Assessment of Bus Service Quality Based on Women's Perception in An Emerging Mega City Dhaka

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Abstract: This study evaluates women's perception of bus service quality in Dhaka city, Bangladesh. A questionnaire survey was conducted to 663 women respondents to know their opinion regarding the existing service. A series of structural equation models were developed using twenty-six SQ variables to examine the factors affecting the service quality. To compare the initial model with other models and to select the best one, a list of indices (i.e., Root Mean Squared Error of Approximation, Standardized Root Mean Square Residual, Comparative Fit Indices and Tucker-Lewis Index) were employed in this study. Result shows that, Model 4 (M_4) appears to be best which satisfies all the standard fit indices. Most significant factors affecting the convenience of the bus service are Punctuality of bus, Frequency of service, and Ticketing system. This study might be useful for policy-makers, public transport operators and officials involved in developing the public bus system.

Keywords: Bus service quality, Women's perception, Structural equation models, Punctuality of bus

1. INTRODUCTION

Public transportation plays a vital role in urban population. It has extensive effect on all aspects of people's daily life activities (Odufuwa, 2012). It creates opportunities for urban people to access economic activity, helps in spinning social networks and facilitates family life (Wane, 2001). An effective transport system is necessary for monetary activity and quality of life for the urban people. Without an effective transportation system, urban people cannot work properly. Therefore, transport system is called 'lifeblood' of city life (Vuchic, 2003). However, inadequate and ineffective public transportation limits the users' choices to access facilities and employment opportunities (Pojani and Stead, 2015). Whereas an effective public transportation system leads to rapid economic progress and enhances the social life of a city.

Public transit facilities generally refer to the service provided to citizens by government or private organizations to ensure that daily activities are easily accessible. Among public transport facilities in city areas, bus is the most flexible and the cheapest mode of public transport in Asian developing cities like Dhaka (Rahman et al., 2017). Besides, it provides an important function for the movement of a significant number of people in developing cities to meet a range of access needs. The need for mobility is increasing consequently due to rapid urbanization. In many developing countries like Asia, Africa, and the Middle East, the urban transport market has experienced a major shift to private motorization for a variety of societal, economic, and political reasons (Sen, 2016). Demand for transport is increasing in parallel with the rapid increase of populations in city areas in South Asian countries. Among them, specifically Bangladesh, India, Sri Lanka, Afghanistan, Nepal, Maldives, and Bhutan, nowadays, face a significant transport and mobility challenge (Jain, 2013).

Dhaka is among the most densely populated countries developing states in South Asia which offers a very inefficient, nonproductive, unsafe, insufficient, and overcrowded public transit service (Rahman, 2010). With the growth of the city, a significant lack has been seen between the availability of public transport and demand (Rahman and Nahrin, 2012). Unfortunately, the status of bus services cannot fulfill the demand of mobility for the population (Gallagher, 2016).

People's travel pattern and transport policies have strong impressions upon the social, economic, and environmental development of a country. Because of a wider variety of social classes, cultural backgrounds and economic situations in developing countries’ urban context; for example, male and female members from the same household has different travel patterns (Peters, 2001). Travel behaviors of the people are affected by the choice of residential location (Choocharukul et al., 2008). Gwilliam (2003) stated that the risk awareness also affects travel patterns.

Women's travel patterns in the Global South are characterized by accelerating changes in mobility patterns and gender gaps that narrow as income rises (Rosenbloom and Plessis-Fraissard, 2009), whereas women in developed countries have significant automobility, but the gender gap in licensing and vehicle use persists. Working women's travel patterns are more complex than men's in both developed and developing nations, because they are involved not only in outside jobs but also in family duties (Duchene, 2011; Turner and Grieco, 2000). Because of their dual obligations, they travel more frequently than working men to perform various domestic responsibilities such as childcare and transporting parents to doctors or health care facilities, shopping, visiting relatives, and so on (Anand & Tiwari, 2006; Wachs, 2009; Hjorthol, 2008; Rosenbloom and Plessis- Fraissard, 2009).

Though Bangladesh is a conservative country from the viewpoints of social structure and religious norms, at present the majority of women of this country have a notable presence in the social, economic, educational, political and cultural sectors (Islam et al., 2016). The participation of women in economic activities creates mobility and transportation demands for accessibility. Though public transport is not gender sensitive considering societal culture and religious norms, inappropriate policies and investment make a distinction in accessibility needs of women (Sen, 2016). Besides, women in Dhaka city face some cultural constraints in accessing public transport due to social seclusion (Peters, 1999). Moreover, public transport environment is not comfortable for women commuters because of over-crowdedness (Rahman, 2010). Women frequently face the danger of physical touching or harassment and discourteous behavior from bus staffs (i.e., helpers, conductors, drivers and/or ticket inspectors) and from other male passengers (Rahman, 2010; Islam et al., 2016). Specially in Dhaka city, eve teasing and harassing women in crowded buses has become very common and even female passengers face difficulty getting in and out of the bus during rushes as they cannot compete with male commuters (Rahman, 2010; Jain, 2013; Zohir, 2003). Rahman (2010) also revealed that most of the drivers are reluctant to take women as passengers because they move slowly, has many security issues and taking large space. Even the bus staffs often announce ‘no seats are available for women’ to avoid women commuters. Therefore, the regular female passengers always need to show a rigorous appearance and uphold a sharp tongue for finding a bus with a comfortable seat safe from all kinds of unpleasant circumstances (Khan and Chakma, 2015).

