at 25%, while taxis accounted for 15.63%. Carpooling and bicycling were less common, with 12.5% and 15.63% of respondents using these options, respectively. Overall, the data reflects diverse usage patterns and transportation preferences among the respondents. The results are summarized in Table 1.

Table 1: Respondents Profile

Category	Subcategory	Number of Respondents	%
Gender	Male	150	46.88%
	Female	170	53.13%
	Total	320	100%
Age	18-22 Years	100	31.25%
	23-27 Years	90	28.13%
	28-32 Years	75	23.44%
	33 Years and Above	55	17.19%
	Total	320	100%
Usage Frequency	Daily	120	37.50%
	Weekly	95	29.69%
	Monthly	60	18.75%
	Occasionally	45	14.06%
	Total	320	100%
Transport Type	Bus	100	31.25%
	Train	80	25.00%
	Taxi	50	15.63%
	Carpool	40	12.50%
	Bicycle	50	15.63%
	Total	320	100%

Reliability and Multicollinearity

Table 2 presents the reliability and multicollinearity analysis of the independent variables related to perceived accessibility. Cronbach's alpha values, which measure the internal consistency of the constructs, range from 0.815 to 0.931 in this study, indicating high reliability. A threshold of 0.70 is generally considered acceptable [57], and all alpha values exceed this threshold. Notably, safety and security have the highest alpha value of 0.931, signifying exceptional consistency, while cost has the lowest at 0.815, still well above the acceptable limit. Other constructs, such as functionality (0.829), information (0.818), comfort (0.899), and friendly public open space (0.8441), also demonstrate strong internal consistency. These results affirm that the variables reliably capture their intended dimensions [57].

To assess multicollinearity, the Variance Inflation Factor (VIF) values are examined. A VIF value below 5 indicates no significant multicollinearity [58]. All VIF values in this study fall within acceptable limits, ranging from 1.21 to 1.52. Cost has the lowest VIF at 1.21, indicating minimal correlation with other predictors, while comfort has the highest VIF at 1.52, still within acceptable limits. VIF values for functionality (1.45), information (1.32), safety and security (1.39), and friendly public open space (1.47) further confirm the independence of these variables. Additionally, the measurement model was tested using Smart PLS, a robustness analysis tool for the study. Factor loadings analysis revealed that all values were greater than 0.5, meeting the requirement for factor loadings [59]. These findings indicate that the constructs are both reliable and free from multicollinearity issues, making them suitable for inclusion in further analysis. The results are displayed in Table 2.

Table 2: Reliability and Multicollinearity

Variable	Alpha Value	VIF Value
FUN	0.829	1.45
INFO	0.818	1.32
COM	0.899	1.52
COS	0.815	1.21
SS	0.931	1.39
FPOS	0.841	1.47
PA	0.782	.....

Note: FUNC-Functionality, INFO-Information, COM-Comfort, COS-Cost, SS-Safety and Security, FPOS-Friendly Public Open Space, PA-Perceived Accessibility.

Correlation Matrix

Table 3 presents the correlation matrix of the study, showing the relationships between the six variables. The results indicate varying degrees of correlation. Functionality demonstrates moderate positive correlations with Information (0.612) and Friendly Public Open Space (0.715), suggesting that improvements in functionality positively influence perceptions of information and public spaces. Comfort exhibits a strong correlation with cost (0.823), indicating that higher comfort levels are typically associated with higher costs. Safety and security show moderate positive correlations with Comfort (0.622) and Cost (0.605), implying that improvements in safety and security are linked to better comfort and increased costs. Friendly Public Open Space also shows a moderate positive correlation with Information (0.739), highlighting a strong relationship between perceptions of public space and the availability of information. All correlations are moderate to high, with values above 0.4 considered substantial and those above 0.7 reflecting strong relationships. The results are summarised in Table 3.

