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Service Quality of Public Buses Perceived by Female Commuters in a Developing City

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Abstract: This paper evaluates the present service quality of existing public buses in Dhaka city experienced by its female commuters. For that, first, a close-ended questionnaire survey, founded on a Service Quality (SQ) model customized from SERVQUAL and RESCA models is conducted where female commuters evaluate various aspects of a trip they have just completed by bus and rate the overall trip as 'satisfactory' or 'unsatisfactory'. Afterwards, Binary Logistic Model is applied to analyze collected data to identify significant variables that influence the bus users' satisfaction. Finally, Multiple Correspondence Analysis (MCA) is employed to ascertain the relative dependency of variables graphically. The model identifies boarding- alighting status and harassment issues as the most important variables which greatly influence the safety, security and comfort related issues of female commuters. Finally, conclusions are made with some policy recommendations.

Keywords: Public Bus, Service Quality, Female commuters, Binary Logistic Model, Multiple Correspondence Analysis.

1. BACKGROUND

Public transportation plays a fundamental role in the lives of urban population since it creates opportunities for the city dwellers to have access to economic activity, facilitates family life and helps in spinning social networks (Wane, 2001). Cities and metropolitan areas are hearts of variegated activities that require well-organized convenient transportation system. A city cannot function properly without an effective transportation system. Among all the typical modes of public transportation, the buses are arguably the most versatile and the cheapest in context of a city. It holds paramount importance in serving the ever-increasing travel and accessibility demand in a developing city due to rapid urbanization with the flexibility that it can offer (Rahman *et al.*, 2017). For the past few decades, service quality of public transport has become an important subject to the researchers as it is recognized as one of the most challenging areas for the transportation industry (Giannopoulos, 1989; Govender, 2014a; 2014b, Wijaya, 2009). Measuring service quality is difficult as it involves a great deal of subjectivity (Govender, 2014a; 2014b). Quality public transport can ensure greater mobility of people and thus help the citizens to participate in the socio-economic development (Govender, 2014a; 2014b). At present gaging service quality of public buses through the eyes of its female commuters is getting importance in print and electronic media because of their increasing mobility demand induced by involvement in outside activities of the household and

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their greater vulnerability to issues such as safety and security. Therefore, bringing in the gender dimension in service quality evaluation has become imperative (Wijaya, 2009).

Transport policies and people's travel-pattern have strong impressions on the social, economic, and environmental development of a country. Because of a greater variety of social classes, economic status and cultural backgrounds in urban context of developing countries, there are likely to be greater differences in travel patterns between male and female members of the same household (Peters, 1999; Peters, 2001; Riverson *et al.*, 2006, Rosenbloom, 2006). Hamilton *et al.*'s (2005) study revealed non-homogeneous nature of women's travel pattern which is led by their age, terrestrial location, socioeconomic class and ethnicity, employment and parenting status. On the contrary, men's travel pattern remains almost even throughout their whole life (Turner and Fouracre, 1995). The issue of women empowerment is getting momentum as more and more the societies are understanding importance of increasing women's share in the workforce and how they are contributing to the economic growth of nations (Mahadevia, 2015; Rosenbloom, 2006). However, for such contributions mobility needs for women are becoming obligatory (Mahadevia, 2015; Rosenbloom, 2006). These days, women are generating a significant number of trips on regular basis. Working women's travel-pattern is more complex than that of men because of their twofold responsibilities both in outside job and household activities (Duchene, 2011; Turner *et al*., 2000).

People make choices among different modes of transport keeping in mind the issues such as their purpose of travel, fare expenses, comfort and convenience and characteristics of a vehicle. Women are more concerned about their safety issues while using public transport than men (Tarigan *et al.*, 2010). Gwilliam's (2010) observation tells that female passengers are more vulnerable to physical attack or sexual assault often by the bus staffs or other male co-passengers in public transport. Zohir (2003) found the lack of proper co-ordination between the gender-enabling environment and the transport sector. In Dhaka city, public transport environment is not comfortable for women. Women prefer more separation from men and are unlikely to travel in overcrowded buses with other male passengers (Rahman, 2010). And inadequate numbers of public buses mostly remain over-crowded that resists the accessibility of women (Rahman, 2010). Dhaka's social structure restricts the travel choices of female service-holders, the most unprivileged group of commuters, compared to males within the same income bracket (Nasrin, 2015). An evaluation report of Swedish International Development Cooperation Agency (SIDA, 2006) revealed that in Dhaka city women's dignity and security are at risk while travelling on crowded buses as they face the dangers of physical touching and uncivilized behavior from drivers, ticket inspectors and other male passengers (Rahman, 2010, Islam *et al.*, 2016). Eve teasing and harassing women in crowded buses are very common and women commuters face problems of getting in and off the bus while overcrowding as they cannot compete with male commuters (Rahman, 2010; Jain, 2013; Zohir, 2003, Sazida et al, 2016). 94% women commuting in public transport have experienced sexual harassment in verbal, physical and other forms _ a study by development organization BRAC has revealed (2018). A somewhat surprising revelation of the study is that males belonging to relatively older age group of 41-60 years have been identified as the major perpetrators. To avoid such uncomfortable situation, women are forced to look for alternative options such as walking long distances or hiring CNG (compressed natural gas) auto rickshaw or taxi with high fares (Rahman, 2009; Sen, 2016, Shefali, 2000) and non-motorized three-wheelers (SIDA Evaluation report, 2006). A World Bank study revealed that 35% of female commuters relied on cycle-rickshaws as their sole mode of transport (Peters, 1999). A study (ADB, 2012) concluded that walking is the only mode of daily travel for approximately 13% of the surveyed working women. The same study also revealed that approximately 12% of the women respondents had to change work place and 11% of the women had to quit their

