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Public Transport Users Mode Choice and Its Determinants in Addis Ababa City

Yibeltal Dubale Tazzie*

**Lecturer of Transport Planning and Management, College of Urban Development and Engineering, Ethiopian Civil Service University*

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Abstract

This study investigates the public transport mode choice and its determinants in Addis Ababa, focusing on two major public transport corridors: East-West (Ayat - Torhailoch) and North-South (Piassa - Kality). For this study data were collected from 665 public transport users through questionnaires and 15 key informants through interviews, as well as desk reviews. The data were analyzed using descriptive and inferential statistics with the help of SPSS version 26 and Microsoft Excel. The study reveals poor public transport service in the study area, with 80.3% of the respondents dissatisfied with availability, accessibility, affordability, safety, and security of the public transport systems. Many respondents traveled 0.5-1 km to reach stations and experienced long waiting times, exceeding average African passenger waiting times (30 minutes).The result also shows that demographic factors such as such as age, occupation, education level, and monthly income, as well as waiting time, cost, comfort, reliability and perception significantly affects the public transport mode choice. From the multinomial logistic regression, the Nagelkerke Pseudo R-squared value is 0.652, suggesting that the model accounts for around 65.2% of the variation of dependent variable explained by the independent variables.These findings provide valuable insights for policymakers to make informed decisions and improve public transport services that can satisfy the public transport users mode preferences behavoiurs. The study emphasizes the need for policy interventions to enhance the quality, accessibility, and affordability of public transport services.

Keywords: public transport, mode choice, determinants

1. Introduction

Public transportation systems significantly impact urban quality of life, impacting residents' well-being and affecting their overall well-being (Ismail, Hafezi, Nor & Ambak, 2012). Efficient public transportation systems offer affordable, and reliable travel for the residents, enabling access to employment, education, healthcare, and essential services (Martinez et al., 2019).

On the other hand, poor public transportation services cause traffic congestion, pollution, and reduced access to essential services, negatively impacting quality of life (Khattak, Noland & Hicks, 2003).

Ethiopia's capital Addis Ababa relies heavily on public transport systems for daily activities, with a significant portion of the population relying on them (Gebeyehu & Takano, 2007). However, the city of Addis Ababa faces several public transport challenges including traffic congestion, environmental pollution, accidents, inadequate public transport service and infrastructure, affecting public transportation service quality and efficiency (Fenta, 2014). Despite these challenges, studies on public transport service and mode choice habits of Addis Ababa's public transportation users are limited (Jee et al., 2022).

Public transport users choose their preferred mode based on its suitability for their specific needs and the range of options available to them (Eriksson, 2008). Socio-economic factors, including income, age, and occupation, significantly impact public transport mode choice behavior (Jee et al., 2022; Krammes et al., 2022). Furthermore, the inherent attributes of various transportation modes, such as travel time, cost, comfort, convenience, and safety, also play a vital role in determining the preferences of public transport users (Guo et al., 2021; Kim et al., 2021). Therefore, a comprehensive understanding of the factors that influence the mode choice behavior of public transport users is crucial for the development of effective and sustainable transportation interventions in Addis Ababa.

2. Materials and Methods

2.1. Study Area

The study was carried out in Ethiopia's capital city of Addis Ababa, which has emerged as an important regional financial, economic, and political center. Along with that, it is home to several international organizations, the African Union (AU), the United Nations Economic Commission for Africa (UNECA), over 100 embassies, and more. Geographically, the city is located between $8^0$46'00" N – $9^0$11'30" N latitude and $38^0$35'30" E – $38^0$57'30" E longitude. The topography of the area ranges from rolling to hilly, with steep gradients and numerous stream valleys. The city's elevation is between 3100 and 2100 m a.s.l, with moderate weather and climatic conditions.

Addis Ababa's physical expansion has been remarkable, having expanded from an estimated 32 km2 in 1912 to 540 km2 at present, with the city being divided into 11 sub-cities and 120 smaller administrative units known as Wereda (Weldeghebrael, 2021). By 2017, the city's population had almost reached 4 million, accounting for 25% of Ethiopia's urban population (World Bank, 2017). The city has seen fast population expansion. By 2037, the exponential growth rate is predicted to have made it into a megacity with a population of about 10 million. In recent years, growth has been low density and expansive, with geographical expansion surpassing population increase (Dejene, 2019). This has implications for the cost of infrastructure and service delivery, traffic congestion, social inclusion, and overall liability.

Addis Ababa is considered Ethiopia's growth engine and central to the country's vision of becoming a middle-income, carbon-neutral, and resilient economy by 2025. The city's economy is growing annually by 14%, contributing approximately 50% of the national GDP (World Bank, 2015). Therefore, understanding the public transportation system and the factors influencing mode choice behavior is critical for the city.

2.2. Research Design

The current research used a mixed-methods approach to comprehensively understand transport conditions and mode choice factors, employing both qualitative and quantitative techniques. Furthermore, both descriptive and explanatory research designs with cross-sectional survey were utilized to analyze the existing public transport condition and mode choice factors.

2.3. Data Sources and Method of Data Collection

The research utilized primary and secondary data sources, including surveys questionnaire, interviews, and field observations. Secondary data were collected through desk reviews of institutional archives, reports, published works, and websites, ensuring a comprehensive and credible understanding of the research problem. The combination of primary and secondary data sources ensured a comprehensive and credible understanding of the research problem.

