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Identification of Factors Affecting Service Gap in Public Transport Buses: A Case Study of Jaipur City, India

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***Abstract*--The study targets to offer direction for - transport specialists and researchers together on how to mainstream gender-related concerns into road transport projects to improve development effectiveness and to reduce gender inequality in public bus transport in the city of Jaipur. Access to transportation and mobility, transportation safety, personal security, and participation in the transportation sector can have different issues and approaches depending on the gender. The study draws attention to the most basic ways in which gender affects and is affected by transport policies and projects and provides practical approaches to address gender-related problems in road transport projects. A complete questionnaire is formed and responses were collected through an online survey covering all the sections regarding the factors that could affect women's mobility patterns. 493 respondents participated and surveys were Descriptive analysis and factor analysis were performed on perception variables to find out the underlying factors affecting safety.**

***Keywords*-public bus transport, transportprojects, factor analysis.**

I. INTRODUCTION

A. GENERAL

According to most studies, gender differences in travel patterns are mainly accounted for by the division of roles in the labour market and the family, which affect women's employment conditions, income levels and mobility needs. Gender is a significant factor in accounting for differences in mobility and travel behaviour. Women's mobility in day-to-day life differs from that of men; for instance, women are more likely to travel shorter distances and to stop more frequently than men during their journeys. By including gender mainstreaming in the transport sector means recognising and addressing gaps in gender equality that are going to affect sector plans and policies as well as design, planning and facilitation of its structure and services.

B. IMPORTANCE OF THE STUDY

The public bus can be considered as the lifeblood of the state economy as most urban dwellers especially women depend on it to commute, for various purposes. Problems arise when poorpublic transport provision like bus service and its infrastructure are not being well taken care of. Women suffer an uneven share of public transport in order to fulfil their social, economic and domestic services. Hence, their travel patterns depend on the various actions and events they make to accomplish work in the formal as well as informal sector, children care, shopping, medical visits, school drop-off etc. women are likely to make more complex and more trips as compared to men in both urban and rural areas. In relation to accessing transport services women also have to overcome other major concerns such as cultural acceptance, personal safety and avoiding harassment

C.BACKGROUND

The subject of taking account of gender in transport is a fairly latest one.Various studies from around the world have shown that women especially of lower income strata depend more on public transport than men.Access to available means of transport is restricted with respect to women mobility as various studies have stressed on the fact that travel and transport requirementsof men and women differ and access to transport is limited too. Furthermore,

women access to transit services is more restricted for women, hence making constricting the number and purposes if trips they make.

E. OBJECTIVE

The objective of this study is to identify the parameters that affect safe and secure travel for women in public bus transport in Jaipur and address their unmet needs which. To study and understand the paradigm around women safety concerns in public transport globally and best practices adopted globally to ensure safer travel for women commuters worldwide.

II. LITERATURE REVIEW

Pankaj Sharma et al. (2017)[1]In order to improve the service quality of public bus transport system of Jaipur about 30 percent passengers recommended to increase the frequency of buses.Apart from the parameters such as availability of timetable at bus stops, overcrowding in the bus and availability of seat during peak hours most of the parameters had a tally less than 3.0 (neither satisfied nor dissatisfied) which further indicates that majority of commuters seem to be satisfied with maximum of the service parameters of public transportation system. The parameters such as fare, safety at bus stop consistency, frequency, service and network had a mean value of less than 2(satisfied)and was highly valued by the commuters. While on the other hand the parameters which were rated lowest were information on buses about next stops, overcrowding, time table, information of bus stop and reliability. These were the parameters which were discovered while observation and were suggested by the passengers for improvement in the service quality of the public bus transport system in the city of Jaipur

Besides, Hassan et al (2013) [2]Has studied that the parameters such as cost. frequency, seat availability, cleanliness, comfort, Infrastructure and vehicle design, ticketing system, travel time, duration, staff behaviour, access to information and safety and security are the most desirable service quality parameters which are indicated as the efficiency indicators. By implement a whole-journey approach in urban planning and research is important because it needs to be acknowledged not only how specific steps of the journey affects women's mobility, but also how the parts interact with each other using a holistic perspective.

