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MEASURING THE EFFECTS OF PASSENGERS' SOCIO-DEMOGRAPHIC FACTORS ON SATISFACTION WITH PUBLIC BUS SERVICES IN A DEVELOPING CITY: A CASE STUDY IN SEMARANG, INDONESIA

Summary. The present study aimed to assess passenger satisfaction with bus transit services based on passengers' socio-demographic characteristics, given the service quality. An ordinal logistic regression analysis was conducted to relate passengers' socio-demographic characteristics to their satisfaction with public bus services. The socio-demographic characteristics studied were age, gender, marital status, occupation, income, housing type, family size, and motor vehicle ownership. Data were collected by administering an onboard survey to public bus passengers. In total, 580 completed a questionnaire asking about their socio-demographic characteristics and their satisfaction with bus transit services. The study reveals that significant differences exist in the levels of passengers' satisfaction depending on their socio-demographic characteristics. Greater satisfaction was significantly associated with being married, unemployed, and young. The delivery of public bus services needs to consider different segments of passengers.

1. INTRODUCTION

The City of Semarang, the capital of Central Java Province, Indonesia, is the fifth-biggest city in Indonesia, with over 1.8 million people and an area of 373.78 square kilometers. As the economy and population grow, the city is facing rapid growth in motorization. Available modes of public transport are buses, taxis, *angkot* (minibuses), *ojek* (hired motorcycles), and motorized and unmotorized three-wheelers. However, most citizens rely heavily on private vehicle transportation, especially motorcycles. As a result, the city faces growing problems of transportation inefficiency, delays, and traffic accidents. A better public transportation system is needed. The first route of the so-called Trans Semarang Bus Rapid Transit (TS BRT) was operated in 2009 to provide a better means of public transportation. Because it is crucial to shift from private to public transportation, researchers and practitioners alike are continually preoccupied with comprehending what determines passenger satisfaction and what factors relate to it.

Much has been done to study passenger satisfaction with public transit services. Public transport operators measure passenger satisfaction to evaluate service level and quality. Eboli and Mazzulla [1] related passenger satisfaction with bus services and the attributes of the services supplied by public bus services used by students to reach their campus in southern Italy. Nwachukwu [2] investigated passenger satisfaction with the service quality attributes of public bus transport services in Abuja, Nigeria. Castillo and Benitez [3] used three types of models—a generalized linear model, weighted means, and a multivariate discrete distribution—to study the contribution of the individual satisfaction scores to the global satisfaction score. Budiono [4] used a self-rated questionnaire to study passengers' satisfaction with service quality attributes to investigate overall passenger satisfaction and factors that influence public transport passenger satisfaction in Jakarta and Yogyakarta, Indonesia. Yanik et al. [5]

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analyzed the variables affecting access to rail transit stations and the satisfaction of transit passengers with the transit systems. Wan et al. [6] explored the connection between riders' general satisfaction and fundamental driving components of the BRT service in New York City. Most research has focused on the effects of service quality on passenger satisfaction.

The influence of socio-demographic factors on satisfaction has been studied in other fields. For example, in health care, Hall and Dornan [7] conducted a meta-analysis to assess the relationship between patients' socio-demographic factors and their satisfaction with medical care. Seiler et al. [8] studied the impact of customer demographics on service value, customer satisfaction, and customer loyalty in the private banking industry. Oyewole [9] investigated whether demographic variables influence customers' satisfaction with services in the airline industry by influencing several other aspects of consumer behavior. Recently, Mak and Jim [10] examined the effect of socio-demographic variables on visit-related preferences and applied the findings to improve urban parks.

In the public transit industry, the influence of socio-demographic factors is seldom discussed. Imaz et al. [11] inspected service quality, trip attributes, and the individual's financial and mental traits, including components depicting propensity development factors that influence transit passenger loyalty. Cheng et al. [12] investigated the connections between observed variables and latent variables in the measured model, the impacts of exogenous factors on endogenous factors in the auxiliary model, and the impact of the passengers' socio-economic attributes on satisfaction. Ponrahono et al. [13] explained that geographical perspectives determine how travelers rate services and affect the degree of satisfaction among travelers from urban and rural regions. Fellesson and Friman [14] presented a transnational examination of the perceived satisfaction with public transport services in eight European nations; the respondents rated their agreement with 17 quality-related articulations regarding local public transport services.

