

# A Study on the Barriers and Challenges for the Usage of Active Transportation in Sri Lanka

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## ABSTRACT

Active transportation includes human-powered travel like walking, cycling, and skating. Active Transportation offers various benefits for users, society, and the economy in Sri Lanka. However it is not widely recognized as a primary commuting mode for daily travelers. This study mainly focuses on identifying potential barriers and potential challenges to the usage of active transportation in Sri Lanka and identifying the relationship between them especially focusing on the Colombo district. The study is limited only into the cycling because of the availability of data. The study has a quantitative approach and its cross-sectional study. A questionnaire was distributed physically and online to daily Colombo commuters for work, education and other purposes. Using convenience sampling, 384 responses were collected. The collected data were analysed by using IBM SPSS statistical tool. Most daily travelers to Colombo are males, with females fewer due to safety concerns while cycling. The majority belong to the millennial/Gen Z generation. Their trips prioritize work, followed by leisure activities. Few come for studies. The study has found four potential barriers and three potential challenges to the usage of active transportation. Identified barriers are infrastructure barriers, safety barriers, environmental barriers, and public perception about cycling. Identified challenges are costs related to cycles, air pollution, and educational aspects. It was also identified that there are negative relationships to the usage of active transportation in Sri Lanka from the above-mentioned barriers and challenges. As recommendations to future studies, it is better to look at other types of active transportation without limiting cycling focusing on the whole Sri Lankan context as this study is based only on Colombo. It will be good for future researchers can focus on the benefits and impact of potential barriers and challenges of active transportation.

This study also provides some recommendations like creating new transport policies to promote cycling in Sri Lanka.

**Index Terms**— *Active Transportation, Potential Barriers, Potential Challenges, Cycling*

## INTRODUCTION

Active transportation, encompassing walking, cycling, and various non-motorized modes such as rickshaws, skateboards, and wheelchairs, serves both transportation and recreational purposes. (VTPI, 2010; gTKP, 2010). Diverse modes cater to different needs and communities, contributing to more efficient and equitable transportation networks. Within this system, walking and cycling stand out as the primary active transportation choices, with walking being an ancient mode of travel while cycling emerged roughly two centuries ago. Walking, the oldest form is as old as the species, while cycling, the second, is only about 200 years old. Researches have observed a clear decline in active transportation in from the end of the 20<sup>th</sup> century in most countries such as USA, UK, European countries and etc. In USA according to the national transportation survey data which is providing longitude data has shown that walking has fallen from approximately 9.3% in 1969 to only 8.6% of all recorded trips in 2001, although changes in survey methods suggest the earlier figure may be artificially low (Florida Department of Transportation and Center for Urban Transportation Research, 2006:4).

Specially in Sri Lanka cycling is not identify as a mode of transportation for commuters. Most of the middle class families own their vehicles so they can move from one place to another easily with the availability of fuel in the country. Sri Lanka's transportation system depends heavily on automobiles. This indicates that access to other modes of transportation is generally limited and that land use patterns and transportation

infrastructure primarily promote automobiles. Traffic congestion has become a huge problem in Sri Lanka. Mainly highly populated cities like Colombo, Kandy, and Gampaha are suffering from traffic congestion. In Colombo and other major cities, traffic congestion occurs during certain times of the day which are called speak periods or rush hours. The balance between the demand and the supply of road space is identified as the main two clear parameters which impact the creation of traffic congestion. (Amal , 2004).

As per Damunupola A.K.A (2021) challenges for cycling in Sri Lanka are categorized under 3 categories as safety and security, infrastructure facilities, and product and process related issues. Fernando, D. (2022) has stated that the barriers are included poor city planning in urban areas and excessive regulations in the country. Also many of the members of the workforce, living far away from their workplace and they have to have a convenient mode of transportation not only for reporting to work but also for other personal needs.

From early 2022, the government of Sri Lanka has suspended activities in oil refineries due to a shortage of crude oil inventories. Because of that people didn't get the chance to travel to fulfill their day-to-day work as they used to. Due to this situation, people started using active transport modes to full fill their basic short trips. As lots of people had to continuously queue up in fuel stations due to the fuel shortage, a lot of people moved bicycles and walking as their daily commutes. ( Times of India, 22 July 2022). This has reduced traffic congestion as well as impacted the environment in a good way. But after the fuel crisis was solved, people again changed to using their private vehicles for cycling. It indicates that there's an issue for the usage of active transportation. Those issues can be either barriers or challenges which limits commuters from choosing active transportation as their mode of transport.

