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Identifying paratransit service quality based on low-income working women's perception: A case study in Dhaka city by Structure Equation Model (SEM)

Dr. Farzana Rahman[a,*] and Md. Ariful Islam[b]

[a,*] *Professor, Department of Civil Engineering, University of Asia Pacific, Dhaka-1205, Bangladesh*
[b] *Graduate Research Assistant, Department of Civil Engineering, University of Asia Pacific, Dhaka-1205, Bangladesh*

Abstract

In this study Structure Equation Model (SEM) was used to capture the service quality of paratransit from low-income working women's perception who habitually use urban paratransit modes getting to and from the workplace in Dhaka city, Bangladesh. Achieving the study objective, a questionnaire survey was conducted on existing paratransit routes connecting slum areas of Jhauchor and Kamrangichor areas where no bus service is available. Total 410 regular paratransit users of different profession participated in the survey in July 2017. The respondents were asked about 22 service attributes with their socioeconomic characteristics i.e. their monthly income, travel cost, origin, destination and the overall satisfaction on present service condition. To evaluate the paratransit service quality the passengers were asked to rate their perception on a five point likert scale. A series of SE models are developed to identify the relationships between the overall paratransit SQ and different endogenous, exogenous and latent variables. Among the different models developed, the best one is selected using statistical parameters and consistency with real life expectations. Out of twenty-two SQ variables, 'Riding safety', 'Cleanliness of paratransit', 'Ticketing system', 'Security of passengers', 'Movement flexibility in any road' 'Lighting facilities', 'Movement flexibility inside the paratransit' and 'Seat comfort level' are found to be the observed variables having greatest influence on the paratransit SQ. The findings of this research may be help by operators and policy-makers to formulate strategies for improvement of urban paratransit service quality for low-income working womens.

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Keywords: Paratransit service quality, low-income working womens perception, Structural Equation Model

1. Introduction

Dhaka, the capital city of Bangladesh is one of the most densely populated cities having a population of over 18 million as of 2016 (world population review.com., 2016) with the highest growth rate in the world. More than 4 million people in Dhaka live in slums and resident settlements without secure residence and under frequent threat of expulsion. Dhaka covers more than 105 million people within an area of only 1463.60 square km, and half of the

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dwellers are women (Bangladesh National Portal, 2016). As urbanization changes the face of poverty in Bangladesh, widespread insecurities within the urban environment force low-income households to deploy new strategies of labor mobilization that challenge the women to take part in family wages. According to Moon and Miah (2017) the women in respect of financial support contributed 40 percent to 58 percent of their income to the family expenses. The income thresholds are (defined as those with a GNI per capita): low income-$1,025 or less; lower middle income-$1,026 to $4035; upper middle income-$4036 to $12,475; and high income-$12,476 or more (World Bank, 2012). According to (Bangladesh Labour Foundation BLF, 2018) low-income mainly include garments, textile, domestic worker, street vendors, agricultural workers, waste pickers, retail, logistics, jute and cotton, leather and shoe, handloom, ship breaking, security, day labor and so on.

The number of domestic workers in Bangladesh is about 2 million, out of which 83% are female workers (according to last quantitative research carried out on domestic workers in Bangladesh in 2007 by ILO and UNICEF, The daily independent, 21 March 2016). Ready Made Garment (RMG) industry of Bangladesh is the highest export earning sector and is the second largest exporter of RMG in the world after China (Ali, 2017). About 4.2 million workers (BGMEA, 2017) are employed in this sector; approximately 80% of whom are women (Worldbank, 2017). Walking serves the highest percentage of trips in slum areas where incomes are lower, trip distances are shorter, and public transport is not available while longer distances are served by bus or paratransit. Women prefer to choose Rickshaw (non-motorized vehicle) due to its availability although it takes more time for commuting than bus (Islam et al. 2016). However, Rickshaw has only access to certain community or region and a bit expensive compared to other motorized public transport.

Among different public transportation modes, paratransit has become a vital mobility option in many developing countries by filling in gaps left unserved by public transit systems and providing efficient feeder connections. Paratransit offers several advantages compared to other public transport modes, such as high accessibility and mobility, more beneficial operating cost for short trips, easy and unimpeded lane movement and relatively low maintenance costs (DLLAJ, 2001). Paratransit modes are best in meeting the transport requirements of the low-income people in terms of fares and flexibility in developing countries (Kaltheier, 2002). This mode is contributing only 18% of traffic flow while being able to transport more than 50% of passenger trips. In Dhaka, it is found that around 72% households use paratransit for their daily travel (Shimazaki and Rahman, 2002). Paratransit is an indispensable mode of public transport in developing countries, where mass transit systems are inadequate. Paratransit provides personalized and flexible transport services, filling service gaps between private transport modes and mass transit systems (Roos and Alschuler, 1975). It assists socioeconomic activity through its availability and by providing employment opportunities for poor and low-skilled workers (Cervero and Golub, 2007).