It is tough to match passengers' emotional satisfaction with hidden factors related to service and passenger attributes [5]. The present study assessed passenger satisfaction with the TS BRT service based on passengers' socio-demographic characteristics, given the service quality provided. The present study investigated whether demographic variables influence passengers' satisfaction with city bus services in the same way they influence several other aspects of passenger behavior.

2. METHOD

2.1. Data collection

The onboard survey method was administered for data collection. Questionnaires were given to and completed by passengers while waiting at the bus shelters or riding the TS BRT on regular weekdays and weekends [15, 16]. The questionnaires comprise two parts. In the first part, respondents were asked general questions about their socio-demographic characteristics, such as their gender, marital status, occupation, age, monthly salary, housing type, number of family members, and the number of motorized vehicles owned by their family. In the second part, each respondent was asked to rate their general satisfaction with the Trans Semarang BRT service on a scale from 1 to 10, where 1 represents the lowest level of satisfaction and 10 represents the highest level of satisfaction.

2.2. Model fitting

Since the responses in this study were ordinal, a natural choice of model was the proportional-odds model [17]. The logits can apply the ordering when response categories are ordered [18]. The accumulative probability of Y is the chance that Y is equal to or less than a specific value. Using the proportional odds model, we compared the probability of an equal or smaller response, $Y \leq j$, to the probability of a larger response, $Y > j$ [19].

The cumulative probabilities show the ordering, with $P(Y \leq 1) \leq P(Y \leq 2) \leq \cdots \leq P(Y \leq J) = 1$. Equation (1) shows a model that simultaneously uses all cumulative logits [18, p. 275]:

$$logit[P(Y \leq j|\boldsymbol{x})] = \alpha_j + \boldsymbol{\beta}'\boldsymbol{x}, \quad j = 1, \ldots, J-1 \tag{1}$$

where $\boldsymbol{x}$ is the explanatory variable. Each intercept, α_j, applies to each cumulative logit, and the model has the same effects $\boldsymbol{\beta}$ for each logit. The logit is an increasing function of this probability. The $\{\alpha_j\}$ are increasing in j, because $P(Y \leq j|\boldsymbol{x})$ increases in j for fixed $\boldsymbol{x}$. The cumulative logit model satisfies Equation (2) [20]:

$$logit[P(Y \leq j|\boldsymbol{x}_1)] - logit[P(Y \leq j|\boldsymbol{x}_2)] = log\frac{P(Y \leq j|\boldsymbol{x}_1)/P(Y>j|\boldsymbol{x}_1)}{P(Y \leq j|\boldsymbol{x}_2)/P(Y>j|\boldsymbol{x}_2)} = \beta'(\boldsymbol{x}_1 - \boldsymbol{x}_2) \quad (2)$$

A *cumulative odds ratio* is an odds ratio of cumulative probabilities. The odds of arriving at a response that is $\leq J$ at $\mathbf{x} = \mathbf{x}_1$ are $\exp[\beta'(\boldsymbol{x}_1 - \boldsymbol{x}_2)]$ times the odds at $\boldsymbol{x}_1 - \boldsymbol{x}_2$. This model is called *the proportional odds model* [21] because the log cumulative odds ratio is proportional to the distance between $\mathbf{x}_1$ and $\mathbf{x}_2$. For each logit, the exact proportionality constant applies [20]. The right side of Equation (1) is a simple linear model with one slope, β, and an intercept that changes depending on j, α_j, where j is the level of an ordered category with J levels.

In the present study, there are 10 levels of satisfaction. The intercept differs depending on the level of interest. We are interested in modeling the chance of being in one satisfaction level (or less) versus being in a higher satisfaction level. The levels are used as limits. In this model, $P(Y \leq J) = 1$, meaning that the highest level returns a probability of 1. The model with a simple linear model is the log odds of the probability, not the probability. The analysis was conducted in R (R Core Team 2014), and fitting for the proportional-odds logistic regression model was done using *polr*, a function contained in the MASS package [17, p. 204].

3. RESULTS

3.1. About the Trans Semarang BRT

The TS BRT has eight main corridors with 364 bus shelters. Besides the main service corridors, there are four feeder corridors throughout the TS BRT service coverage area. The fleet was running on a non-exclusive bus lane roadway mixed with other traffic. The buses operate every day from 5:30 a.m. until 6:30 p.m., with a scheduled 15-minute headway. However, because the buses do not have an exclusive bus lane, the bus schedule is highly unreliable. The bus fare is 3500 IDR (Indonesian rupiahs), which is equivalent to about 25 cents USD) for general passengers and 1000 IDR (7 cents USD) for students and senior citizens. Passengers may transfer to different routes for no additional charge.