Table 3: Correlation Matrix

	FUN	INFO	COM	COS	SS	FPOS
FUN	1					
INFO	0.612	1				
COM	0.363	0.721	1			
COS	0.443	0.427	0.823	1		
SS	0.337	0.429	0.622	0.605	1	
FPOS	0.715	0.739	0.435	0.526	0.621	1

Regression Results

After evaluating the reliability of the model, the next step involved testing the study hypotheses. The results from the multiple regression analysis reveal that all six factors positively and significantly impact perceived accessibility. Specifically, Functionality (β = 0.431) and Information (β = 0.332) have the most substantial positive effects, suggesting that they are key drivers in enhancing perceptions of accessibility. Comfort (β = 0.252) also positively influences accessibility, although its impact is somewhat weaker. Safety and Security (β = 0.282) contribute significantly to improving accessibility perceptions, while Friendly Public Open Space (β = 0.352) also plays a positive and significant role. Cost (β = 0.182) likewise has a positive and significant influence on perceived accessibility. Overall, these results indicate that the factors considered in the study collectively have a meaningful and positive impact on the perceived accessibility of spaces and services (Figure 2). The findings are summarised in Table 4.

Table 4: Regression Results

Independent Variable	Standardized Beta (β)	T-Value	P-Value	Decision
FUN->PA	0.431	3.52	0.002	Supported
INFO->PA	0.332	2.92	0.004	Supported
COM->PA	0.252	2.22	0.027	Supported
COS->PA	0.182	1.82	0.074	Supported
SS->PA	0.282	2.53	0.014	Supported
FPOS->PA	0.352	3.01	0.003	Supported
R Square	0.682			

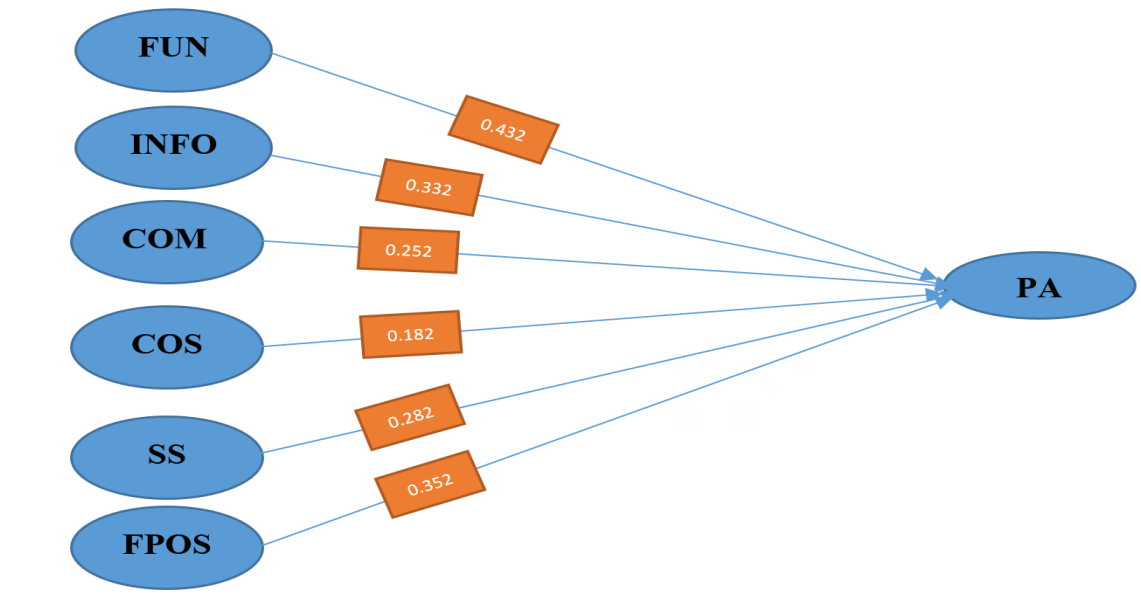

Figure 2: Coefficient Values

DISCUSSION

The study aimed to examine the impact of public service quality, safety and security, and public open spaces on the perceived accessibility of public services. The results from the multiple regression analysis demonstrate that functionality has a positive and significant effect on perceived accessibility. This highlights the crucial role that the functionality of services and spaces plays in shaping how accessible users perceive them to be. Services or spaces that operate efficiently, are easy to use, and fulfil their intended purpose are more likely to be viewed as accessible. In public transportation, factors such as clear signage, user-friendly platforms, and effective service schedules contribute significantly to individuals' perceptions of accessibility. These findings reinforce the notion that when public services meet functional expectations and operate smoothly, they are more likely to be seen as accessible, thereby encouraging greater utilisation. This aligns with the research of Chau, *et al.*[52] and Jamei, *et al.*[60], which underscores the importance

of functionality in improving the accessibility of public spaces. Overall, the results suggest that functionality in public transport systems enhances the user experience, making it easier for individuals to navigate and effectively utilise services, ultimately boosting the perceived acceptability of public transport systems.

