

Passenger Satisfaction of Public Bus Services: A Case Study on Chandra-Hemayetpur Route in Savar

Mohammad Mizanur Rahman¹

Abstract: Efficient and reliable bus services are essential components of a sustainable urban transportation system. In densely populated countries like Bangladesh, where mobility challenges are exacerbated by rapid urbanization, understanding the existing bus service conditions and customer satisfaction levels becomes crucial. This study employs a comprehensive approach to assess the current state of bus services and analyze customer perceptions in Chandra-Hemayetpur Route in Savar, Dhaka. Through a combination of quantitative surveys and qualitative interviews, 18 factors were examined including bus availability, comfort in bus, bus fare rate, delay time and accessibility. Moreover, customer satisfaction was also measured through principal component analysis with the regression model and identify areas for improvement in the bus service. The findings of this research highlight the critical issues within the four component system, such as bus condition, driver's skills, delay time; comfort in bus; uncomfortable space in bus seat; contractor behavior and crime in the bus. The research found that a significant proportion of bus passengers, above 50%, expressed dissatisfaction or high levels of dissatisfaction with the 18 factors assessed in the Chandra - Hemayetpur route segment of Savar. The total satisfaction level is 3.30, suggesting a proximity to dissatisfaction on the Likert scale (1 to 5; where 4 = dissatisfied). The insights from this study provide valuable guidance for policymakers and transport authorities to enhance the quality of bus services, thereby fostering a more efficient and customer-oriented public transportation network. This research contributes to the broader discourse on satellite town to city connecting road in developing nations and underscores the significance of addressing public transportation challenges for sustainable urban development.

Keywords: Public Transportation, Bus Service, Customer Satisfaction, Urban Transportation, Comforts Mobility.

Introduction

Public transportation plays a crucial part in the socio-economic development of a country by enabling the efficient transit of people and products throughout both urban and rural areas (Bamwesigye & Hlavackova, 2019; Berg & Ihlström, 2019; Tiwari, 2002). In a nation characterized by high population density, such as Bangladesh (Hussain, 2013), where the phenomena of fast urbanization and growing mobility needs pose distinctive obstacles (Roy, 2009), the significance of an effective and dependable bus transportation system cannot be overstated (Rahman, 2019; Khan, et al., 2018). The effect of bus services on commuters' everyday life extends beyond mere convenience (Guell et al., 2012), as it also exerts influence on the broader urban environment, air quality, and

¹ Associate Professor, Department of Urban & Regional Planning, Jahangirnagar University, Savar, Dhaka, email: mizanurp@juniv.edu

economic productivity (Quddus et al., 2019; Cervero et al., 2017; Beaudoin & Lawell, 2017) and urban growth (Rahman et al., 2021).

The efficient functioning of public transportation is a crucial determinant in enhancing the quality of life within an urban setting (Lai & Chen, 2011). Bus networks provide a flexible and adaptable mode of public transportation that caters to diverse accessibility requirements within urban regions (Liu et al., 2017; Bauchinger et al., 2021). The evaluation of transport service performance should be conducted based on the perspectives of passengers (Weng et al., 2018; Eboli & Mazzulla, 2011). Therefore, it is crucial to ascertain the opinions of passengers on the quality of service provided. The representation of public transit in satellite town to city connecting road encompasses several features, including traffic congestion and overcrowding (Rahman et al., 2017), insufficient traffic management, high accident rates (Jianxin et al., 2021; Jamil et al., 2021), and a growing concern over air pollution issues (Ali et al., 2023; Shakil et al., 2016; Alam, 2018).

The public transportation service in connecting route of Dhaka city is characterized by significant deficiencies and inadequacies, resulting in a limited ability to fulfill the requirements of its users (Rahman et al., 2017). Public Transportation (PT) plays a crucial part in the overall efficacy of a city connecting route system (Benevolo et al., 2016; Tseng et al., 2005). PT supports the mobility of those from lower socioeconomic groups who are unable to purchase private vehicles (Giuliano, 2005) and offers to the passengers for better services. Furthermore, it assumes an essential role in the formation and maintenance of sustainable communities characterized by intensive land use (Miller et al., 2016) and these characteristics are justified for the catchment of bus stops and also for the selected Chandra-Hemayetpur route of savar (Akther and Rahman, 2017). By alleviating traffic congestion (Mrad & Mraih, 2023), PT contributes to the overall sustainability (Greene & Wegener, 1997) of shared resource consumption and demonstrates responsiveness to environmental (Bibri et al., 2020) and green development and health sensitive concerns (Rahman, 2021; Sharif et al., 2014). The significance of buses in metropolitan areas cannot be overstated; nonetheless, their services often fail to adequately fulfill the demand, resulting in suboptimal performance (Katz & Rahman, 2010; Ali, 2010). A significant proportion of travelling trips occur during office hours (Rahman and Kabir, 2021a), and the choice of transportation mode is contingent upon the individual's preference for comfort (Rahman and Kabir, 2021b). However, in some instances, individuals may not have other alternatives for selecting a mode of transportation for office-related purposes, other than using a bus on the designated (Savar) route (Akter et al., 2021). Individuals with mobility problems, built environment and road management system also may exhibit varying degrees of pleasure in relation to their ability to walk and use PT (Khan, 2019; Hossain et al., 2019). In addition walking to bus stops may be encouraged in well-designed urban areas with pedestrian-friendly features, which can increase overall satisfaction (Rahman et al., 2020; Rahman and Noman, 2018).