jobs because of transport issues. Despite of being easier modes, these para-transit facilities could not ensure secure, safe, and comfortable travel for women passengers or the mobility-impaired group as well (Abir & Hoque, 2011; Rahman, 2010, Nasrin,2015). Fares of those para-transits are much higher than the bus which sometimes become unaffordable to low- or middle-income female group (Nasrin, 2015; Shefali, 2000). Hence, this unsafe, unaffordable and inaccessible transport system, both bus and para-transit, has certainly restrains women's access to work, education and necessary social services (Jain, 2013).In urban areas, fear and anxiety about personal security, such as sexual assault, attack, robbery, harassment, and verbal abuse (Buvinic *et al.*, 1999), hinders women's mobility (Krieg *et al.*, 2009). Hence, understanding the travel-pattern of urban people and the reasons for choosing one transport mode over another are important features to assess the service quality.

Existing literature suggest that globally most of the researches have been focused on identifying differences and similarities in travel-pattern of men and women or women's less accessibility to public transport especially in rural areas. Several prevailing studies on service quality of public buses often ignores the gender dimension. Some of those studies highlighted the safety and security constraints faced by the women to access to the public transport in developed societies of Global North in very limited circumference. Unfortunately, the transportation related problem faced by women in developing states of Global South is a less researched area. However, this research will present a framework to portrait the actual scenario of the service quality of public buses in the context of a developing city, taking Dhaka city as a representative. The specific focus on female travelers is expected to highlight the variance in gender-based aspects that will reveal the female travelers' experience with present service quality of public buses. The specific scope of this study is to find out the service level of existing public bus services plying all around the Dhaka city. The focus group of this study area is mainly the university going young female students and the female commuters involved in the present workforce to the city.

2. STUDY AREA

Dhaka, the capital city of Bangladesh, is one of the most densely populated developing megacities in South Asia. Dhaka offers a very insufficient, inefficient, nonproductive, unsafe and overcrowded public transit service (Haque *et al.*, 2012; Mannan and Karim, 2008; Rahman, 2010; Rahman and Nahrin, 2012). A deficit is exposed extensively between the supply and demand of public transport with the expansion of the city (Rahman and Nahrin, 2012). Unfortunately, the existing status of bus services does not attend the mobility needs of the population sufficiently (Gallagher, 2016; Mannan and Karim, 2001). According to Peters (1999), women in Dhaka face cultural constraints for properly accessing public transport because of social seclusion. Although being a conservative country from the perspective of culture and social structure, at present women's activities outside residence are significant. Bangladesh has recently been graduated as lower middle-income class, declared by World Bank in 2015 (WB website, 2018) and is headed to leave the Least Developed Country category of United Nations by 2024 for getting graduation to the next upper category, propelled by better health and education, lower vulnerability and a flourishing economy (UN News, 2017). For this great achievement involvement of women in the labor market made great contribution that has enhanced the economic growth of the nation and the trend is deemed as essential to maintain the prosperity. Involvement of women in labor force has increased from 9.8 million in 2003 to 16.8 million in 2013 (WB website, 2016). According to Bangladesh Bureau of Statistics (BBS, 2017) the present female literacy rate of aged 15 years

or older is 65.3% and in urban areas this rate is 74.3%. The largest proportion of working-age population lives in urban areas (69.8%) whereas 66.7% overs the rural population (LFS-2018). According to Statistical Pocket Book 2017, the economically active female labor force has increased from 17.2 million in 2010 to 20 million in 2017 as well as the female employment status also changed positively from 54.1milion in 2010 to 60.8 million in 2017. Of them, in urban areas, 41.0% of female youth are employed which is much greater than male youth employment rate of 28.8% (LFS 2018). Hence, the statistics show that the involvement of female labor force in economic activities is increasing day by day. Of them, a large number of economically active women are working in the capital. The garment sector in Dhaka city alone employs about 70% of the total female labor force in the city (Shefali, 2000). The trend indicates a positive increase in female labor force participation in the future, with women competing directly with men. Moreover, a substantial number of female students live in this city as most of the educational institutions and private universities in Bangladesh are situated in Dhaka. Hence, women contribute a substantial part of the total daily trips and the trend is hoped to enhance in near future.

Women involvement in economic activity creates mobility and transportation demands for accessibility. Though public transport is not gender sensitive, but due to societal culture and religious norms, inappropriate policies and investment make difference in accessibility needs of women (Sen, 2016). Public transport environment is not comfortable for women. Despite of dependency of substantial number of passengers on public buses (Karim *et al.*, 1999), very few studies have been done concerning their service quality from the perspective of female users.

3. METHODOLOGY

The methodology of this study can be divided down into several components. First, the study was conducted a thorough literature review on transportation and service quality of public transportation. Then, a service quality model was developed to collect data. Finally, mathematical analysis was conducted.