The main objective of the study is to identify the barriers to the usage of active transportation in Sri Lanka. The secondary objectives are to identify the barriers to implementing active transportation in Sri Lanka and identify the relationship of barriers and challenges with the usage of active transportation.

## RESEARCH METHODOLOGY

### *Independent Variables*

### *Dependent Variable*

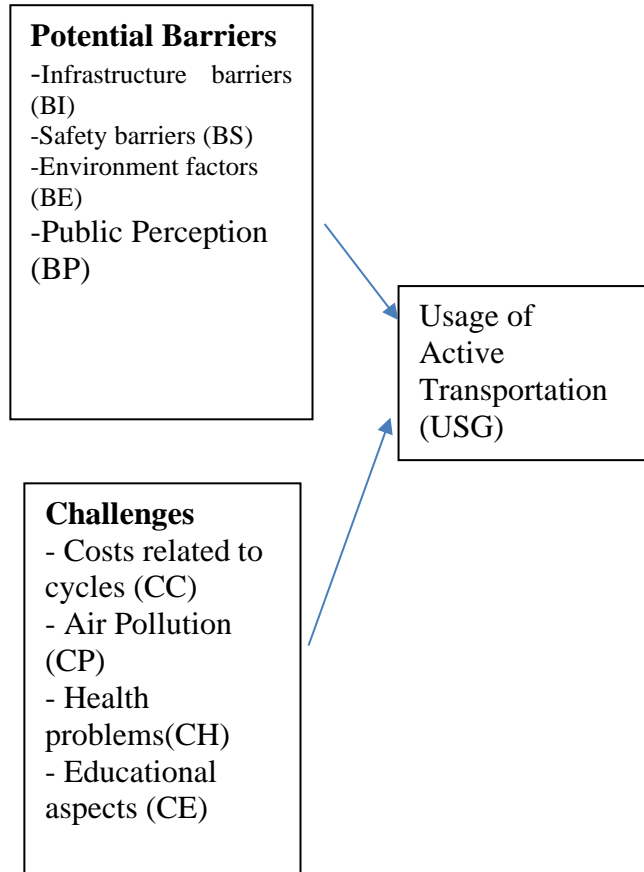


Figure 1 – Conceptual Framework

The conceptual framework for the study is developed based on literature review. Independent variables are derived from existing models and case studies, focusing on infrastructure, safety, environment, and public perception. Potential challenges include economic factors, air pollution, education, and health problems. The study's dependent variables include the frequency of cycling, likelihood to cycle in the future, and recommending cycling to others. The study area is the Moratuwa to Colombo fort stretch, chosen based on land use

patterns. The target population is daily commuters in the Colombo district, specifically those traveling from Moratuwa to Colombo fort along the Galle road corridor. The sample population, selected through convenience sampling, comprises individuals using active transportation. With a 95% confidence level and a 5% margin of error, data were collected from over 384 respondents. Convenience sampling was chosen due to Colombo's large population and the practicality of selecting participants from the Galle road corridor, allowing for a more detailed exploration of individual perspectives on active transportation.

The study collected primary data through a survey distributed among the sample population. The survey instrument was a questionnaire structured around the conceptual framework variables. The questionnaire had four categories: demographic factors, two categories related to independent variables, and a final category based on the dependent variable. Respondents used a likert scale to provide answers to questions related to the variables, allowing for a structured assessment of their perspectives.

### **Data Analysis**

Factors affect to Barriers for active transport evaluate by using SPSS statistics package. Descriptive statistics are then applied to analyze answers to the questions on the identified barriers and challenges (mean, median, standard deviation, and frequency). To do the analyses, the variables relating to the identified barriers will be recorded in 5 categories;

### **Validity and the Reliability**

To ensure the reliability of the scale in multiple likert scale questionnaire, cronbach's alpha is used. Questionnaire is considered to be more reliable to collect primary data pertaining to the survey, if cronbach's alpha co-efficient value is superior.