Tiwari and Jain (2012) [3**]** The public transport system has the probability of inviting a large no of customers especially private vehicle users. Therefore, in order to encourage private vehicle users to use public transport often the route specific public transport system should be encouraged. The route specific transportation will reduce the travel time as it is dependent on bothurban and transport development patterns of the area in specific. Delbosc and Currie (2011) [4]found thatmostly public transport services are generally designed to travel toward city centre during rush hours which doesn't match with travel patterns of women in general who often travel local neighbourhood outside rush hours making short and linked trips. To take account of safety problems, women should be allowed greater scope to alight closer to their final destinations, outside the normal bus stops, in the evening and at night. Gender, incidents of personal safety, feeling comfortable with people you don't know on public transport had the influence on perception of safety Babinard (2010)[5] studied that gender equality policies have been developed by many countries while others have prepared gender action plans. Practical and concrete perspectives can be expanded by including women in the planning of transport systems for other vulnerable users such as children, the elderly and the disabled. By reducing long periods of time waiting for transport, improving adequate facilities, and addressing overcrowding and lack of safety for women can be improved. Pedestrian safety of both men and women can be increased by making road components such as sidewalks as a part of road public transport projects. Targeted local responses non-commuter or decentralized services to help women access specific destinations such as markets, educational and employment facilities, administration offices and services should be supported.Sideris and Fink (2008) [6] said that the consequences of fear have led women to utilized precautionary measures

and strategies that affect their travel patterns. The measures and strategies adopted by women are such as behaving in a certain manner among people, selecting certain routes, changing their mode of choice and passage and traveenvironment and sometimes finally shunning certain environmental situations and many more. According to Lynch and Atkins (1988) [7] Many women take steps to avoid putting themselves into what they consider to be vulnerable positions; sometimes not travelling at all. Women are constrained in their travel choices and their lifestyles are restricted. While some women take assertive action, many are less confident.Meghna Verma et al(2017) [8] study was planned to identify the various service gap that exist related to safety and at the same time the expectations of women commuters from the bus service of the city. The study aimed particularly the participation of women because Bangalore has been growing at a fast pace with increasing levels of congestion with a high percentage of women being dependent on public buses. The analysis comprises of questions related to the various parameters such as socio-economic background, perception of safety, complain and grievance system etc. which were asked by conducting a survey. The factor analysis and descriptive analysis was adopted to extract the major factors contributing the service gap. Logit model was also calculated for binary dependent variable of feeling of safety. The results from the study that infrastructure is an important parameter that affects the safety while travelling. The various factors such as proper lightning at bus stops, levelling of footpaths along with security alarms in buses also affects the perception of safety in mind.

A. SUMMARY

The above literature concludes that factors like overcrowding, lack of space, information, delay, unreliable public transport services impact women more as compared to men.Therefore, the definition of public transport for the project is not limited to travel journey inside the bus but can be summarised into the following aspects of journey such as access and egress trips, waiting at bus stop, boarding and alighting and journey inside.

III. STUDY AREA

Jaipur is the capital city of the state of Rajasthan and is surrounded by Aravalli hills. it is spread to a distance of 467 sq.km and houses a population of 3.4 million making it the 10^{th} largest city of country and the fastest growing being a popular destination because of its cultural heritage, history and architecture it makes it extremely popular among tourist by the name of “Pink City”

A. MODE SHARE AND TRIP LENGTH

In terms of physical and demographic parameters the city of Jaipur had seen a tremendous growth. The people were unwillingly fortified to buy personalized vehicles for their own conveyance as the maximum percentage is shared by two-wheelers which is accounts for 40.67 percent and the minimum percentage of only 0.54 percent is contributed by metro. Cars and taxi accounts for 24.01 percent while 23.73 percent is contributed by bus and mini-bus. The data indicates that in case of public transport bus service is quite a popular option in comparison to metro. Thetotal trips done by users through various mode is 9.12 km. out of the total trips done homebased trips have an average length of 8.74 km while non-home-based trips account for 7.87 km.