Women, irrespective of their pecuniary development, have less access to better or faster transportation means, exhibit diverse and more complex travel patterns than men. Recently, the women mobility issues have got importance in light of huge involvement of

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women in employment sector as they have to rely more on public bus which is not even safe for them (Sham et al., 2012).

Over the last two decades, the researchers have been giving attention to identify the relationship between the SQ of transit system and people's accessibility (Minocha et al., 2008). Several studies about public bus service quality have been conducted but the gender dimension has not been considered (Andreassen, 1995; Eboli & Mazzulla, 2007; Edvarsson, 1998; Fellesson and Margareta, 2008; Friman and Gärling, 2001; Peters, 200l). Research works on public bus service quality considering gender aspects in developing countries (i.e. Bangladesh, Pakisthan and India) is less extensive than in developed countries (Peters, 200l). The main goal of this study is to assess SQ of bus transit based on women's perception in Bangladesh by evaluating different empirical models. Apart from this, the study also attempts to address problems faced by the women bus commuters and provide some recommendations in order to improve the existing condition of bus service in Bangladesh.

Public bus transport is one of the most important areas of transportation. Several previous studies regarding public bus transport service focused on efficiency, productivity, financial viability, demand, pricing, impact on congestion, restructuring, carbon dioxide emissions, air pollution and so on (Singh, 2002; Tiwari, 2002; Deb and Sundar, 2002; Pucher et al., 2004; Singh, 2015; Badami and Haider, 2007; Pucher et al., 2007; Schipper et al., 2009; Singh, 2012; Singh, 2014).

Several models have been employed to assess bus service quality. SERVQUAL model, developed by Parasuraman et al. (1988), is a method of evaluating service quality experienced by customers. It gives a subjective measure of the difference between expectations and perceptions regarding five service quality dimensions (i.e. tangible, reliability, assurance, empathy, and responsiveness) which are common to all services (Zeithaml et al., 1986; Hartikainen et al., (2004); Akan (1995). However, this model has been widely applied in several contexts across different sectors to measure customer satisfaction, for example, in the area of hotels, travel agencies and clubs (Cronin and Taylor, 1992; Knutson et al., 1990), food and beverage establishments (Stevens et al., 1995), airlines (Petrick, 2002), online-based shopping (Yoo ancl Donthu, 2001), educational services (Toncar et al.,2006), electronic services (Parasuraman et al., 2005), library (cook et al., 2001), legendary houses (Frochot and Hughes, 2000) and in the field of ecotourism (Khan, 2003).

RECSA model, developed McKnight et al. (1986), is delineated from reliability, extent of service, comfort, safety, and affordability. They suggested that service quality dimensions should be considered as the sum of general attributes. However, to measure service quality in the context of the passenger transport, a different approach and some attributes are required. Some attributes may be delays on routes, personal security, traffic safety, frequency of service, directness of service, ride comfort, noisiness, availability of seats, temperature control, crowdedness, availability of service, sheltered waiting areas and walking distances to vehicles (McKnight et al., 1986).

Structural Equation Model (SEM), developed by Wright (1921), is a casual modeling which includes a different set of mathematical models, statistical methods and computer algorithms that fit networks of constructs to data (Kaplan, 2008). SEM includes confirmatory composite analysis, confirmatory factor analysis, path analysis, partial least squares path modeling and latent growth modeling. It introduces exogenous, endogenous and latent variables to assess unobservable 'latent' constructs. It is usually applied in several areas of research. Some examples are in the areas of natural science (Grace and Pugesek 1997; Mitchell 1992), psychology and social science (Muthén et al. 2006; MacCallum and Austin, 2000), in the field of economics and statistics (Boari, 2000; Eskildsen and Dahlgaard, 2000) and especially in the field of public transport (Rahman et al. 2016; Hadiuzzaman et al. 2017; Fillone et al. 2005; Bamberg and Schmidt 1998; Tam et al. 2005). SEM has major three advantages over traditional multivariate techniques. SEM models estimate parameters of measurement error variance for both dependent and independent variables (Byrne, 2011). Thus, measurement error can be reduced. Besides, SEM permits the estimation of latent variables (unobserved variables) from observed variables; thus, the creation of composites considers measurement error. Finally, fully developed models may be tested against the data using SEM as a conceptual or theoretical structure or model can be evaluated for sample data fit. Therefore, SEM has been used in this study to get good findings.

The remaining parts of this paper are formulated as follows. Part 2 shows the related previous literature regarding this research. Part 3 explains detailed methodology of this research. Part 4 presents the model findings and the final part of this analysis concludes with important findings and provides potential suggestions for further studies and references.

2. METHODOLOGY

2.1 Experimental context

In this study, a two-tread methodology has been used. The initial part introduces data collection method which incorporates a purpose-built Stated Preference (SP) questionnaire survey. To highlight the difficulties in delivering the necessary information to passengers, a pilot survey was conducted. Afterwards, the questionnaire survey was concluded considering requisite correction found in the pilot survey. The second part introduces development of a set of SE models. These models are developed to examine the comprehensive relationships between the overall SQ of buses and the selected SQ variables. Each empirical model was developed following the trial and error approach in terms of accommodating different variables and evaluating the overall goodness of fit values of the respective models. To test parameter estimation, a two-tailed t-test was employed. In this case, a critical value of 1.64 for a confidence level of 90% was envisaged as the threshold for the identification of the relevant parameters. Finally, comparing all the empirical models, the best one, which is the most revelatory to the real life was selected.

2.2 Variables used in SE models

To develop different SEMs, a total of twenty-six Service Quality (SQ) variables are employed. Among them, twenty-two are observed and the rest four are unobserved variables (latent variables). These variables have been chosen from reviewing related literature on SQ analysis, expert counsel of academicians, and focus group discussion (FGD) with bus users, drivers and policy makers (e.g. Dhaka Transport Coordination Authority and Bangladesh Road Transport Authority).