From literatures, two most applied models in service quality assessment in transportation studies are found: SERVQUAL (Parasuraman *et al.*, 1988) and RESCA (McKnight *et al.*, 1986) model or their customized forms modified according to the context of the research. There are five dimensions in the SERVQUAL model: Tangibles (physical facilities of service), Reliability (dependability and accuracy of the service), Responsiveness (readiness, willingness and promptness in assisting customers), Assurance (ability, knowledge and curtseys of the employees and their capability to arouse trust and confidence), and Empathy (caring and individualized consideration). The RESCA model also contains five dimensions: Reliability (arrival on time, notification of delay, waiting away from home, delays en-route), Comfort (guarantee of getting seat, smooth ride, sheltered waiting areas, air conditioning), Extent of service (total service hour, services on weekend, public holidays, weekdays and service in evening), Safety (low probability of accidents, falling and assault), and Affordability (alternatives-season tickets, cheap fare, value of money). In this study, the characteristics of both of these models were combined and modified according to the context of female travellers in Dhaka city. Finally, a new Service Quality (SQ) model was proposed having five dimensions and their corresponding attributes, in total 20, as presented in parenthesis: Reliability (Availability of bus arrival information at bus stops, waiting time for bus, average duration at each stoppage), Comfort (Availability of seats right after boarding, travel status – standing, seating or mixed, cleanliness inside the bus, level of crowding, noise

and temperature), Safety & Security (allowing safe boarding and alighting, conductors picking up passengers hurriedly or modestly, female passengers getting harassed – verbally and/or physically/sexually, various kinds of harassments of female passengers by male passengers or drivers or conductors), Responsiveness & Empathy (refusing female passengers to board irrespective of availability of seats, acceptability of behaviour of drivers and conductors towards female passengers, negative attitude shown by male passengers towards female passengers, reaction of fellow passengers – male or female – when a female passenger gets harassed verbally and/or physically/sexually, whether the victim protested against the perpetrator, whether the authorities, here, driver and conductor, took account the complaint, if passengers insisted the driver to break rules) and Affordability (whether excess fare was collected). Next, a close-ended questionnaire, where the respondent has to choose answer from give options, was developed based on the newly adopted SQ dimensions and their attributes to evaluate individual trips. The questionnaire consisted of 37 no. of questions which were classified into seven parts where the first part from question no. 1 to 4 covered information about the respondent, such as, age, occupation, purpose and frequency of using public. The second last part of the questionnaire (question no. 36) requested the participants to rate their overall trip as either 'satisfactory' or 'unsatisfactory'. Each of the remaining five parts form question no. 5 to 35 corresponded to each of the six dimensions of service quality. And lastly, some suggestions were made by the respondents in question no. 37. Table 1 shows the SQ model along with options included in the questionnaire. The short names have been assigned to each of the variables (within parenthesis) for the convenience of future reference.

Table 1: Service Quality Model Parameters

Dimension	Attribute included in questionnaire as categorical variable	Probable options
Reliability	Bus Arrival Information (BAI)	No Yes
	Waiting Time for Bus (WT)	0 min 1-5 min 5-10 min 10-15 min 15-20 min 20-25 min 25-30 min >30 min
	Duration at each stoppage (SD)	1-2 min 2-3 min 3-5 min 5-10 min 10-15 min >15 min
Comfort	Availability of seats right after boarding (ASB)	No Yes
	Travel Status (TS)	Standing Sitting in female seat Sitting in general seat Mixed, sitting & standing
	Bus Inside Quality i.e., Cleanliness (BIQ)	Very dirty Moderately dirty Moderately clean Very Clean
	Noise Status (NS)	Not crowded Crowded Very crowded

	Crowed Status (CS)	Not noisy Noisy Very much noisy
	Temperature or Heat Condition (HC)	Intolerable Tolerable
Safety & Security	Boarding and Alighting Status (BAS)	Driver didn't stop the bus properly Driver picked passengers on running situation Driver stopped the bus properly
	Picking Passengers (PP)	Hurriedly Modestly
	Female Passenger Harassment (FH)	No harassment Yes, once Yes, several times
	Harassment by bus driver or helper (HDH)	No harassment Yes, physically touched or harassed Yes, verbally harassed
	Harassment by Male passengers (HM)	No harassment Yes, physically touched or harassed Yes, verbally harassed
Affordability	Weather excess fare is collected (EF)	No Yes
Responsiveness and Empathy	Refusing female passengers to board irrespective of availability of seats (RF)	No Yes
	Acceptability of attitude of drivers and conductors towards female passengers (UA)	No Yes, Immodest attitude
	Appearance of personnel i.e. Bad Attitude of Male passengers towards female passengers (BAM)	No Yes Several incidents
	Protest against bad behavior (PAB)	No incidents happened Yes, male passenger protested Yes, female passenger protested Yes, both male and female passengers protested Yes, the victim protested
	Procedure for follow-up on complaints i.e. taking account complaints (TAC)	No Yes

A nonprobability convenience sampling method, called as 'Snowball Sampling', is applied to conduct the questionnaire survey. This method makes easy access to population or subjects with target characteristics e.g. in our case female passengers of public buses of Dhaka city are the subject group. According to Cavana *et al*. (2000) snowball sampling is aptly exercised if the elements in the population contain specific features and information. Snowball sampling complies a friend-to-friend network (Hossain, 2017). In our study, to conduct the questionnaire survey, at first a university going female student (who is a regular user of public bus service in Dhaka city) was chosen and briefed about our study and information required for the survey questionnaire. Then, she was given the aforementioned questionnaire and asked to evaluate her one individual trip that she had just completed. At the same time, she was also asked to tag some of her female friends who are the regular users of public bus services in Dhaka city and they would also provide their trips information in the same questionnaire just after completing their trips. Accordingly, same strategy was applied for choosing the survey respondents who are involved in different jobs or service sectors. Each of the respondents was initially briefed about the survey questionnaire so that they can

easily understand required information to be extracted from the trip. The respondents willingly participated in the trip rate survey and share their travel experiences. Each of the respondents was provided several copies of questionnaire so that she can evaluate more than one trip whenever she travels by bus. The samples were collected until data permeation. The bus-routes map is shown in Figure 1. Afterwards, a binary logistic regression (BLR) model was applied to analyze collected data to find out which variables significantly influence the bus users' satisfaction. Then, Multiple Correspondence Analysis (MCA) was employed to identify the relation of variables in the model graphically and consequently their relative dependencies, i.e., which variables influence relatively more the passengers' perceived satisfaction, were measured. The following subsections briefly describe these activities.