B. PUBLIC BUS TRANSPORT IN THE CITY

The public transport system in Jaipur consists mainly of city buses operated by Jaipur City Transport Services, minibuses operated by private operators, and intermediate public transport modes such as taxis and auto rickshaws across the entire city. All over a total of 10 routes have been defined as high traffic density routes. Jaipur City Transport Services operates a fleet of 300 buses. The existing city buses operate on seven radial and three circular routes spread across the city, with a high concentration around the core area. The minibus fleet of about 1,900 operates on 28 routes. The buses cover 143 bus stops all over the city and satellite towns. Only about 30 buses are available per 100,000 population.

IV. DATA COLLECTION ANDMETHODOLOGY

For this study the primary data was collected through the questionnaire. The study was conducted in the Jaipur city. The targeted individuals for the data collection were students or working women. Out of 500 surveys forms only 439 were selected as some forms had missing values and some were filled in inappropriate manner. At last,439 forms were selected to conduct the study.The questionnaire survey was designed to understand the various characteristics and dimensions of women's journey and their respective experiences while commuting. The questionnaire outlined various parameters.

V. DATA ANALYSIS AND INTERPRETATION

A. DESCRIPTIVE ANALYSIS

In order to study the respondent's satisfaction on observed variables and service quality attributes descriptive analysis was performed. The mean and standard deviation of the variable are shown in table I. The descriptive statistics table shows 30 attributes and their respective mean scores and standard deviation. It can be analysed from the table that the mean scores vary from a minimum score of 2.02 to a maximum value of 3.47 which leads to the fact that the respondents had a varied perception of all the service attributes. Also, from the table standard deviation for the components varies from .799to1.148.According to respondents the attribute: Feeling unsafe about luggage at the time of getting off the Bus has the highest mean score 3.47 and standard deviation 1.044. On the other hand, the service attributes: bus stops are safe for girl child and bus stops are safe for women are having the lowest mean score as 2.02 and standard deviationas.831and.799 respectively.

B. ELIGIBILITY TEST DATA

In order to perform factor analysis on the collected data it is necessary to check that whether the given data can be processed by factor analysis or not. therefore, in order to check it is required to calculate the value of KMO (Kaiser-Meyer-Olkin). this test is intended to find out whether the given data can be proceeded through factor analysis.

KMO values varies from 0 to 1. A value equal to 0 indicates that there is dispersion in the arrangement of correlations as the sum of partial correlations is more in relation to sum of correlations factor analysis.

Therefore, factor analysis cannot be performed on such data. on the other hand, a value of 1 indicates that there is no dispersion in the patterns as they are relatively compact hence factor analysis can be performed on the given data. Table II shows the KMO value of .956 for the given data as per the calculations done by software SPSS 21 which indicates factor analysis can be performed on the data for further analysis of the study.

C. BARLETT' S TEST OF SPHERICITY

Bartlett's test identifies that whether the variable involved in the analysis are correlated or not. In order to perform the factor analysis there should be some relationship between the variables involved. Table II shows bartlett's test is highly significant as $p < 0.001$ hence factor analysis can be performed.

D.FACTOR ANALYSIS

The factor analysis was performed in SPSS tool. Factor analysis is a statistical method to discover the underlying arrangement of a given set of variables. It helps in reducing quality data from a large no of variable data to a small number of factors in order to make the calculations simple.

The technique puts a common score by extracting the common score variance from the given set of variables. The common variance or score can be used for further analysis.Factor analysis assumes some assumptions same as multiple regression as it is part of multi general linear hypothesis. the assumption is to be followed before analysing the data by factor analysis. There should be linear relationship between the data meaning that the data should be linear or non-internal. There should be not be any multicollinearity and multivariable normality between the variables for the aim of significant testing.