2.3 Sample

The SP questionnaire for collecting data was divided into two sections. The first section aims to acquire demographic information of users. The second section concentrate on twenty-two SQ variables given in a close-ended pattern. For better understanding of the users, both qualitative and numerical scales have been used in the questionnaire. A summary of the descriptive statistics of the collected data is shown in Table 1.

Structural Equation Model (SEM) is a large sample technique. In this case, the sample size is usually larger than 200 (Lei and Wu, 2007). Nonetheless, the required sample size depends on the model complexity and the distributional characteristics of observed variables.

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In this study, the initial target regarding the sample size was 1000 but due to user's reluctance for participation in survey and rush hour movements, the actual sample size is restricted to 663. The survey was conducted at twelve major bus stands of Dhaka city. Among the 663 women bus commuters, 2% stated the overall SQ represented by the convenience of bus service, as 'Excellent', 5% stated it as 'Very good', 32% as 'Good', 42% as 'Poor' and the rest 19% stated it as 'Very Poor.'

Table 1. Summary Statistics of variables

Item no	Variables	Mean	Standard deviation	Numerical scale	Qualitative scale
1	Fitness of bus	3.78	0.864	1-5	Excellent to very poor
2	Transport cost	3.35	1.00	1-5	Costly to cheap
3	Security of passengers during off peak period	3.75	0.907	1-5	Excellent to very poor
4	Punctuality of bus	3.84	0.897	1-5	Precisely punctual to delayed
5	Condition of bus stand	3.86	0.932	1-5	Excellent to very poor
6	Convenience of Service	3.72	0.882	1-5	,,
7	Driver safety (Driver skill)	3.90	0.941	1-5	,,
8	Accessibility of bus stand	3.64	0.905	1-5	,,
9	Frequency of service	3.55	0.871	1-5	,,
10	Availability of information	3.83	0.888	1-5	,,
11	Lighting facility	3.45	0.828	1-5	,,
12	Noise level	3.76	0.862	1-5	Noiseless to very noisy
13	Ticketing system	3.63	0.972	1-5	Excellent to very poor
14	Physical condition	3.95	0.884	1-5	,,
15	Courtesy of Helpers/ Conductor	3.87	0.920	1-5	,,
16	Security in bus stand	3.89	0.897	1-5	,,
17	Safety at bus stand	3.82	0.838	1-5	,,
18	Seat condition	3.82	0.880	1-5	,,
19	Cleanliness of bus	3.68	0.809	1-5	,,
20	Speed of bus	3.73	0.914	1-5	,,
21	Personal safety	3.82	0.930	1-5	,,
22	Travel time (during holidays)	3.34	0.955	1-5	Precisely accurate to very inaccurate
23	Travel time (during office days)	4.17	0.881	1-5	,,

3. PROPOSED STRUCTURAL EQUATION MODELS

To develop the proposed structural models, the following common notations have been used in this study:

C = Convenience of the Bus Service

Y = Endogenous variables

x = Exogenous variables

λ, Γ = Parameters of Y and x respectively

Δ, ε = Measurement Errors in C and *Y* respectively

γ, α = Parameters of L when affects y and *Y* respectively

L = Latent variables

ρ= Measurement errors in y

λ_0 = Constant variable

Model 1 (M_1): In this model, four endogenous variables and 18 exogenous variables are employed to examine the Service Quality (SQ) of buses, represented by convenience of the Bus service, in Dhaka city. The structure of the model 1 (M_1) is shown in the Figure 1. The model 1 (M_1) can be expressed with help of the following equation:

$$C= \lambda_0 + \lambda Y + \delta \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y = \Gamma x + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

