



HAL
open science

Travel behavior characteristics of informal public mode users: A case study of E-rickshaw users of Rangpur city corporation (RpCC) in Bangladesh

Ashrafuzzaman Pramanik, Shafiq-Ur Rahman, Ashraf Uddin Fahim

► **To cite this version:**

Ashrafuzzaman Pramanik, Shafiq-Ur Rahman, Ashraf Uddin Fahim. Travel behavior characteristics of informal public mode users: A case study of E-rickshaw users of Rangpur city corporation (RpCC) in Bangladesh. *RTS. Recherche, transports, sécurité*, 2023, 2023, 12p. 10.25578/RTS_ISSN1951-6614_2023-01 . hal-04081330

HAL Id: hal-04081330

<https://hal.science/hal-04081330>

Submitted on 2 May 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

Travel behavior characteristics of informal public mode users: A case study of E-rickshaw users of Rangpur city corporation (RpCC) in Bangladesh

Caractéristiques des comportements de déplacement des utilisateurs des modes publics informels : une étude de cas des utilisateurs d'e-rickshaw de Rangpur City Corporation (RpCC) au Bangladesh

Ashrafuzzaman Pramanik, Shafiq-Ur Rahman, Ashraf Uddin Fahim

© Univ Gustave Eiffel 2023

Abstract Informally operated para-transit or Intermediate Public Transport (IPT) systems provide demand-responsive transit in many developing countries' cities. People are dependent on informal public transport for their mobility, mainly due to the absence of a formal public transport system. The purpose of this paper is to provide users' opinions about existing E-rickshaw services in a medium-sized city in Bangladesh. A case study was conducted in Rangpur, Bangladesh. A total of 400 passengers of E-rickshaws were randomly selected from 10 major points of the city for face-to-face interviews. Passengers were interviewed using a pre-determined questionnaire to determine their satisfaction with the service as well as any major issues or difficulties they encountered while using the E-rickshaw service. The Likert Scale and Performance Index were applied to assess their satisfaction level. Around 74% of the respondents chose the E-rickshaw for their usual trips. The performance

index for the fare rate of E-rickshaw was calculated as 4.06, i.e., the fare rate is close to very satisfied. E-rickshaw waiting times had a modest negative connection with «preference to use E-rickshaw rather than public transport» and «perceptions on route fixation». 'Affordable fare per km for public transport' shows a slight positive link with 'safety by using E-rickshaw' and 'preference to use E-rickshaw rather than public bus'. E-rickshaw safety and route focus have a slight positive association. After the study, it can be said that, being a potential bearing mode of transport in the present and future, the E-rickshaw is the best contender as an informal mode of public transport in the mixed traffic environment of Bangladesh where formal public transport is unavailable.

Keywords Informal public transport; E-rickshaw; satisfaction, Likert scale; performance index

Ashrafuzzaman Pramanik (✉)
Faculty, Department of Urban and Regional Planning
Pabna University of Science and Technology, Pabna-6600,
Bangladesh.
Email: ashraf.pramanik@gmail.com

M. Shafiq-Ur Rahman (✉)
Faculty, Department of Urban and Regional Planning
Jahangirnagar University, Savar, Dhaka, Bangladesh.
Email: shafiq@juniv.edu

Ashraf Uddin Fahim (✉)
Faculty, Department of Urban and Regional Planning
Pabna University of Science and Technology, Pabna-6600,
Bangladesh.
Email: fahim.urp@pust.ac.bd

Résumé Les systèmes de transport à la demande ou de transport public intermédiaire (IPT) exploités de manière informelle fournissent un transport adapté à la demande dans de nombreuses villes de pays en développement. Les gens dépendent des transports publics informels pour leur mobilité, principalement en raison de l'absence d'un système de transport public formel. Le but de cet article est de fournir les opinions des utilisateurs sur les services de pousse-pousse électriques existants dans une ville de taille moyenne au Bangladesh. Une étude de cas a été menée à Rangpur, au Bangladesh. Au total, 400 passagers de pousse-pousse électriques ont été sélectionnés au hasard dans 10 points principaux de la ville pour des entretiens en face à face. Les passagers ont été interrogés à l'aide d'un questionnaire prédéterminé pour déterminer leur satisfaction à l'égard du service ainsi que les problèmes ou difficultés majeurs rencontrés lors de l'utilisation du

service E-rickshaw. L'échelle de Likert et l'indice de performance ont été appliqués pour évaluer leur niveau de satisfaction. Environ 74 % des répondants ont choisi le pousse-pousse électrique pour leurs déplacements habituels. L'indice de performance pour le tarif du pousse-pousse électrique a été calculé à 4,06, c'est-à-dire que le tarif est proche de très satisfaisant. Les temps d'attente des pousse-pousse électriques avaient un lien négatif modeste avec «la préférence pour utiliser le pousse-pousse électrique plutôt que les transports en commun» et «les perceptions sur la fixation de l'itinéraire». « Tarif abordable au kilomètre pour les transports en commun » montre un léger lien positif avec « la sécurité en utilisant l'E-rickshaw » et « la préférence pour l'utilisation d'un E-rickshaw plutôt que d'un bus public ». La sécurité des pousse-pousse électriques et l'orientation sur les itinéraires ont une légère association positive. Après l'étude, on peut dire que, étant un mode de transport porteur potentiel dans le présent et l'avenir, le pousse-pousse électrique est le meilleur candidat en tant que mode informel de transport public dans l'environnement de trafic mixte du Bangladesh où le transport public formel est indisponible.

Mots-clé transports publics informels ; pousse-pousse électrique ; satisfaction, échelle de Likert ; index des performances

1. Introduction

Rapid urbanization in developing countries has led to an unprecedented increase in demand for mobility services, which in turn has put tremendous pressure on urban transport infrastructure and services [1]. Even in cities, formal public transport services are often inadequate and unreliable, giving rise to the population's dependence on personal mobility options and informal public transport services to meet their mobility needs [2]. The definition of public transport often does not include informal transport services like tempo, CNG auto-rickshaw, E-rickshaws, share autos, taxis, minibuses, etc [3]. In the absence or scarcity of formal public transportation systems, an informal transport service serves cities as para-transit or intermediate public transportation (IPT) and plays an important role in the transportation sector [4].