Similarly, the study found that information positively and significantly influences the perceived accessibility of public information systems. These findings emphasise that in the transportation sector, the availability of clear, accurate, and accessible information is essential for guiding individuals through public services. According to the respondents' perceptions, having access to timely and relevant information about transport schedules, service procedures, and directions significantly enhances their overall experience and perception of accessibility. This result aligns with the research of Chau*, et al.*[52] and Watthanaklang*, et al.*[10], who also demonstrated that providing accurate and timely information improves user satisfaction, thereby enhancing perceived accessibility. Specifically, in public transportation systems, particularly in urban environments, the dissemination of information through various channels—such as online platforms, customer service desks, and digital signage—plays a pivotal role in bridging accessibility gaps. When users are well-informed about available services, key facilities' locations, and any special accommodations, they are more likely to view these services as accessible and use them with greater confidence. Consequently, it is argued that transportation companies should invest in proper information desks or platforms that enhance travellers' accessibility to their destinations, ultimately improving the perceived acceptability of the country's transportation system.

The study also revealed that comfort positively and significantly influences the perceived accessibility of the public transportation system. Existing literature has highlighted that public transportation services that provide a comfortable environment—whether in terms of physical aspects like seating, cleanliness, and maintenance, or service experience such as minimal waiting times—tend to foster positive perceptions of accessibility. Similar conclusions were drawn by Chau*, et al.*[52] and Watthanaklang*, et al.*[10], who found that comfort significantly impacts user satisfaction and perceptions of accessibility within both public transportation and healthcare systems. Specifically, users are more likely to view a service as accessible if they can sit comfortably, enjoy clean and well-maintained stations, and experience reduced waiting times. Therefore, these results emphasise the importance of addressing both the physical and emotional needs of users to enhance their perception of accessibility to public services, underscoring the value of creating comfortable environments that facilitate positive experiences.

Friendly public open spaces also significantly enhance the perceived accessibility of public transportation. Well-designed spaces that foster social interaction contribute to a greater sense of accessibility, as evidenced by Brorsson*, et al.*[61] and Nordh*, et al.*[62], who found that public areas like parks and plazas play a key role in promoting community and inclusion. The findings underscore the importance of integrating inviting open spaces with transit hubs to encourage public transport use, thereby fostering a more sustainable urban ecosystem. This suggests that governments should invest in such spaces, as this not only improves transport efficiency but also enhances community well-being.

The results also revealed that safety and security significantly enhance the perceived accessibility of public transportation systems. In particular, the perception of safety in public services, including physical safety from crime and secure systems, encourages greater use of these services. Well-lit, monitored, and threat-free spaces instil confidence in users, thus improving overall accessibility. These findings highlight the need for spaces that are not only functional and comfortable but also secure and welcoming. This is consistent with the work of Oviedo*, et al.*[63] and Tiwari*, et al.*[41], who stressed that safety is a vital factor in perceived accessibility. The findings suggest that public transport quality, friendly open spaces, and safety all positively influence perceived accessibility, reinforcing the importance of a holistic design approach to public services and spaces that prioritises various accessibility factors.

CONTRIBUTIONS

This study presents several important theoretical contributions. Firstly, it makes a valuable addition to the literature by examining the combined impact of public transport efficiency, safety and security, and open, friendly public spaces on perceived accessibility. While previous research has mainly explored the individual effects of these factors, this study takes a novel approach by investigating them together within public sector projects, providing a comprehensive framework for understanding how multiple public sectors interact to influence access. The study advances theories of accessibility by suggesting that the relationship between these factors is interactive, with improvements in one area,

such as security, potentially enhancing other aspects like public transport or public space infrastructure. Secondly, the study offers fresh insights into resource management concepts, which have traditionally been limited to specific services like transportation or urban development. The idea of promoting safe and user-friendly public spaces within a broader urban context is a unique perspective that challenges conventional thinking. This theoretical expansion paves the way for future research that could further explore these interdependencies and develop more refined models of accessibility, applicable to different urban settings. Lastly, the research highlights the importance of public service quality in urban environments, particularly in terms of socioeconomic inclusivity. It questions traditional views that tend to overlook the cumulative effects of various service elements on accessibility. By focusing on how transport, safety, and public spaces can be designed collectively to enhance perceived accessibility, the study provides a richer, more integrated understanding of urban mobility.