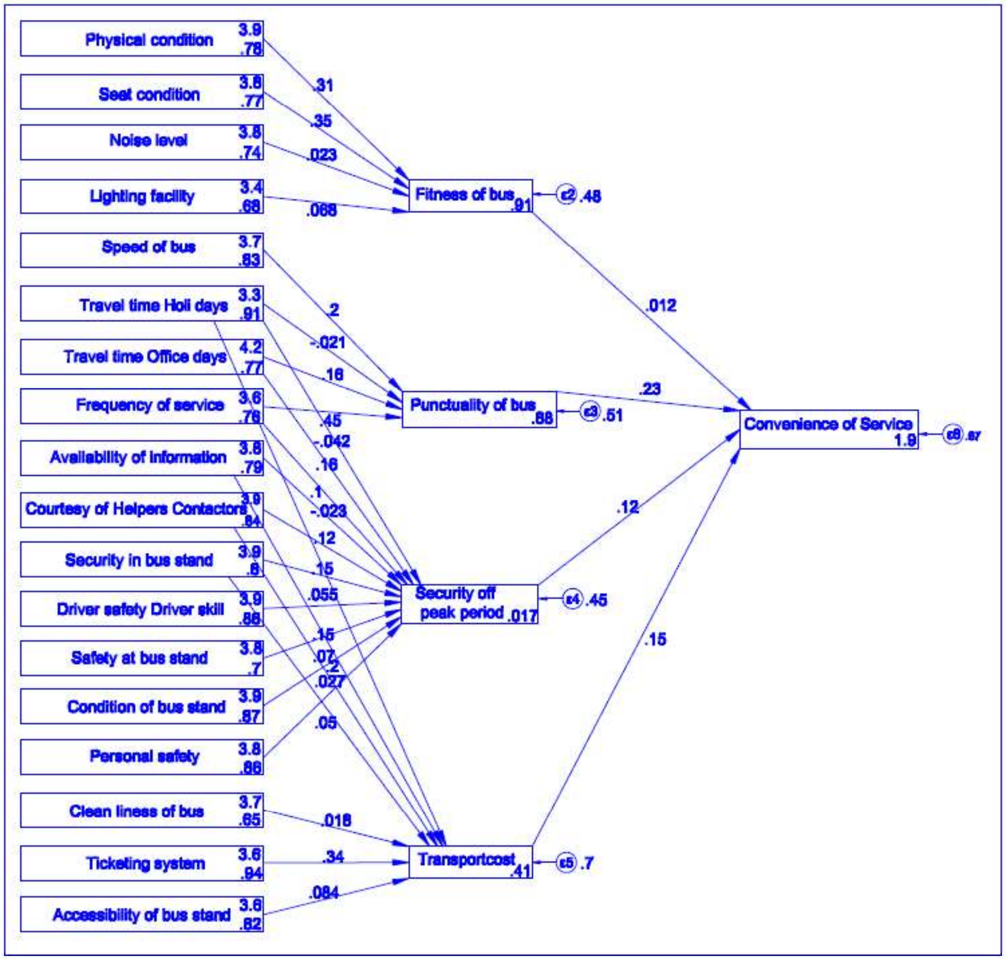

Figure 1. Path diagram of M_1

Model 2 (M_2): This model is developed with twenty-two endogenous variables and one latent variable represented by System Performance (L_1) to examine the convenience of the bus Service. The organization of M_2 is represented in Figure 2. Mathematically, the model can be expressed as follows:

$$C = \lambda_0 + \lambda Y + \delta \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$Y = \alpha L + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$L = \frac{y - \rho}{\gamma} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

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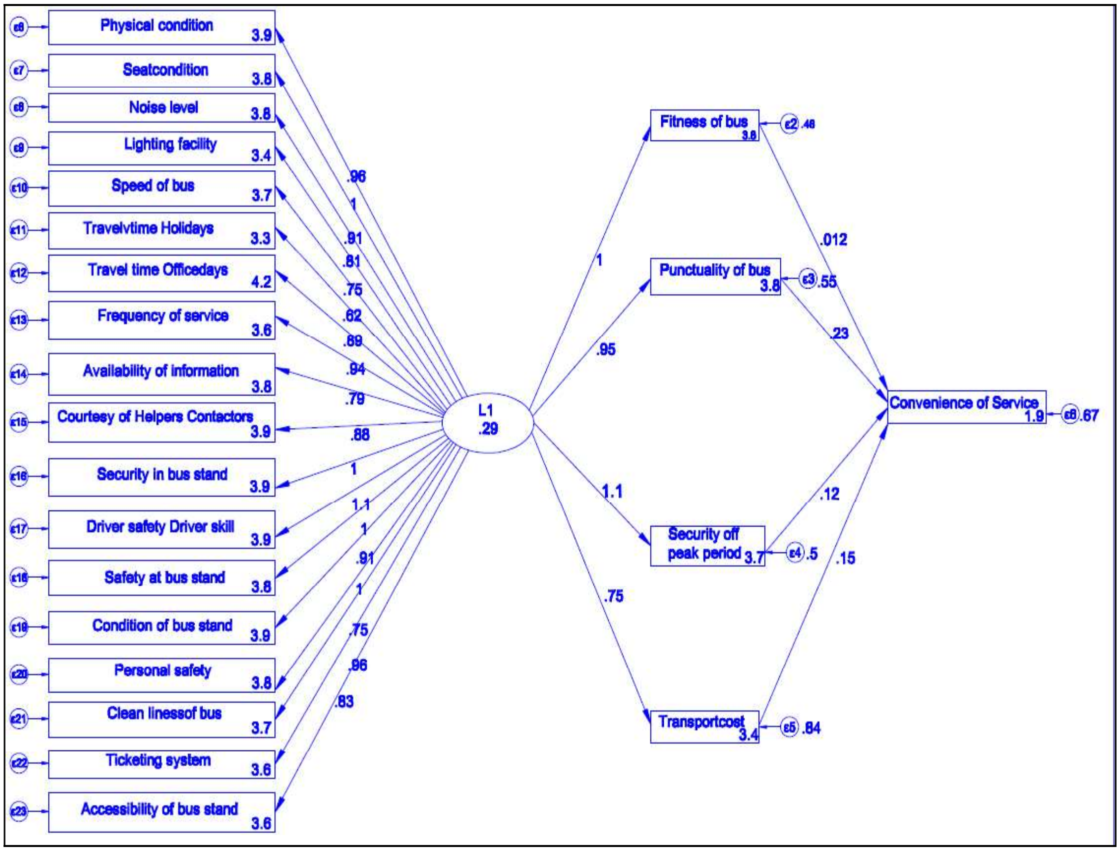

Figure 2. Path diagram of M_2

Model 3 (M_3): M3 is developed with twenty-two endogenous variables and two latent variables namely Physical Appearance and Service Features to examine the convenience of the bus service. The endogenous variables calibrate the latent variables. The organization of M_3 is represented in Figure 3. The following equation can be written from the structure of M_3:

$C= \lambda_0 + \lambda Y + \delta$ …………………. (6)

$Y= \alpha L + \varepsilon$ ……………………….. .(7)

$Y = \gamma L + \rho$……………………… (8)