In developing countries, it is necessary to satisfy the mobility needs with sufficient capacity while quality is constrained by various issues. Paratransit plays a vital role among the different public transportation modes available in developing cities, especially where mass transit system is insufficient. In many cities, more than half of the total public transportation demands are carried by them (Joewono and Kubota, 2005). Paratransit modes are usually demand responsive and provide shared trips. Their services may differ considerably on the degree of flexibility they provide to their users. Most popular individual type of motorized paratransit has various local names in different countries such as ‘tempo’ in Bangladesh, ‘becak’ in Indonesia, ‘jeepney’ in the Philippines, ‘tuktuk’ in Thailand, ‘mammy wagons’ and ‘matatu’ in Africa and ‘xiclos’ in Vietnam. To have a clear understanding of the types of vehicles used as a paratransit in Bangladesh, some photographs of usual vehicle of each group of paratransit are shown in Figure 1. Generally, these vehicles are based on three-wheeled scooter chassis; its seat arrangement is such that it can carry 10/12 persons at the back and two persons at the front, beside the driver. Most of these vehicles are indigenously manufactured to fit the market needs and are ill-equipped and non-standardized (Phun and Yai, 2016). Nevertheless, paratransit is highly popular in this country as it goes a long way to reduce the gap between demand and supply generated in response to the lack of mass transit systems. These vehicles usually run along a more or less defined route and then stop to pick up or discharge passengers upon their request. Dhaka city has 32 defined paratransit routes offering mobility to the users.

Zeithaml et al. (1990: 19) stated that service quality, as perceived by customers, can be defined as the extent of discrepancy between customers' expectations or desires and their perceptions. Service quality is measured from the customer's perspective as transit quality depends on passengers’ perceptions on each attribute characterizing the service. Asking customers to rate each attribute on an importance scale is the method mostly used by the operating companies. According to Gronroos (1993) the quality of a service, as perceived by the customer, is a result of a comparison between the expectations of the customer and his real-life experiences.

This study aims at finding the variables influencing the service quality (SQ) of paratransit based on low-income working womens perception. To this end, several empirical models are developed based on structural equation modeling (SEM) using a data set of paratransit users of Dhaka city. SEM is a powerful multivariate analysis technique, allowing the modeling of a phenomenon in which a set of relationships between observed and latent variables are established. To be specific, SEM is a combination of factor analysis and multiple regressions. SEM is adopted in various fields of research and generalized by Jöreskog (1973).

Fig. 1. (a) Auto Tempo; (b) CNG; (c) Rikshaw; (d) Leguna

The remaining sections of this paper are outlined as follows. Section 2 presents the previous studies on SQ evaluations and empirical models of public transportation including paratransit. Section 3 presents study location, sample size, selected SQ variables and proposed empirical models. Model findings and discussions are presented in Section 4. Section 5 includes major findings and provides recommendations for future research.

2. Literature

Delivering an attractive urban transport system is vital by providing public transportation services to meet users' travel demands and expectations. Public transportation enhances the quality of life in societies as it accomplishes a lot of functions for passengers having a direct bearing on the national economy (Henry and Litman, 2006) of a country. If public transportation is in general perceived to be good and cheap, it can suppress demand for private cars as shown by Cullinane (2002). Deng and Nelson (2010) further described that high quality of public transportation can greatly improve the accessibility of its catchment area by shortening time. Considering the current scenario of globalization, public transportation service needs introspective sensitivity towards the SQ offered (Randheer et al. 2011). According to de Oña et al. (2013) the analysis of SQ has become an issue of maximum importance in recent public transportation studies.

The primary objective of SQ analysis is to improve facilities such that user expectations and needs can be met as. Service quality (SQ) is perceived as an important determinant of users' demand (Prioni & Hensher, 2000) to identify importance of service features for users' satisfaction. According to Parasuraman et al, (1988) the feeling of satisfaction may depend on several factors like service quality, product quality, price, status and individual attributes. Service quality is a measure of how well the service level that is delivered matches customer expectations, while a firm delivering quality service means conforming to customer expectations on a consistent basis (Joewono and Kubota, 2007; Transportation Research Board, 1999, 2004; Lai and Chen, 2011). Service quality is an abstract concept that is hard to be defined, and in practice, often used interchangeably with satisfaction (Lai and Chen, 2011; Sumaedi et al. 2012). Berry et al. (1990) pointed out that 'customers are the sole judges of service quality'.