The battery-operated auto rickshaw (E-rickshaw) is the updated form of the rickshaw, which is locally known as the Easy bike or Auto. It normally has four to six seats for passengers along with the driver. An e-rickshaw is an informal mode of public transport in the urban transportation system of Bangladesh [5]. The mode, which was introduced in Bangladesh in 2008, has gained popularity among urban passengers because it is less expensive than other locally available modes of transportation and provides reasonable safety and comfort to users during travel [6]. This popularity, in turn, results in the rapid growth of the mode of Bangladesh.

E-rickshaws have become one of the preferred modes of transport between short distances and are operating in major urban and suburban areas as well as townships (Rana *et al.* 2013) [7]. Now, the mode has become an inseparable part of urban people's mobility networks, especially in small and medium-sized cities [5].

In this regard, this study tried to explore travel the characteristics of E-rickshaw users as an informal public mode of transport in Rangpur city, Bangladesh. This study also revealed the E-rickshaw users' satisfaction with existing services. The various models of this mode are now available in Bangladesh. The photographic view of the E-rickshaw is shown in Figure 1.

Figure 1. E-rickshaw



Source: Khan, 2018 [8]

2. Literature review

Cervero (2000) [9] considers “informal transport” as the right term as it best reflects the informal and illicit nature of the system that is officially sanctioned outside of the public transport sector. Informal transport services are also notable for their role as “gap fillers”. Formal transportation modes, to a great extent, are preferred by city authorities over informal transport because of their regularity. They exist in large part to fill the service void left unfilled by formal public transport drivers [9]. According to Sukla *et al.*, 2014 [10], informal transport is defined based on elements that they share despite their origins. They are referred to varyingly as ‘informal transport’, ‘para-transit’, ‘transport artisanal’, ‘third-world transport’ or ‘intermediate transport’. Though they refer to the same sector, some authors use the terminology distinctively.

Roy (2018) [11] mentions that cities in Sub-Saharan Africa are characterized by informal transportation services, compensating for the lack of institutionalized transportation systems. In Kampala, Uganda, the

vast army of boda-boda (boda) motorcycle taxis has proliferated through the city, with passengers and/or cargo goods straddled behind the boda drivers as they navigate through the city’s congested and dilapidated roads.

Rana *et al.* (2013) [7] showed that E-rickshaws are generally used for traveling short distances (less than 5 kilometers). This mode of transport is also generating employment in Bangladesh. However, no large investment in E-rickshaws by any financial institutions or organizations is observed except at a personal level. Power consumption and run time per full charge also directly affect the operating performance of the E-rickshaw [12].

According to the past researches [13]; [14] and [15], the E-rickshaw is the most commonly used motor vehicle after buses for health care, education, shopping, and social trips, and it is more frequently used than motorized two-wheeled vehicles for all trip purposes except work, personal business, and entertainment. Rahim *et al.*, 2017 [16] discovered that E-rickshaws are much more reliable and available during peak hours of the day. The service of this particular mode of transport is also highly satisfactory in comparison to buses and battery rickshaws.

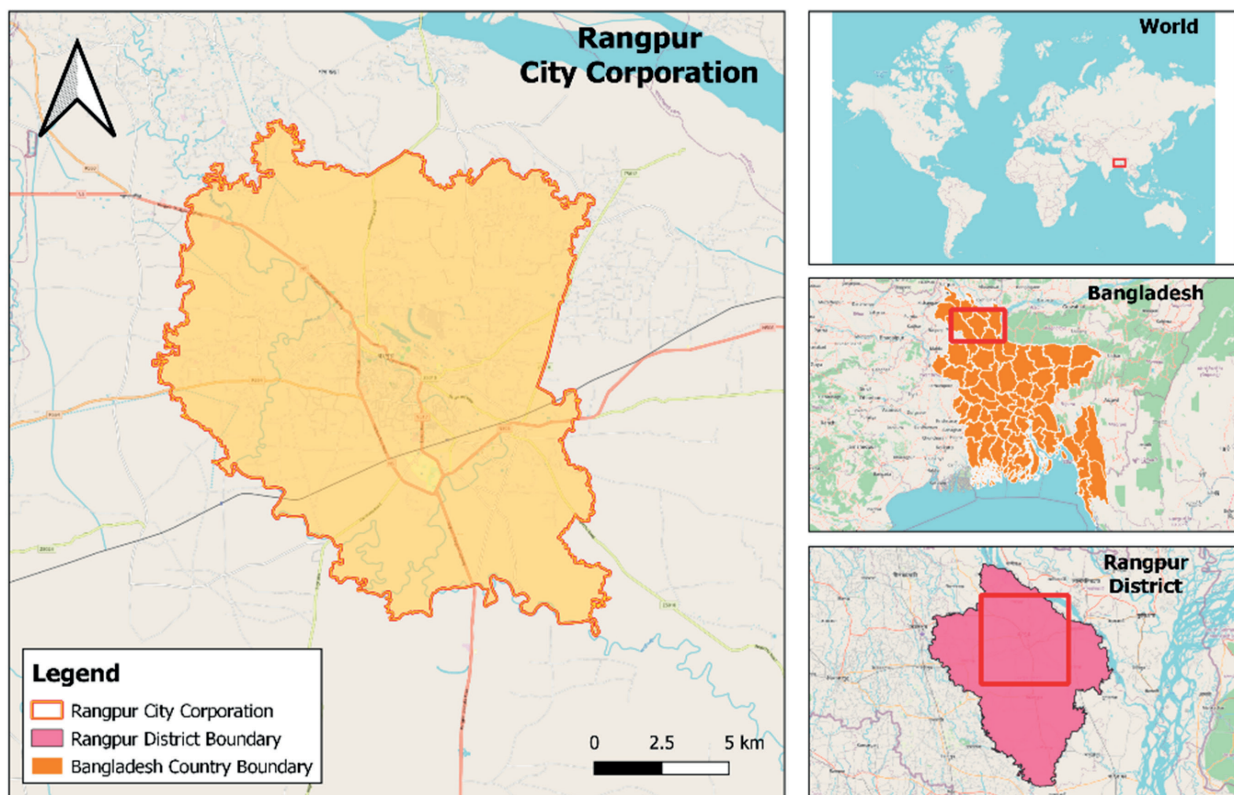
Informal public transport has various, often ambivalent characteristics [17]. The researchers [18]; and [1]) provided some integrated reviews of informal public transport scenarios in the developing countries. According to them, the strong presence of informal transport in the cities indicates that transport needs are not being met sufficiently by city governments through formal public transport services. Informal transport is also an essential source of income for many people and, in many cases, a part of larger economic interests [1].