3.2. Passengers' socio-demographic characteristics

The questionnaire was completed by 580 respondents. Table 1 presents a summary of the socio-demographic characteristics of these TS BRT passengers. Young single females were the most common TS BRT passengers. The proportion of passengers under 25 years old was 75%, while those above 55 comprised only 4% of the sample. Regarding gender, the females dominate the Trans Semarang BRT customer base (79%). Most of the passengers were single (69%).

In terms of occupation, most Trans Semarang BRT users were students (63%), while 28% were workers; the rest were unemployed (including homemakers). Most passengers (67%) did not have a monthly income or earned less than 500,000 IDR (about 34 USD) per month. Passengers who earned above 3.5 million IDR (about 241 USD) were only 1% of the sample. The minimum wage in the City of Semarang was about 2.5 million rupiahs (about 172 USD) per month at the time of this study.

Few passengers (8%) came from families that did not have motorized vehicles. Most of the passengers (92%) came from families with at least one motorized vehicle of some kind (primarily motorcycles), and 60% of the passengers came from families that owned more than one motorized vehicle. However, most passengers (61%) had families with four or more members living in a single household. The proportion of TS BRT passengers who did not live with their families, meaning they

lived alone apart from the family in a rented room or house, was quite large (44%). This group includes people who did not have access to motorized vehicles owned by their families (captive). This group includes passengers who were categorized as students. Only 34% of respondents who lived away from their families had exclusive use of a motorized vehicle.

Table 1

Respondents' socio-demographic characteristics

Demographic	Freq.	Percentage		Demographic	Freq.	Percentage
Gender:				Monthly salary (million rupiahs):		
Female	377	65%		< 0.5	256	67%
Male	203	35%		0.5-0.9	6	2%
Marital status:				1.0-2.0	29	8%
Married	121	21%		2.1-3.5	68	18%
Single	459	79%		3.6-5.0	18	5%
				>5	3	1%
Age (years):				Housing types:		
<17	73	13%		Family home	323	56%
17-24	357	62%		Boarding house	256	44%
25-34	58	10%		NA	1	0%
35-44	10	2%		The number of the family member:		
35-45	21	4%		1	10	3%
45-55	39	7%		2	19	6%
>55	22	4%		3	99	30%
Occupation:				4>	199	61%
Student	363	63%		The number of motorized vehicles owned by family:		
Worker	162	28%				
Unemployed	48	8%		0	43	8%
Other	7	1%		1	167	32%
				2	214	41%
				3	101	19%

3.3. Passenger satisfaction

Fig. 1 shows the overall frequency distribution of passengers' satisfaction with the TS BRT services. Overall satisfaction disperses from the lowest score of one to the highest score of 10. The mode satisfaction value is eight, and the median value is about 7.3. Over 80% of passengers gave a score of six or higher, showing that they were relatively satisfied with the bus service.

Table 2 presents the frequency distribution of the levels of satisfaction among passenger groups. The age variable was regrouped into three levels. Overall, the average level of passenger satisfaction with bus services is 7.56 out of 10. Female passengers were only marginally more satisfied than males. Older passengers tended to be more satisfied than younger passengers.

Regarding passengers' occupations, unemployed passengers (including homemakers) were the most satisfied, whereas students tended to be the least satisfied. On average, married passengers were only marginally more satisfied than single passengers. Based on motor vehicle ownership, those who did not own a motor vehicle were more satisfied than those who did.