SEM methodology has been widely applied in several fields of research, and in recent years it has started to be most frequently used in the field of performance measurement in public transport. This is because SQ depends on a series of observed and unobserved variables. Stuart et al. (2000) analyzed the effect of customer satisfaction for the New York City subway system using SEM. Rahman et al. (2016) applied SEM to develop relationships between user satisfaction and several components of paratransit service quality. The analysis revealed that the latent variables 'Service Features' and 'Physical Appearance' related to the factors of 'Speed of paratransit', 'Punctuality and reliability', 'Riding safety', 'Travel cost', and 'Fitness of vehicle', had a major effect on user satisfaction. De Oña et al. (2013) showed that unobserved variables are commonly denominated dimensions which provide a better understanding of how customers perceive various service variables (by grouping them in a factor representing the variables similarly considered). They discovered that the latent construct 'Service', which was linked to observed variables like 'Frequency', 'Punctuality', 'Speed', 'Proximity', 'Fare' and 'Information' had the greatest influence on the overall bus transit SQ of Granada, Spain. Joewono and Kubota (2007) evaluated the SQ of Indonesian paratransit using nine variables: 'availability', 'accessibility', 'reliability', 'information', 'user service', 'comfort', 'safety', 'fare' and 'environmental impact'.

A number of studies have shown that among the urban low-income worker of the developing countries, womens are worse off than men in terms of both physical mobility and access to employment (Salon and Gulyani, 2010). In every case, these studies find that working women are having lower-paying jobs and are less likely to have job security. The studies were conducted in Delhi (Anand and Tiwari, 2006) and Pune, India (Astrop et al., 1996), Chengdu, China and Chennai, India (Srinivasan, 2008), Durban, South Africa (Venter et al., 2007), and Ibadan, Nigeria (Abidemi, 2002). Anand and Tiwari (2006) also report that women in one slum in Delhi feel unsafe while travelling, both because of the lack of road safety for pedestrians and because they are often sexually harassed while travelling. Working women are less likely to travel outside their home settlement for work and, if they do travel, they are less likely than men to use motorized transportation for their commute (Salon and Gulyani, 2010).

From the literature review, it can be found that in most cases, the exploration about user perception on the public transportation SQ employed data from developed countries; however, it is a fact that there are so many things differentiating the characteristics, behaviors, expectations, needs, and perceptions between developed and developing countries.

Limited number of studies explored paratransit SQ data from developing countries. Moreover, even fewer studies applied SEM to establish a relationship between paratransit SQ and the constructs describing it from low women working women's perception. This study is an endeavor to focus on the environment of paratransit in regards to low income female commuters and their mobility constrains.

3. Methodology

3.1. Data collection

A comprehensive questionnaire survey was carried out face to face to the low-income working women in Dhaka city, Bangladesh. The survey was conducted from 15^{th} to 20^{th} July 2017 during working days and holidays, when paratransit users (women) either start for their work or return after work. Targeted sample was from slum areas of Jhauchor and Kamrangichor where no bus service is available. The respondents were asked about 22 service attributes along with their socioeconomic characteristics. To evaluate the paratransit service quality the passengers were asked to rate their perception on a five point likert scale ranging from 1 to 5 (1 is for 'excellent' and 5 is for 'very poor'). Total 400 samples were interviewed by seven surveyors.

3.2. General information of respondents

The sample is characterized by a total number of low-income working women. About half (48%) of the users are aged between 31 and 40 years while 25%, 24% and 3% are between 18 and 30, between 41 and 50 and between 51 and 60 years old. More than half (55%) of the respondents are household workers while 16% are garments workers and 15% are day labor. 68% of the respondents monthly income range is 5000 Tk. – 10000 Tk. while 24% of their monthly income is less than 5000 Tk. 79% of the respondents daily travel expenditure is up to 20 Tk. and 19% of their daily travel expenditure is between 21Tk. – 40 Tk. Table 1 shows the general characteristics of the respondents.

Table 1. General characteristics of the respondents

Features	Statistics
Gender	Female (100%)
Age	18~30 Years old (25%), 31~40 Years old (48%), 41~50 Years old (24%), 51~60 Years old (3%)
Occupation	Household worker (55%), Garments workers (16%), day labor (15%), Sales worker (3%), Other (11%)
Monthly income	<5000 Tk. (24%), 5000~10000 Tk. (68%), 10000~15000 Tk. (7%), >150000 Tk. (1%)
Travel cost	0~20 Tk. (79%), 21~40 Tk. (19%), 41~60 Tk. (1%), 61~80 Tk. (1%), >80 Tk. (0%)

1 US $ = 83 Tk.

3.3. Preliminary statistics

The questionnaire survey focuses on 22 SQ variables provided in a close-ended format. In this survey, both qualitative and numerical scales are provided for measuring importance and satisfaction level of the respondents. Table 2 shows the preliminary statistics of paratransit service attributes with mean ranges from 3.05 to 3.91 and standard deviations range from 0.734 to 1.104. The Travel time in holidays have the lowest mean value 3.05 and the Ease of entry and exit has the highest value mean value 3.91.