The assessment of bus transport performance has always been important for operators (Ahasan & Kabir, 2019) and has gained considerable global attention in recent times (Tyrinopoulos & Antoniou, 2013). There is now a growing focus on gaining a deeper

knowledge of the many dimensions of service quality in relation to client demands (De Oña and De Oña, 2015). This is due to the significant correlation that has been demonstrated between service quality and customer happiness (Oliver, 1993; Kassim & Asiah Abdullah, 2010). Consequently, service providers are motivated to get a deeper understanding of the elements that influence customer satisfaction in order to improve their profitability (Angelova & Zekiri, 2011). Hence, the majority of these factors discussed in the existing literature have been distinguished by means of customer satisfaction surveys. These factors can be categorized as follows: socio-economic conditions of the passengers, trip characteristics, service characteristics, vehicle characteristics, and accessibility. However, it is important to note that the setting of developing nations significantly differs from other regions, resulting in varying aspects that influence consumer satisfaction. As an example, Diana, (2012) draws the conclusion that individuals living in highly crowded urban areas exhibit lower levels of satisfaction with their public transportation services compared to those residing in regions with lower population density. In addition to geographical and cultural considerations, variations in public transport services and infrastructure will also impact the overall satisfaction levels of passengers (Felleson & Friman, 2008).

The primary objective of this research is to provide a comprehensive analysis of the current state of bus services in satellite town/Export Processing Zone (EPZ) to city connecting road and explore the many aspects that contribute to consumer satisfaction within this context. Given the pressing challenges of traffic congestion, insufficient infrastructure, and environmental considerations, it is imperative to have a thorough comprehension of the present condition of bus services and the perspectives of their users. This knowledge is essential for the design of effective policies and the improvement of service provision. This study adopts a comprehensive strategy that incorporates both quantitative and qualitative methodologies in order to accomplish its research goals. Through a comprehensive evaluation of several variables like frequency, dependability, comfort, price, and accessibility, our objective is to provide a comprehensive analysis of the current bus service circumstances. Furthermore, via the examination of client satisfaction levels, the objective is to discover crucial pain spots and places that are in urgent need of repair.

The results of this study will not only offer a valuable contribution to the academic discussion around transportation and urban planning, but will also be a useful resource for policymakers, transport authorities, and stakeholders engaged in the public transportation industry. The primary objective is to provide accurate and reliable information to facilitate decision-making based on evidence. This will ultimately contribute to the improvement of bus services, promoting a public transportation system in Bangladesh that is more sustainable, efficient, and focused on meeting the needs of customers. The next sections of this paper explain the main findings and analyze the consequences of this study finding in the context of sustainable development and city connecting transportation. The strategies used for data collecting and analysis are also provided as well.

Study Area/Selected Road (Chandra Bus Stand to Hemayetpur Bus Stand)

In order to assess consumer satisfaction with the bus service, a specific route has been chosen for analysis. The selected route spans a distance of 31 kilometers, starting at Chandra bus stop and concluding at Hemayetpur bus stand. The location of this road is in Savar Upazila. This road in concern is a four-lane thoroughfare that serves as a corridor connection (Rahman and Ritu, 2018) between Dhaka metropolis and the western region of Dhaka (Jamil et al., 2021). Establishing a connection with the Dhaka Export Processing Zone (EPZ) is of significant importance (Rahman et al., 2020). There are several bus services that serve to the transportation needs of travelers traveling from Savar, a satellite town (Rahman, 2012), to Dhaka and the EPZ region. The Chandra and Baipail bus stop has significance in facilitating connectivity with other economically significant areas, such as Uttara and Gazipur. Hemayetpur serves as a significant connection point for linking several industrial areas, including Hemayetpur itself, and the nearby district of Manikganj and Dhamrai upazila (Mahmudet al., 2020). The chosen route consists of a total of 23 bus stands, all of which are visually shown in Figure 1.

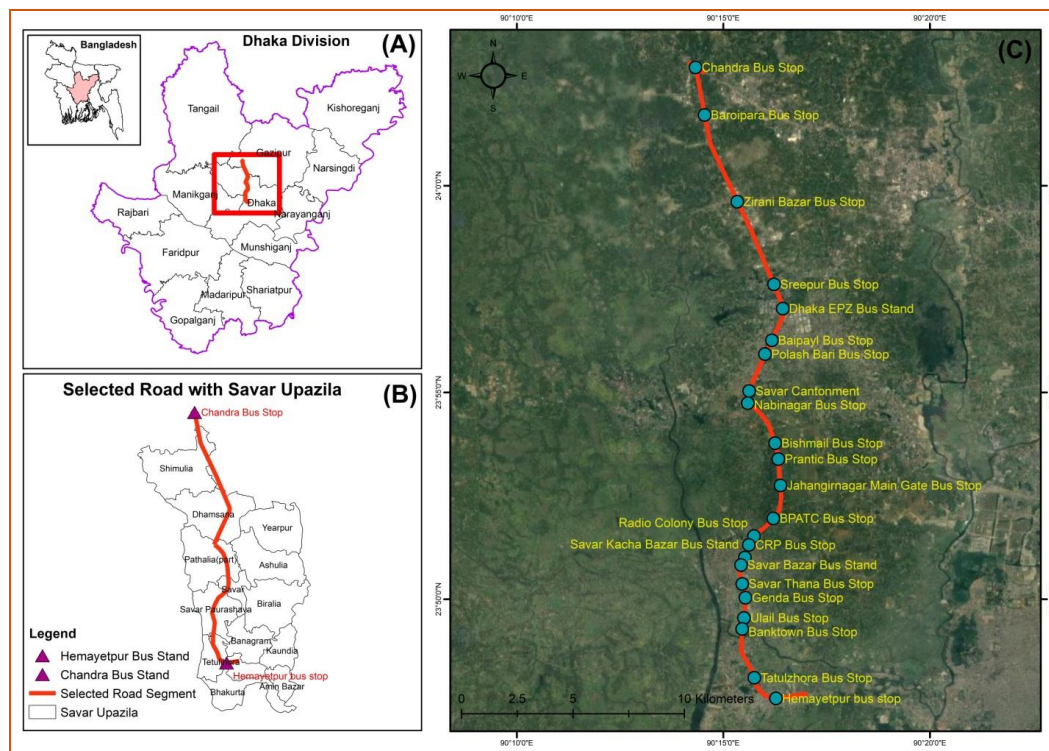


Fig 1: Road section and bus stand name are used to assess the satisfaction level of bus service.