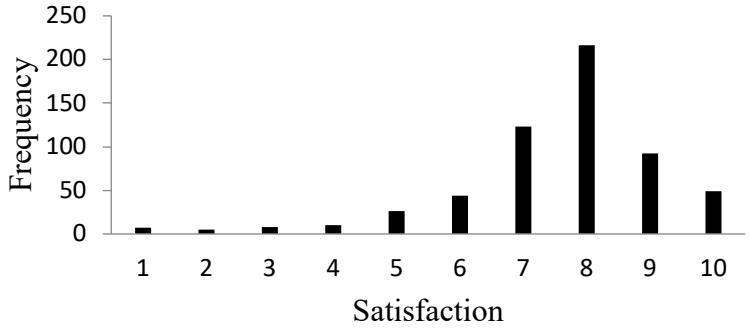

Fig. 1. Frequency distribution of passengers' satisfaction with bus services

Table 2

Frequency distribution of satisfaction levels among passenger groups

Variables	Classes	SATISFACTION										Avg.
		1	2	3	4	5	6	7	8	9	10	
Gender	Female	2	0	5	8	14	31	66	158	61	32	7.69
	Male	5	5	3	2	12	13	57	58	31	17	7.30
Age	Young (<24 yrs.)	4	4	8	10	18	30	102	149	68	37	7.52
	Adults (25-55 yrs.)	3	1	0	0	8	13	21	54	17	11	7.54
	Old (>55 yrs.)	0	0	0	0	0	1	0	13	7	1	8.32
Occ.	Worker	2	1	3	2	7	17	28	61	23	18	7.59
	Student	5	4	5	8	19	26	90	123	57	26	7.43
	Unemployed	0	0	0	0	0	1	5	32	12	5	8.27
Mar.stat.	Married	2	1	0	0	2	8	16	60	19	13	7.89
	Single	5	4	8	10	24	36	107	156	73	36	7.47
Veh.own.	No	0	0	0	0	0	2	7	24	6	4	8.07
	Yes	7	5	8	10	26	42	116	192	86	45	7.51
	Total	7	5	8	10	26	44	123	216	92	49	7.56

4. MODEL BUILDING

Passenger satisfaction data were collected by an onboard survey to calibrate an ordinal logistic regression model in which the independent variables are the passengers' social and demographic characteristics. The dependent variable is overall passenger satisfaction with bus services.

Let response Y = passenger satisfaction levels, with J =10. The passengers are classified based on their gender (male or female), marital status (single or married), occupation (unemployed, student, or worker), age (young: less than 24 years, adult: 25-55 years, or old: over 55 years) and motor vehicle ownership (yes or no). The *polr* function of the MASS package [17] was used to fit the model.

The summary output of the model (Table 3) shows that, since there are 10 levels of responses, we get 10–1=9 intercepts. The model has five predictors, so there are five parameter estimates (slope coefficients, $\boldsymbol{\beta}$s) for the GEN, MARST, OCC, AGE, and VEHOWN variables. GEN has "female" as the baseline, while the baseline for MARST is "married," the baseline for OCC is "student," the baseline for AGE is "adult," and the baseline for VEHOWN is "no." The parameter estimates yield estimated logits, hence the estimates of $P\,(Y \leq j)$ [20].

Table 3

Summary Output for Fitting the Proportional-odds Model

Variables	Coefficients	Standard Error	t - value	p-value
GEN-Female (baseline)	0.0000			
GEN-Male	-0.3057	0.1622	-1.885	0.059
MARST-Married (baseline)	0.0000			
MARST-Single	-0.6871	0.3415	-2.012	0.044
OCC-Student (baseline)	0.0000			
OCC-Unemployed	0.9423	0.3607	2.613	0.009
OCC-Worker	0.3948	0.2255	1.751	0.080
AGE-Adult (baseline)	0.0000			
AGE-Old	0.6246	0.392	1.593	0.111
AGE-Young	1.0101	0.3188	3.169	0.002
VEHOWN-No (baseline)	0.0000			
VEHOWN-Yes	-0.4458	0.2726	-1.636	0.102
Intercepts:				
	Value	Std. Error	t value	p-value
1|2	-4.5802	0.535	-8.5617	0
2|3	-4.0289	0.4763	-8.4581	0
3|4	-3.5016	0.44	-7.9577	0
4|5	-3.0771	0.4205	-7.3183	0
5|6	-2.3954	0.4011	-5.9727	0
6|7	-1.7088	0.3904	-4.3767	0
7|8	-0.5648	0.3828	-1.4753	0.14
8|9	1.0998	0.3857	2.8514	0.004
9|10	2.3585	0.4038	5.8405	0
Residual Deviance: 2007.594 (df: 16)				
AIC : 2039.594				

An examination of the p-values in Table 3 suggests that, except for GEN and VEHOWN, each variable may contribute to the model. GEN and VEHOWN failed to achieve the 0.05 level of significance, although the GEN variable came close. The estimated coefficients for GEN, which estimate the log odds for male passengers versus the reference value of females—along with the estimated coefficients for VEHOWN, which estimate the log odds for owning a vehicle versus the reference value of not owning one—suggest that these categories are similar since the p-values are not significant. If the 0.10 level of significance was used instead, the results would suggest that male passengers are less satisfied with the bus service than female passengers, and those who own motor vehicles are less satisfied with bus service than those who do not.