Table 2. Preliminary statistics

Item no.	Description	Mean	Standard deviation	Numerical scale	Qualitative Scale
1.	Paratransit service quality	3.53	0.940	1 – 5	Excellent to very poor
2.	Seat comfort level	3.44	0.911	1 – 5	Comfortable to very uncomfortable
3.	Fitness of vehicle	3.59	0.933	1 – 5	Excellent to very poor
4.	Noise level	3.69	0.864	1 – 5	Noiseless to very noisy
5.	Lighting facilities	3.44	0.985	1 – 5	Excellent to very poor
6.	Cleanliness of paratransit	3.48	0.971	1 – 5	Excellent to very poor
7.	Ticketing system	3.64	0.987	1 – 5	Excellent to very poor
8.	Ease of entry and exit	3.91	0.936	1 – 5	Excellent to very poor
9.	Sitting arrangement	3.66	0.899	1 – 5	Excellent to very poor
10.	Movement flexibility inside	3.72	0.941	1 – 5	Excellent to very poor
11.	Quality of driver	3.61	0.998	1 – 5	Excellent to very poor
12.	Speed of paratransit	3.37	1.104	1 – 5	Free flow to forced flow
13.	Availability of paratransit	3.57	0.905	1 – 5	Excellent to very poor
14.	Travel time office day	3.80	0.957	1 – 5	Precisely accurate to very inaccurate
15.	Travel time in holiday	3.05	1.011	1 – 5	Precisely accurate to very inaccurate
16.	Integration of supporting modes	3.55	0.734	1 – 5	Excellent to very poor
17.	Security of goods	3.68	1.036	1 – 5	Excellent to very poor
18.	Security of passengers	3.71	0.922	1 – 5	Excellent to very poor
19.	Riding safety	3.63	0.930	1 – 5	Fully safe to unsafe
20.	Travel cost comparing with other	3.40	0.951	1 – 5	Costly to cheap
21.	Performance for long route movement	3.59	0.973	1 – 5	Excellent to very poor
22.	Movement flexibility in any road	3.59	0.947	1 – 5	Fully flexible to constrained

A total of twenty-two paratransit SQ variables are used for developing different models. Among them, twenty-one are observed and the remaining one is latent variable (see, Table 3). These variables are selected from extensive literature review on paratransit SQ analysis, focus group discussion and expert counsel of academicians, practitioners, paratransit operators and policy makers (e.g. Bangladesh Road Transport Authority and Dhaka Transport Co-ordination Authority).

Table 3 SQ variables and their roles in the proposed structure equation models (SEM)

Item no	Description	Model 1 (M 1)		Model 2 (M 2)	
		Variable type	Notation	Variable type	Notation
1.	Fitness of vehicle	Ex.	x_1	En.	q_1
2.	Riding safety	Ex.	x_2	En.	q_2
3.	Quality of driver	Ex.	x_3	En.	q_3
4.	Ticketing system	Ex.	x_4	En.	q_4
5.	Security of passengers	Ex.	x_5	En.	q_5
6.	Seat comfort level	Ex.	x_6	En.	q_6
7.	Cleanliness of paratransit	Ex.	x_7	En.	q_7
8.	Lighting facilities	Ex.	x_8	En.	q_8
9.	Sitting arrangement	Ex.	x_9	En.	q_9
10.	Speed of Paratransit	Ex.	x_{10}	En.	q_{10}
11.	Travel cost comparing with other	Ex.	x_{11}	En.	q_{11}
12.	Noise level	Ex.	x_{12}	En.	q_{12}
13.	Ease of entry and exit	Ex.	x_{13}	En.	q_{13}
14.	Movement flexibility in any road	Ex.	x_{14}	En.	q_{14}
15.	Travel time office day	Ex.	x_{15}	En.	q_{15}
16.	Travel time in holiday	Ex.	x_{16}	En.	q_{16}
17.	Availability of paratransit	Ex.	x_{17}	En.	q_{17}
18.	Movement flexibility inside	Ex.	x_{18}	En.	q_{18}
19.	Security of goods	En.	Q_{19}	En.	Q_{19}
20.	Integration of supporting modes	En.	Q_{20}	En.	Q_{20}
21.	Performance for long route movement	En.	Q_{21}	En.	Q_{21}
22.	Service Feature (SF)	N/A	N/A	Lt.	η_1