### **KMO and Bartlett's Test**

The proportion of variances in the variables that might be caused by underlying factors, are indicated as a statistic in Kaiser-Meyer-Olkin (KMO) test. The higher values which are closer to 1.0 generally indicates that the factor analysis is useful with the data. If the values are less than 0.50, the factor analysis probably won't be useful.

Higher KMO value gives a higher correlation between variables. The test measures the sampling adequacy of each measure as well as the complete model. There are several rules of thumbs stated by the authors when applying the Kaiser-Meyer-Olkin (KMO) test

Bartlett's test, test for hypothesis that the correlation matrix is an identity matrix. It illustrates the redundancy between variables. The test is also utilized to create a solid relationship between variables. This test is used to determine the homogeneity of the variables. The test is also used to verify the assumptions, that variances are equal across groups or samples. If the KMO value is more than 0.7, Bartlett's test is also significant.

### **Reliability Test for Created Factors**

Reliability of variables is are calculated by using cron batch alpha. Reliability test for the created factors and for the overall data set transcended the value of 0.6 of cronbach's alpha value demonstrating that the reliability of the variables is in an adequate level and data set can be analyzed.

### **Descriptive Analysis**

Descriptive statistics tend to describe the basic features of the data in the study. The quantitative descriptions of the of the study is presented in a manageable form by the descriptive statistics. This research has utilized the responses of 384. This large amount of data is simplified in a sensible way through the descriptive statistics. This method is use to find frequency circulations, measures of mean, median, mode and also measure of variability. Also demographical factors of the research like age, gender, income level, educational level, purpose to travel to colombo are analyzed by using descriptive statistics.

### **Inferential Analysis**

*Regression analysis (Linear regression model and other diagnostic tests)*

In this research regression analysis is utilized to examine the influence of one or more independent variables on the dependent variable. The method makes the study easier and flexible. The process of performing regression allows to confidently determine which factors matter the most, which

factor can be ignored and how the factors influence each other. Durbin watson test is carried out to find if there is a relationship with other variables. Regression model is having several assumptions. Regression model should be correctly specified. If there are 04 independent variables, that model should be specified for 04 independent variables as,  $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4$  5. Regression model should be linear Association between independent and dependent variables should be linear.

**Model Summary**

According to the model summary, multiple correlation is given by R. This indicates the strength of the joint association between independent variables and dependent variable, passenger satisfaction. Following decisions are taken based on the value of multiple correlation. If,  $R \geq 0.7$  (Strong association)  $R \geq 0.5$  (Average association)  $R < 0.5$  (Weak association) Coefficient of determination is given by R square. That is the proportion of the dependent variable covered by the regression model is explained by R square and the value is always lying between 0 and +1.

*Analysis of variance (Regression ANOVA)*

Jointly significance of the result is tested using the ANOVA table. Probability of F test statistics should be significant ( $P \leq 0.05$ ) to model to be appropriate indicating independent variables jointly influence on passenger satisfaction. If the probability of F test statistics is insignificant, the model is not valid.. Determination of the coefficients individual effect is tested by using coefficient table. If the probability values of the coefficient are significant, those variables are having individual effect also in addition to the jointly effect.

**RESULTS**

Table 1- Validity

<b>KMO and Bartlett's Test</b>		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.85 1
Bartlett's Test of Sphericity	Approx. Chi-Square	111 7.1 42
	Df	36
	Sig.	.00 0

Source – Research Data

KMO (Kaiser-Meyer-Olkin) test is a measure of sampling adequacy used in factor analysis to determine if the data set is valid and suitable for factor analysis. Bartlett's test of sphericity, on the other hand, is a test of whether the correlation matrix between variables is significantly different from an identity matrix. Values closer to 1 indicate that the data set is highly valid for factor analysis,

In the table KMOL value is close to 1, It is 0.851, It shows the data is highly valid and suitable for the factor analysis.

The significance value of the table which also known as P value of the Barlett’s test is came as 0.000. From the results it can be identified that, the above value is lesser than the const and significance value of 0.05. It can be indicated that the validity and suitability of the responses collected to a study has being addressed through the study.

