**Course No:**

Plan 446

**Course Title:**

Transportation Planning Studio

**Task:**

***Final Report Submission***

**Submitted by: (Group 03)**

Tahsin Tabassum (1615004)

Nuzath Tabassum Esha (1615014)

Md. H. M. Sabbir (1615021)

Farabi Sarker Shanto (1615025)

Maria Mehrin (1615028)

**Course Teachers:**

Dr. Asif-Uz-Zaman Khan, Professor

Ms. Paromita Nakshi, Assistant Professor

Ms. Nawshin Tabassum, Lecturer

**Submission Date:** 25 July, 2021

Urban and Regional Planning Department

Bangladesh University of Engineering and Technology

# Impacts of Covid-19 Pandemic on Travel Behavior of People in Dhaka

## Acknowledgment

Firstly, we want to express our sincere gratitude and thanks to the almighty Allah, who has provided us with the opportunity to conduct this study smoothly and to submit this report.

We also express deepest gratitude to our honorable teachers, Dr. Asif-Uz-Zaman Khan, Professor, Ms. Paromita Nakshi, Assistant Professor and Ms. Nawshin Tabassum, Lecturer, Department of Urban and Regional Planning, BUET for their kind assistance, thoughtful suggestions, constant guidance, supervision and intense coordination towards the successful completion of the study.

We would like to give special thanks to all the respondents of the Dhaka who gave their valuable time and interest to cooperate with us in filling the questionnaire and providing with the information. Without their assistance the study could not be completed.

We express our heartiest thanks to all our classmates and our group mates for their constant support and inspiration during the study.

We want to express our love and respect to our beloved families for their continuous encouragement and support, through the duration of the study.

Finally we like to thank all of them who wished our well and inspired us throughout the study for the completion of the report.

# Abstract

Travel behavior refers to a complex decision-making process during a trip, regarding travel mode choice, route choice, departure time choice, destination choice. The recent outbreak of the COVID-19 pandemic in Bangladesh, especially in Dhaka, has a significant influence on travel behavior. Various measures imposed by the governments to control the spread of COVID-19 and individual risk perception and safety precautions have influenced travel behavior significantly. This study identifies the changes of travel behavior of Dhaka city due to COVID-19 pandemic and risk perception and travel risk before and during 1st and 2nd wave of COVID-19. An online questionnaire survey was conducted where total 448 persons from all around Dhaka took part voluntarily. The result shows that people have lessened their shopping trips during pandemic while medical purpose trips were considered most important trips during 1st wave of the pandemic. Work trips have most variations of mode changes for travelling across the three time periods. Those who haven't taken the vaccine are found to be perceived higher levels of unsafe. Gender doesn't have any significant impact on the travel behavior. This study introduces choice and captive riders based on the available choice of travel modes. In spite of bus being the most perceived risky mode, captive riders continue to use it. Study shows that captive riders have moderate risk perception which is manipulated by their situation. Outcomes of this study could be useful in transport planning and policymaking based on the travel needs of people. In particular, government could take policies for people attending office on alternate days and other measures to ensure social distancing as people impose the most importance on social distancing while traveling. For making sustainable Dhaka, more importance should be given on the management of MRT and BRT after completing the construction and clear guidelines for adopting office vehicles.