En. = Endogenous variables; Ex. = Exogenous variables; Lt = Latent variables

3.4. Proposed structural equation models

In this research, candidate models of different structures are developed and fitted to find the optimal one. For the ease of understanding following common notations are followed:

x indicates exogenous observed variables
Q and q indicates endogenous observed variables
Z indicates paratransit SQ
η indicates latent variables
ρ indicates measurement errors in q
ε indicates measurement errors in Q
ζ indicates errors in η
δ indicates errors in Z
λ indicates parameters of the Q variables
α indicates parameters of the η variables when influence Q variables
γ indicates parameters of η variables when influences q variables

μ indicates parameters of η variables when influence Z
Γ indicates parameters of the x variables
λ_0 indicates constant value
A series of SE models are developed to identify the relationships between the overall paratransit SQ and different endogenous, exogenous and latent variables. The target is to reveal which variables represent the main SQ aspects. Starting from an initial candidate model in which a set of variables of the SQ are proposed, these models are reexamined in new candidate models, modifying the structure and pattern of variables. The structures of the models are given below:

3.5. Development of model (M1)

Model M1 is constructed with three endogenous variables (item 19–item 21; Table 3) and eighteen exogenous variables (item 1–item 18; Table 3) to estimate paratransit SQ. There is no latent variable in this model. The structure of M1 is shown in Figure 1. From the structure of M1, the following equation can be written.

$$Z = \lambda_0 + \lambda Q + \delta \quad (1)$$

Q used in equation (1) can be expressed as:

$$Q = \Gamma x + \varepsilon \quad (2)$$

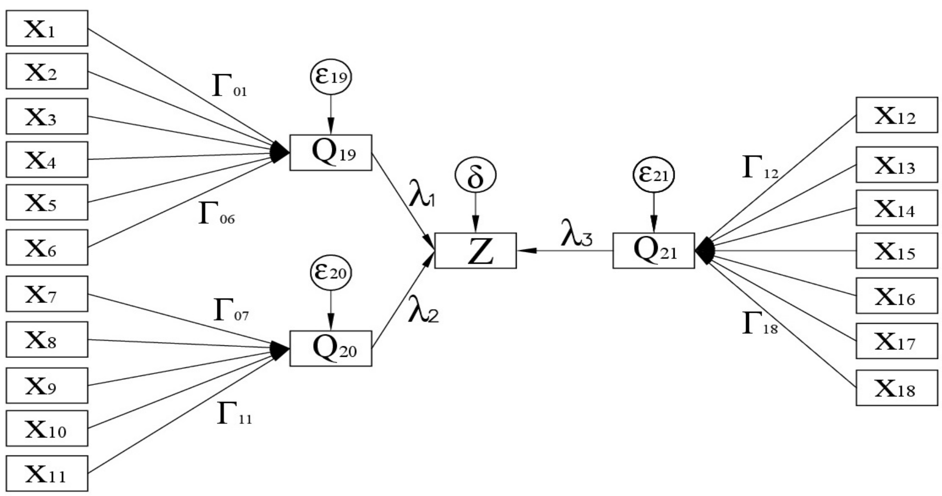

Fig. 1. Path diagram of model 1

3.6. Development of model (M2)

Model M2 is constructed with eighteen endogenous variables (item 1–item 18; Table 4) and one latent variable (item 23; Table 4) to estimate paratransit SQ. The latent variable (item 23; Table 4) is calibrated by 18 endogenous variables (item 1 –item 18; Table 4). There is no exogenous variable in this model. The structure of M2 is shown in Figure 2. From the structure of M2, the following equation can be written.

$$Z = \lambda_0 + \lambda Q + \delta \quad (3)$$

where Q in Equation (3) symbolizes the three endogenous variables (item 19–item 21; Table 4).

$$Q = \alpha\eta + \varepsilon \quad (4)$$

η symbolizes the latent variable which is calibrated by the remaining eighteen endogenous variables (item 1–item 18; Table 4).