2.4. Sampling and Sampling Technique

2.4.1. Sample Size Determination

The study focuses on passengers using various transport modes, including LRT, city buses, midibuses, minibuses, taxis, Lada, and digital taxis. A 96% precision sample size was determined to ensure accurate results, using Kothari's (2004) formula.

$$\mathbf{n = \frac{z2pq}{e2}}$$

Where N = total number of public transport user

n = desired sample size,

Z = at 96% level of confidence, which is 2.05;

p = estimated characteristics of target population = 0.5;

q = 1- p (maximum variation) = 0.5

e = significance level (4%) margin of error

$$n = \frac{z^2pq}{e^2} = \frac{(2.05)^2*(0.5)*(0.5)}{(0.04)^2} = 687$$

2.4.2. Sampling Techniques

This study utilized non-probability sampling techniques, including quota and convenience sampling, to ensure equal representation of geographical location and passenger transport modes. The sample was distributed equally among six locations and modes, including LRT, city buses, midibuses, minibuses, lada and digital taxi. Moreover, purposive sampling was employed to gather in-depth information from professionals and officials in the transport sector office.

2.5. Method of Data Analysis

The study used quantitative and qualitative analyses, including spatial analyses, to analyze data. Quantitative statistics, such as Mean and Standard Deviation, were used with SPSS Version 26. Thematic analysis supported the quantitative analysis. A multinomial logistic regression analysis was performed using the forward stepwise likelihood ratio method, and a Hos-mer-Lemeshow statistics goodness-of-fit analysis was conducted to assess the model's ability to accurately describe the data. The coefficients of each predictor were interpreted as the ratio change in odds of the event of interest for one-unit changes in the predictor. Parameters with significant negative coefficients decreased the likelihood of a response category compared to the reference category, while positive coefficients increased it.

3. Results and Discussion

3.1. Travel Characteristics of the Respondents

3.1.1. Mode of Travel

The survey result revealed that out of the 665 respondents, the majority (38.3%) used minibusses (White and Blue) taxis as their frequently used mode of transport. City buses (Anbessa, Sheger & Alliance), were the second most widely used with 33.4% of respondents. While the least used mode was lada taxi, with only 3.1% of the respondents using it. The high usage of minibusses indicates a high demand for this mode of transport, necessitating more minibus services and routes. This information can be useful to policymakers and transport service providers to understand the travel behavior and mode preferences of the residents in the study area.

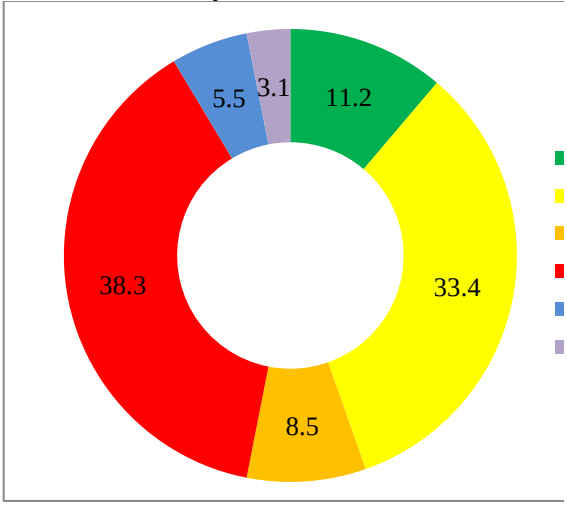

Figure 1 Frequeltly Mode of Travel by the Respondents (Source: Field Survey, 2023)

3.1.2. Travel Purpose

The result shown in figure 2 below revealed that the majority of respondents (58.2%) reported traveling for work, with education being the second reason (23.1%). Only 8.4% traveled for shopping, 7.2% for recreation, and 3.1% for other reasons.

The study population's travel patterns reveal that work is the most common reason for travel, suggesting a business district or numerous workplaces. A high percentage of respondents travel for education, indicating a significant student population. Low percentages travel for shopping and recreation, suggesting the area may not be a major commercial or entertainment destination.

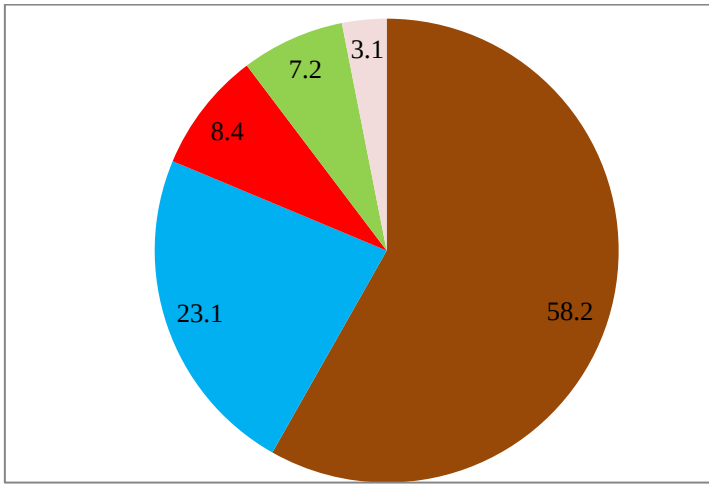

Figure 2 Travel Purpose of the Respondents (Source: Field Survey, 2023)

3.1.3. Travel Frequency

The survey presented in Table 3 revealed that 47.4% of the respondents reported traveling 5 times a week, with 22.3% traveling 6 times a week. Only a small percentage traveled less frequently, with 7.2% traveling once a week, 4.1% traveling twice a week, 2.2% traveling three times a week, and 1.4% traveling four times a week. This indicates that the majority of the respondents were regular commuters, traveling to their destinations at least 5 times a week.