The study also offers several practical implications for urban planning and policy-making. Firstly, the findings suggest that policymakers and urban planners should recognise that public transport quality, safety and security, and friendly public open spaces are interconnected elements, which must be considered together to optimise accessibility. Secondly, the study provides valuable insights for security departments, aiding in the improvement of safety at transport hubs, which could significantly enhance users' perceptions of transport quality. Thirdly, the research highlights the importance of creating welcoming public spaces around transport infrastructure, as these spaces can positively influence the accessibility experience for users. Fourthly, the study emphasises the need for urban development projects to prioritise safety and public space as key factors that influence accessibility, encouraging a balanced focus on these aspects alongside improvements to transport systems. Lastly, the study underscores the importance of inclusive urban policies that address the diverse needs of different population groups. It calls on policymakers to ensure that urban environments are accessible to all, especially marginalised groups such as the elderly, children, and people with disabilities. This could involve implementing universal design principles for public spaces and transport systems, which would enhance accessibility for everyone, regardless of their individual needs or challenges.

LIMITATIONS AND FUTURE DIRECTIONS

The research possesses multiple limitations that warrant consideration. The utilisation of a convenience sample method may induce bias, hence constraining the generalisability of the findings among various demographics of public transport passengers. Future study may employ probability sampling methods to augment sample diversity and boost the generalisability of the findings. Secondly, the study's cross-sectional approach collects impressions at a singular moment, so limiting the capacity to evaluate changes in perceived accessibility over time or in reaction to specific enhancements. Future research may employ longitudinal designs to monitor these changes and acquire a more profound comprehension of the evolution of perceived accessibility. Moreover, dependence on self-reported data may engender response bias, thus compromising the veracity of the findings. The study concentrated on a restricted range of characteristics, possibly neglecting other critical factors affecting perceived accessibility, including economic status and personal mobility issues. Future study may broaden its scope by integrating other moderating or mediating variables, so enhancing the model and providing a more thorough comprehension of perceived accessibility.

CONCLUSION

The study examined how public service quality, safety, and open spaces affect public transport accessibility. A quantitative cross-sectional design was used to collect 320 valid responses from public transport customers via self-administered surveys utilising easy sampling. Multiple regression study showed that public transport quality, safety, security, and public open spaces positively and significantly affect perceived accessibility. This study emphasises the necessity of integrating service quality, safety, and public open spaces within accessible frameworks to improve public transit models. In practice, the findings help policymakers and transport authorities prioritise changes in these areas to increase public transport accessibility and customer happiness. The paper also notes its limitations and advises future investigation.

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Appendix 1: Survey Instrument

	Statement
Functionality	Travel times on public transport are reasonable.
	Public transport mostly runs on schedule.
	I am satisfied with the number of departures.
	Transfers are easy.
	The nearest stop is close to where I live.
Information	The information provided is good when traffic problems occur.
	The information provided is good at stops and terminals.
Comfort	Traveling by public transport is comfortable.
	The buses and trains are modern.
	The buses and trains are clean.
	I normally get a seat when I travel by public transport.
Cost	Public transport gives value for money.
	Public transport fares are reasonable.
Safety and security	The temperature inside the vehicle is good.
	Cleanliness of the vehicle and stations is effective.
	Safety on board (regarding accidents) is more reliable.
	Safety regarding robbery and violence is more effective.
Perceived accessability	Ease of entrance and exit from the vehicle and/or stations.
	Ease of transfers/good connections with other modes of transport.
	Individual space is available inside the vehicle.
Friendly public open spaces	The density of people in the area is manageable.
	The amenities available in the area meet my needs.
	I feel safe in the area.
	The urban landscape is visually appealing and well-maintained.