Anova

The probability of F test statistics of the regression ANOVA is highly significant. This means that the model is jointly significant. According to table, significant value ( p-value) is equal to 0.00. It is less than the constant significant value 0.05, which means the ANOVA table is significant. Therefore, it can be

interpreted that independent variables jointly influence identify barriers and challenges which reduce the usage of Active Transportation. Hence this model is highly valid.

Table 2- Reliability

Variable	Cronbatch's Alpha	N items
<b>Infrastructure Barriers</b>	0.639	3
<b>Safety Barriers</b>	0.676	3
<b>Environmental barriers</b>	0.598	3
<b>Public Perception</b>	0.621	3
<b>Costs related to cycles</b>	0.632	3
<b>Air Pollution</b>	0.765	3
<b>Health Problems</b>	0.741	3
<b>Educational aspects</b>	0.721	3
<b>Usage of Active transportation</b>	0.748	3

Source- Research Data

When analyzing cronbatch’s alpha values , air pollution, health problems ,educational aspects and usage of active transportation (Dependent variable) have values more than 0.7. It has higher internal consistency and in highly acceptance level. Values for infrastructure barriers, safety barriers, public perceptions and costs related to cycles are over 0.6. Those also in acceptable level. Environmental barriers has a value of 0.598, even though it is less than 0.6, it is really closer for that value. So it can be interpreted that also this value can be accepted.

Since all the variables have values very close to 0.7, each of these eight (8) elements have an adequate value in terms of internal consistency, accuracy, and reliabilit

Table 3- Correlation Analysis

Independent Variables		Usage of Active Transportation
<i>Infrastructure Barriers</i>	Pearson Correlation	-.395**
	Sig. (2-tailed)	0.000
	N	389
Safety Barriers	Pearson Correlation	-.448**
	Sig. (2-tailed)	0.000
	N	385
Environmental barriers	Pearson Correlation	-.301**
	Sig. (2-tailed)	0.000
	N	387
Public Perception	Pearson Correlation	.330**
	Sig. (2-tailed)	0.000
	N	389
Costs related to cycles	Pearson Correlation	-.426**
	Sig. (2-tailed)	0.000
	N	389
Air Pollution	Pearson Correlation	-.441**
	Sig. (2-tailed)	0.000
	N	389
Educational aspects	Pearson Correlation	-.408**
	Sig. (2-tailed)	0.000
	N	389
Health problems	Pearson Correlation	-0.006
	Sig. (2-tailed)	0.902
	N	389
<b>**.</b> Correlation is significant at the 0.01 level (2-tailed).		

Source – Research Data

The table displays the correlations between independent variables and the dependent variable. With the exception of public perception, all independent variables exhibit negative correlations with the dependent variable. It indicates a decrease in active transportation usage. The strongest factor reducing active transportation is safety barriers (-0.448), while public perception shows a slight positive relationship. However, the impact of public perception on increasing active transportation usage is uncertain. Health problems are found to be insignificant and cannot be considered an independent variable affecting active transportation usage.

Table 4 – CORRELATIONS

Model		Unstandardized Coefficients	Std. Error	Significance
1	(Constant)	0.755	0.249	0.003
	Infrastructure barriers	-0.185	0.048	0
	Safety barriers	-0.242	0.051	0
	Environment barriers	-0.006	0.049	0.009
	Public Perception	0.008		
	Costs related to cycles	-0.077	0.059	0.019
	Air Pollution	-0.262	0.061	0
	Educational aspects	-0.171	0.057	0.003
<b>a Dependent Variable: Usage of Active Transportation</b>				

Source – Research Data

All the probabilities of above discussed six independent variables are highly significant with negative beta values. This shows that those independent variables influence negatively on the dependent variable which means they reduce the usage of active transportation. Only one independent variable has a positive beta value (public perception independent variable does not influence individually but can be influenced jointly).