Table 1 Travel Frequency of the Respondents

Travel Frequency	Frequency	Percentage (%)
Once/Week	48	7.2
Twice/Week	27	4.1
Three times/Week	15	2.2

Four times/Week	9	1.4
Five times/Week	315	47.4
Six times/Week	148	22.3
Everyday	102	15.4
Total	665	100

Source: Field Survey (2023)

3.2. Existing Public Transport Condition along the Study Corridor

This section presented the analysis of the existing public transport and travel conditions in the study corridors. Addis Ababa, a rapidly growing African city, faces challenges in providing efficient and sustainable public transport options. With a growing population and urbanization, the demand for public transport has grown significantly. Assessing the current state of the transport system is crucial to improve the city's efficiency, accessibility, and sustainability, ultimately enhancing residents' quality of life.

3.2.1. Current Public Transport Status

Table 2 shows the level of agreement on the current public transport service based on various parameters, including service availability, accessibility, affordability, safety, and security. Accordingly, the majority of respondents (46.0%) disagreed with the current public transport service availability, with only 7.2% strongly agreeing. This is consistent with Smith et al.'s (2021) study on limited public transport availability in urban areas.

Accessibility was also a concern, with 39.8% of respondents disagreeing with the current level of public transport accessibility. Only 11.3% agreed with the accessibility, which is consistent with Johnson & Lee's (2022) research. Nearly half of respondents (48.4%) disagreed with the affordability of public transport, indicating a widespread perception of high costs. This suggests a need for public transport service cost improvement, particularly for low-income groups. This finding aligns with the study by Garcia and Martinez (2020), which identified affordability as a significant concern for public transport users.

Safety was a significant concern, with 41.4% of respondents disagreeing with the current public transport service, supporting Brown & Williams' (2019) research on safety concerns. Security also received mixed responses, with 43.9% of respondents disagreeing with the current public transport service, indicating a significant proportion of respondents having concerns about security while using public transportation. This finding substantiates the study by Thompson & Davis (2023), which emphasized the importance of addressing security issues to enhance public transport.

Overall, the level of agreement across all parameters reveals a similar pattern, with the majority of respondents (43.9%) expressing disagreement regarding the current public transport service parameters such as availability, accessibility, affordability, safety, and security.

Table 2 Level of Agreement on the Current Public Transport Service

No	Parameters		SDA	DA	N	A	SA	Total
1.	Service availability	N	306	199	36	76	48	665
		%	46.0	29.9	5.4	11.4	7.2	100.0
2.	Accessibility	N	265	156	62	107	75	665
		%	39.8	23.5	9.3	16.1	11.3	100.0
3.	Affordability	N	322	165	52	81	45	665
		%	48.4	24.8	7.8	12.2	6.8	100.0

No	Parameters		SDA	DA	N	A	SA	Total
4.	Safety	N	275	164	77	90	59	665
		%	41.4	24.7	11.6	13.5	8.9	100.0
5.	Security	N	292	178	60	85	50	665
		%	43.9	26.8	9.0	12.8	7.5	100.0
		N	292	172	57	88	55	665
	Average	%	43.9	25.9	8.6	13.2	8.3	100.0

Source: Field Survey (2023)

NB: *SDA=Strongly Disagree, DA=Disagree, N=Neutral, A= Agree, and SA=Strongly Agree*

Figure 3 shows that the majority of respondents (80.3%) rate the current public transport condition as "Poor," followed by 11.3% who consider it "Moderate." Only 8.4% of respondents perceive it as "Good."