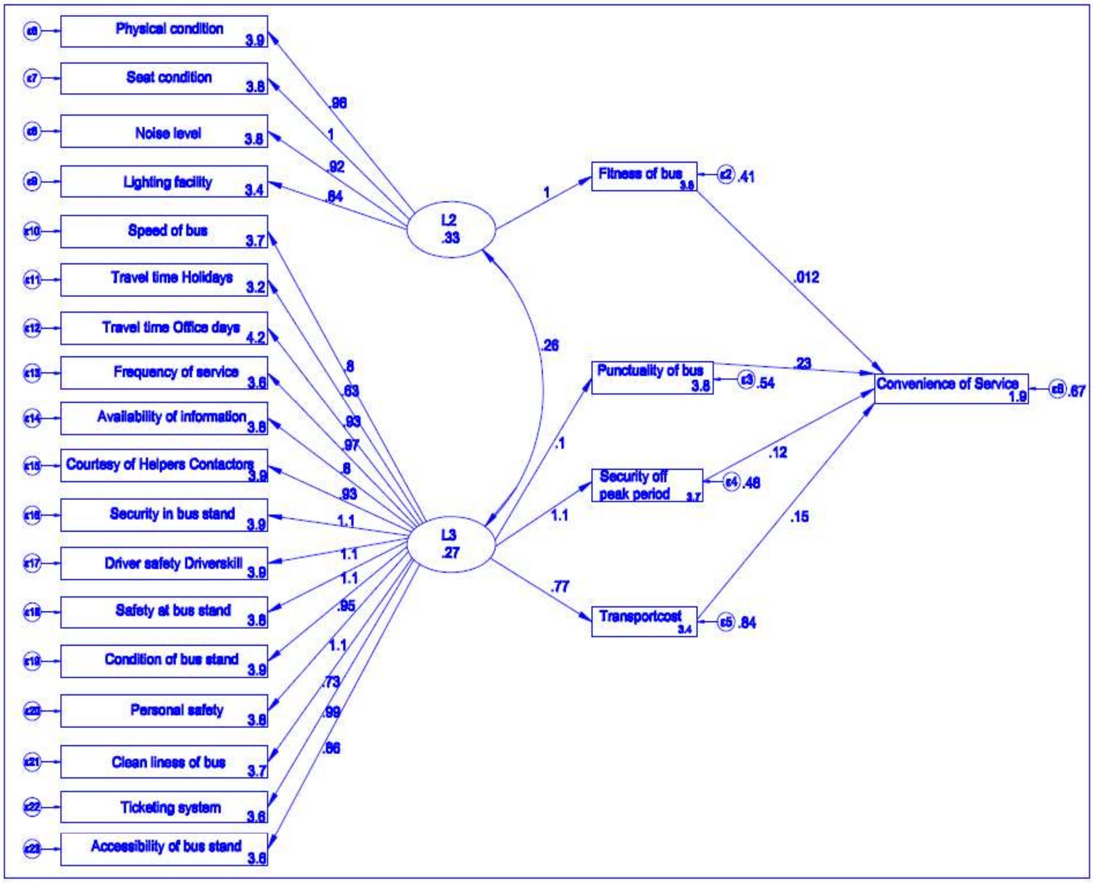

Figure 3. Path diagram of M_3

Model 4 (M_4): M_4 is developed with three latent variables (Physical Appearance, Safety and Security, and Service Feature represented by L2, L3 and L4 respectively) connected with twenty-two endogenous variables. The organization of M_4 is represented in Figure 4. The following equation can be written from the structure of M_4:

$C = \lambda_0 + \mu L + \delta$ ……………… (9)

$L = \frac{y - \rho}{\gamma}$………………………(10)

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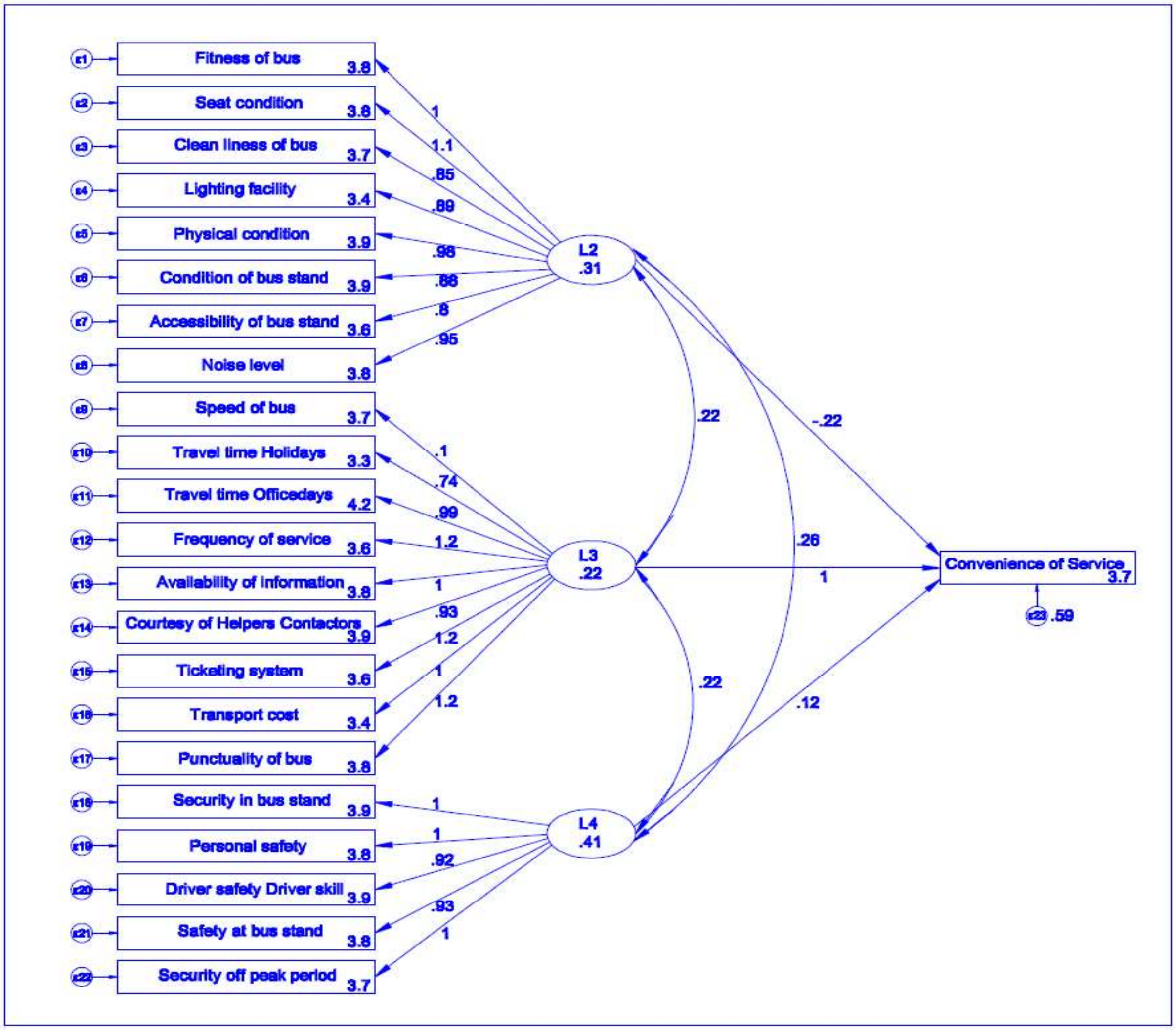