E. PRINCIPAL COMPONENT ANALYSIS

For extracting the factors, the method used is principal component analysis because it assumes is being assumed that the totalvariance is equal to the common variance hence there is no unique variance. The main aim of the study is to detect and calculate the score for the factors thus the analysis resulted into four factor solutions. The amount of variance explained by a given component is explained by eigen values. It can be noticed from the table that a relatively large variance is explained by the first few factors and a very low variance is explained by the other factors. For the analysis only components having high eigen values are most likely to signify the underlying factors in the data. the rest of the other components having relatively low eigen values are neglected for further analysis as they are not signifying the objective behind the 30 questions. It can be interpreted that thefour-factor explained 65.799% of the variance.

Factor 1 has the highest eigen values which is 12.095. therefore, the eigen value for factor 1 is 12.905 (43.017 %) indicates that factor 1 itself is sufficientin explaining43.017% of the total of all the factors that are affecting safety of women while using public bus transport in Jaipur city.

The total eigen values for factor 2 are 3.816 (12.721%), meaning that factor 2 explains a total of 12.721% of all the 30 total factor affecting safety of women in public bus transport. Similarly, factor 3 has eigen values 1.986 which accounts for a total of 6.619% of the total of all the 30 factors.

Similarly, factor 4 has the least eigen values which is 1.033 (3.442), which concludes that factor 4 is able to explain a total of 3.442% of all the 30 factors which affects safety of women while using public bus transport in the city of Jaipur.

Therefore, it can be interpreted that a total of four factors are useful in further analysis of the study and the rest of the factors can be neglected for further analysis.

F.FACTOR ROTATION

A rotated matrix or also known as rotated factor matrix can be defined as a matrix of factor loadings for each component or variable on each factor. The factor loadings less than 0.3 have not be shown by the matrix because we set the value at 0.3 in order to simplify the data.

Table III shows the rotated component matrix for the given data which is calculated after rotation of the component matrix. It can be noticed from the table that there are four factors and their respective factor loadings. Fifteen variables load have high factor loading on factor 1 and six variables or components load highly on factor 2. Similarly, six variables load highly on factor 3 and three variables load on factor 4.

From the rotated component matrix as shown in table III it is observed that the first component is measured by the variables V5, V8, V4, V7, V6, V11, V9, V14. V12, V24. V28, V19, V23, V10 AND V29.Therefore, it can be interpreted that all these variables indicate towards a common information which can be concluded into single factor.

The second component is measured by the variables V16, V18, V15, V17, V13 and V22. The third component is measured by the following variables V25, V26, V30, V27, V21 and V20.

Similarly, the fourth component is measured by the following variables V1, V2 and V3. After analysing all the components, it can be interpreted that all 30 variables can be grouped into four categories.

G. GROUPING OF VARIABLES

FACTOR 1-SAFETY WHILE BOARDING AND ALIGHTING

1. Feel unsafe of getting run over by another bus or vehicle if bus doesn’t stop at the Bus Stop.
2. Boarding a bus is a challenge, as Buses do not stop exactly at the Bus Stop.
3. Many people end up with various sprains at the time of getting off the bus due to non-levelling of Bus Stops.

4. Feeling unsafe about luggage at the time of getting off the Bus.
5. Bus hardly stops at the Bus Stop, hence feel unsafe while getting off the bus].
6. Feel unsafe with co passengers only.
7. Feel very unsafe while reaching to the door of Bus from the seat.
8. Crimes against women are more in empty buses.
9. Special seats for Females can't guarantee their safety.
10. Don't know how safe will be the Bus stop where I am getting down.
11. Crimes against women are more in overloaded buses.
12. Few seats should be reserved only for young mothers or elderly or physically challenged women, not for all women.
13. Don't know with surety if I am getting off at the right bus stop.
14. Feel unsafe with drivers and conductors also.
15. All women Bus cannot guarantee the safety of women at the Bus Stop.