$$\eta = (q - \rho)/\gamma \quad (5)$$

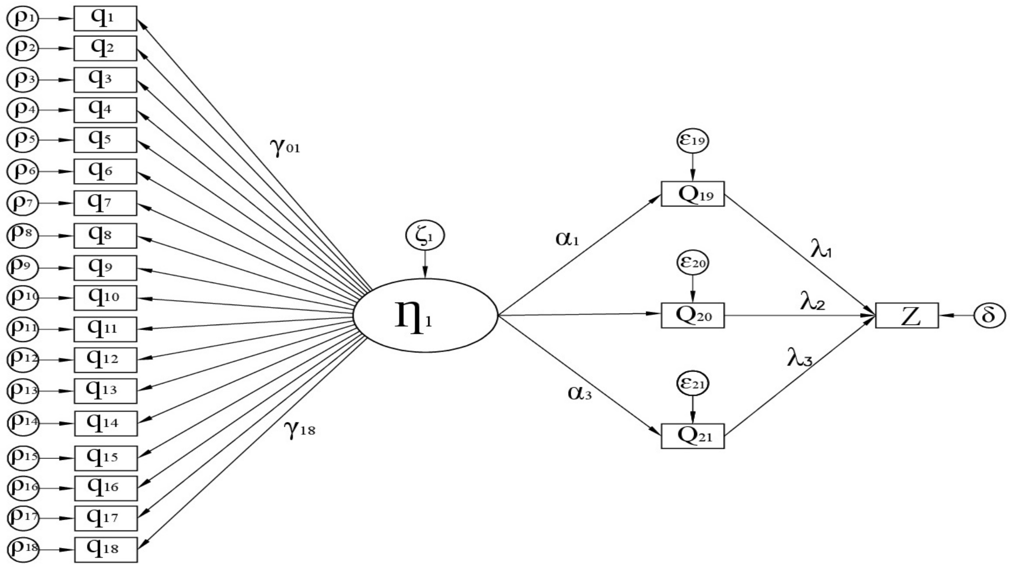

Fig. 2. Path diagram of model 2

4. Empirical results and discussion

Reliability concerns the accuracy of the measurement procedure. Although, there are a number of different reliability coefficients, one of the most commonly used is the Cronbach's alpha. It is a measure of internal consistency, i.e. how closely the items are related as a group. For this research, a Cronbach's alpha value of 0.953 is obtained, which exceeds Byrne's (2010) acceptable limit of 0.6 and also falls in the category of excellent ($\alpha \geqslant 0.9$) internal consistency. Thus, it can be said that internal consistency of the variables used in this research are excellent.

SEM methodology is applied in this research to analyze SQ. The two developed models (M1 and M2) show the connections of different variables with the overall paratransit SQ. Table 4 shows the parameter values of all variables (exogenous, endogenous and latent) that are used to develop the models. The significant variables are determined based on a two-tailed t-test with a critical value of 1.64 for 90% confidence limit. Also these parameter values are used to compare the proposed candidate models and to find out the optimal one. The optimal model represents the actual scenario of developing countries. To compare the developed models with each other and to select the best one, a number of goodness-of-fit indices namely RMSEA, SRMR, CFI, TLI and AIC are employed (listed in Table 5).

The model M1 having no latent variables is constructed with 22 observed variables. Among the three endogenous variables (item 19–item 21; Table 4) 'Security of goods', 'Integration of supporting modes', 'Performance for long route movement' are composed of eighteen exogenous variables (item 1-item 18; Table 4). The relations between exogenous and endogenous variables are established by trial and error method. To obtain the model structure, variables are shuffled and the best structure with this format is obtained. 'Riding safety' (0.406, $p < 0.01$; Table 4) is most significant variables that influence SQ positively, which represents the real scenario because safe vehicle is always preferable by the passengers. 'Security of goods' (0.372, $p < 0.01$; Table 4) is the 2nd most significant variables that influence SQ positively. In Dhaka city most of the low-income working women habitually travel by paratransit every day for work purpose and they feel scared about their belongings since snatching and pickpocketing might occur inside the paratransit. 'Movement flexibility in any road' (0.307, $p < 0.01$; Table 4) is one of the most significant variables that influence SQ positively. Traffic congestion is an issue of great concern for the inhabitants of Dhaka city, resulting in commuter's frustration, longer travel time and delays. Majority of the low income women everyday travel by paratransit since they do not have any other convenient option. 'Availability of paratransit' is one of the important variables that should influence SQ positively because adequate number of vehicle is always needed to cope up with passengers demand. However, the results of M1 (-0.045, $p > 0.10$; Table 4) show that 'Availability of paratransit' is an insignificant variable; it influences paratransit SQ negatively which does not match the real scenario. Furthermore, M1 results shows other contrasts such as 'Ease of entry and exit' (-0.161, $p < 0.01$; Table 4) influences 'Integration of supporting modes' negatively. For these irrational results though M1 has moderate fit indices (CFI = 0.624, TLI = 0.485, AIC = 17913.096; RMSEA = 0.169, SRMR = 0.063; Table 5), M2 is developed.