3. Research design

3.1. Study area

Rangpur is the second largest city in the northern region of Bangladesh, located about 335 km north-west of the capital city, Dhaka [19]. Rangpur is one of the newly established City Corporations (municipality) in the country. The city is situated on the bank of the river Ghagat—a moribund tributary of the river Teesta. Figure 2 shows the location of Rangpur City in the context of the country and the Rangpur City Corporation area.

Figure 2. Rangpur City Corporation area



Source: Pramanik and Rahman, 2019 [19]

There is a total of 1427 km of road network in Rangpur city. Considering the roadway hierarchy (functional classification), the roads are categorized into national

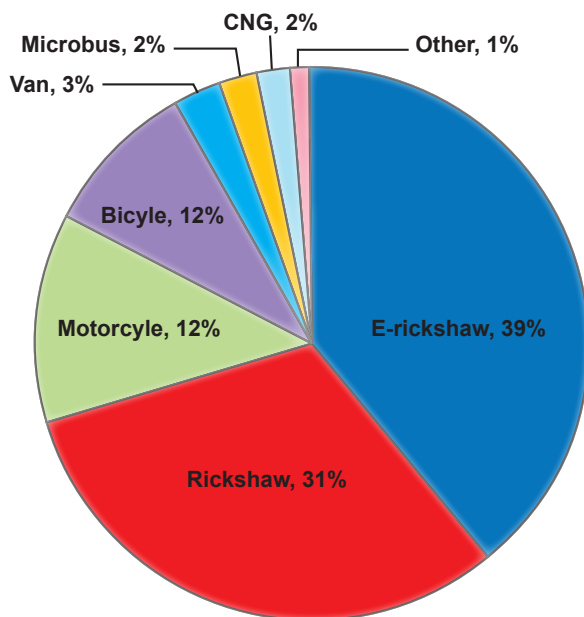
highways, primary roads, secondary roads, tertiary, and access roads (as seen in Table 1), where the majority (88%) are tertiary and access roads.

Table 1 Existing roads in Rangpur City

Functional Category	Length (km)	Length (mile)	%
National Highway	32.85	20.41	2.30
Primary Road	34.69	21.55	2.43
Secondary Road	99.98	62.12	7.00
Tertiary and Access	1259.93	782.88	88.26
Total	1427.44	886.97	100.00

Source: Pramanik and Rahman, 2019 [19]

Due to the absence of formal public transport in Rangpur city, E-rickshaws have been operating on all types of roads and in all areas of Rangpur city. According to Rangpur City Corporation (2020), traffic composition in the city was E-rickshaw (39%), rickshaw (31%), motorcycle (12%), and bicycle (9%) (as seen in Figure 3). In Rangpur, there are three types of rickshaws: E-rickshaw (Figure 1), Battery-rickshaw (Figure 4), and Cycle-rickshaw (Figure 5). Among them, the E-rickshaw has the highest percentage share (39%) of occupants.

Figure 3. Traffic Composition in Rangpur City

Source: Pramanik and Rahman, 2019 [19]

3.2. Study methods

A total of 400 passengers of E-rickshaw (at 5% confidence interval and 95% confidence level) were randomly selected from 10 major points of the city for face-to-face interviews. In this study, an «individual» was chosen as a sampling unit. Using the convenience sampling methods, the surveyors collected data from June 01, 2020 to September 30, 2020, maintaining a one-week interval. The temporary E-rickshaw stand was

used as a survey location for this study. Passengers were interviewed using a pre-determined questionnaire to explore their opinions about E-rickshaw services, their usage of E-rickshaw as a travel mode, the major problems and suggestions regarding the service. The questionnaire was divided into three major parts: a) trip information, b) passengers' travel behavior, and c) perceptions regarding E-rickshaw services.

The Likert Scale was applied to assess the passengers' level of satisfaction. The Likert scale is a unidimensional scale that researchers use to collect respondents' attitudes and opinions. It is a rating system, used in questionnaires, that is designed to measure people's attitudes, opinions, or perceptions. Subjects choose from a range of possible responses to a specific question or statement; responses typically include 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree'. Often, the categories of response are coded numerically, in which case the numerical values must be defined for that specific study, such as 1 is «strongly agree» and 2 is «agree» and so on [20].

Figure 4. Battery-rickshaw

Source: Khan, 2018 [8]

Figure 5. Cycle-rickshaw

Source: Khan, 2018 [8]

The Performance Index Method was adopted to analyze the performance of E-rickshaws. In that case, respondents were asked to give their opinion on some selected attributes of E-rickshaw like fare rate, travel safety, travel comfort, travel speed, travel time, crowd, operator behavior, and quality of service over a 5-point scale (0–5), where value 0 indicates the worst situation and value 5 indicates the best or excellent performance. Then the performance index of the mode for each of these factors was determined from users’ responses, which results in the situation of this mode in terms of those factors or attributes.