FACTOR 2 – ACCESSIBILITY

1. Bus information is easily available through calls, SMS's & on the Internet.
2. Bus stops are conveniently located.
3. There is proper light at Bus stops in the night.
4. All women Bus cannot guarantee safety of women inside the bus.
5. Destination Displays Systems are available inside the bus.

FACTOR 3 – ON BOARD SECURITY

1. Crimes against women can be reduced by running special buses for women.
2. Crimes against women are less when all get place to sit in a bus
3. Computerized ticketing system leaves little scope for cheating & bribing.
4. Display of information about bus time will reduce the waiting time, that in turn will reduce the crime at Bus Stop.
5. Drivers & Conductors are more courteous to young mothers or elderly or physically challenged women.
6. Drivers & Conductors are courteous.

FACTOR 4 – SAFETY AT THE BUS STOP

1. Bus stops are safe for young mothers and elderly ladies.
2. Bus stops are safe for girl child.
3. Bus stops are safe for women.

This analysis indicates that the initial questionnaire is practically composed of four factors:

Factor 1- Safety While Boarding and Alighting

Factor 2-Accessibility

Factor 3- On Board Security And

Factor 4-Safety at Bus Stop.

VI. CONCLUSIONS

Data from the study has shown that women commuters were unsatisfied with various parameters such as frequency, bus information, punctuality. The users were highly unsatisfied with the safety parameters especially safety at bus stops, safety while boarding and alighting, and overcrowding. On the other hand, the various service parameters such as cost, travel time. The important parameters drawn from the study are given below –

- There is need to improve infrastructure especially bus stops. The bus stops and vehicle should be designed as per women's requirements. There were also instances of unsheltered bus stops at some locations.
- The frequency of buses should be increased during the peak hours and on busy routes.

- The buses should operate as per given schedule. The information should be displayed inside the bus andavailable through some services such as apps at the time of waiting.
- Boarding and alighting the vehicle was one most loaded factor as buses do not stop exactly at the stop.

VII. FUTURE SCOPE

For future research it is important to study how to attract more commuters towards the public transportation. By conducting various researches that could analyse what are the various parameters that make work in making public transportation work for both men and women. The same study can be taken forward and applied for other cities too. Research for the other sections of the society such as physically disable, children and elderly people can also be done.

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Table I

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
[Bus stops are safe for young mothers and elderly ladies]	1	5	2.05	.799
[Bus stops are safe for girl child]	1	5	2.02	.831
[Bus stops are safe for women]	1	5	2.02	.799
[Many people end up with various sprains at the time of getting off the bus due to non-levelling of Bus Stops]	1	5	3.21	.946
[Feel unsafe of getting run over by another bus or vehicle if bus doesn't stop at the Bus Stop]	1	5	3.40	1.048
[Bus hardly stops at the Bus Stop, hence feel unsafe while getting off the bus]	1	5	3.47	1.044
[Feeling unsafe about luggage at the time of getting off the Bus]	1	5	3.41	1.065
[Boarding a bus is a challenge, as Buses do not stop exactly at the Bus Stop]	1	5	3.45	1.133
[Feel very unsafe while reaching to the door of Bus from the seat]	1	5	3.44	1.053
[Feel unsafe with drivers and conductors also]	1	5	3.21	1.013
[Feel unsafe with co passengers only]	1	5	3.27	1.014
[Special seats for Females can't guarantee their safety]	1	5	3.30	1.104
[All women Bus cannot guarantee safety of women inside the Bus]	1	5	3.03	1.135
[Crimes against women are more in empty buses]	1	5	3.44	1.045
[Bus stops are conveniently located]	1	5	2.78	1.106
[Bus information – schedule & route maps are available & reliable]	1	5	2.77	1.117
[There is proper light at Bus stops in the night]	1	5	2.56	1.088
[Bus information is easily available through calls, SMS's & on the Internet]	1	5	2.68	1.148
[Few seats should be reserved only for young mothers or elderly or physically challenged women, not for all women]	1	5	3.33	1.112
[Drivers & Conductors are courteous]	1	5	3.08	.962
[Drivers & Conductors are more courteous to young mothers or elderly or physically challenged women]	1	5	3.31	.983
[Destination Displays Systems are available inside the bus]	1	5	2.80	1.086
[Don't know with surety if I am getting off at the right bus stop]	1	5	3.25	1.000
[Don't know how safe will be the Bus stop where I am getting down]	1	5	3.31	.994
[Crimes against women can be reduced by running special buses for women]	1	5	3.31	1.124
[Crimes against women are less when all get place to sit in a bus]	1	5	3.28	1.064