The estimated coefficients for OCC-Unemployed suggest that the log odds of unemployed passengers differ from those of students. The estimated coefficients for OCC-Worker, which estimate the log odds for workers versus the reference value of students, suggest that these categories are similar since the Wald statistic is not significant. OCC-Worker failed to achieve the 0.05 level of significance. These results suggest using a simpler model that dichotomizes OCC into two levels: non-worker (unemployed) and worker/student. If the 0.10 level of significance was used instead, the results

would suggest that working passengers are more satisfied with the bus service than students and that unemployed passengers are more satisfied than employed passengers.

Table 4

Summary output for a simpler model

Variables	Coefficients	Standard Error	t value	p-value
MARST-Married (baseline)	0.0000			
MARST-Single	-0.919	0.3312	-2.775	0.006
OCC-Student/Worker (baseline)	0.0000			
OCC-Unemployed	0.647	0.2985	2.167	0.030
AGE-Adult/Old (baseline)	0.0000			
AGE-Young	0.7234	0.2981	2.427	0.015
Intercepts:				
	Value	Std. Error	t value	p-value
1|2	-4.5866	0.4228	-10.8475	0.000
2|3	-4.0387	0.3454	-11.6914	0.000
3|4	-3.5134	0.2933	-11.9805	0.000
4|5	-3.0896	0.2632	-11.7402	0.000
5|6	-2.4113	0.2314	-10.4186	0.000
6|7	-1.7301	0.2137	-8.097	0.000
7|8	-0.6039	0.2005	-3.0122	0.003
8|9	1.0344	0.2037	5.0773	0.000
9|10	2.2884	0.2335	9.7985	0.000
Residual Deviance: 2019.029				
AIC: 2043.029				

The estimated coefficients for AGE-Young suggest that the log odds of younger passengers differed from that of adult passengers. The AGE-Old had a positive estimate effect, implying that older passengers are more satisfied than adult passengers, but these estimates fall short of statistical significance. The estimated coefficients for AGE-Old, which estimate the log odds for older passengers versus the reference value of adult passengers, suggest that these categories are similar since the Wald statistic is not significant. The AGE-Old variable did not achieve the 0.05 level of significance and would not have even if the 0.10 level of significance was used instead. These results suggest using a simpler model that dichotomizes AGE into two levels: Young (less than 25 years old) and Adult/Old (25 years old and older).

The results of fitting the simpler model are shown in Table 4. The new dichotomous variables are labeled OCC and AGE in the output. All the estimated coefficients of each variable category differ significantly from their respective baseline categories. The deviance value, which follows the chi-square distribution, was used to test the overall model goodness-of-fit. Based on the chi-square test of the deviance value (2019.029, with 12 degrees of freedom), the null hypothesis (i.e., the resulting model has explanatory power equal to the model that only has a constant) was rejected. A comparison between the extended model in Table 3 and the reduced model in Table 4 shows an insignificant impact of socio-demographic aspects on overall passenger satisfaction under a more restrictive significance level. Those passenger socio-demographic aspects are related to gender and vehicle ownership.

5. MODEL INTERPRETATION

Table 4 presents the coefficients for the proportional odds model. Based on the signs and magnitudes of the coefficients, several results immediately stand out. The first variable–marital status–has highly significant and adverse effects. Single passengers are less likely than others to be satisfied

with bus services. The following two variables are also significant and have a positive effect. Passengers who are unemployed (including homemakers) are more likely than employed passengers (including students) to be satisfied. Also, younger passengers are more satisfied with the bus service than older passengers.

The model can be written as Equation (3):

$$logit[P(Y \leq j|\boldsymbol{x})] = \alpha_j - 0.919MARST_{Single} + 0.647OCC_{Unemployed} + 0.7234AGE_{Young},\ j = 1, \ldots, J-1 \quad (3)$$

where $\boldsymbol{x}$ is the level of the explanatory variable (*MARST, OCC,* or *AGE*).

For illustrative purposes, consider the logit for a young single worker who identifies as having a satisfaction level of 5 or lower. Plugging in values returns the estimated log odds. The baseline level for occupation in this model is Student/Worker, so we set x = 0 for $OCC_{Unemployed}$ when doing calculations. By entering the suitable values into Equation (3), we get -3.2852.