## Table of content:


**Content** **Page No.**

**Acknowledgment** ..... **i**

**Abstract** ..... **ii**

**Table of content:** ..... **iii**

**List of figures** ..... **v**

**List of tables** ..... **vi**

**Chapter 1: Introduction** ..... **1-2**

1.1 Background of the study ..... 1

1.2 Objectives of the study ..... 2

1.3 Scope of the study ..... 2

1.4 Limitations of the study ..... 2

**Chapter 2: Literature Review** ..... **3-8**

2.1 Factors Influencing Travel Behavior of Individuals ..... 3

2.2 Travel Behavior in Dhaka ..... 3

2.3 COVID-19 Situation in Dhaka and Her Response to the Pandemic ..... 4

2.4 Risk Perception during COVID-19 ..... 7

2.5 Studies related Travel Behavior during COVID-19 ..... 7

**Chapter 3: Methodology** ..... **9**

3.1 Data Collection: ..... 9

3.2 Data Analysis: ..... 9

**Chapter 4: Impacts of COVID-19 on Travel Behavior** ..... **10-19**

4.1 Trip Purpose ..... 10

4.2 Trip Frequency for Primary Trips ..... 10

4.3 Mode for Primary Trips ..... 13

4.4 Shift from Bus for Work and Shopping Purpose Trips ..... 15

4.5 Captive and Choice Riders ..... 17

4.6 Socio-Economic Profile of Captive and Choice Riders.....17

**Chapter 5: Risk Perception of COVID-19 and Travel Risk ..... 20-28**

5.1 Risk Perception Index:.....20

5.2 Change in Safety Feeling from First Wave to Second Wave: .....21

5.3 Correlation between Safety Level Change and Change in Frequency for Work Purpose: .....22

5.4 Correlation between Safety Level Change and Change in Frequency for Shopping Purpose:.....22

5.5 Correlation between Safety Level Change and Trip Made outside Dhaka:.....23

5.6 Correlation between Safety Level Change and Vaccination: .....23

5.7 Gender wise Worriedness: .....24

5.8 Correlation between Worriedness and Change in Travel Frequency: .....25

5.9 Aspects Considered Most for Choosing Transport Mode: .....25

5.10 Perceived risk for modes:.....26

5.11 Ranking of Modes for Sustainable Dhaka based on public Opinion:.....27

**Chapter 6: Major Findings, Policy Recommendations and Conclusion..... 29-31**

6.1 Major Findings:.....29

6.2 Conclusion and Policy Recommendations.....30

**References:..... vii-xi**

**Appendix A: Questionnaire ..... xii-xix**

**Appendix B: Risk Perception Index.....xx**

## List of figures

**Figure 2.1**: Thana wise distribution of COVID-19 cases in Dhaka. ..... 6
**Figure 4.1**: Change in frequency from T1 to T2 for work purpose ..... 11
**Figure 4.2**: Change in frequency from T2 to T3 for work purpose ..... 11
**Figure 4.3**: Change in frequency from T1 to T2 for education purpose ..... 11
**Figure 4.4**: Change in frequency from T2 to T3 for education purpose ..... 11
**Figure 4.5**: Change in frequency from T1 to T2 for shopping purpose ..... 12
**Figure 4.6**: Change in frequency from T2 to T3 for shopping purpose ..... 12
**Figure 4.7**: Gender wise change in frequency ..... 12
**Figure 4.8**: Change in mode choice for work purpose due to COVID-19 ..... 13
**Figure 4.9**: Change in mode choice for education purpose due to COVID-19 ..... 14
**Figure 4.10**: Change in mode choice for shopping purpose due to COVID-19 ..... 14
**Figure 4.11:** Modal distribution before COVID-19 for work purpose ..... 15
**Figure 4.12:** Modal shift from Bus for work purpose during 1st wave of COVID-19 ..... 15
**Figure 4.13:** Modal shift from Bus for work purpose during 2nd wave of COVID-19 ..... 15
**Figure 4.14:** Modal distribution before COVID-19 for shopping purpose ..... 16
**Figure 4.15:** Modal shift from Bus for shopping purpose during 1st wave of COVID-19 ..... 16
**Figure 4.16:** Modal shift from Bus for shopping purpose during 2nd wave of COVID-19…. 16
**Figure 4.17**: Percentage of choice and captive riders ..... 17
**Figure 4.18:** Gender distribution of captive riders ..... 18
**Figure 4.19:** Gender distribution of choice riders ..... 18
**Figure 4.20**: Education level of captive riders ..... 18
**Figure 4.21**: Education level of choice riders ..... 18
**Figure 4.22**: Employment status of choice riders ..... 19
**Figure 4.23**: Employment status of captive riders ..... 19
**Figure 5.1**: Classification of choice riders based on risk perception index ..... 21
**Figure 5.2**: Classification of captive riders based on risk perception index ..... 21
**Figure 5.3**: Change in safety feeling of safety from 1st wave to 2nd wave ..... 21
**Figure 5.4**: Aspects considering most for choosing transport mode ..... 26
**Figure 5.5**: Scoring of modes based on risk perception ..... 27

## List of tables

**Table 4.1**: Change in importance of trip purpose.....10
**Table 5.1**: Assigned score according to degree of agreement.....20
**Table 5.2**: Cross tab between change in safety level and change in frequency for work purpose from 1st wave to 2nd wave. .....22
**Table 5.3**: Cross tab between change in safety level and change in frequency for shopping purpose from 1st wave to 2nd wave .....23
**Table 5.4**: Cross tab between change in safety level and trip made outside Dhaka for the last Eid-ul-Fitre.....23
**Table 5.5**: Cross tab between feeling of safety during second wave and number of vaccine doses taken.....24
**Table 5.6**: Cross tab between Gender and people who was more worried in the first wave than second were.....24
**Table 5.7**: Cross tab between who was more worried in the first wave than second wave and who travelled more frequently in second wave than first wave.....25
**Table 5.8**: Assigned score according to choosing transport mode.....26
**Table 5.9:** Assigned score according to perceived degree of risk.....27
**Table 5.10**: Assigned score according to importance .....28
**Table 5.11**: Ranking based on opinion of captive riders.....28
**Table 5.12**: Ranking based on opinion of choice riders.....28