Factors for Bus Service Assessment

There are many factors that might influence the quality of bus service provided. Customer satisfaction is influenced by several aspects, with their significance contingent upon the geo-social setting and the specific service being examined, such as bus, trains,

or airplanes. However, when examining public bus services, some elements of the service might be deemed crucial across various metropolitan contexts, as shown by several research (Dell'Olivo et al., 2017). The criteria under consideration include frequency, travel duration (alternatively referred to as journey time in some scholarly investigations), safety, dependability, and timeliness. It is important to note that there is a limited body of research on public transport bus services in medium to low income regions. Most studies examining customer satisfaction have mostly focused on train services (Machado-Leó et al., 2017; Nandan, 2010; Ghosh & Ojha, 2017; Agarwal, 2008) and non motorized transport- NMT (Fahim et al., 2022). Safety emerges as a prominent determinant of consumer satisfaction in the majority of this research. The characteristics that have the greatest impact on public transport consumers, which reflect their wants and preferences, cannot be universally generalized across different services. Instead, these variables are unique to each single transport system (Dell'Olivo et al., 2017). The dependence of public transport systems is contingent upon several elements, including but not limited to the geographical location, the specific kind and mode of public transit, and the cultural and traditional practices of its users (Sinha & Labi, 2011). The examination of existing literature indicates that the evaluation of service quality, as perceived by customers, has significant importance in the realm of bus transport management and operations (Kettinger & Lee, 1994). In order to maximize bus passenger satisfaction, it is essential for service providers and operators to possess a comprehensive understanding of service quality (De Oña et al., 2013). This understanding enables them to develop effective policies and strategies. The importance of context-specific qualities in the assessment of service quality is also disclosed. Presently, while several studies have been conducted on the quality of rail-based services in developing nations (Nandan, 2010; Ghosh & Ojha, 2017; Agarwal, 2008; Irfan, Kee & Shahbaz, 2012), there is a dearth of research on the quality of bus services. Furthermore, to the best of the authors' knowledge, none of the research conducted in developing countries have used nearest megacity connecting bus that influence consumer satisfaction. The study intends to investigate the association between overall bus service quality and other influencing variables.

Methodology

Principal component analysis (PCA) was used to find public bus transit service satisfaction factors. Principal component analysis finds a few components that explain most of the variance in observed variables. The original variables are replaced with linear combinations of fewer major components. According to Wood et al., (2005), fewer primary components may keep most of the original variables' variability. PCA minimizes the major component axis' sum of squared perpendicular distances. The PCA describes the most frequent variation with the fewest explanatory notions by reducing related variables into smaller components (Field, 2013).

The Kaiser criteria (eigenvalue-one) are the most used PCA criterion for component/factor count (Kaiser, 1960). Using the eigenvalue-one criterion, components

with eigenvalues > 1 are maintained. Before making a decision, consider other component retention considerations. The scree test (Cattell, 1966) shows component eigenvalues. Significant factor loadings exceeding 0.40 should be analyzed (Hair et al., 1998). Retained components/factors may be named by the variables they heavily load. To simplify reading, preserved factors/components are rotated orthogonally. The first principal component analysis component explains the greatest observed variable variance. The next components are uncorrelated and add less variation to the dataset.

Sampling and Data Collection

The data were collected by the use of a questionnaire survey between the periods of April to May 2023. The questionnaire used in the study was developed by drawing upon the findings of previously published studies examined in this research, along with conducting comprehensive in-depth interviews and engaging in prolonged brainstorming sessions. The sample of this research consisted of bus passengers in Savar, including both Chandra-Hemayetpur route and Hemayetpur - Chandra bus route. This cohort was selected due to their uniform usage of buses, while also exhibiting diversity in terms of characteristics such as occupation, age, income, mobility, and other relevant factors. The primary objective was to gather the judgments and views of those who possess the necessary expertise to assess the current state of public bus services and the degree of satisfaction with these services in savar.

This investigation focused on the selection of 23 bus stops in Savar as survey places (Figure 1). Both the left and right side of the bus stops were selected to conduct the survey. Participants were chosen from the bus that made the ride by the bus for the selected route segment.

Data for this research was collected using a self-rated questionnaire. Participants were requested to provide their evaluation of their general contentment with public bus transportation services, as well as the specific characteristics or qualities of those services that have an impact on their satisfaction levels (see Table 1). The attributes of public bus transport service that impact bus passenger satisfaction in this study were derived from a comprehensive review of published studies, extensive brainstorming sessions, in-depth interviews conducted with bus passengers, and the author's personal encounters with public bus transport services. The rating used a Likert scale consisting of five points, where a score of 5 represented "excellent satisfied," a score of 4 represented "satisfied", a score of 3 represented "neutral/undecided", a score of 2 represented "dissatisfied", and a score of 1 represented "highly dissatisfied".

The study had a sample size of 390 respondents that were surveyed. Data was collected using field and questionnaire surveys. A field survey gathers vital information on locations, passengers, and vehicle types. Survey respondents rated their satisfaction as described in the questionnaire. The questionnaire study was conducted in 23 bus stops showed in figure 1. These survey locations were visited on various days and hours to

cover respondent from all bus services. Data was collected between 8-12 am in the morning and 3-6 pm in the afternoon. The variables used to measure passenger satisfaction are comfort, safety, and security of bus. The factors chosen for this study include public bus available seat, space for leg, fare, bus availability, condition of the bus, drivers skill, contractors behavior, fan availability, cleanliness, standing passengers, delay time, noise pollution, safety, sudden breaks, comfort, passengers request, information and crime and like these total 18 factors were identified and surveyed to assess the satisfaction level of the passengers in the selected road segment of Savar. Table 1 lists all factors for the bus passenger's satisfaction assessment.