3.3. Statistical approach

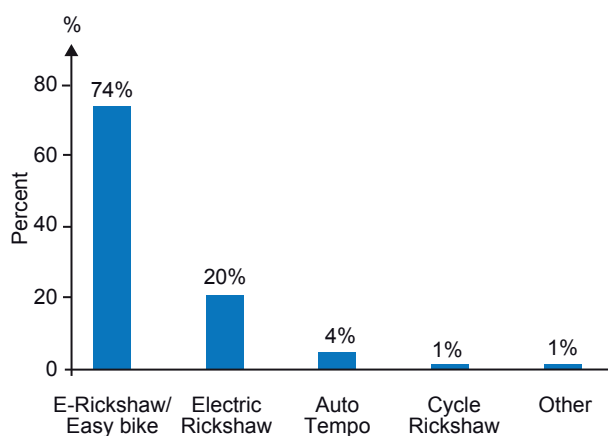
The distribution of factors and the chi-square test are employed to understand the respondents’ basic characteristics. The Chi-square (χ^2 value) Test was performed with the studied variables at a significant level of p less than 0.05 with a 95% confidence interval. The Chi-square test shows the relationship between the variables and the factors. When the value of the p value is less than 0.05, the relationship between the variables of the factors is significant [21]. Table 2 shows the distribution of the factors with chi-square values where all variables are significant except the variable «movement of E-rickshaw in the city centre» of Rangpur.

4. Results and discussion

4.1. Travel mode choice

Survey data on travel mode use revealed that around 74% of the respondents usually choose the E-rickshaw for their usual travel (Figure 6). Compared with other informal modes such as battery-operated rickshaw or auto-tempo, the proportion of respondents using the E-rickshaw was very high.

Figure 6. Transport modes used by the respondents for commuting daily trip

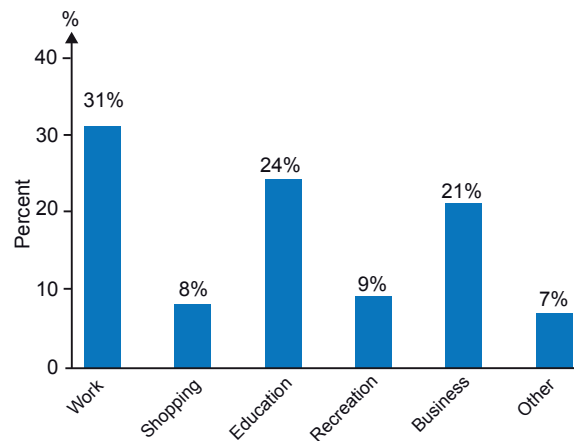


Source: E-rickshaw Passengers’ Survey, 2020

4.2. Purposes and reasons for choosing E-rickshaw

Almost 30–40% of the E-rickshaw users mentioned that they regularly used the E-rickshaw for a trip to a fixed or specified destination. Figure 4 shows the major purposes of the E-rickshaw trips. The major purposes of the respondents were work (31%), business (21%), education (24%), and shopping (8%).

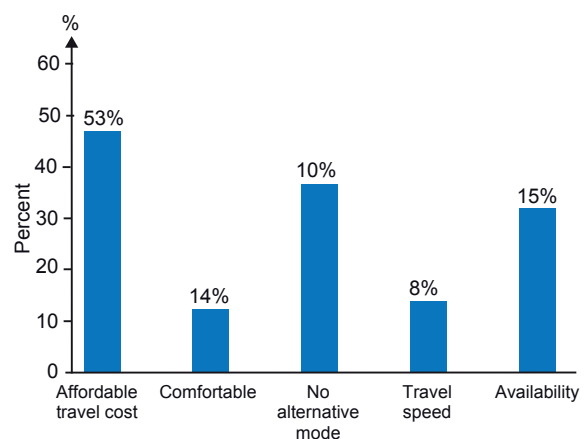
Figure 7. Purpose of trips by E-rickshaw users



Source: E-rickshaw Passengers’ Survey, 2020

Figure 8 shows that more than half of the respondents, around 53%, avail of the E-rickshaw because its travel cost is lower than any other locally available travel mode. Only 14% mentioned that they chose an E-rickshaw for comfortable travel. Almost 10% of the respondents mentioned that except for E-rickshaw, they do not have any other travel mode.

Figure 8. Reasons for choosing E-rickshaw for the trips



Source: E-rickshaw Passengers’ Survey, 2020

Table 2 Distribution of the variables for E-rickshaw Passengers (N=400)

Variables	%	Chi-Square (χ^2) value	df	p value
Age	Below 20 = 10%	104.960	5	.000
	20-25 = 18.5%			
	26-30 = 21.5%			
	31-45 = 31.5%			
	46-50 = 13.5%			
	Above 51 = 5%			
Monthly income	Less than 5000 = 1%	268.160	7	.000
	5000-10000 = 9%			
	10001 – 15000 = 10.5%			
	15001 – 20000 = 6.5%			
	20001 – 25000 = 11.5%			
	25001 – 30000 = 11%			
More than 30000 = 12.5				
Vehicle ownership	Motor Cycle = 9%	581.840	2	.000
	Car = 1%			
	None = 90%			
E-rickshaw use frequency per week	1-2 = 15%	286.500	4	.000
	3-4 = 21%			
	5-7 = 51.5%			
	Sometimes = 10.5%			
	No Use or rarely = 2%			
Waiting time for E-rickshaw	Not At All = 29.5%	197.700	4	.000
	1-5 Minutes = 38%			
	5-10 Minutes = 25%			
	10-15 Minutes = 7%			
	More than 15 Minutes = .5%			
Perception on the surveying area	Highly Congested Area = 16.5%	368.720	3	.000
	Congested Area = 65%			
	No Congestion = 17.5%			
	No Idea = 1%			
Safety by travelling E-rickshaw	High Risk = 30%	110.720	3	.000
	Risky = 44%			
	Neither Risk nor Safe = 10%			
	Safe = 16%			
Preference to use E-rickshaw rather than public bus	Strongly Disagree = 15%	185.600	4	.000
	Disagree = 45%			
	Neither agree nor disagree = 22%			
	Agree = 13%			
	Strongly Agree = 5%			
Perceptions on route fixation	Strongly Disagree = 7%	233.600	4	.000
	Disagree = 2%			
	Neither agree nor disagree = 19%			
	Agree = 45%			
	Strongly Agree = 27%			
Movement of E-rickshaw in the city centre	Strongly Disagree = 25%	4.160	3	.245
	Disagree = 21%			
	Neither agree nor disagree = 28%			
	Agree = 26%			