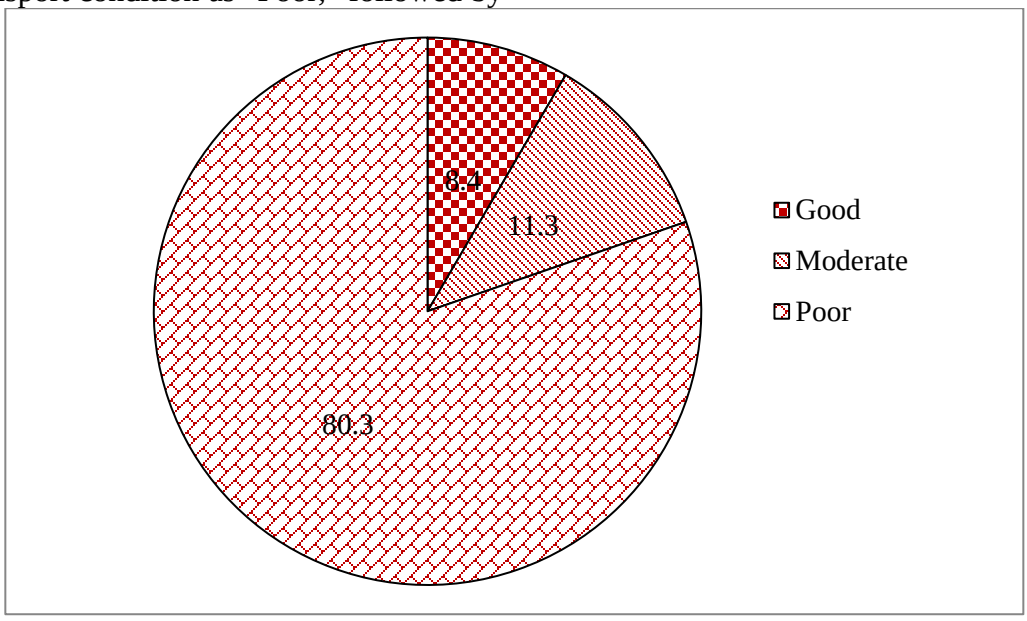

Figure 3 Response on Public Transport Condition (Source: Field Survey, 2023)

This finding is consistent with previous studies on urban infrastructure and service quality in public transport. For instance, in a study on urban infrastructure, Johnson et al. (2020) found that a significant number of respondents rated the current condition of infrastructure as poor. Similarly, Smith & Dobson (2019) investigated the perception of service quality in public transport and highlighted that a considerable portion of respondents perceived the public transport as inadequate. Addressing identified issues is crucial to improve the overall quality and effectiveness of the public transport system.

3.2.2. Walking Distance from Home Public Transport Stations

Figure 4 shows that 38.8% of participants travel between 0.5 and 1 km to access public transport, with 28.0% traveling between 1 and 1.5 km. 5.6% travel more than 2 km, and 19.4% travel less than 0.5 km. These findings offer valuable insights into travel patterns and proximity to public transport, which can inform transport planning decisions. In areas with shorter travel distances, additional stops or routes may be needed to accommodate high demand.

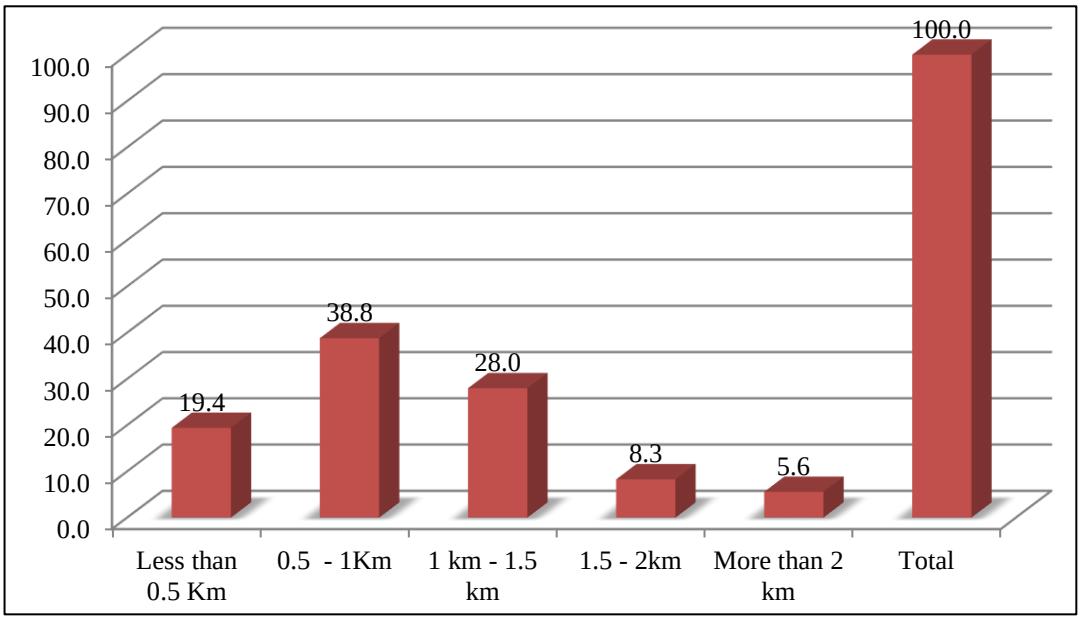

Figure 4 Distance Traveled to get Public Transport (Source: Field Survey, 2023)

Armstrong-Wright and Thiriez (1987) suggest a walking distance of 0.3-0.5 km for public transport, with a maximum of 1km. However, most participants travelled beyond these ranges, making it crucial to improve waking distance and strategically locate stops to enhance accessibility and convenience for commuters.

3.2.3. Waiting Time at Stations

The study found that 42.4%) of the participants reported a 30-minute to 1-hour waiting time for public transport, while 21.5% reported 1 to 1.5 hours, indicating a significant portion of the population experiencing longer wait times. This is a significant concern, as the average waiting time for African passengers is 30 minutes (Kumar & Barret, 2008). The figure results indicate that a significant proportion of individuals in the study area face longer waiting times, indicating that a significant number of people experience longer waiting times than the average for African passengers.