Figure 4. Path diagram of M_4

4. EMPIRICAL RESULTS

To examine the accuracy of the measurement procedure reliability test is conducted. One of the most widely used reliability coefficient is the Cronbach's alpha coefficient. This alpha is usually used to examine the internal consistency of the total variables included in the study. In this study, the value of the Cronbach's Alpha is .95 which is greater than the acceptable limit of 0.6 proposed by Byrne's (2010). Thus, it is concluded that the entire feature included here are adequately constant.

Four different models (M_1, M_2, M_3 and M_4) have been developed to examine the relationships between the overall bus service quality and different exogenous, endogenous and latent variables. The aim is to identify which parameters represent the main SQ aspects. The parameter values of exogenous, endogenous and latent variables used to construct the models are shown in Table 2. To determine the significant variables from the parameter values a two-tailed t-test having critical value of 1.64 for the confidence level of 90% is used. Finally, in order to identify the optimal one, all the developed models are compared to each other. The optimal model usually represents the actual scenario.

Table 2. Estimated Parameters Values of SEMs

Serial no.	Description	M_1	M_2	M_3	M_4
1	Fitness of bus	0.012^{s} (0.77)	0.022^{s} (0.77)	0.031^{s} (0.77)	1.000^{s} (0.00)
2	Punctuality of bus	0.226^{s} (0.00)	0.226^{s} (0.00)	0.226^{s} (0.00)	1.195^{s} (0.00)
3	Security of passengers during off peak period	0.121^{s} (0.003)	0.121^{s} (0.003)	0.121^{s} (0.003)	0.999^{s} (0.00)
4	Transport cost	0.147^{s} (0.00)	0.147^{s} (0.00)	0.147^{s} (0.00)	1.034^{s} (0.00)
5	Accessibility of bus stand	0.084^{a} (0.04)	0.826^{s} (0.00)	0.861^{s} (0.00)	0.803^{s} (0.00)
6	Availability of information	-0.023^{z} (0.48) 0.200^{a} (0.00)	0.787^{s} (0.00)	0.803^{s} (0.00)	1.034^{s} (0.00)
7	Cleanliness of bus	0.018^{a} (0.68)	0.750^{s} (0.00)	0.727^{s} (0.00)	0.845^{s} (0.00)
8	Condition of bus stand	0.070^{z} (0.03)	0.915^{s} (0.00)	0.948^{s} (0.00)	0.878^{s} (0.00)
9	Courtesy of helpers/ conductors	0.123^{z} (0.0300) 0.027^{a} (0.50)	0.880^{s} (0.00)	0.925^{s} (0.00)	$.929^{s}$ (0.00)
10	Driver safety	0.055^{z} (0.12)	1.067^{s} (0.00)	1.137^{s} (0.00)	0.918^{s} (0.00)
11	Frequency of service	0.449^{y} (0.00) 0.102^{z} (0.004)	0.940^{s} (0.00)	0.966^{s} (0.00)	1.193^{s} (0.00)
12	Lighting facility	0.068^{x} (0.09)	0.813^{s} (0.00)	0.841^{s} (0.00)	0.893^{s} (0.00)
13	Noise level	0.023^{x} (0.55)	0.913^{s} (0.00)	0.920^{s} (0.00)	0.945^{s} (0.00)
14	Personal safety	0.2199^{z} (0.00)	1.035^{s} (0.00)	1.097^{s} (0.00)	1.039^{s} (0.00)
15	Physical condition	0.307^{x} (0.00)	0.960^{s} (0.00)	0.957^{s} (0.00)	0.981^{s} (0.00)
16	Safety at bus stand	0.149^{z} (0.00)	1.046^{s} (0.00)	1.097^{s} (0.00)	0.929^{s} (0.00)
17	Seat condition	0.350^{x} (0.00)	1.040^{s} (0.00)	1.036^{s} (0.00)	1.064^{s} (0.00)
18	Security in bus stand	0.146^{z} (0.00) -0.050^{a} (0.22)	1.031^{s} (0.00)	1.093^{s} (0.00)	1.000^{s} (0.00)
19	Speed of bus	0.203^{y} (0.00)	0.755^{s} (0.00)	0.801^{s} (0.00)	1.011^{s} (0.00)
20	Ticketing system	0.341^{a} (0.00)	0.961^{s} (0.00)	0.988^{s} (0.00)	1.191^{s} (0.00)
21	Travel time (during office day)	0.162^{y} (0.00) 0.158^{z} (0.00)	0.894^{s} (0.00)	0.931^{s} (0.00)	$.990^{s}$ (0.00)
22	Travel time (during holidays)	-0.021^{y} (0.49) -0.042^{z} (0.14) 0.199^{a} (0.00)	0.624^{s} (0.00)	0.626^{s} (0.00)	$.743^{s}$ (0.00)
23	System Performance		1^{x} 0.95^{y} 1.1^{z} 0.75^{a}		
24	Physical Appearance			01^{x}	-.22
25	Service Features			01^{y} 1.1^{z} 0.77^{a}	1
26	Safety and Security				.12