Source: E-rickshaw Passengers' Survey, 2020

4.3. Travel characteristics of E-rickshaw passengers

Travel characteristics of E-rickshaw users are presented in Table 3 by categorizing them into various groups. The majority (60%) of the E-rickshaw users have a low in-vehicle travel time of less than 30 min. The respondents informed us that they preferred to spend less time waiting and therefore preferred the high frequency services offered by low-capacity informal transport modes like E-rickshaw. It was observed that close to 50% of the access-egress trips for E-rickshaws had a travel time of less than 10 min.

Table 3 Travel characteristics of E-rickshaw passengers

Variable	Classification	Percentage
In-vehicle travel time	< 30 min	60
	30-60 min	30
	> 60 min	10
Wait time	<= 5 min	65
	5-15 min	35
	> 15 min	10
Access + Egress travel time	<= 10 min	50
	11-20 min	30
	> 20 min	20
In-vehicle trip length	< 1 km	90
	2-5 km	5
	6-10 km	4
	> 10 km	1
Access + Egress trip length	<= 1 km	78
	2-3 km	12
	> 3 km	10

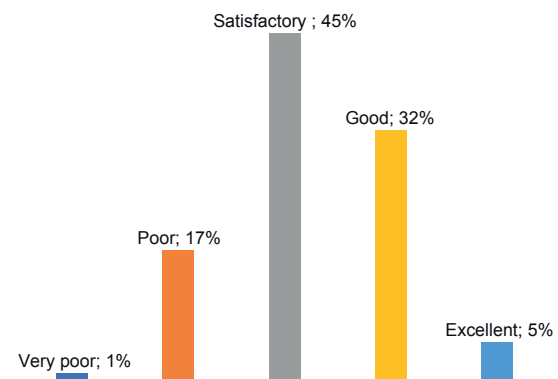
Source: E-rickshaw passengers’ survey, 2020

The shorter access-egress times for E-rickshaws were also a result of their boarding and alighting passengers all along their routes of operation. In the case of in-vehicle trip length, E-rickshaw users were observed to have a majority (90%) of their trips in the lower trip length categories, i.e., trips shorter than 1 km. The majority (78%) of the users informed us that E-rickshaws have access and egress distances of less than 1 km.

4.4. Users’ satisfaction about E-rickshaw services

Respondents were asked about the existing condition of E-rickshaw service quality. 45% of the respondents said that the overall quality of informal public transport service was satisfactory, while 32% of the users thought that the existing condition was good. Figure 9 below shows the user perception of the prevailing E-rickshaw quality.

Figure 9. Users’ perception on E-rickshaw service qualitytrips



Source: E-rickshaw Passengers’ Survey, 2020

User opinions were collected on the following attributes: fare rate, travel time, comfort of travel, safety, travel speed, crowd, operators’ behavior, and quality of service. The results are presented in Table 4.

Table 4 Performance of attributes based on opinion of E-rickshaw users

Attributes	Scale					Total respondents
	1 (strongly dissatisfied)	2 (dissatisfied)	3 (neutral)	4 (satisfied)	5 (strongly satisfied)	
Fare rate	0	0	20	336	44	400
Travel time	16	80	10	288	6	400
Travel comfort	50	112	18	220	0	400
Safety	156	190	8	46	0	400
Travel speed	0	30	130	230	10	400
Crowd	152	178	20	46	0	400
Operators’ behavior	38	140	68	156	0	400
Quality of service	0	38	104	224	34	400

Source: E-rickshaw Passengers’ Survey, 2020

Based on the opinions of the respondents, the performance index (a calculation of how well work meets its defined attributes) for the attributes was calculated, as seen in Table 5 below. The index for the fare rate of E-rickshaw was 4.06 and ranked first, which means the fare of E-rickshaw, was excellent or users were satisfied. The quality of service for e-rickshaws is nearly satisfactory (Index 3.64). However, the E-rickshaw was unable to ensure safety (Index 1.86). The light weight of the mode and lack of skills training for the operators are major reasons for the lack of safety associated with E-rickshaws.

Table 5 Performance index of attributes based on opinion of E-rickshaw passengers

Attributes	Performance Index	Rank
Fare rate	4.06	1
Travel time	3.47	4
Travel comfort	3.02	5
Safety	1.86	8
Travel speed	3.55	3
Crowd	1.88	7
Operators' behavior	2.87	6
Quality of service	3.64	2

Note: Performance Index = $\sum(\text{Value} \times \text{Scale}) / \text{Total respondents}$

5. Statistical analysis

To investigate the relationship between factors, Pearson Correlation Matrix (PCM) was used to learn about the respondents' demographic characteristics and travel behavior. PCM is a widely used method to understand the relationship of different studied variables. It assigns a value between +1 and -1, where 0 is no correlation, +1 is total positive correlation, and -1 is total negative correlation. It would be very difficult to understand the relationship between each variable by simply staring at the raw data. A correlation matrix can help us quickly understand the correlations between each pair of variables. In this study, the Pearson Correlation Matrix (PCM) is used to describe the relationship among the selected variables (Table 6).