[Display of information about bus time will reduce the waiting time, that in turn will reduce the crime at Bus Stop]	1	5	3.20	1.039
[Crimes against women are more in overloaded buses]	1	5	3.39	1.077
[All women Bus cannot guarantee the safety of women at the Bus Stop]	1	5	3.29	1.071
[Computerized ticketing system leaves little scope for cheating & bribing]	1	5	3.35	1.156

Table II

KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.956
Bartlett's Test of Sphericity	**Approx. Chi-Square**	9402.342
	df	435
	Sig.	.000

Table III

Rotated Component Matrix

	Component			
	1	2	3	4
V5[Feel unsafe of getting run over by another bus or vehicle if bus doesn't stop at the Bus Stop]	.816			
V8 [Boarding a bus is a challenge, as Buses do not stop exactly at the Bus Stop]	.800			
V4[Many people end up with various sprains at the time of getting off the bus due to non-levelling of Bus Stops]	.788			
V7[Feeling unsafe about luggage at the time of getting off the Bus]	.785			
V6[Bus hardly stops at the Bus Stop, hence feel unsafe while getting off the bus]	.761			
V11[Feel unsafe with co passengers only]	.732			
V9[Feel very unsafe while reaching to the door of Bus from the seat]	.716		.374	
V14[Crimes against women are more in empty buses]	.686		.355	
V12[Special seats for Females can't guarantee their safety]	.645	.378		
V24[Don't know how safe will be the Bus stop where I am getting down]	.645		.493	
V28[Crimes against women are more in overloaded buses]	.583		.565	
V19[Few seats should be reserved only for young mothers or elderly or physically challenged women, not for all women]	.582		.518	
V23[Don't know with surety if I am getting off at the right bus stop]	.573		.513	
V10[Feel unsafe with drivers and conductors also]	.567	.442		
V29[All women Bus cannot guarantee the safety of women at the Bus Stop]	.449	.325	.421	
V16[Bus information – schedule & route maps are available & reliable]		.842		
V18[Bus information is easily available through calls, SMS's & on the Internet]		.839		
V15[Bus stops are conveniently located]		.816		
V17[There is proper light at Bus stops in the night]		.754		
V13[All women Bus cannot guarantee safety of women inside the Bus]	.369	.697		
V22[Destination Displays Systems are available inside the bus]		.679		
V25[Crimes against women can be reduced by running special buses for women]	.416		.730	
V26[Crimes against women are less when all get place to sit in a bus]	.468		.656	
V30[Computerized ticketing system leaves little scope for cheating & bribing]	.555		.598	
V27[Display of information about bus time will reduce the waiting time, that in turn will reduce the crime at Bus Stop]	.364	.304	.586	
V21[Drivers & Conductors are more courteous to young mothers or elderly or physically challenged women]	.467		.567	
V20[Drivers & Conductors are courteous]	.398	.387	.472	
V1[Bus stops are safe for young mothers and elderly ladies]				.866
V2[Bus stops are safe for girl child]				.840
V3[Bus stops are safe for women]				.835