Table 1: Factors for the assessment of the public bus satisfaction

Factors	Variables Description
F ₁	Available seats to sit in Buses
F ₂	Enough space for leg in Bus
F ₃	Fare for the bus travel
F ₄	Bus availability
F ₅	Condition of the bus (glass etc)
F ₆	Drivers Skill
F ₇	Contractors behavior
F ₈	Facilities inside bus like fan
F ₉	Cleanliness of Bus
F ₁₀	Lots of standing Passengers
F ₁₁	Delay time for more passenger
F ₁₂	Noise level of the bus
F ₁₃	Passenger safety for get on (entry) and get off (exit)
F ₁₄	Safely driven the bus/sudden breaks
F ₁₅	Comfort of the bus
F ₁₆	Passengers request
F ₁₇	Information and announcement by the contractor
F ₁₈	Crime at bus or lost something
OS	Overall satisfaction with public bus transport services

Results and Discussion

Descriptive analysis

Table 2 displays the statistical frequency distribution of respondents' impression about the overall satisfaction and particular service quality aspects that impact their satisfaction with public bus transport services in Chandra-Hemayetpur route of Savar. According to the data shown in Table 2, the level of overall satisfaction (mean of factor F_1 to F_{18}) with public bus transport services, as judged by passengers, was found as 3.30 (near to the dissatisfaction) which indicate they are near to the dissatisfied, a standard deviation of 0.334, and a variance of 0.112.

The passenger satisfaction with public bus transport services was found to have a low perception of the particular service qualities, as shown in table 2. As an example, consider the variable F_1 , which represents the availability of seats in buses. The mean score for this variable is 3.59, indicating that, on average; seats are typically not available in buses. The standard deviation for this variable is 1.118, indicating the degree of variability in the responses. The variance for this variable is 1.249, representing the square of the standard deviation. Specifically, 25.38 percent of the respondents expressed 'highly dissatisfied' with the statement on seat availability, while 33.59 percent 'dissatisfied'. In total, about 54 percent of respondents expressed some form of dissatisfaction with the statement. The responses of "neutral/undecided" and "satisfied" accounted for 16.15 percent and 24.87 percent respectively, while the response of "highly satisfied" had a score of zero percent.

The variable F_{18} , which pertains to crime at bus or lost something, had a 'dissatisfied' rate of 18.46 percent and a 'highly dissatisfied' rate of 1.79 percent. The percentages for the response categories 'satisfied' and 'neutral/undecided' were 46.41 percent and 21.03 percent respectively. The percentage for the response category 'highly satisfied' was 12.31 percent. The mean score was 2.51, which is less than 3 and it means near to the satisfied for this statement. The standard deviation was 0.988 and the variance was 0.975.

Table 2: Frequency distribution of satisfaction level and service attributes responses (N=390)

Variable Description	Excellent Satisfied		Satisfied		Neutral/U ndecided		Dissatisfie d		Highly Dissatisfie d		Mea n	Std. Deviati on	Varianc e
	N	%	N	%	N	%	N	%	N	%			
F ₁ =Available seats to sit in Buses	0	0.00	97	24.8 7	63	16.1 5	131	33.5 9	99	25.38	3.59	1.118	1.249
F ₂ = enough space for leg in Bus	22	5.64	14 0	35.9 0	25	6.41	157	40.2 6	46	11.79	3.17	1.198	1.435
F ₃ = Fare for the bus travel	0	0.00	98	25.1 3	74	18.9 7	168	43.0 8	50	12.82	3.44	1.004	1.007
F ₄ = Bus availability	36	9.23	93	23.8 5	37	9.49	142	36.4 1	82	21.03	3.36	1.299	1.686
F ₅ = Condition of the bus (glass etc)	41	10.5 1	11 4	29.2 3	34	8.72	141	36.1 5	60	15.38	3.17	1.291	1.666
F ₆ = Drivers Skill	41	10.5 1	11 6	29.7 4	35	8.97	139	35.6 4	59	15.13	3.15	1.289	1.661
F ₇ = Contractors behavior	0	0.00	10	2.56	29	7.44	307	78.7 2	44	11.28	3.99	.539	.290
F ₈ =Facilities inside bus like fan	0	0.00	10 0	25.6 4	21	5.38	208	53.3 3	61	15.64	3.59	1.035	1.070
F ₉ = Cleanliness of Bus	0	0.00	12 8	32.8 2	28	7.18	155	39.7 4	79	20.26	3.47	1.146	1.314
F ₁₀ = Lots of standing Passengers	0	0.00	71	18.2 1	18	4.62	231	59.2 3	70	17.95	3.77	.950	.903

Variable Description	Excellent Satisfied		Satisfied		Neutral/U undecided		Dissatisfied		Highly Dissatisfied		Mean	Std. Deviation	Variance
	N	%	N	%	N	%	N	%	N	%			
F ₁₁ = Delay time for more passenger	0	0.00	104	26.67	25	6.41	195	50.00	66	16.92	3.57	1.058	1.120
F ₁₂ = Noise level of the bus	0	0.00	135	34.62	27	6.92	199	51.03	29	7.44	3.31	1.029	1.059
F ₁₃ = Passenger safety for get on (entry) and get off (exit)	0	0.00	101	25.90	26	6.67	217	55.64	46	11.79	3.53	1.003	1.005
F ₁₄ = Safely driven the bus/sudden breaks	37	9.49	189	48.46	15	3.85	125	32.05	24	6.15	2.77	1.175	1.381
F ₁₅ = comfort of the bus	12	3.08	97	24.87	13	3.33	174	44.62	94	24.10	3.62	1.185	1.404
F ₁₆ = Passengers request	50	12.82	199	51.03	27	6.92	102	26.15	12	3.08	2.56	1.102	1.214
F ₁₇ = information and announcement by the contractor	17	4.36	185	47.44	40	10.26	113	28.97	35	8.97	2.91	1.137	1.292
F ₁₈ = crime at bus or lost something	48	12.31	181	46.41	82	21.03	72	18.46	7	1.79	2.51	.988	.975