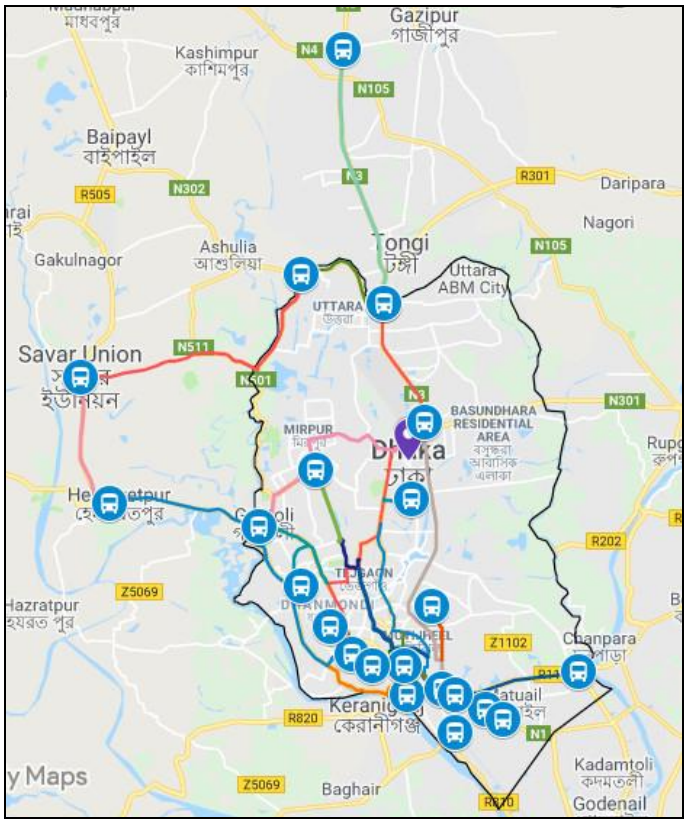

Figure 1: Bus Routes Map of the Study area

3.1 Mathematical Model

3.1.1 Logistic regression model

In case of the outcome variable being categorical in nature a logistic regression (LR) model could be applied to investigate relationships between predictor variables and a response variable (Bucur *et al.*, 2016). The BLR model is a special case of the generalized linear model (Ramon *et al.*, 2010) which aids to model the dichotomous categorical response variable depending on the explanatory variables of the continuous or categorical type (Šoltés *et al.*, 2018). As in our case, both the explanatory variables and response variable are categorical in nature. So here, BLR model is applied to find out the influence of predictor variables over response variable. Here, the response variable possesses two categories which represent the probability of the 'Satisfied' to be 1 and 'Dissatisfied' to be 0. The Linear Regression estimates the value of the response variable based on the values of the predictor variables. On

the contrary, logistical regression gives the values of dependent variable after transforming the linear value using logarithm function. Hence, the BLR applies the logarithmic transformation of the odds of probability p for the perceived SQ 'Satisfied' (y = 1) to the probability (*1–p*) of being 'Dissatisfied' (y = 0). The natural logarithm of the odds is called logit and, unlike probability p, acquires any real values and can be modelled by a linear regression model.

$$logit(p) = ln\frac{p}{1-p} = \theta + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_i x_i \quad (1)$$

Where, *p* is the probability, and $\beta_1, \ldots, \beta_k$ are the parameters of the model and $x_1, x_2, \ldots, x_k$ are the values of the explanatory variables $X_1, X_2, \ldots, X_k$. The Newton-Raphson algorithm is generally used to obtain maximum likelihood estimators of parameters of the LR model (Allison, 2012). After estimating, it is important to verify the statistical significance of the model and also the influence of the individual explanatory variables on probability p is significant. The significance of a LR model is performed by a zero-hypothesis test $\beta^T = (\beta_1, \beta_2, \ldots, \beta_k) = 0^T$ against an alternative hypothesis – at least one regression coefficient is non-zero, while three different test chi-square statistics are mostly used (Likelihood ratio, Score statistics, Wald statistics).

A Wald test is used to confirm the significance of the explanatory variable influence. It tests the zero-hypothesis showing that the respective explanatory variable. Wald statistic:

$$Wald = \mathcal{B}^T V_b^{-1} \mathcal{B} \quad (2)$$

Here, $\mathcal{B}$ is the vector of regression coefficients estimates that stand at dummy variables for the respective factor (categorical explanatory variable) and V_b is the variance-covariance matrix of $\mathcal{B}$. Wald statistic has asymptotically $\chi 2$ distribution with degrees of freedom equal to the number of parameters estimated for a given effect.

The effect of the explanatory variable Xi on the dependent variable Y is quantified in logistic regression by the odds ratio (OR – odds ratio) estimated by the formula:

$$OR = e^{\beta i} \quad (3)$$

The odds ratio in BLR expresses how the odds will change: Y = 1 compared to the odds that Y = 0, in unit growth of the explanatory variable in conditions ceteris paribus.