p- values are shown within first braces.

x influences 'Fitness of the bus'

y influences 'Punctuality'

z influences 'Security of passengers during off peak period'

a influences 'Travel Cost'

s indicates 'Endogenous Variables'

t indicates 'Exogenous Variable

A number of goodness-of-fit indices are used to compare the initial candidate model with others. Hooper et al. (2008) provided guidelines regarding absolute, incremental and parsimony indices for determining model fit. They also suggested that acceptable threshold limits for each of these indices. Absolute fit indices tell how well a particular model fits the sample data and allow the model to be chosen with greater fitness. It includes Root Mean Square Error of Approximation

(RMSEA), Standardized Root Mean Square Residual (SRMR), the root mean square residual and the chi-squared test. Incremental fit indices refer to a group of indices which is used to compare the chi-square value with a base line model for rejecting the null hypothesis implying that all variables are uncorrelated (Marsh et al., 1996). It includes Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI). In this study, RMSEA, SRMR, CFI and TLI have been employed to check model fitness. Table 3 represents the values of RMSEA, SRMR, CFI and TLI of the four different developed models.

Table 3. Fit Indices of the Models

Fit indies	M_1	M_2	M_3	M_4	Ideal range
Absolute fit indices					
Root Mean Squared Error of Approximation (RMSEA)	0.081	0.094	0.091	0.08	.05-0.10
Standardized Root Mean Square Residual (SRMR)	0.046	0.075	0.074	0.066	<.08
Incremental Fit Indices					
Comparative Fit Indices (CFI)	0.810	0.743	0.757	0.813	>0.95
Tucker-Lewis index (TLI)	0.732	0.713	0.728	0.790	>0.95

M_1 is developed without any latent variable. In this model, 'Fitness of the bus', 'Punctuality', 'Security of passengers during off peak period' and 'Travel cost' have been used as endogenous variables. All endogenous variables are linked with eighteen exogenous variables. 'Fitness of the bus' is linked with 'Physical condition', 'Seat condition', 'Noise level' and 'Lighting facility' while 'Punctuality' is linked with 'Speed of bus', 'Travel time (during holidays)', 'Travel time (during office days)' and 'Frequency of service' whereas 'Security of passengers during off peak period' is connected with 'Travel time (during holidays)', 'Travel time (during office days)', 'Frequency of service', 'Availability of information', 'Courtesy of helpers', 'Security in bus stand', ;'Driver skill', 'Safety at bus stand', 'Condition of bus stand' and 'Personal safety'. 'Travel Cost' is connected with 'Travel time (during holidays)', 'Availability of information', 'Courtesy of helpers', 'Security in bus stand', 'Cleanliness of bus', 'Ticketing system' and 'Accessibility of bus stand'.

In M_1 'Fitness of the bus' (0.012) represents the physical appearance of bus which is explained by the above mentioned four exogenous variables. The rest of the three endogenous variables namely 'Punctuality' (0.23), 'Security of passengers during off peak period' (0.12), and 'Travel Cost' (0.15) shows the service features provided by bus which are explained by the remaining thirteen exogenous variables (see Figure 1). The relationship between exogenous and endogenous variables is established by trial and error method.

The result of M_1 represents some negative feeling of users' about 'Availability of information' (-0.023), 'Security in bus stand' (-0.05), and 'Travel time during holidays' (-0.02) which have negative impact on 'security off peak period', 'Transport Cost' and 'punctuality' respectively. The values of RMSEA, SRMR, CFI and TLI are 0.081, 0.046, 0.810, and 0.732 respectively in M_1.

In M_2, System Performance is used as a latent variable. System performance is defined as all the performance quality of the bus. Four endogenous variables (i.e. 'Fitness of the Bus', 'Punctuality', 'Security off peak period', and 'Travel Cost') are employed to construct the model which rely on 'System Performance'.

According to the result of the M_3 (shown in table 3), all the variables have positive impact on the bus service quality and bearing value in the range of .5 to 1.1. Table 3 shows the fit indices of this model. From the result of absolute fit indices, the value of RMSEA is 0.094 which lies in the ideal range of .05-0.10. The value of SRMR is 0.075 which satisfies the ideal range (<.08). In case of incremental fit indices, the value of CFI is 0.74 which is close to the ideal range (shown in table 3) while the value of TLI is 0.713 which is also close to the ideal range.