Table 3: Overall satisfaction rating according to different socio demographic characteristics of the respondents (N = 390)

Variable		Overall satisfaction rating (%)					Count	Overall Satisfaction Score (Mean)
		Excellent Satisfied	Satisfied	Neutral/Undecided	Dissatisfied	Highly Dissatisfied		
Age_Groups	0-14	5.76	27.98	8.23	40.74	17.28	27	3.36
	15-29	4.21	30.60	9.06	43.05	13.08	203	3.30
	30-45	4.35	31.34	9.12	42.09	13.10	106	3.28
	46-50	3.30	31.77	6.94	42.71	15.28	32	3.35
	60+	5.05	31.06	8.59	39.39	15.91	22	3.30
Sex	MALE	4.58	31.04	8.89	42.08	13.40	228	3.29
	FEMALE	3.98	30.32	8.71	42.83	14.16	162	3.33
Education	Primary	4.99	32.02	8.66	40.02	14.31	59	3.27
	SSC	3.64	29.01	10.49	44.07	12.78	90	3.33
	HSC	4.39	33.12	7.14	41.59	13.76	105	3.27
	Honours	3.91	28.91	8.90	43.88	14.39	88	3.36
	Illiterate	1.85	28.70	11.11	43.52	14.81	6	3.41
Occupation	Service	4.27	35.04	4.49	43.16	13.03	26	3.26
	Busniess	4.49	30.14	8.87	43.09	13.42	94	3.31
	Student	4.13	30.15	9.40	42.17	14.15	117	3.32
	Housewife	3.10	29.58	8.50	43.46	15.36	34	3.38
	Worker all type	4.66	31.16	9.47	41.59	13.12	105	3.27
	Retired	5.13	32.48	6.84	41.45	14.10	13	3.27
Family_size	2 members	1.85	31.48	3.70	46.30	16.67	3	3.44

Variable		Overall satisfaction rating (%)					Count	Overall Satisfaction Score (Mean)
		Excellent Satisfied	Satisfied	Neutral/Undecided	Dissatisfied	Highly Dissatisfied		
	3 members	3.68	29.89	7.67	45.46	13.30	71	3.35
	4 members	4.78	31.48	9.07	42.10	12.58	201	3.26
	5 members	3.13	29.28	8.22	42.25	17.13	48	3.41
	6 members	4.74	31.06	9.56	39.80	14.85	61	3.29
Earning_member	1 person	4.54	30.08	8.45	43.53	13.39	236	3.31
	2 person	4.07	32.32	9.37	39.99	14.25	131	3.28
	3 person	3.80	27.19	10.23	44.74	14.04	19	3.38
	4 person	2.78	34.72	5.56	43.06	13.89	4	3.31
Monthly_income In BDT/Taka	Below 10000	0.00	0.00	0.00	100.0	0.00	1	3.67
	10000-20000	2.78	30.12	7.46	45.32	14.33	38	3.38
	20000-30000	4.78	30.37	8.88	42.71	13.27	214	3.29
	30000-40000	2.12	33.60	12.43	34.13	17.72	21	3.32
	40000-50000	4.60	31.21	8.28	42.27	13.64	110	3.29
	Above 50000	1.85	30.56	13.89	39.81	13.89	6	3.33

According to the data shown in Table 3, a majority of the participants fell within the age range of 15 to 29 years, while the second largest age group consisted of those aged 30 to 45 years. Of the total respondents, 58.46% identified as male, while 65% reported having an education level equivalent to or below a higher secondary certificate (HSC). According to our analysis of the profession status, it was found that a mere 22.56% of individuals have successfully completed their education, while almost 30% are now engaged in studies. More over 60% of the passengers' families consist of just one person who earns money, whereas 54.87% of these working people have a monthly salary ranging from 20,000 to 30,000 BDT. It is noteworthy to highlight that across all socio-demographic categories, there is a prevalence of a 'dissatisfaction' status ranging from 40% to 50% for the overall satisfaction rating.