3.1.2 Multiple correspondence analysis

Multiple Correspondence Analysis (MCA) is a multidimensional descriptive method effectively practiced to visualize the relationship between qualitative variables in various arenas such as the social sciences, marketing, health, psychology, educational research, political science, genetics, etc. MCA helps to expose relationship-pattern among qualitative variables in complex datasets (Greenacre, 1993). MCA usually symbolizes the datasets as "clouds" of points in a multidimensional Euclidean space (Kalayci and Basaran, 2014). MCA analyzes a set of observations with a set of nominal variables and each nominal variable comprises several levels, and each level is coded as a binary variable. i.e. MCA applies the principle of standard Correspondence Analysis (CA) on an indicator matrix (i.e., a matrix with the entries 0 or 1) (Groenen and Josse, 2016). By executing CA on the indicator matrix, two sets of factor scores: one for the rows and one for the columns are obtained. These factor scores indicate that their variance is equal to their corresponding eigenvalue. The inner product result of indicator matrix represents in the Burt Matrix. Eigenvalues obtained from the Burt Matrix analysis give a better approximation of the inertia explained by the factors than eigenvalues of indicator matrix. The number of dimensions to be kept in the solution depends on dimensions with inertia (Eigenvalues). Greenacre (1993) advocated that an adjusted inertia provides an improved quality map. The MCA results can be interpreted on the basis of the relative positions of the categories and their distribution along the dimensions; as categories become more similar in distribution, the closer (distance between points) they are

represented in space.

4. ANALYSIS AND RESULT

4.1 Data Collection & Aggregation Analysis

A total of 641 trips were evaluated by young female public bus users between October, 2017 and March, 2018 through the questionnaire survey. Among the participants 322 were undergraduate or graduate students and the remaining 319 were service holders. They age range of the participants were between 20-40 years and 51% of them were between 20 to 30 years old. Around 63% of the respondents use public buses 5 or more days a week. Only 10 percent of the participants reported to use bus only once a week. Of the 641 trips, 44% were for education, 32% were work trips and 7% were shopping trips. The remaining 17% trips were classified as other personal trips. Analysis of the trip data revealed that around 67% of the respondents rated their overall trip experience to be unsatisfactory and only 33% of them were satisfied with the trip that they made with public bus.

Regarding reliability, on 85% occasions respondents could not find any information regarding bus arrival time. The participants had to wait longer than 10 minutes in 55% occasions. Even during the trip, in 30% cases the buses made stops longer than 5 minutes in intermediate stations. From the point of view of service, the participants felt that they found an appropriate bus to ride in 42% of their trips. However, on 45% cases they saw that the drivers or conductors denied female passengers from boarding as the ‘female only’ seats on the bus were full though there were empty general seats or standing capacity still available. About 18% of the respondents could remain seated in a ‘female only’ seat and 26% of the participants could manage a ‘general’ seat throughout their trip. However, the remaining 56% had to either remain standing or could manage seat for a portion of the trip. In the survey, the respondents rated various aspects of comfort. They found the interior of the buses to be either very dirty in 31% cases; the buses were in general crowded (56%) or very crowded (27%); they were noisy (56%) or excessively noisy (26%) and also the heat inside was reported to be intolerable in 47% of the surveyed trips. Women found it hard to board or alight buses as in only 26% cases the drivers stopped the bus properly. But in rest of the time, the drivers were either not stopping the bus properly (44%) or picking up passengers in running condition (30%) which made boarding specially risky and difficult for the female passengers. The conductors also exhibited similar attitude as in the survey, 68% time the female participants complained that the conductors were picking up passengers hurriedly. As presented by the responses in the survey, harassment in buses towards young female passengers by drivers, conductors as well as passengers was widespread. Around 56% times during their trip the respondents saw women being subjected to harassments of which 26% times they observed it taking place more than once during their journey. In 29% occasions the drivers or conductors verbally abused female passengers and in 10% cases they physically touched female passengers. Male passengers are equally involved in such situations as the participants saw them physically harassing female passengers in 19% trips and in 21% occasions they verbally abused female passengers. In around 84% occasions, when female passengers get harassed against any complain, rather than getting help, they get reprimanded by drivers, conductors and fellow male passengers. In case of physical harassments, the respondents reported that only in 8% situations they saw the victims protesting. Unfortunately, in such situations, in about 12% cases both male and female passengers stood by the victim. It was also noticed that female passengers are very much reluctant to move forward and help a harassed and

protesting female passengers (10%). And when the victims complain, only in 18% cases their objections are taken as complains.

Some other interesting aspects of trip also got revealed in the survey, such as, on 31% occasions the respondents saw conductors asking for higher fare than the usual from female passengers, taking the chance that they may not know the actual fare.