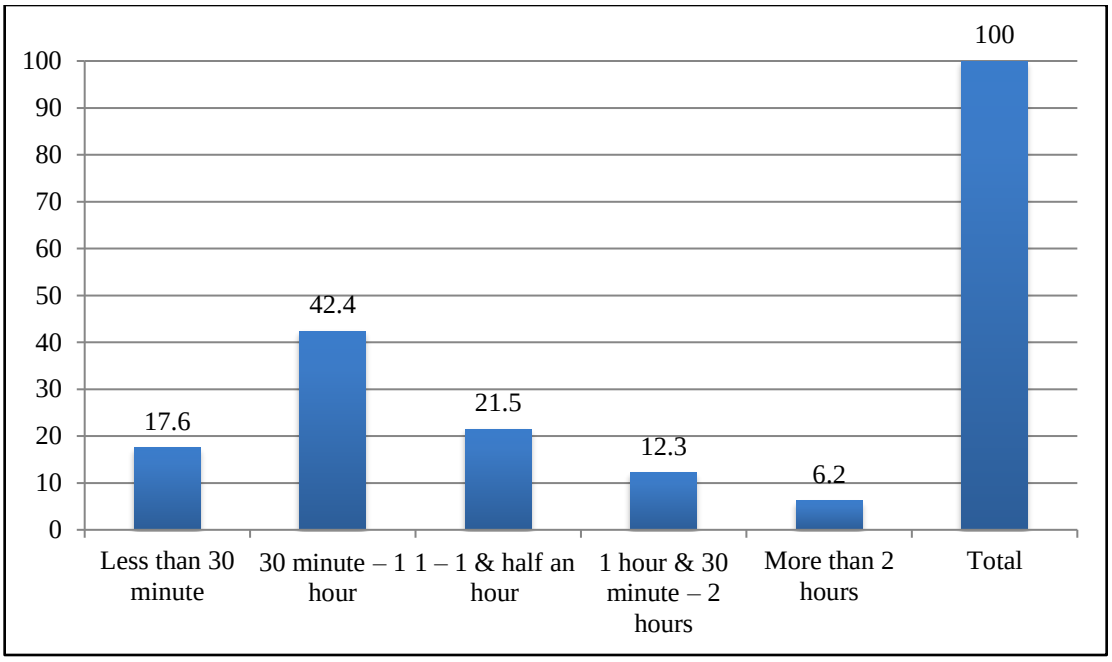

Figure 5 Waiting Time at Public Transport Stations (Source: Field Survey, 2023)

3.3. Mode Choice by Demographic Profile

3.3.1. Mode Choice by Sex

Table 3 displays the mode preferences of respondents based on their sex, revealing the most preferred and least preferred modes of transport for each sex. Minibuses and city buses are the most preferred modes for both males and females, with 17.1% and 25.0% of males and 25.0% of females using them, respectively. The least preferred mode is the Light Rail (LRT), with 4.4% and 6.2% of males and 6.2% of females using it. This trend is consistent with urban areas where minibuses and city buses are widely used, possibly due to factors like convenience, affordability, and accessibility. The lower preference for LRT may be due to limited coverage and not yet widespread adoption. These findings are specific to the surveyed population and may not be generalized to other contexts. However, they offer valuable insights into mode choice patterns and can inform transport planners and policymakers to tailor their efforts to cater to the specific preferences and needs of different user groups.

Table 3 Mode Choice by Sex

Modes of Transport	Sex					
	Male		Female		Total	
	N	%	N	%	N	%
LRT	29	4.4	41	6.2	70	10.5
City bus	96	14.4	104	15.6	200	30.1
Midi- Bus	24	3.6	33	5.0	57	8.6
Minibus	114	17.1	166	25.0	280	42.1
Digital taxi	14	2.1	23	3.5	37	5.6
Lada taxi	5	0.8	15	2.3	20	3.0
Total	282	42.4	383	57.6	665	100.0

Source: Field Survey (2023)

Table 4 displays statistical analysis results from Pearson Chi-Square, Likelihood Ratio, and Linear-by-Linear Association. The results show a significant relationship between the variables, with a p-value of 0.000. The Likelihood Ratio test yielded a p-value of 5.003 and a p-value of 0.001, while the Linear-by-Linear Association test showed a p-value of 1.01 and a p-value of 0.003, indicating a significant linear relationship between the variables. These findings indicate the importance of the variables and suggest a meaningful association between the variables being examined.

3.3.2.Mode Choice by Age

Table 5 displays passenger mode choice by age, with city buses and minibuses preferred by respondents aged 26-35 and 36-45. Minibuses are preferred by those above 55 years. LRT is preferred by younger respondents, with 3.9% choosing it between 18-25. These insights can aid transport planners and policymakers in improving public transport services and infrastructure.

Table 4 Chi-Square Tests of Mode Choice by Sex

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.022[a]	4	0.000
Likelihood Ratio	5.003	4	0.001
Linear-by-Linear As-	1.01	1	0.003
N of Valid Cases	665		

Source: Field Survey (2023)

Table 5 Passenger Mode Choice by Age

		Age Category						
		18-25	**26-35**	**36-45**	**46-55**	**Above 55**	**No Response**	**Total**
LRT	N	26	18	12	6	2	10	74
	%	3.9	2.7	1.8	0.9	0.3	1.5	11.1
City bus	N	65	82	38	11	8	18	222
	%	9.8	12.3	5.7	1.7	1.2	2.7	33.4
Midi- Bus	N	20	13	8	6	4	6	57
	%	3.0	2.0	1.2	0.9	0.6	0.9	8.6
Minbus	N	36	52	37	30	74	26	255
	%	5.4	7.8	5.6	4.5	11.1	3.9	38.3
Digital Taxi	N	6	5	2	15	5	4	37
	%	0.9	0.8	0.3	2.3	0.8	0.6	5.6
Lada Taxi	N	3	2	1	9	2	3	20
	%	0.5	0.3	0.2	1.4	0.3	0.5	3.0
Total	N	156	172	98	77	95	67	665
	%	23.5	25.9	14.7	11.6	14.3	10.1	100

Source: Field Survey (2023)

Table 6 shows a strong relationship between mode choice and respondent age, with a Pearson chi-square value of 65.086 and a p-value of 0.000, indicating a significant relationship at the 0.05 level.