Findings show that 'monthly income' has weak positive correlation between 'perceptions on route fixation'. 'Monthly income' has weak negative correlation between 'waiting times for E-rickshaw'. 'Waiting times for E-rickshaw' has weak negative correlation 'preference to use E-rickshaw rather than public bus', 'perceptions on route fixation'. 'Affordable fare per km for public transport' has weak positive correlation between 'safety by travelling E-rickshaw' (correlation value = .147) and 'preference to use E-rickshaw rather than public bus' (correlation value = .223). 'Safety by travelling E-rickshaw' has weak positive correlation between 'perception on route fixation'

	Age	Monthly income	Vehicle ownership	E-rickshaw use frequency per week	Waiting time for E-rickshaw	Affordable fare per km for public transport	Safety by travelling E-rickshaw	Preference to use E-rickshaw rather than public bus	Perceptions on route fixation	Movement of E-rickshaw in the city centre
Age	1									
Monthly income	-.309	1								
Vehicle ownership	-.148	.063	1							
E-rickshaw use frequency per week	.083	.029	.066	1						
Waiting time for E-rickshaw	.009	-.148	.076	-.011	1					
Affordable fare per km for public transport	-.059	.098	-.032	.023	-.021	1				
Safety by travelling E-rickshaw	.006	.039	.065	.116	-.099	.147	1			
Preference to use E-rickshaw rather than public bus	-.013	.040	-.014	.062	-.177	.223	.058	1		
Perceptions on route fixation	-.046	.139	.037	-.037	-.173	.002	.208	.037	1	.136
Movement of E-rickshaw in the city centre	-.005	-.036	.038	-.033	.028	-.062	.012	.005	.136	1

In this study, a multinomial logistic regression model is used to investigate how E-rickshaw users feel about the routes available to them as they are traveling around the city. The result of this model is shown in Table 7. The chi-square statistic of the model is significant (364.439, $p < 0.05$), indicating that the multinomial logistic regression model has a significant to explain the factors that influence passengers satisfaction on fixed route. The p-value was less than 0.05 proving that there is a significant relationship between the dependent variable and independent variables in the model. The deviance (598.777, $p = 0.286$) statistics test proves that the model is fit. Since the test are not statistically significant, that is the p value is greater than 0.05. The Pseudo R-Square measures are Cox and Snell (0.598), Nagelkerke's (0.647) and McFadden (.352). The model accounts represent relatively decent-sized effects of variance. The likelihood ratio test proves that the independent or predictor variables was significant, which proves that these predictors contribute significantly to the final model.

While comparing the attribute of strongly disagree relative to strongly agree, result shows (Table 7) that passengers who have monthly income of BDT¹ 10000-15000 relative to more than BDT 30000 have 34.381 times probability of being dissatisfied with fixed route system. All the age groups have less than 0.01 probability of being dissatisfied with the fixed route system compared to persons whose age is more than 50. People who make

trip with purpose of education and business relative to others have 0.025 and 0.012 times probability of being disagreed with the service.

While comparing the attribute of neither agree or disagree relative to strongly agree, result shows passenger whose earning is BDT 5000-10000, BDT 10000-15000 and more than BDT 30000 relative to who has no income have 4.695, 14.715 and 4.058 times probability of being neither agree or disagree with the service (Table 7). Passengers whose age are 26-30, 31-45 and 46-50 years relative to age group more than 50 years have 0.049, 0.074 and 0.027 times probability of being neither agree nor disagree with the service. People who make trip with purpose of work, shopping, education and business relative to others have 0.192, 0.146, 0.151 and 0.061 times probability of being neither agree nor disagree with the service.

While comparing the attribute of agree relative to strongly agree, result shows passenger whose earning is BDT 25000-30000 relative to who has no income have 0.182 times probability of being satisfied with fixed route service. Passengers whose age are 26-30 and 46-50 years relative to age group more than 50 years have 0.114 and 0.155 times probability of being satisfied with fixed route service. Passenger who thinks travelling in E-rickshaw has high risk and risk relative to safe have 0.358 and 0.268 times probability of being satisfied with fixed route service.

Table 7 Factors for satisfaction on fixed route by the passengers

		Ref	B	Std. Error	Wald	df	Sig.	Odd ratio	
Strongly Disagree	Intercept		-3.086	2134.31	0	1	0.999		
	Waiting time	More than 15 minutes	Not at all	-1.212	2133.393	0	1	1	0.298
			1-5 minutes	-1.001	2133.393	0	1	1	0.367
			5-10 minutes	-1.07	2133.393	0	1	1	0.343
			10-15 minutes	2.157	2133.393	0	1	0.999	8.642
			Less than 5000	-7.736	399.204	0	1	0.985	0
	Monthly Income BDT	None	5000-10000	1.939	1.192	2.645	1	0.104	6.949
			10000-15000	3.538	1.101	10.318	1	0.001	34.381
			15000-20000	-8.905	99.294	0.008	1	0.929	0
			20000-25000	-13.342	77.109	0.03	1	0.863	1.61E-06
			25000-30000	-11.353	94.317	0.014	1	0.904	1.17E-05
			More than 30000	1.308	1	1.71	1	0.191	3.698
	Age	Above 51	Below 20	-5.096	1.809	7.935	1	0.005	0.006
			20-25	-7.575	1.824	17.249	1	0	0.001
			26-30	-6.656	1.718	15.018	1	0	0.001
			31-45	-8.002	1.819	19.352	1	0	0
			46-50	-6.248	1.749	12.756	1	0	0.002
	Trip purpose	Others	Work	-2.611	1.368	3.642	1	0.056	0.073
			Shopping	0.179	1.43	0.016	1	0.901	1.195
			Education	-3.707	1.56	5.645	1	0.018	0.025
			Recreation	0.618	1.411	0.191	1	0.662	1.854
Administrative			15.708	3348.382	0	1	0.996	6637692.556	
Business			-4.393	1.599	7.549	1	0.006	0.012	
Safety	Safe	High risk	10.846	62.552	0.03	1	0.862	51333.48	
		Risk	10.023	62.554	0.026	1	0.873	22528.098	
		Neither risk nor safe	-0.311	106.647	0	1	0.998	0.733	