4.2 Logistic Regression Analysis:

In this study BLR was applied on twenty categorical predictor variables described in Table 1 (e.g. Bus Arrival Information, Waiting Time for Bus, Duration at each stoppage, Availability of seats right after boarding, Boarding and Alighting Status, Picking Passengers, Female Passenger Harassment, Harassment by bus driver or helper, Harassment by Male passengers, Travel Status, Bus Inside Quality, Crowed Status, Noise Status, Temperature or Heat Condition, Weather excess fare is collected, Refusing female passengers to board irrespective of availability of seats, Acceptability of attitude of drivers and conductors towards female passengers, Appearance of personnel i.e. Bad Attitude of Male passengers towards female passengers, Protest against bad behavior, etc.) explaining a binary response variable (Satisfied or Dissatisfied to the trip). To assess the goodness of fit of the model, two approaches are examined: -2 Log Likelihood and Pseudo R^2. Table 2, represents the respective values of the goodness-of-fit values for -2 log likelihood, Cox and Snell R^2 and Nagelkerke R^2 yielded after the last iteration. The lower value of -2 log likelihood implies the better fitting of the model. The correlation measure provided by BLR analysis is the pseudo-R^2. Cox & Snell R^2 and Nagelkerke R^2 are two measures considered as pseudo R^2. Higher values indicate the greater model fit. The pseudo-R^2 as appearing in Table 2 accounts for the amount of variance explained in the outcome variable by the independent variables. The Cox & Snell and Nagelkerke pseudo-R^2 suggest that the variation in the level of trip satisfaction outcomes explained by the indicator variables ranges between 38.8% and 49.9%, suggesting that a relatively significant level of variation is explained by the model. This measure (pseudo-R^2) also assesses the accuracy of the model by comparing the predicted values of the model to the observed values.

Table 2: Goodness of fit statistics

Statistic	Independent	Full
Observations	641	641
Sum of weights	641.000	641.000
DF	640	596
-2 Log(Likelihood)	968.176	652.967
R²(McFadden)	0.000	0.326
R²(Cox and Snell)	0.000	0.388
R²(Nagelkerke)	0.000	0.499
AIC	970.176	742.967
SBC	974.639	943.803
Iterations	0	12

Again, the model goodness can also be explained by hypothesis testing as presented with Table 3. In this study, the probability values for the three different test chi-square statistics – the likelihood ratio, score statistics and Wald statistics are lower than 0.0001, i.e., significant information is explained by the variables.

Table 3: Testing Hypothesis

Test of the null hypothesis H0: Y=0.329 (Variable TR):			
Statistic	**DF**	**Chi-square**	**Pr > Chi²**
-2 Log (Likelihood)	44	315.209	< 0.0001
Score	44	312.963	< 0.0001
Wald	44	144.241	< 0.0001

The Classification table (Table 4) in a cross tabulated format provides means of assessing the predictive ability, where diagonal elements are the correct classification and off diagonals elements represents the wrong (incorrect) classifications. The overall correct classification is 74.10% that indicates that the model predicts 74.10% of cases correctly.

Table 4: Classification table for the training sample

	Predicted			
Observed	**Dissatisfied**	**Satisfied**	**Total**	**% correct**
Dissatisfied	332	108	430	74.88%
Satisfied	58	153	211	72.51%
Total	380	261	641	74.10%

The Receiver Operating Characteristic **(**ROC) curve quantifies the accuracy of the predicted model that discriminate the predicted values between positive (true) and negative (false) cases by plotting the area under the curve (AUC). The value of the AUC varies from 0.5 to 1. The ROC curve (Figure 2) obtained from the BLR model shows that the area covered by the predictive model is 0.796 suggesting that the model fit can be considered to be satisfactory.

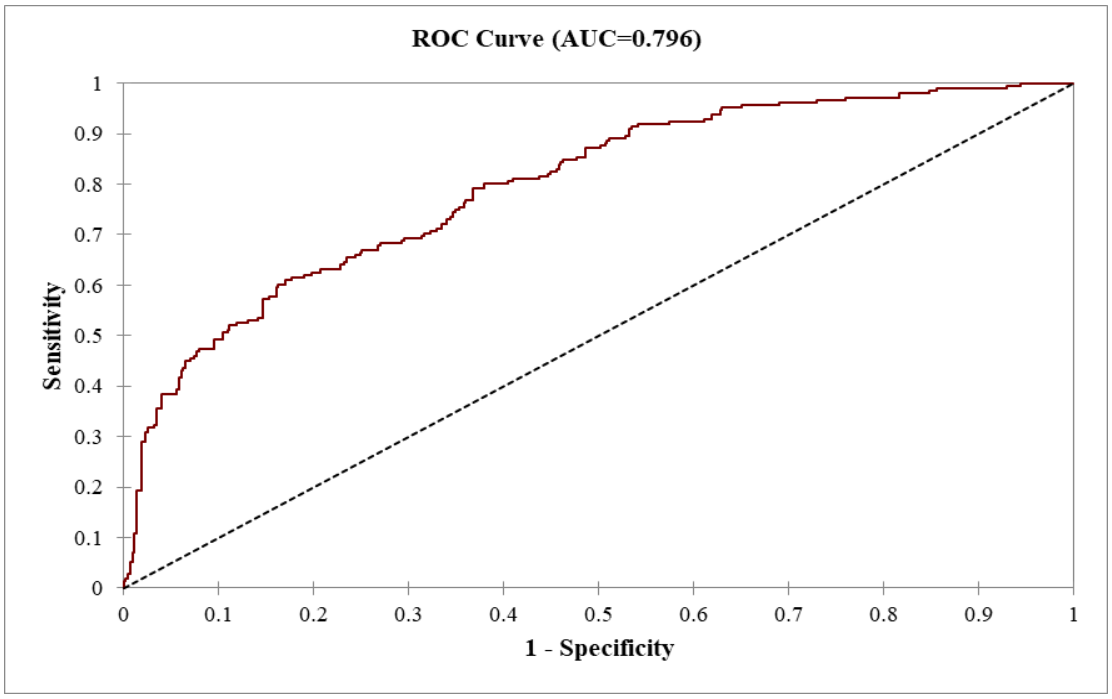

Figure 2: ROC Curve for BLR

Table 5 represents the p-values of independent variables 'Boarding-Alighting Status',

'Harassment by bus helper', 'Harassment by Male passenger', 'Bus Inside Quality', 'Refused Female to board', and 'Protest against bad attitude' form Likelihood Ratio Tests where p-value of each of the variable is less than 0.05. This indicated that these variables are significantly related to the response variable and have influence on predicted outcome of the model.