Concerning the regression analysis and coefficient value, the study developed a function with their respective beta values. The function is illustrated as follows,

$$\text{Usage of Cycling} = 0.755 + (-0.185)\text{Infrastructure barriers} + (-0.242)\text{Safety barriers} + (-0.006)\text{Environmental Barriers} + (0.008)\text{Public Perception} + (-0.077)\text{Costs related to cycles} + (-0.262)\text{Air Pollution} + (-0.171)\text{Educational Aspects} + \epsilon$$

In the above-mentioned equation, the beta values of each independent variable show the one-unit change of the independent variables will have an impact on the dependent variable, usage of active transportation

Table 5  
One Sample T Test (Testing Hypothesis)

	T	Sig. (2-tailed)	Mean Difference
Infrastructure Barriers	100.88	0	3.90488
Safety barriers	92.909	0	3.81662
Environment barriers	118.547	0	4.04861
Public Perception	109.577	0	3.46392
Costs related to cycles	96.897	0	3.73265
Air Pollution	93.588	0	3.65467
Educational Aspects	112.719	0	3.99572
Health Problems	101.54	0	3.77806
Usage of Active transportation	63.211	0	2.98029

Source – Research Data

From the above one sample test table, it can be shown that all significance values of independent variables are equal to 0.00. It means that they are lesser than the chosen level of significance 0.05. It indicates that null hypothesis related to the independent variables can be rejected and also can be concluded that the sample mean is significantly different from the hypothesized population mean.

From above interpretations following null hypotheses can be rejected.

- Potential barriers do not impact the usage of active transportation – H1,0
- Potential Challenges Factors do not impact the usage of active transportation – H3,0

### Descriptive Statistics

All the means of the descriptive statistics are closer to the maximum statistics level and those means are above 3.5. It indicates that responses regarding variables are at an agreed level. The quantitative level of the likert scale is 1 -5. All the means are close to the likert scale 4.

The dependent variable, usage of active transportation has the highest standard deviation. It indicates that it has a comparatively higher variance. From independent variables, safety barriers have the highest standard deviation as it has a higher variance compared to other independent variables. Public perception has the lowest number of standard deviations, which indicates it has a variance.

Skewness levels are measured from -1 to +1. From skewness, it can be measured the asymmetry of a probability distribution. In descriptive statistics, it indicates the degree to which a distribution deviates from symmetry. In this statistic, all the skewnesses are having negative results. The majority of the observations in the dataset are concentrated towards the higher end of the scale and there are fewer observations towards the lower end. In other words, the data is lopsided towards the left. However since all the data are located within the range of -1 to +1, it can be said that this data has a normal distribution.

There are 3 negative kurtosis values in the data set for safety barriers, public perception, and health problems. It indicates that the distribution of those variables is flatter (more spread out). This means that the data values are more dispersed and have fewer extreme values (i.e., values that are much larger or smaller than the mean). The majority of the data values are clustered around the mean, with fewer values in the tails of the distribution. But absolute values of kurtosis are less than three times of standard error of kurtosis, it also shows that the data has normal distribution.

From the skewness values and kurtosis values, it can be interpreted that the data has a normal distribution, and therefore other tests (pearson correlations) can be carried out to analyze the data.

Although many researchers have concluded that barriers to transportation, few studies have investigated this relationship concerning cycling.

Some studies have shown either challenges or barriers to cycling. The results of this study showed both the potential barriers and challenges for cycling in the Sri Lankan context. As expected, the study has found relationships with potential barriers and challenges with cycling. Some studies, it has shown that a person's need for acceptance from family and social groups grows with their network size. The decision to cycle as transportation can be influenced by these groups' views. (Xing et al., 2010). Subjective norms play a significant role in the decision to commute by bike. Coworkers' cycling behavior and employer-provided financial incentives also impact bike usage. (Dill & Voros, 2007). Even this study, has identified that the income level of the people also impact to the active transportation as a barrier, specially people with higher income levels tend to use their own private vehicles. Perception of colleagues towards using cycling and Personal statuses which people likely to maintain also affect to the usage of active transportation.

Infrastructure barriers impact to cycling in 3 different ways according to the study. Land Use mix in Colombo City specially the enough space in the city, housing density, compactness, street interconnectivity, and the degree of land use mix are all influence to do active transportation (Badland et al., 2008). Present of cycle lanes on the road and limited parking for cycles in Colombo metropolitan area affect to choice of cycling. Due to the lack of bike lanes on the roadways, cyclists must share the same area with cars, and the absence of separation increases the risk to their safety. In a research conducted by Tin et al. (2010), 88% of participants stated that the presence of bike lanes would significantly increase their likelihood of cycling.