M_3 is developed to reduce the limitation of model M_1 and M_2 where two latent variables (i.e. 'Physical Appearance' and 'Service Feature') is used. Each latent variable is calibrated by a number of endogenous variables which depend on the various endogenous variables. However, 'Physical Appearance' is calibrated by an endogenous variable (i.e. Fitness of the Bus) which depends on four endogenous variables (i.e. physical condition, Seat Comfort, Noise Level and Lighting Facility) while 'Service Feature' is calibrated by three endogenous variables (i.e. Punctuality, Security off peak Period and Travel Cost) which depend on the remaining fourteen endogenous variables.

The result of M_3 shows that the coefficient value of all the variables is positive (.5 to 1.5) signifying that all have positive influence on the 'Convenience of the bus service'. The result of fit indices of the model is shown in table 3. In case of absolute fit index, the value of RMSEA is 0.091 which lies in the ideal range (.05-0.10). The value of SRMR is 0.074 which satisfies the ideal range (<.08). In case of incremental fit indices, the value of CFI is 0.757 which is close to the ideal range (shown in table 3) while the value of TLI is 0.728 which is also close to the ideal range.

In M_4, three latent variables (i.e., 'Physical Appearance', 'Service Feature', and 'Safety and Security') are employed. These latent variables are calibrated by twenty-two endogenous various. Summery result of M_4 is shown in table 3. The result shows that the coefficient value of all the variables is positive which lies between 0.5 and 1.2; thus, all the variables have positive impact on the convenience of the bus service. The coefficient value of 'Punctuality of bus' (1.195) indicates that the it has statistically significant positive impact on the convenience of the bus service. Women value time more than men since their comprehensive responsibilities (Riverson et al., 2006). Punctual bus service ensures commuters to arrive at their destination in proper time and thereby affect the bus service quality positively. Similarly, 'Frequency of Service' (1.193) affects the bus service quality in Dhaka city positively. The coefficient value of 'Ticketing System' is 1.191 inferring that it affects bus service quality positively. Automated ticketing system is especially very essential for women commuters for ensuring convenient bus service. Besides, good Seat condition (1.064) ensures comfort and safe bus journey and thereby affects the bus service quality positively. The others significant factors are 'Personal safety' (1.039), 'Transport cost' (1.034), 'Availability of information' (1.034), 'Speed of bus' (1.011), 'Fitness of bus' (1.00) and 'Security in bus stand' (1.00).

The coefficient value of latent variable 'Physical Appearances' is -.22 while the coefficient values of 'Service Features' and 'Safety and Security' are 1.0 and .12 respectively while 'Physical appearance' has negative coefficient value. Thus, it is concluded that service quality (SQ), represented by convenience of the bus service, is not affected by physical appearance considering the women commuters' perception in Dhaka city.

The result of fit indices of M_4 is shown in table 3. In case of absolute fit index, the value RMSEA is 0.08 which lies in the ideal range (.05-0.10) while the value of SRMR is 0.066 which satisfies the ideal range (<.08). In case of incremental fit indices, the value of CFI is 0.813 which is close to the ideal range while the value of TLI is 0.790 which is also close to the ideal range. Thus, the structure of M_4 appears to be the best choice to perceive the bus SQ.

5. CONCLUSIONS

This study examined the relationships between bus service quality and several service attributes of bus transit in Dhaka city, Bangladesh based on women's perception. SEM, a sophisticated technique, is used in this study which introduces endogenous, exogenous and latent variables. Four different structural equation models have been developed to identify the factors affecting overall bus SQ. Among these four different models, the best one (M_4) is chosen comprehending statistical parameters (RMSEA = 0.08, SRMR = 0.066, CFI = 00.813, TLI = .790; Table 3) which is similar to real life expectations. In M_4, three latent variables namely 'System Performance', 'Physical Appearance' and 'Service Features' are employed. According to the findings of the M_4, the most statistically significant factor affecting the bus SQ in Dhaka city is 'Punctuality of bus'. Punctuality of bus service ensures women commuters to arrive at their destination in desired time and thereby affect the bus service quality positively. Results also revealed that 'Frequency of service' and 'Ticketing system' have significant impact on the bus SQ.

The issues faced by women passengers are poor seat condition; poor physical fitness of the buses; poor safety condition at bus stand; lack of proper ticket counters or representatives; no display of chart or schedule at the bus stops; inadequate designated seats for women commuters; bad attitudes of the helpers, conductors, drivers and/or male passengers toward women passengers; dirty and untidy environment inside the bus; lack of security of the women commuters during off-peak period; and high noise level. In order to improve the bus service comfortable to the users, some suggestions have been drawn that were emphasized by the respondents during the survey. First of all, a properly maintained bus schedule should be displayed at each bus stop. All bus operators should have their ticket counters at bus stoppages. Advance ticketing facilities could also be introduced. Bus staffs (helpers, conductors and drivers) should be trained up properly about how to deal with women commuters. Seat condition and other physical fitness of the buses should be improved. Security and safety condition at bus stand should be improved. The findings of this study will be useful to policy maker, public transport operators and involved officials for improving the public bus transport sector.

In Bangladesh, gender-related transportation research is understudied. Nonetheless, this study has several limitations that must be addressed. A quantitative study was conducted that required questionnaire survey data of a significant number of samples being a challenge. Furthermore, the research was limited to Dhaka. Aside from that, the study's scope is confined to young educated female passengers (ages 20 to 40). Aside from that, the study focuses solely on passengers, excluding bus operators and other stakeholders involved in delivering public bus services (drivers, conductors, stop attendants, and so on), regulatory agencies, and government policymakers.

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