Table 5: Likelihood Ratio tests

Source	DF	Chi-square (Wald)	Pr > Wald	Chi-square (LR)	Pr > LR
Boarding-Alighting Status (BAS)	2	28.039	< 0.0001	29.179	< 0.0001
Harassment by bus helper (HBH)	2	17.407	0.000	17.955	0.000
Harassment by Male passenger (HM)	2	11.652	0.003	12.185	0.002
Bus Inside Quality (BIQ)	3	11.660	0.009	13.298	0.004
Refused Female to board (RF)	1	14.985	0.000	15.136	0.000
Protest against bad attitude (PAB)	4	15.521	0.004	16.297	0.003

Using Table 6, it can be interpreted that 'BIQ-V. clean' possessing highest odd-ratio (7.25) among all the variables and influences bus commuters' satisfaction positively i.e. if the bus inside environment is very clean then bus users become satisfied to that trip. On the contrary, the variable 'BIQ-V. Dirty' has negative impact with the response variable i.e. commuters may feel discomfort with dirty environment. Again, "BAS-Stopped" positively influence the satisfaction perception of bus users if the bus is properly stopped during boarding and alighting as the odds-ratio of this category possess higher value (3.470). Simultaneously, 'HBH-Phy. Harassed', 'HBH-Verb. Harassed', 'HM-Verb. Harassed' these three variables, possessing p-values 0.006, 0.000 and 0.001 respectively, indicate high negative impact on satisfaction on perceived quality of bus service. Again, 'RF-Yes' also has negative impact on passengers perceived experience as whenever bus driver/conductor refuse female passengers to get into the bus, then respondents became disappointed with the bus service quality. The other variables influence can be explained as well in Table 6.

Table 6: Variable in Equation

Effect	Value	Standard error	Wald Chi-Square	Pr > Chi²	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
intercept	0.427	0.212	4.053	0.044			
BAS-Didn't stop	0.000	0.000					
BAS-Running	0.318	0.224	2.028	0.154	1.375	0.887	2.131
BAS-Stopped	1.244	0.237	27.574	< 0.0001	3.470	2.181	5.521
HBH-No harassment	0.000	0.000					
HBH-Phy. Harassed	-1.048	0.378	7.670	0.006	0.351	0.167	0.736
HBH-Verb. Harassed	-0.891	0.245	13.259	0.000	0.410	0.254	0.663
HM-No harassment	0.000	0.000					
HM-Phy. Harassed	-0.288	0.270	1.135	0.287	0.750	0.442	1.273
HM-Verb. Harassed	-0.958	0.281	11.621	0.001	0.384	0.221	0.666
BIQ-M. Dirty	0.000	0.000					
BIQ-M.clean	0.179	0.240	0.560	0.454	1.196	0.748	1.914
BIQ-V. Dirty	-0.475	0.221	4.616	0.032	0.622	0.403	0.959

BIQ-V.clean	1.981	0.985	4.042	0.044	7.250	1.051	50.000
RF-No	0.000	0.000					
RF-Yes	-0.769	0.199	14.985	0.000	0.464	0.314	0.684
PAB-No Incidents	0.000	0.000					
PAB-Y-B-P	-0.576	0.354	2.645	0.104	0.562	0.281	1.125
PAB-Y-F-P	0.714	0.323	4.870	0.027	2.042	1.083	3.849
PAB-Y-M-P	0.146	0.312	0.220	0.639	1.158	0.628	2.133
PAB-Y-V-P	-0.857	0.406	4.456	0.035	0.424	0.191	0.941

4.3 Multiple Correspondence Analysis:

The relationships among the variables, which explain whether a female passenger is satisfied or not with her trip by bus, 'Bus Arrival Info', 'Waiting Time', 'Stoppage Duration', 'Availability of Seat right after Boarding', 'Travel Status', 'Boarding-Alighting Status', 'Picking Passengers', 'Female Harassment', 'Harassment by bus driver/helper', 'Harassment by Male passenger', 'Excess Fare', 'Bus Inside Quality', 'Crowed Status', 'Noise Status', 'Heat Condition', 'Refused Female to board', 'Unacceptable Attitudes of bus staffs towards female', 'Bad attitudes of male passenger towards female', 'Protest against bad behavior' and 'Taking Account Complain' were examined by BLR model. The findings yielded 'Bus Arrival Info', 'Harassment by bus helper', 'Harassment by Male passenger', 'Bus Inside Quality', 'Refused Female to board', and 'Protest against bad behavior' as significant variables. In this stage, MCA was applied considering these six variables to visualize the inter-dependency among the variables through a graphical representation (see Figure 3). From the Figure 3, it is very clear that the MCA analysis dispersed the data into two separate clusters of response variable i.e. 'Satisfied' and 'Dissatisfied' where each cluster represents dependency of response variable on its related independent variables.