Table 6 Chi-Square Tests of Mode Choice by Age

	Value	Df	Asymp. Sig.
Pearson	65.086[a]	15	0.000
Likeli-	51.38	15	0.001
Linear-by-Linear Association	6.508	1	0.000
N of	665		

a. 8 cells (40.0%) have an expected count of less than 5. The minimum expected count is .43. *Source: Field Survey (2023)*

3.3.3. Mode Choice by Occupation

Table 7 shows that 27.7% of respondents work in private companies, with 20% using minibuses as their preferred mode of transport. Government employees and unemployed individuals mostly use city buses, while 14.3% use a combination of city buses and minibuses. Low use of minibuses, lada taxis, and digital taxis is observed across all occupation categories.

Table 7 Mode Choice by Occupation

Public Transport Mode	**Occupation**								
	Government	Private Company	NGOs	Self-Employed	Unemployed	Students	Retired	Total	%
LRT)	9	13	0	18	24	6	4	74	11.1
City bus	36	25	6	65	28	55	7	222	33.4
Midibus	24	21	0	2	5	3	2	57	8.6
Minibus	38	117	5	48	16	29	2	255	38.3
Digital taxi	17	5	8	0	2	2	3	37	5.6
Lada taxi	11	3	3	0	1	0	2	20	3
Total	135	184	22	133	76	95	20	665	100.0
%	20.3	27.7	3.3	20	11.4	14.3	3	100.0	

Source: Field Survey (2023)

The table aabove indicates that mode choice is closely related to respondents' occupation, with different occupational groups showing different preferences. This information can help transport planners and policymakers understand travel patterns and needs of different groups and design tailored transport systems. Three statistical tests, Pearson Chi-Square, Likelihood Ratio, and Linear-by-Linear Association, yielded significant results with p-values less than 0.05. These findings have implications for policymakers and transport planners in designing transport systems that consider the preferences and needs of different occupational groups.

Table 8 Chi-Square Tests Mode Choice by Occupation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.125[a]	15	0.000
Likelihood Ratio	68.546	15	0.000
Linear -by-Linear Association	15.02	1	0.000
N of Valid Cases	665		

a. 10 cells (40.0%) have an expected count of less than 5. The minimum expected count is .47.

Source: Field Survey (2023)

3.3.4. Mode Choice by Educational Status

Table 9 shows that minibuses are the most widely used public transport mode among degree holders (35.7%), with 29.7% using LRT, followed by 18.9% in secondary education. City buses are also the most popular among degree holders and secondary education, with 19.3% and 38.5% of respondents using these modes.

Table 9 Mode Choice by Educational Status

Public Transport Mode	Educational Status								
	Illiterate	Read & Write	Primary Education	Secondary Education	Certificate /Diploma	Degree & Above	No Response	Total	%
LRT	0	4	9	14	17	22	8	74	11.1
City bus	0	11	39	88	36	44	4	222	33.4
MidiBus	0	2	6	20	13	14	2	57	8.6
Minibus	0	16	26	15	70	91	37	255	38.3
Digital taxi	0	0	2	2	13	19	1	37	5.6
Lada taxi	0	0	0	1	8	11	0	20	3.0
Total	0	33	82	140	157	201	52	665	100.0
%	0.0	5.0	12.3	21.1	23.6	30.2	7.8	100.0	

Source: Field Survey (2023)

The table reveals a significant relationship between education and public transport choice among respondents. Higher-educated respondents used digital taxis, LRT, and minibuses more frequently, while lower-educated respondents used city buses more frequently. The Pearson's Chi-square value (83.520) and Likelihood Ratio test confirmed the relationship, with a p-value of 0.0001. The Linear-by-Linear Association test also showed a significant relationship between mode choice and education, with a value of 18.415 and a significance level of 0.000.

3.3.5.Mode Choice by Monthly Income

Table 11 reveals income-influenced mode choice in public transport, with lower-income respondents using city buses and minibuses, while higher-income individuals prefer lada taxis and digital taxis. These modes are cheaper and more accessible for different income levels.

Table 10 Chi-Square Tests by Educational Status

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	83.520[a]	22	0.000
Likelihood	89.663	22	0.000
Linear-by-Linear Asso-	18.415	1	0.000
N of valid Cases	665		

Source: Field Survey (2023)

Table 11 Mode Choice by Income

Public Transport Mode	Monthly Income							
	Less than 2500	2500 - 5000	5001 - 7500	7501 - 10000	Above 10000	No Response	Total	%
LRT	12	18	26	6	2	10	74	11.1
City bus	21	80	84	11	8	18	222	33.4
Midibus	11	13	15	8	4	6	57	8.6
Minibus	14	52	83	41	40	25	255	38.3
Digital taxi	0	1	1	9	21	5	37	5.6
Lada taxi	0	0	3	4	10	3	20	3.0
Total	58	164	212	79	85	67	665	100
%	8.7	24.7	31.9	11.9	12.8	10.1	100	

Source: Field Survey (2023)

Table 12 shows a strong relationship between mode choice and respondents' income level, with a significant value of 76.524. This indicates a significant impact on mode choice, impacting policymakers and transport planners in designing accessible and affordable transportation systems for different income groups.