As the Environment barriers, distant from households to Colombo city and delays caused by high traffic conditions impact cycling. Based on a survey of Austin, Texas citizens, residents frequently drive to stores nearby since crowded roads make it hard to take a walk there. (Susan et al., 2001).

According to Mogaji, (2022), commuters in Lagos worry about the costs related to cycles, costs related to buying a good new bicycle as well as repairing costs of bicycles that can be used for

commuting. Also, there is an issue with the prices of safety gear to protect themselves when cycling. By conducting the study, it has been identified that this also affects Sri Lanka more than other challenges as this is a 3<sup>rd</sup> world country and the economic changes are so high. With the current economy of the country, all of these prices are getting higher, so it directly affects, people who have to spend more just for cycles from their income.

There are so many downloops in educating people about the usage of cycling in the current system in Sri Lanka. There aren't any programs for educating people about cycling practices and benefits. Also, in the school curriculum, there isn't any extensive training about safe and effective cycle techniques. In Danish schools, syllabuses are included with class lessons as well as training on roads. They first put kids cycling training tracks specifically made for children and then on regular cycling facilities all over the city (Pucher et al. 2010). Drivers should be educated about the safety of pedestrian users and cyclists. Because of these things education aspects also affect the usage of active transportation. Even if they violate traffic laws, drivers in Germany, Netherlands, and Denmark are nonetheless held liable for accidents with children and adult bikers. (Pucher & Buehler., 2008).

When talking about air pollution, misted and unclear polluted air, diseases which can be caused by exposure to air pollution and exhaust fumes by motorized vehicles make people think of using cycling as when using a cycle, commuters are always exposed to those things it can be imparted to them. When air quality declined, bicyclists were inclined to keep cycling if they felt more comfortable and safer. Fewer individuals commute by bicycle, policies aimed at encouraging a pleasant atmosphere for riding should be paired with the substantial investments made to improve bicycle infrastructure, as they are likely to be replaced by. (Zhao et al., 2018)

Chen. et al. (2016) shows that Chinese adults throughout the past twenty years, has been associated with an ongoing decrease in physical activity and a rise in poor diet, both of which boost the risk of developing these illnesses. Even though some studies have shown health problems as a challenge to do active transportation, in this



study it has shown that it doesn't directly implies with the Sri Lankan context.

## CONCLUSION

Three out of the four potential barriers, excluding public perception, display a negative correlation with the usage of cycling in Sri Lanka, indicating that these variables diminish the utilization of cycling. Similarly, all three identified potential challenges show inverse relationships with cycling, suggesting a reduction in usage.

Future research would benefit from exploring other forms of active transportation, not solely focusing on cycling. This study was based in a segment of the Colombo district, and it would be advantageous for future research to encompass other districts in Sri Lanka, providing a comprehensive national context. It would be beneficial for these studies to concentrate on understanding the impact of potential barriers and challenges in active transportation, along with studies highlighting the benefits associated with it.

The study presents recommendations to promote cycling in Sri Lanka, as well as suggestions for conducting future research in this field. Geographical limitations and some demographic constraints were identified as limitations of this study.

## DECLARATIONS

### A. Study Limitations

There are some limitations to the generalisability of this study to the broader context. In this study only from the available modes of active transportation, Cycling has chosen to carry the study forward. As well, more in-depth discussion with different categories of active transport users (those who are confident/experienced, those who are inexperienced, etc.) is required.

Also, the study survey is conducted in the Galle road corridor from Moratuwata to Pettah which only covers a few cities in the Colombo metropolitan area to represent the Colombo District. Economic Levels will not be considered a barrier to choosing cycling as a mode of transportation.

### B. Acknowledgements

I am thankful to every respondent who participated and spent their valuable time giving answers to the questionnaire and making this effective research.

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I owe my most generous appreciation and gratitude to my family and friends who are always there in my difficult times and pushing me to make it a triumph.

### C. Informed Consent

I participant name, agree to participate in the research project titled project title, conducted by researcher(s) name who has (have) discussed the research project with me.

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