1. Bangladeschi Taka : official currency of bangladesh

		Ref	B	Std. Error	Wald	df	Sig.	Odd ratio	
Disagree	Intercept		8.216	3702.37	0	1	0.998		
	Waiting time	More than 15 minutes	Not at all]	-33.915	3690.792	0	1	0.993	1.02E-13
			1-5 minutes	-34.078	3690.839	0	1	0.993	1.02E-13
			5-10 minutes	-17.515	3690.236	0	1	0.996	2.48E-08
			10-15 minutes	-16.016	3692.205	0	1	0.997	1.11E-07
	Monthly Income	None	Less than 5000	28.727	326.555	0.008	1	0.93	2.99086E+12
			5000-10000	2.192	140.021	0	1	0.988	8.956
			10000-15000	17.949	60.578	0.088	1	0.767	62393180.18
			15000-20000	0.923	106.073	0	1	0.993	2.516
			20000-25000	-1.902	155.616	0	1	0.99	0.149
			25000-30000	0.341	93.709	0	1	0.997	1.406
			More than 30000	17.717	103.65	0.029	1	0.864	49469705.21
	Age	Above 51	Below 20	-1.274	178.327	0	1	0.994	0.28
			20-25	0.164	143.472	0	1	0.999	1.178
			26-30	-14.739	173.627	0.007	1	0.932	3.97E-07
			31-45	-18.095	153.462	0.014	1	0.906	1.39E-08
			46-50	-16.879	176.682	0.009	1	0.924	4.67E-08
	Trip purpose	Others	Work	0.133	74.143	0	1	0.999	1.142
			Shopping	-0.911	106.975	0	1	0.993	0.402
			Education	-16.594	98.613	0.028	1	0.866	6.21E-08
Recreation			-2.552	185.122	0	1	0.989	0.078	
Administrative			6.693	0	.	1	.	806.467	
Business			-14.707	85.258	0.03	1	0.863	4.10E-07	
Safety	Safe	High risk	16.435	77.766	0.045	1	0.833	13722051.45	
		Risk	2.004	97.129	0	1	0.984	7.418	
		Neither risk nor safe	18.243	102.703	0.032	1	0.859	83697255.24	
Neither agree or disagree	Intercept		7.745	969.976	0	1	0.994		
	Waiting time	More than 15 minutes	Not at all]	-15.149	968.012	0	1	0.988	2.64E-07
			1-5 minutes	-15.345	968.012	0	1	0.987	2.17E-07
			5-10 minutes	-13.696	968.012	0	1	0.989	1.13E-06
			10-15 minutes	-14.791	968.012	0	1	0.988	3.77E-07
	Monthly Income	None	Less than 5000	-10.353	251.075	0.002	1	0.967	3.19E-05
			5000-10000	1.547	0.778	3.95	1	0.047	4.695
			10000-15000	2.689	0.746	13.007	1	0	14.715
			15000-20000	1.376	0.737	3.486	1	0.062	3.958
			20000-25000	0.997	0.674	2.184	1	0.139	2.709
			25000-30000	-0.616	0.682	0.816	1	0.366	0.54
			More than 30000	1.401	0.701	3.997	1	0.046	4.058
	Age	Above 51	Below 20	-13.505	93.25	0.021	1	0.885	1.36E-06
			20-25	-1.745	1.084	2.59	1	0.108	0.175
			26-30	-3.022	1.058	8.156	1	0.004	0.049
			31-45	-2.606	1.005	6.729	1	0.009	0.074
			46-50	-3.598	1.117	10.376	1	0.001	0.027
	Trip purpose	Others	Work	-1.653	0.747	4.891	1	0.027	0.192
			Shopping	-1.927	0.991	3.776	1	0.052	0.146
			Education	-1.889	0.833	5.139	1	0.023	0.151
Recreation			-1.177	0.969	1.477	1	0.224	0.308	
Administrative			-1.999	5117.735	0	1	1	0.135	
Business			-2.796	0.763	13.419	1	0	0.061	
Safety	Safe	High risk	10.97	61.693	0.032	1	0.859	58113.289	
		Risk	10.43	61.693	0.029	1	0.866	33863.486	
		Neither risk nor safe	11.649	61.696	0.036	1	0.85	114557.477	

		Ref	B	Std. Error	Wald	df	Sig.	Odd ratio	
Agree	Waiting time	Intercept	4.263	1224.449	0	1	0.997		
		More than 15 minutes	Not at all	-1.609	1224.448	0	1	0.999	0.2
			1-5 minutes	-1.065	1224.448	0	1	0.999	0.345
			5-10 minutes	-0.27	1224.448	0	1	1	0.763
			10-15 minutes	-1.255	1224.448	0	1	0.999	0.285
	Monthly Income BDT	None	Less than 5000	-0.078	1.084	0.005	1	0.943	0.925
			5000-10000	0.43	0.669	0.413	1	0.521	1.537
			10000-15000	0.585	0.639	0.836	1	0.361	1.794
			15000-20000	-0.115	0.663	0.03	1	0.863	0.892
			20000-25000	-0.285	0.522	0.299	1	0.585	0.752
			25000-30000	-1.703	0.517	10.862	1	0.001	0.182
			More than 30000	0.636	0.536	1.408	1	0.235	1.889
	Age	Above 51	Below 20	-2.909	1.046	7.738	1	0.005	0.055
			20-25	-1.015	0.992	1.046	1	0.306	0.362
			26-30	-2.172	0.965	5.062	1	0.024	0.114
			31-45	-1.436	0.934	2.363	1	0.124	0.238
			46-50	-1.866	1.001	3.478	1	0.062	0.155
	Trip purpose	Others	Work	0.593	0.731	0.657	1	0.418	1.809
			Shopping	0.444	0.848	0.274	1	0.601	1.558
			Education	0.177	0.769	0.053	1	0.817	1.194
Recreation			0.507	0.909	0.311	1	0.577	1.66	
Administrative			15.892	3348.381	0	1	0.996	7979536.212	
Business			-0.983	0.744	1.744	1	0.187	0.374	
Safety	Safe	High risk	-1.027	0.442	5.402	1	0.02	0.358	
		Risk	-1.312	0.407	10.362	1	0.001	0.269	
		Neither risk nor safe	0.172	0.633	0.074	1	0.786	1.188	

The reference category is strongly agree.