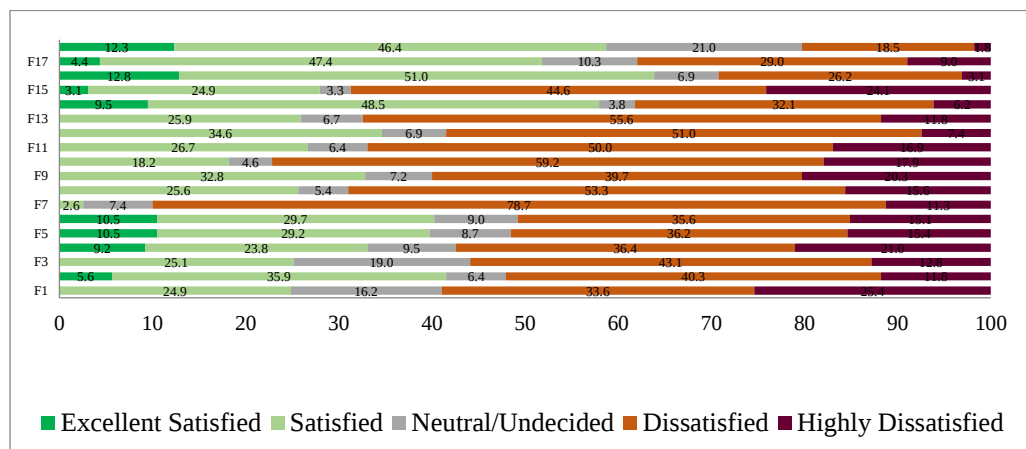


Fig 2: Percentage bus passengers satisfaction level for 18 factors

Figure 2 displays the satisfaction rating in detail, revealing that the majority of components are primarily characterized by a rating of 'dissatisfaction'. The factor denoted as F₇, which pertains to contractors' behavior, has the greatest degree of dissatisfaction measuring at 78.7%. The factors F₁₀ (presence of standing passengers), F₁₁ (delay time due to more passengers), and F₁₂ (noise level on the bus) similarly have a dissatisfaction level of about 50%. Specifically, F₁₀ has a dissatisfaction level of 59.2%, F₁₁ has a dissatisfaction level of 50.0%, and F₁₂ has a dissatisfaction level of 51.0%. The variables F₁ (availability of seats on buses) and F₁₅ (comfort of the bus) show a statistically significant degree of 'highly dissatisfaction', with proportions of severely dissatisfied individuals at 25.4% and 24.1% respectively.

In the study area, it was found that just two factors were able to meet the expected level of passenger satisfaction in relation to public bus transport services. The factor, denoted as F₁₆, pertains to the passengers request in the bus and another one is F₁₈: lost something in the bus. For factor F₁₆, it exhibits a mean value of 2.56, which less than the threshold of 3 and it means that little bit satisfied. The standard deviation for this variable is 1.102, while the variance is 1.214. The corresponding scores for the 'highly satisfied' and 'satisfied' categories are 12.82 percent and 51.03 percent, respectively. The percentage of respondents who indicated a 'dissatisfied' response was 26.15 percent, while those who

indicated a 'highly dissatisfied' response accounted for 3.08 percent. The 'neutral/undecided' response had a score of 6.92 percent.

The factor F_7 , which pertains to the behavior of drivers and conductors, had a mean score of 3.99, indicating that their behavior was generally negative and not satisfied to the bus passengers. Furthermore, the standard deviation for this variable was 0.539, suggesting a moderate level of variability in the responses. The variance, calculated as 0.290, provides further insight into the dispersion of the data points. The responses to the survey question were distributed as follows: zero percent of participants selected 'highly satisfied', 2.56 percent were 'satisfied', 7.44 percent chose 'neutral/undecided', 78.72 percent opted for 'dissatisfied' and 3.99 percent selected 'highly dissatisfied'. The passengers/respondents exhibited indecision regarding three variables: The F_{18} factor, which focused on crimes occurring on buses or instances of lost belongings, yielded a mean value of 2.51, which is below the threshold of 3 (middle point). In light of this finding, it is reasonable to consider that the individuals in this unsure group may lack awareness of the prevalence of crime on buses.

The frequency distribution is shown in Figure 3, illustrating that of the 18 factors examined, passengers in Chandra-Hemayetpur route, Savar observed service quality features of public bus transport service as dissatisfactory. In Chandra-Hemayetpur route, only two factors met passenger average satisfaction expectations for public bus service (F_{16} and F_{18}). The element F_{16} is bus passenger requests, while F_{18} is missing items in bus. Based on the data conducted, it can be concluded that the majority of passengers using public bus service in Chandra-Hemayetpur route, Savar is dissatisfactory.

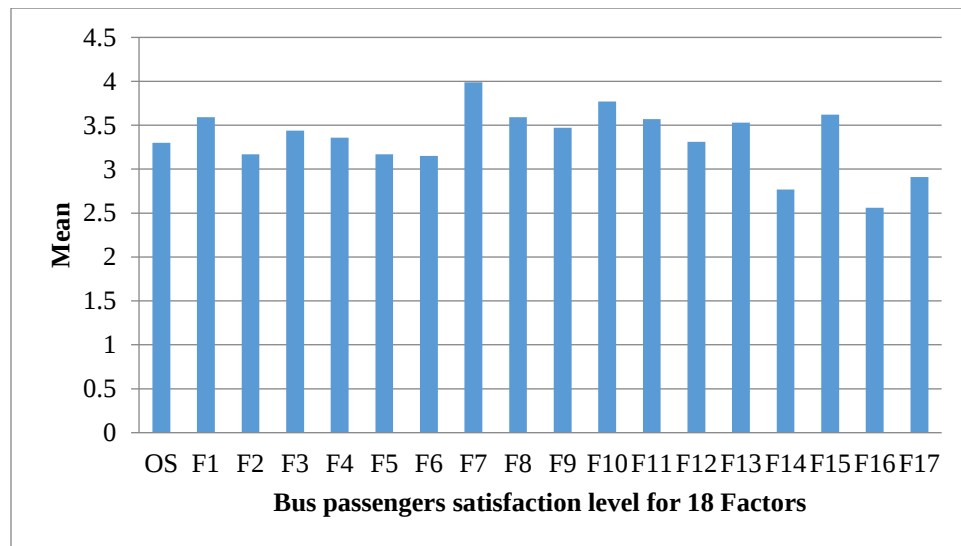


Fig 3: Mean distribution of service quality for bus passengers

There is no significant association found between the socio-demographic characteristics and the metrics of bus pleasure. However, there exists a correlation between some factors of passenger satisfaction indices. The variables F_{15} , representing the comfort of the bus, and F_{16} , representing passengers' requests, exhibit a high positive correlation (+0.71) with the overall satisfaction level. Additionally, the variable F_{14} (Safely driven the bus/sudden

breaks) has a positive connection (+0.65) with the overall satisfaction level. The passengers perceive a good correlation between the skill of the drivers and the condition of the bus, as shown by the substantial correlation between F_5 = Condition of the bus (glass etc) and F_6 = Drivers Skill, as shown in Figure 4.