Model (M2) represents the real scenario. M2 introduces one latent variable named 'Service feature' (item 22; Table 4). 'Service feature' is calibrated by twenty one endogenous variables (item 1-item 21; Table 4) representing the overall service provided by paratransit. The three endogenous variables are dependent on the latent variable. The model results show that 'Riding safety' (0.906, $p < 0.01$; table 4), is utmost significant variables that influence on the SQ positively, which represents the real scenario, same as model M1. In Dhaka city most of the low-income working women habitually travel by paratransit every day for work purpose and they have fright always about their belongings, risk of life (accidents occur often), bad situation of road, there is no interest in the traffic law etc. 'Cleanliness of paratransit' (0.878, $p < 0.01$; table 4), is the 2nd most significant variables that influence on the SQ positively, Because the supervisors of paratransit do not take care of own vehicle properly but they trip repeatedly in a day. These services affect on the low-income working women to use paratransit. There is a probability if cleanliness of paratransit is improved, passengers are more interested to travel by these vehicle. 'Ticketing system' (0.869, $p < 0.01$; table 4), is the 3rd most significant variables that influence on the SQ positively. Near slum areas of Jhauchor and Kamrangichor no ticket counters are available for paratransit vehicle. So it is difficult to pay travel fair of pratransit to contractor. 'Security of passengers' (0.863, $p < 0.01$; table 4), is the 4th most significant variables that influence on the SQ positively, which represents the real scenario. Security of passengers is most significant variable, especially for low-income working women suffering harassment from helper and other male passengers of paratransit. 'Movement flexibility in any road' (0.857, $p < 0.01$; table 4), is one of the most significant variables that influence on the SQ positively, which is described as a significant variables on model-1. 'Lighting facilities' (0.845, $p < 0.01$; table 4), is the 6th most significant variables that influence on the SQ positively, the lighting facility isn't good enough for the low-income working womens when they return home from workplace in the evening, as the convenience of the paratransit service is poor. 'Movement flexibility inside' (0.806, $p < 0.01$; table 4), is the 7th most significant variables that influence on the SQ positively, movement flexibility inside the paratransit isn't enough for passenger because the place is less than the passengers. It creates overcrowding inside the pratransit. 'Seat comfort level' (0.812, $p < 0.01$; table 4), is the 8th most significant variables that influence on the SQ positively, seat arrangement is such that it can carry 10/12 persons at the back and two persons at the front, beside the driver. It creates more congested seating arrangement for paratransit passenger. There is a probability if seat comfort level is improved then service quality might be improved. 'Travel cost comparing with other' (0.783, $p < 0.01$; table 4) is 9th most significant variables that influence on the SQ positively, which represents the real scenario. In Dhaka city travel cost of paratransit are slightly high for low-income working womens, whereas if travel cost of paratransit is increased comparing with other then service quality might be improved but the travel cost is decreased it more convenient for low-income womens. Alos, 'Fitness of vehicle', 'Quality of driver', 'Sitting arrangement', 'Speed of Paratransit', 'Noise level', 'Ease of entry and exit', 'Travel time office day', 'Travel time in holiday', Availability of paratransit', 'Security of goods', 'Integration of supporting modes' and 'Performance for long route movement' are the significant variables that influence on the SQ positively, these all results are match with the real scenario accurately. Also, this model has satisfactory fit indices (CFI = 0.753, TLI = 0.724, RMSEA = 0.140, SRMR = 0.076; AIC = 19097.365; Table 5). Thus, the structure of M5 represents the best choice to perceive the paratransit SQ. Table 4 show Estimated results of paratransit service quality (SQ) models.

Table 4 Estimated results of paratransit service quality (SQ) models

Item no.	**Description**	**Model 1 (M 1)**		**Model 2 (M 2)**	
		Estimated parameter	p-value	Estimated parameter	p-value

1.	Fitness of vehicle	0.138[x]	0.001	0.752[s]	0.000
2.	Riding safety	0.406[x]	0.000	0.906[s]	0.000
3.	Quality of driver	0.163[x]	0.000	0.689[s]	0.000
4.	Ticketing system	0.130[x]	0.004	0.869[s]	0.000
5.	Security of passengers	0.253[x]	0.833	0.863[s]	0.000
6.	Seat comfort level	0.100[x]	0.078	0.812[s]	0.000
7.	Cleanliness of paratransit	0.121[x]	0.028	0.878[s]	0.000
8.	Lighting facilities	0.293[x]	0.000	0.845[s]	0.000
9.	Sitting arrangement	0.180[x]	0.000	0.771[s]	0.000
10.	Speed of paratransit	0.012[x]	0.732	0.530[s]	0.000
11.	Travel cost comparing with other	0.196[x]	0.000	0.783[s]	0.000
12.	Noise level	0.104[x]	0.012	0.620[s]	0.000
13.	Ease of entry and exit	-0.161[x]	0.000	0.720[s]	0.000
14.	Movement flexibility in any road	0.307[x]	0.000	0.857[s]	0.000
15.	Travel time office day	0.074[x]	0.081	0.631[s]	0.000
16.	Travel time in holiday	0.118[x]	0.001	0.485[s]	0.000
17.	Availability of paratransit	*-0.045*[x]	0.319	0.676[s]	0.000
18.	Movement flexibility inside	0.117[x]	0.006	0.806[s]	0.000
19.	Security of goods	0.372[s]	0.000	0.372[s]	0.000
20.	Integration of supporting modes	0.197[s]	0.000	0.197[s]	0.000
21.	Performance for long route movement	0.207[s]	0.000	0.207[s]	0.000
23.	Service Feature (SF)	-	-	1.000[a]	-
				0.458[b]	0.000
				0.866[c]	0.000