Table 12 Chi-Square Tests by Income of Respondents

	Value	Df	Asymp.
Pearson Chi-	76.524[a]	22	0.000
Likelihood Ra-	76.118	22	0.000
Linear-by-Lin-	1.143	1	0.252
N of Valid	665		

a. 13 cells (43.3%) have an expected count of less than 5. The minimum expected count is .55.

Source: Field Survey (2023)

3.4. Factor Affecting Passengers' Mode Choice

Table 13 presents 12 factors affecting passengers' mode choices, with frequency, percentage, rank, and selection for further analysis. Respondents ranked factors based on their importance in influencing mode choice, with waiting time being the most important (15.79%). Reliability and cost were the second and third most important factors, respectively (13.83% and 12.63%).

Table 13 Factors that Affecting Passengers' Mode Choice

No.	List of Factors Affecting Passengers' Mode Choice	Frequency	%	Rank	Factor Selected for Further Analysis
1.	Travel time	71	8.42	5	Selected
2.	Cost/Tariff	84	12.63	3	Selected
3.	Reliability	92	13.83	2	Selected
4.	Accessibility	33	4.96	9	Not selected
5.	Comfort	56	10.68	6	Selected
6.	Overcrowding	27	4.06	7	Not selected
7.	Absence of alternative	47	7.07	13	Not selected
8.	Perception on mode	76	11.43	4	Selected
9.	Safety	34	5.11	12	Not selected
10.	Security	22	3.31	7	Not selected
11.	Cleanness	18	2.71	10	Not selected
12.	Waiting time	105	15.79	1	Selected
	Total	665	100.00		

Source: Field Survey (2023)

3.4.1. Correlation Among Independent Variables

The study analyzed the correlation between cost, reliability, comfort, waiting time, and perception of public transport on mode choice.

Table 14 Correlations Between Independent Variables

		Correlations				
		Comfort	**Reliability**	**Waiting Time**	**Perception**	**Cost**
Spearman's rho	Comfort	Correlation Coefficient	1			
		Sig. (2-tailed)	.			
		N	376			
	Reliability	Correlation Coefficient	.886**	1		
		Sig. (2-tailed)	.000	.		
		N	376	376		
	Waiting time	Correlation Coefficient	.896**	.857**	1	
		Sig. (2-tailed)	.000	.000	.	
		N	376	376	376	
	Perception	Correlation Coefficient	.869**	.839**	.865**	1
		Sig. (2-tailed)	.000	.000	.000	.
		N	376	376	376	376
	Cost	Correlation Coefficient	.943**	.904**	.918**	.863**
		Sig. (2-tailed)	.000	.000	.000	.000
		N	376	376	376	376

**. Correlation is significant at 0.01 (2-tailed).

Table 14 shows a significant correlation between independent variables with a p-value less than 0.05. The measuring variables show a strong positive correlation, with a Spearman's rho correlation matrix result of over 0.86. The closest positive correlation indicates a strong positive relationship between the independent variables.

3.4.2. Model Result

Table 15 shows that the model is significantly predicted by the dependent variable, with a p-value less than the 0.05 threshold. The mode choice factor, the independent variables, also significantly predict the outcome. The chi-square statistic, 98.48, indicates that the independent variables have strong explanatory power, explaining 98% of the dependent variable. Overall, the model's goodness of fit is strong, indicating its effectiveness in predicting the dependent variable.

Table 15 Model Fitting Information

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept only	245.087	256.876	239.087			
Final	248.607	460.805	140.607	98.480	51	.000

Source: Field Survey (2023)

Table 16 shows a Pearson chi-square statistic of 14.385 with 9 df and a significance value of 0.109. This indicates that the data best fit the model, as the goodness-of-fit chi-square value is larger than the p-value. However, the statistical significance level is not significant at the 0.05 level, as the p-value is higher than the significance level. The Deviance chi-square statistic is 17.745 with 9 df and a significance value of 0.038. Overall, the Pearson method is preferred as it shows the model fits the data well, despite not being statistically significant.

Table 16 Goodness-of-Fit

	Chi-Square	Df	Sig.
Pearson	14.385	9	.109
Deviance	17.745	9	.038

Source: Field Survey (2023)

The Pseudo R-Square measures the explanatory capacity of independent variables in a logistic regression model. Table 17 shows the Cox and Snell pseudo R-squared value of 0.544, accounting for 54.4% of the dependent variable's variation. The Nagelkerke pseudo R-squared value of 0.652, 65.2%, and McFadden pseudo R-squared value of 0.416, accounting for 41.6% of the variation.

Table 18 presents the results of the Likelihood Ratio Test for various variables, including model-fitting criteria such as the AIC and BIC for reduced models, as well as the -2 Log Likelihood of the reduced models. The intercept has an AIC of 241.787, BIC of 453.985, and -2 Log Likelihood of 133.787, indicating a perfect fit. The cost factor has an AIC of 237.419, BIC of 437.828, and -2 Log Likelihood of 135.419, indicating a significant relationship between cost and mode choice.