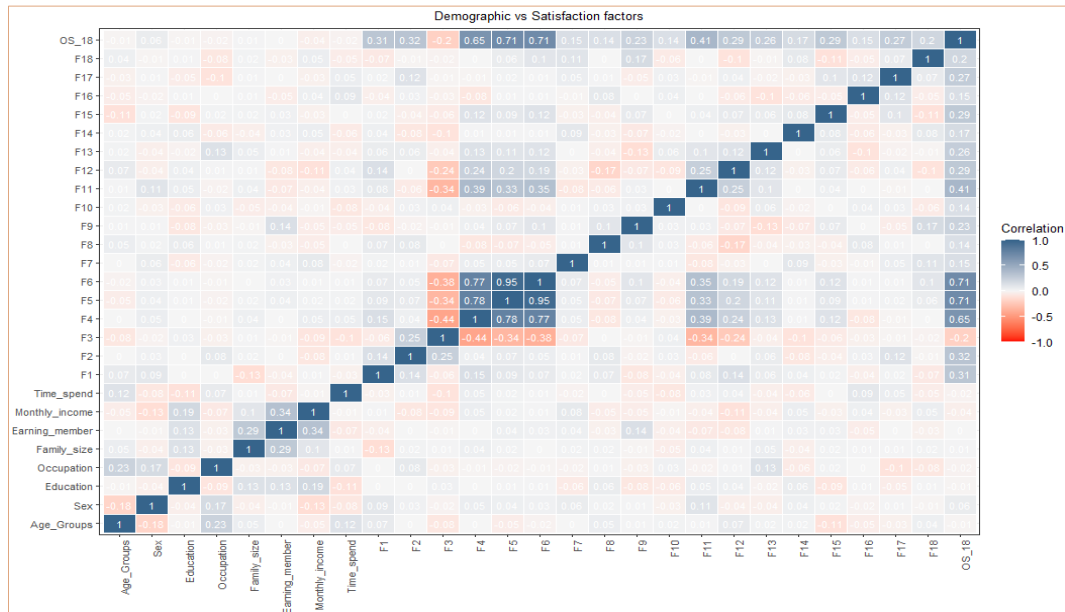


Fig 4: Demographic and passenger's satisfaction factors correlation matrix

Principal Component Analysis

The dimensionality of the 18 bus passenger satisfaction factors on the Savar Chandra-Hemayetpur bus route was studied using principal components analysis. Data were evaluated for appropriateness for this analysis beforehand. The ratio of squared correlation to squared partial correlation is the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO; Kaiser, 1970). KMO spans from 0.00 to 1.00; values closer to 1.00 suggest tight correlation patterns and reliable component analysis (Shrestha, 2021; Costa et al., 2021; Mvududu & Sink, 2013). The research dataset has a KMO of 0.704, suggesting adequate sampling for above the 0.70 (Nunnally, 1978). The Bartlett's Test of Sphericity compares the population correlation matrix to an identity matrix (Wilson & Martin, 1983). When the Bartlett's test p value is $< .05$, clusters of linked variables are significant (Zwick & Velicer, 1982; Watson, 2017). Our dataset confirms strong relationships between items ($\chi^2(153)=1735.749$, $p<.001$) for principal components analysis.

The 18 satisfaction related to service quality, together with the measure of overall satisfaction, were converted into a matrix to assess the inter-correlation among these variables and determine the magnitude of their associations. The presence of high inter-correlations among the variables, as shown by the correlation matrix, suggests the

occurrence of redundancy among some variables. In order to mitigate the influence of highly correlated variables and incorporate the involvement of seemingly redundant variables, Principal Component Analysis (PCA) was utilized to condense the 18 distinct attributes pertaining to the quality of public bus transport services. This process aimed to identify a smaller set of orthogonal factors that could delineate broader domains for strategic planning and decision-making by stakeholders involved in the provision of public bus transport services in city connecting route like Chandra-Hemayetpur route, Savar.

The findings of the examination of the varimax rotated components are shown in Table 4, demonstrating the successful reduction of the initial 18 variables to 4 components. The four components together account for 40.84% of the total explained variation, while the 65.04% of the total variance are explained for the 7 component, but 4 components are included in this research for the better explanation.

The first component has an eigenvalue of 3.33, representing 18.53 percent of the overall explained variance. The component has strong positive loadings on F_4 (Bus availability), F_5 (Condition of the bus glass etc.), F_6 (Drivers Skill), F_{11} (Delay time for more passenger), and F_3 (Fare for the bus travel) has the negative loadings. The aforementioned variables pertain to the factors inside buses that have an impact on the level of satisfaction experienced by passengers. Hence, the first component is designated as "Bus condition, skills and delay time."

Component 2 has substantial and statistically significant positive loadings for F_1 (Available seats to sit in Buses) its significance value is 0.443, F_{12} (Noise level of the bus) and its significance level is 0.480, F_{13} (Passenger safety for get on (entry) and get off /exit) and this factors significance level is 0.469, and F_9 (Cleanliness of Bus) factor has the negative significance level and it is -0.594. This study provides a comprehensive overview of the service quality elements that influence passenger satisfaction while using public bus transportation for commuting within urban areas. The second component is afterwards designated as "Comfort in bus". The eigenvalue of the given variable is 1.442, representing 80.01% of the total explained variance.

Table 4: The Varimax Rotated Matrix determined the satisfaction level of public bus transport services in Savar.