Italic numbers indicate 1.00 < z value < 1.64.
Italic underlined numbers indicate z value < 1.00.
s Endogenous variable.
a Influences security of goods.
b Influences integration of supporting modes.
c Influence performance for long route movement of paratransit.

Table 5 Goodness-of-fit measures of the developed SE models

Fit indices	Model-1	Model-2	Ideal range
Absolute fit indices			
Root Mean Squared Error of Approximation (RMSEA)	0.169	0.140	0.05 – 0.10
Standardized Root Mean Square Residual (SRMR)	0.063	0.076	< 0.10
Incremental fit Index			
Comparative Fit Index (CFI)	0.624	0.753	Close to 1.00
Tucker-Lewis index (TLI)	0.485	0.724	Close to 1.00
Parsimony fit Index			
Akaike's Information Criterion (AIC)	17913.096	19097.365	Comparatively smaller is better

5. Conclusion

This study presents the results of an investigation into the relationship between the overall paratransit SQ and service variables using Structural Equation Modeling (SEM) perceived by low-income women. SEM is a multivariate analysis technique which can describe the inherent structure within a set of data is used for this study.

To identify the structure that suits paratransit data of developing countries, two different SE models are developed. Best among the developed empirical models is selected by different goodness-of-fit values (CFI = 0.753, TLI = 0.724, RMSEA = 0.140, SRMR = 0.076, AIC = 19097.365; Table 5) and consistency with real life expectations.

From these two models, the best structure is found with one latent variable which is service feature. The best model (M2) has eighteen endogenous variables affecting the latent variable and three endogenous variables that are influenced by the latent variable. With this structure, M2 remarkably reflects the real life scenario of developing countries. Furthermore, it shows that 'Riding safety', 'Cleanliness of paratransit', 'Ticketing system' 'Security of passengers', 'Movement flexibility in any road', 'Lighting facilities', 'Movement flexibility inside', 'Seat comfort level', 'Travel cost comparing with other', 'Fitness of vehicle', 'Quality of driver', 'Sitting arrangement', 'Speed of Paratransit', 'Noise level', 'Ease of entry and exit', 'Travel time office day', 'Travel time in holiday', Availability of paratransit', 'Security of goods', 'Integration of supporting modes' and 'Performance for long route movement' are the most significant endogenous variables. This finding supports the collected data of low-income working women of Dhaka city. Thus any development strategy undertaken by the operators which aims at improving the 'safety and security' of the paratransit system will have the greatest influence in meeting customer satisfaction, thereby improving their perceived SQ.

However, these results varies from the research outcomes of various previous studies on public transportation systems, like de Oña et al. (2013) applied SEM to assess the SQ of bus transit system of Granada, Spain. They identified 'Frequency' as the most important observed variable. Whereas, for Bandung, Indonesia, it was 'Comfort' as found by Joewono and Kubota (2007). The differences in findings may be due to the variation in socioeconomic structures, road network conditions, public transportation availability and mode of operation of the study locations. Rahman et al. (2016) applied SEM to find out the SQ of paratransit system of Dhaka, Bangladesh shows that 'Punctuality and Reliability' and 'Service Features' are the observed and latent variables having the greatest influence on the paratransit SQ. Structural equation modeling is not uncommon to find that the fit of a proposed model is poor (Hooper et al. 2008). Assuming the complexity of the phenomenon, the obtained model can be considered satisfactory, despite the suggested thresholds in the literature for having a good model.

It is important to emphasize that all the significant variables have a key role in the global perception of paratransit SQ. Thus, paratransit operators should be more careful about these variables when they formulate measures for promoting this mode of public transportation. Results of this paper are based on individual users' specific observations which reflect their needs and expectations. The determination of the most and the least important SQ variables certainly will help to initiate a staged development of the overall paratransit SQ. Furthermore, it will be interesting to investigate the variables affecting SQ during special occasions and the SQ of the paratransit that are used by the low-income working women on a daily basis.

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