Equation (1) can then be converted into a probability, and the means take the inverse logit. The equation for this is:

$$P(Y \leq j) = exp(\alpha j - \beta x)/(1+exp(\alpha j - \beta x)) \quad (4)$$

Applying -3.2852 to Equation (4), we get 0.038889. This result is a cumulative probability. The probability of having a level of satisfaction of five or lower for a young single worker is about 0.038889. To calculate P(Y=j), P *(Y≤j–1)* is subtracted from *P(Y≤j)* as shown in Equation (5):

$$P(Y=j) = P(Y \leq j) - P(Y \leq j-1) \quad (5)$$

For example, the probability of a young single worker having a level of satisfaction of 5 is 0.013771.

6. DISCUSSION

In the present study, we addressed passengers' satisfaction with public bus services in the Semarang, Central Java, Indonesia, which is a developing city in a developing country in which the roadway traffic is dominated by motorcycles (about 70%). The majority of passengers could be characterized as young, female, single, and students. The study focused on the association between passengers' satisfaction and some of their demographic characteristics, namely gender, age, marital status, occupation, monthly income, housing type, family size, and motor vehicle ownership. Based on previous studies on this topic, the link between passenger satisfaction and their socio-demographic characteristics was not always straightforward [22]. This study revealed that marital status, occupational status, and age are significant factors in determining passenger satisfaction with public bus services.

Gender and motorized vehicle ownership were only marginally statistically significant factors for passengers' satisfaction with bus services. This study suggests that the satisfaction of male passengers with the overall bus service was not significantly different from that of their female counterparts. Regarding vehicle ownership, the level of satisfaction of passengers whose families owned motorized vehicles (choice riders) was not significantly different from that of passengers who did not (captive riders). We should note that a respondent's ownership of a motor vehicle does not always mean that this individual chooses to use it exclusively. The other member of the family probably uses the vehicle.

This study reveals that a passenger's satisfaction with public bus services is significantly affected by their marital status. Single passengers were less satisfied than married passengers. This finding is consistent with another study showing that greater satisfaction was associated with being married [9]. Hall and Dornan [7] also found that higher satisfaction was slightly meaningfully connected to being married.

Meaningful differences exist in passengers' satisfaction with public bus facilities, subject to the occupational status of the travelers. Unemployed passengers were more satisfied than students or workers. The level of satisfaction of students with the overall bus service was not significantly different from that of workers. Considering that students and employed individuals have a higher status than those who are unemployed, this result contrasts with the work of Hall and Dornan [7], who

stated that the "greater satisfaction was marginally significantly related to having higher social status." In a study comparing four types of occupations (entrepreneurs, liberal professionals, government employees, and managers of enterprises), Oyewole [9] found that passengers with a higher professional status tended to be more content than other passengers with the elementary amenities in the airline industry.

Regarding passengers' age, the present study found that significant distinctions exist in passengers' satisfaction with public bus facilities, depending on the age of the passengers. Young passengers were more satisfied than adult or old passengers. The satisfaction level of adult passengers was not significantly different from that of passengers aged above 55 years old. Hall and Dornan's study also showed that "greater satisfaction was significantly associated with being older [7]." In contrast, Oyewole [9] found that age did not have a significant effect.

It is apparent from the present analysis that passengers from different socio-demographic groups reported different levels of satisfaction. The higher the socio-demographic status of the passengers, the lower their level of satisfaction. The observed differences are likely caused by passengers' reasons for using public buses [23]. Public bus services are provided to enable citizens to reach their intended destinations within a city. Passengers use public transport for different reasons, which could be based on necessity or choice. In this study, we could categorize most of the passengers as captive riders. Single female students and lower-paid workers represent the most common types of riders. Captive passengers rely heavily on affordable public transportation services.

7. CONCLUSION

This study reveals that socio-demographic factors affect passengers' satisfaction with public bus services. Passengers' socio-demographic variables are essential to explaining how passengers feel about bus services. The study suggests that passengers' socio-demographic characteristics should be considered in the decision-making process and should not be underestimated because it is likely to influence passenger satisfaction.

The present study shows differences in satisfaction across different socio-demographic groups. Passengers' socio-demographic backgrounds are fundamental to evaluating public bus services, especially when developing targeted policies to enhance passenger-centered services. The results of this study affirm the requirement for a proactive approach to adjusting the conveyance of public bus services to suit the ways of life, needs, and desires of various fragments of the population, as well as to improve practices that address the needs of different types of passengers.

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