Source: E-rickshaw Passengers’ Survey, 2020 & results from SPSS software

6. Conclusion

E-rickshaws are an essential component of the informal public transportation system in the cities of Bangladesh. It was found that E-rickshaw passengers were very satisfied with the availability and quality of existing E-rickshaw services. Although Rangpur city was selected as a case study, the research findings might be applied to other cities with similar mixed traffic environments where e-rickshaws play an important role in local transportation. Further research could be carried out on operational characteristics of E-rickshaws; integrating E-rickshaws with other modes to facilitate an integrated multi-modal system; formulating policy regulations for this.

References

1. Ali, Cervero R. and Golub A. (2007) Informal transport: A global perspective. *Transport Policy*,14(6), pp.445-457
2. Shizamaki, T. and Rahman, M. (2000) Operational characteristics of para-transit in developing countries of asia
3. Basri, R., Khatun, T., Reza, M.S., and Khan, M.M.H. (2015) “Changing Modes of Transportation: A Case Study of Rajshahi City Corporation”
4. Goyal, V. and Asija, N. (2015) FazilkaEcocabs: World’s First Dial-a-Rickshaw Scheme. Experience and Lessons, Case Studies on Sustainable Urban Transport No. 9, GIZ. Available at: http://www.ecocabs.org/media/resources/1440157438_5422_CS9_Fazilka_final.pdf
5. Rana, M.S., Hossain, F., Roy, S.S., & Mitra S. K. (2012) Battery Operated Auto-rickshaw and Its Role in Urban Income and Employment-Generation. *International Journal of Advancements in Research & Technology*, 1(5). Retrieved from https://www.academia.edu/2236858/Battery_Operated_Auto_rickshaw_and_Its_Role_in_Urban_Income_and_Employment_Generation
6. Basri, R., Khatun, T., Reza, M.S., and Khan, M.M.H. (2010) “Changing Modes of Transportation: A Case Study of Rajshahi City Corporation”
7. Rana, S., Hossain, F., Roy, S. S., & Mitra, S. K. (2013) The role of battery operated auto-rickshaw in the transportation system of a city. *Journal of Asian Electric Vehicles*, 11(1), 1635-1644
8. Khan Z. R., (2018) “Final Report on the Efficient Charging System for Electric Three Wheelers”, REEP, Giz, Bangladesh. Available at: https://reep.sreda.gov.bd/projects/Final%20Report_Efficient%20Charging%20System%20for%20Electric%20Three%20Wheelers.pdf
9. Cervero, R. (2000) Informal Transport In the Developing World. , pp.117–144
10. Shukla, P. R., Dhar, S., Pathak, M., & Bhaskar, K. (2014) Electric vehicle scenarios and a roadmap for India. Promoting low carbon transport in india, unep dtu Partnership, Centre on Energy, Climate and Sustainable Development Technical, University of Denmark

11. Roy, A. (2018) E-rickshaw Service in Barddhaman Town: Importance, Problems and Future Prospects. *International Journal of Scientific and Research Publications*, 702-706
12. Dhakal D.S. (2005) "Role of Government, private sector and civic society in promoting battery operated electric three-wheelers in Kathmandu, Nepal", Institute for Global Environmental Strategies (IGES), Kitakyushu office, pp. 19
13. Reddy, K. S., Aravindhan, S. & Mallick, T. k. (2017) Techno-Economic Investigation of Solar Powered Electric Auto-Rickshaw for a Sustainable Transport System. *Energies*, 10(6). Access to : <https://doi.org/10.3390/en10060754>
14. Baker, J. (2005) "Urban Poverty and Transport: The Case of Mumbai", World Bank Policy Research Working Paper 3693. Washington, DC: The World Bank
15. Kumar G., Kaur A., Singh K.K., (2014) Public Transport and urban mobility: Perception of people on services of public transport in Bathinda City, Punjab, India, *International Research Journal of Social Science*, Vol.3(12)
16. Rahman, F., Haque, F., Ehsan, MT., Rahman, M.M., and Hadiuzzaman, M. (2017) "Determination of user's perception of para-transit service quality in Dhaka city based on user's perception." *Inter Journal of Education and Applied Science*, 7, Issue 1: 19-24. ISSN: 2249-4944.
17. Gadepalli, Ravi. (2016) Role of Intermediate Public Transport in Indian Cities. *Economic and Political Weekly*, Vol. 9
18. Joewono, T. B. and Kubota, H. (2007) User perceptions of private paratransit operation in Indonesia. *Journal of Public Transportation*, 10(4), p.5
19. Pramanik, M. A. and Rahman, M. S. U. (2020) Operational characteristics of paratransit in medium-sized city: a case study on E-rickshaws in Rangpur City, Bangladesh. *Journal of Bangladesh Institute of Planners (JBIP)*, vol 12, pp. 45-62, ISSN 2075-9363. Available at: <https://www.bip.org.bd/admin/uploads/bip-publication/publication-24/paper/20201002103045.pdf>
20. Das, S., Pandit, D. (2016) A Framework for Determining Commuter Preference Along a Proposed Bus Rapid Transit Corridor. *Procedia - Social and Behavioral Sciences*. 104, 894-903. London: Elsevier
21. Fahim, A. U., Rahman, M. M., Abir, F. A., & Bhuiyan, M. A. F. (2022) An investigation of users' perception on non-motorized transport services in a municipality area: A cross-sectional study on Pabna municipality. *Case studies on transport policy*, 10(1), 657-663