Rotated Component Matrix^a				
	Component			
	1	2	3	4
F ₁ = Available seats to sit in Buses	.108	.443*	.314	.044
F ₂ = Enough space for leg in Bus	-.033	.154	.785*	-.022
F ₃ = Fare for the bus travel	-.590*	-.014	.362	-.032
F ₄ = Bus availability	.869*	.126	.082	.082
F ₅ = Condition of the bus (glass etc)	.899*	.006	.180	.107
F ₆ = Drivers Skill	.912*	-.032	.153	.130
F ₇ = Contractors behavior	.021	-.054	.140	.588*
F ₈ =Facilities inside bus like fan	-.068	-.308	.323	-.066
F ₉ = Cleanliness of Bus	.160	-.594*	.002	.027
F ₁₀ = Lots of standing Passengers	-.046	-.101	.150	-.167
F ₁₁ = Delay time for more passenger	.567*	.105	-.190	-.191
F ₁₂ = Noise level of the bus	.334	.480*	-.153	-.162
F ₁₃ = Passenger safety for get on (entry) and get off (exit)	.112	.469*	.113	.111
F ₁₄ = Safely driven the bus/sudden breaks	-.024	.152	-.241	.541*
F ₁₅ = Comfort of the bus	.152	.160	-.076	-.046
F ₁₆ =Passengers request	.045	-.333	.179	-.382
F ₁₇ = Information and announcement by the contractor	.020	.002	.365	-.015
F ₁₈ = Crime at bus or lost something	.063	-.373	.067	.573*
Eigenvalues	3.336	1.442	1.360	1.208
% of variance	18.53%	8.01%	7.55%	6.71%
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 8 iterations.				

Component 3 has favorable loadings on F₂ (Enough space for leg in Bus), indicating there is no enough spaces for leg in most of the buses. This component possesses an eigenvalue of 1.360, representing its significance, and explaining 7.55 percent of the overall variance. Component 3 provides a description of the facilities available inside the bus. Hence, it is designated as "Comfortable space in bus."

Component 4 has an eigenvalue of 1.208 and contributes to 6.71 percent of the total explained variance. It exhibits positive loadings on F₇ = 0.588 (Contractors behavior) and F₁₈ = 0.573 (Crime at bus or lost something). Component 4 provides a description of the behavior and crime. Hence, it is designated as "Behavior and crime".

The researcher conducted a regression analysis to examine the relationship between the overall satisfaction ratings and the four underlying factors that influence passenger satisfaction in Chandra-Hemayetpur route of Savar. The findings are shown in Table 5.

Table 5: Overall satisfaction (DV) and four components (IV) regression model

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3.304	.008		410.590	.000	3.288	3.320
	Bus condition, skills and delay time	.243	.008	.727	30.174	.000	.227	.259
	Comfort in bus	.021	.008	.063	2.633	.009	.005	.037
	Comfortable space in bus	.156	.008	.466	19.340	.000	.140	.172
	Behavior and crime	.054	.008	.162	6.724	.000	.038	.070
a. Dependent Variable: Overall Satisfaction (OS) (Mean of F1 to F18)								

Adjusted $R^2 = .774$, $F_{4,385} = 334.162$, $P < .001$

The satisfaction model of public bus transport services could be stated as follows:

$OS = 3.304 + 0.24 (\text{Bus condition, skills and delay time}) + 0.021 (\text{Comfort}) + 0.16 (\text{Space in bus}) + 0.05 (\text{Behavior and crime})$

The equation above may be interpreted as suggesting that the regression line's slope is statistically significant and larger than zero. This implies that there is a positive relationship between the growth in the four underlying component factors and the overall satisfaction. The equation also demonstrates that the aggregate satisfaction of passengers in Chandra-Hemayetpur route of Savar with public bus transport services would be 3.304 percent when all 18 factors of service quality are at the zero level. Once again, the standardized regression coefficient beta (β) values suggest that the component "bus condition, skills and delay time" has the most significant influence on the overall satisfaction of passengers with public bus services in Chandra-Hemayetpur route of Savar. The other variables in the analysis are "comfortable space in bus" ($\beta=0.156$, $p =$

0.000 < 0.05), "behavior and crime" ($\beta = 0.054$, $p = 0.000 < 0.05$), and "comfort in bus", which has the least significant influence ($\beta = 0.021$, $p = 0.009 < 0.05$).

Conclusion and Recommendations

The findings of this research indicate that passengers in Chandra-Hemayetpur route of Savar, say dissatisfaction with the quality of existing public bus services. This research aims to identify the service characteristics that represent passenger satisfaction level in Chandra to Hemayetpur route of Savar. The variables that have been found include the bus condition, driver's skills and delay time, the comfort in bus, the comfortable space in bus and finally the behavior and loss something in bus. The passengers experience regarding the last component 'behavior and loss something' is comparatively better than that of other components. This research offers valuable insights for the improvement of public bus service according to passengers satisfaction level in selected route, since it identifies factors for service improvement and suggests strategies to boost customer satisfaction with public bus services.

Based on the results obtained from this research, the following suggestions are proposed. Passenger comfort is a significant concern for those traveling by bus, therefore necessitating the establishment and monitoring of fundamental requirements by BRTA to assure compliance by bus operators (Sultana, 2013; Sen, 2016). But the ineffective institutional and regulatory framework, hesitation to apply present legislation, and enforcement measures reduce road infrastructure effectiveness (Verdier, 2009; DMDP, 1995). Secondly, implement a more accurate and regular bus timetable to reduce delay times and increase timeliness (Ahmed, 2004; Rahman et al., 2017). Establish a strict maintenance strategy to keep buses clean, functioning, and attractive and upgrade seats and interior design for travel comfort (Rouf et al., 2019). Also the expanding services, improving operations, and increasing public transport information may improve public transportation systems (Transport Research Centre, (2007). Bus service operators may improve Chandra-Hemayetpur passenger satisfaction and efficiency by following above suggestions. However, the ever-changing public transportation environment requires passenger-centric solutions to stay competitive and improve service perceptions. The challenges arise from urban transportation infrastructure and a service system that cannot handle current levels of the selected route. The bus regulations on passenger safety, security, fare, reliability, and service must be considered to retain existing customers and attract new ones. This is essential for making buses a better public transportation option.

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