Table 17 Pseudo R-Square

Cox and Snell	0.544
Nagelkerke	0.652
McFadden	0.416

Source: Field Survey (2023)

Waiting time has an AIC of 239.578, BIC of 404.62, and -2 Log Likelihood of 155.578, indicating a significant relationship between waiting time and mode choice. Comfort has an AIC of 242.123, BIC of 407.166, and -2 Log Likelihood of 158.123, indicating a significant relationship between comfort and mode choice. Perception has an AIC of 249.394, BIC of 414.437, and -2 Log Likelihood of 165.394, indicating a significant relationship between perception and mode choice. Finally, reliability has an AIC of 242.836, BIC of 407.879, and -2 Log Likelihood of 158.836, indicating a significant relationship between reliability and mode choice.

Table 18 Likelihood Ratio Test

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	241.787	453.985	133.787[a]	0	0	.
cost	237.419	437.828	135.419	1.632	3	0.042
Witing time	239.578	404.62	155.578	21.79	12	0.014
Comfort	242.123	407.166	158.123	24.336	12	0.018
Perception	249.394	414.437	165.394	31.607	12	0.012
Reliability	242.836	407.879	158.836	25.048	12	0.015

Source: Field Survey (2023)

4. Conclusions

The study reveals poor public transport service in the study area, with 80.3% of respondents dissatisfied with availability, accessibility, affordability, safety, and security of the public transport system. Many respondents traveled distances of 0.5-1 km to reach stations and experienced long waiting times exceeded average African passenger waiting times (30 minutes), highlighting the need for urgent improvements.

The analysis of mode choice by demographic profiles revealed several findings. Minibuses were the most popular mode of transport for both male and female respondents, followed by city buses. The study also found that age, occupation, education level, and monthly income influenced mode choice. For instance, younger respondents showed a higher preference for LRT, while private company employees and self-employed individuals favored minibuses.

The study highlights factors influencing public transport mode choice in Addis Ababa, including waiting time, comfort, reliability, cost, and perception. The model results also shows that these factors significantly affect the public transport mode choice. Thus, the study emphasizes the need for policy interventions to improve the public transport systems in the city to enhance the quality, accessibility, and affordability of public transport services.

Author Contribution

The author is solely responsible for the production of this research, and all materials used in this study have been properly acknowledged.

Competing interest

There is no competing interest regarding this original research article.

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Conflict of interest

There is no conflict of interest on the pubication of this manuscript

Authors contribution

Both authors have contributed in proposal writing, data collection, analysis and manuscript preparation

5. References

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. Transportation Research Part D: Transport and Environment, 2(3), 199-219.

Dejene, A. (2019). The Dynamics of Urbanization in Addis Ababa: Spatio-Temporal Analysis and Implications for Sustainable Development. Journal of Sustainable Development, 12(3), 161-174.

Ewing, R., & Cervero, R. (2010). Travel and the Built Environment. Journal of the American Planning Association, 76(3), 265-294.

Fenta, A. A. (2014). Urban Transport Policy and Practice in Ethiopia: The Case of Addis Ababa. Journal of Transport Geography, 41, 73-82.

Gebeyehu, M. B., & Takano, T. (2007). Determinants of Mobility and Mode Choice among Urban Poor: A Case Study of Ethiopia. Health and Place, 13(2), 446-455.

Guo, J., Yan, X., Wang, D., & Xu, Y. (2021). Assessing the Influence of Perceived Public Transport

Quality on Mode Choice Behavior: A Case Study of Beijing, China. Sustainability, 13(10), 5589.

Ismail, S., Hafezi, M. H. R., Nor, M. Z. M., & Ambak, K. (2012). Urban Public Transportation System and Its Impact on Quality of Life: A Review. Procedia-Social and Behavioral Sciences, 35, 13-20.

Jee, J., Kim, M., Kim, K., & Lee, S. (2022). Understanding the Factors Influencing Modal Choice: A Comparative Study of Urban Public Transport Users in Seoul, Korea. Sustainability, 14(9), 5034.

Khattak, A. J., Noland, R. B., & Hicks, J. W. (2003). Land Use and Travel Demand: An Examination of the Connections between Land Use Planning and Transportation. Transportation Research Part D: Transport and Environment, 8(2), 129-148.

Kim, S., Kim, K., Lee, S., & Kim, S. (2021). Understanding the Characteristics of Public Transport Users in South Korea: Evidence from Big Data Analysis. Sustainability, 13(8), 4206.

Krammes, R. A., Zietsman, J., & Deka, D. (2021). Understanding Public Transit Choice and the Influence of Built Environment and Demographics: A Case Study of Austin, Texas. Transportation Research, 10, 100386.

Martinez, L. M., Targa, F., & Viegas, J. M. (2019). How Public Transport Affects Quality of Life. Journal of Transport Geography, 77, 94-102.

Weldeghebrael, E. (2021). A Review of Urban Growth and Expansion of Addis Ababa, Ethiopia, 1911-2019. Urban Science, 5(1), 1-18.

World Bank. (2017). Ethiopia Urbanization Review: Urban Institutions for a Middle-Income Ethiopia. Washington, DC: World Bank Group.