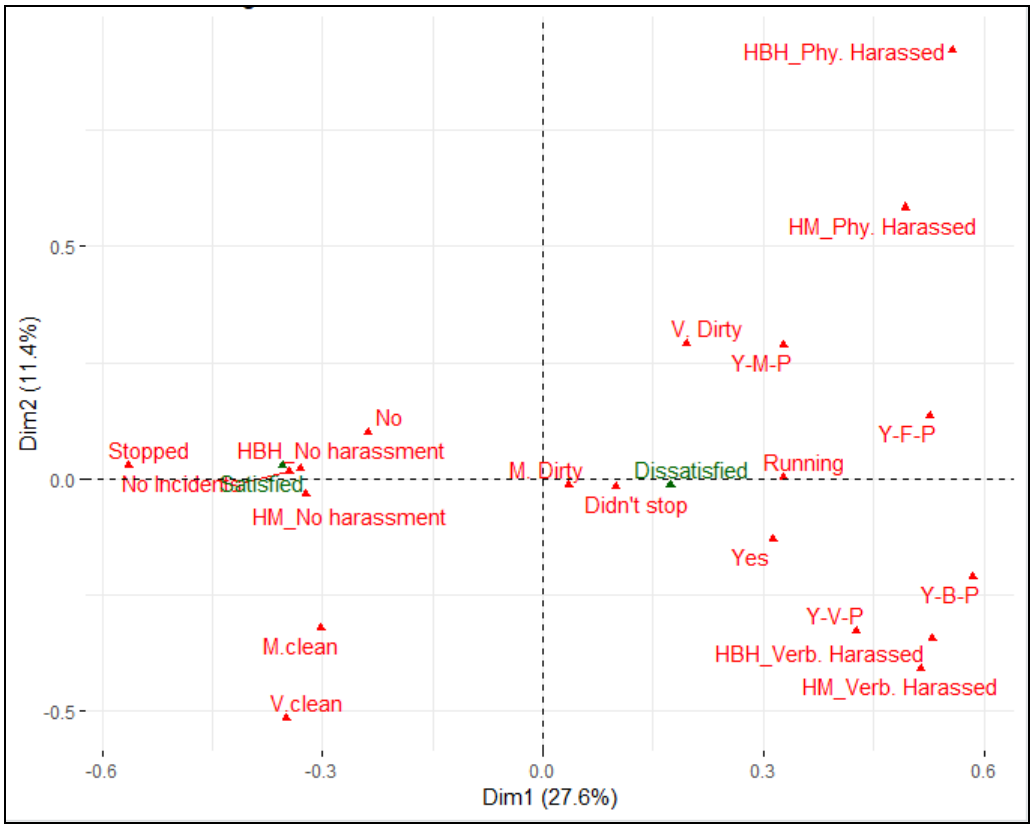

Figure-3: Factor Map of MCA Analysis

From Figure 3, it is revealed that if the bus stops properly during boarding and alighting, and if no incident of any kind of harassments occur then female passengers feel satisfied about their trips. Moreover, clean environment inside the bus also positively influences the passengers' perceived gladness. All of these influence factors are closely inter-related to define the experience of trip as satisfactory. In the contrast, customers' satisfaction exposes negative impression on experienced trip if the bus doesn't stop properly, rather pick up passengers by just slowing down while on the move. Moreover, dirty interior of the bus also has direct influence on defining passengers' experienced trip as 'dissatisfied'. Again, any kind of harassment perpetrated by both bus-staffs and male passengers towards female passengers affect them adversely enough to rate their trip as 'dissatisfied'. Hence, the MCA results closely resemble that of the BLR model.

5. CONCLUSION

The manuscript has evaluated the service quality of public buses in Dhaka city from the perceptions of female passengers. For that, it has conducted a survey where young female passengers have evaluated their experience of the trips that they have completed taking public buses. Then BLR was employed to identify the attributes that had the highest influence on deciding whether the trip experience was satisfactory or unsatisfactory. BLR model found that 'Boarding- alighting status' is the most important variable which greatly influence the safety, security and comfort related issues of female commuters. In this study, 74% respondents have complained about poor and unsafe boarding-alighting facilities of public bus service. Subsequently, impact of incidents of harassment of female passengers by bus stuffs or fellow

male passengers during boarding-alighting as well as inside the bus is found to have quite detrimental impact on their perception about the service quality of public buses. Because more frequently women commuters become vulnerable of being physically touched or harassed by conductors or bus helpers during boarding and alighting, as often the conductors and bus helpers keep standing blocking the door, while women passengers are supposed to get in and off, to be the main source of sexual abuse. The driver also does not stop the bus completely and just slow down the speed. In this situation, by showing an excuse of helping female passengers, the helper tries to hold them while they get down. Even, when women protest in these situations, the conductors, drivers or fellow passengers do not care about. Furthermore, 'Bus inside quality' is found as an influential factor for rating the service quality of buses. Hence, this study has carefully identified the probable grounds of dissatisfaction of female road users about bus service quality.

The study found that the present condition of public transport services in Dhaka city is mostly not women- friendly. However, such situations are discouraging women to ride on public buses. Therefore, it is imperative to improve service quality of public buses for its women passengers and it is expected that such initiatives will improve service quality for both the genders. At the same time, the study also suggests involving more female transportation planners in policy making which will eventually assist in understanding gender specific issues related to public transport and allow accommodating customized solutions thereby. This section synthesizes the suggestions and plausible solutions that emerged from this study with those recommended in the literatures and present policy directions to transform the public bus service of Dhaka city to be more acceptable to its female users. For that reassuring safety on public transport needs to be made a policy priority. However, to be successful, the line of actions presented in this manuscript need active participation from the transit agencies, policy services, law enforcement agencies, organizations related to social development, educators, planners, designers and of course the passengers of public buses.

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