# Chapter 1: Introduction

## 1.1 Background of the study

More than a year has passed since the outbreak of COVID-19 Pandemic (Zafri et al., 2021). Yet it has continued to transmit as 2nd wave with over 190,020,508 confirmed cases and 4,086,950 deaths worldwide (Worldmeter, 2021). Along with the threat to public health, the COVID-19 outbreak has caused enormous disruption in the lifestyle, day-to-day activities and travel behavior around the world (Pawar et al., 2021). Travel is identified as one of the main factors for spreading this infectious diseases worldwide (Anwari et al., 2021). To avoid internal spread, the countries implemented lockdown measures for restricting movement with implying individual level precautions including wearing face masks, cleaning hands, and keeping a distance of 1–2 meters as instructed by WHO guidelines (Zafri et al., 2021).

The first COVID-19 case was reported in Wuhan City, China, in December 2019 (WHO, 2020) and eventually spread all over the world. As of 17 July 2021, there have been around 10.8 million confirmed cases and 17,465 deaths in Bangladesh (Worldmeter, 2021) since the first reported case on March 8, 2020 (World Health Organization Bangladesh, 2020). The severity of the pandemic did lessen during the last few months of 2020 but currently is going through the 2nd wave of this pandemic. The recent discovery of the COVID-19 vaccination has provided a ray of hope (Zafri et al., 2021). Mass vaccination has started on 7 February in Bangladesh and total 4.28 million people are fully vaccinated till now which is 2.5% of population (Google News, 2021). The number is not significant. As a result, restrictive measures including school closures, online teaching, working from home, limited opening of shops and restaurants, restrictions on public gatherings, social events and meeting are still prevailing.

People are modifying their ways of life including travel behavior to continue out their activities until the world come back to a stable condition (Zafri et al., 2021). The travel decisions taken during this changing situation not only depend on the traditional factors identified in the past studies, but also take into account additional factors such as personal safety, and avoiding potential interactions (Neuburger & Egger, 2020), opportunity of teleworking and teleshopping.

During pandemic scenarios, understanding how people's travel behaviors are affected by the COVID-19 pandemic and how they have changed over time can provide useful insights into effectively designing and implementing transportation policies along with COVID-19

mitigation policies (Abdullah et al., 2020). For instance, government could utilize such information for prioritizing measures in improving public transportation services. This study intends to do so precisely by examining changes in travel patterns for various trip purposes "before" and "during the first and second waves" of the COVID19 events in Dhaka, using trip numbers and modes in relation to socioeconomic characteristics and risk perception.

### 1.2 Objectives of the study

The present study focuses on the following objectives:

1. To explore changes in travel behavior of people in Dhaka from before the pandemic to during 1st and 2nd wave of COVID-19
2. To identify the risk perception of COVID-19 and travel risk during 1st and 2nd wave of COVID-19

By examining the variations in travel behavior, the present study will assist the policymakers and transport authorities in understanding the dynamics of fluctuating travel demand during pandemic situations like COVID-19.

### 1.3 Scope of the study

This study seeks to identify the impact of travel behavior during covid-19 pandemic of people of Dhaka city which includes their socio-economic characteristics reason behind travel time, trip purpose, travel mode, etc. This study also introduces choice and captive riders. As there was previously no such study done particularly on this topic in Dhaka, there is an immense scope for the decision maker, transport planner, engineers and other stakeholder to develop travel behavior during and before covid-19 pandemic by providing services for mitigating there sufferings. This can be used as a base line data for undertaking further research in the future.

### 1.4 Limitations of the study

It was not possible to conduct the survey in all the areas of Dhaka city. Considering the safety issues, survey was done only through online platform and google form. Non probabilistic sampling technique has been used here, which has lower level of generalization power of research findings. Moreover, biasness has been found in collected data. More in depth studies can be conducted to identify the other factors related to this study. This study has been conducted for a short time and more information could have been added if there were more manpower and time. Sample size could have been increased for attain more accuracy.

# Chapter 2: Literature Review

## 2.1 Factors Influencing Travel Behavior of Individuals

Travel behavior refers to a complex decision-making process during a trip, regarding travel mode choice, route choice, departure time choice, destination choice (Li et al., 2018). It is known that travel is a derived demand as people do not demand travel for their own sake. Rather, they demand for daily activities such as work, shopping, recreation, and education, and travel allows them to reach these activities (Saha, 2010). Travel behavior illustrates how people use transport to reach these activities.

Travel behavior is affected by many factors including trip specific factors to individual related factors including a) Socio-demographic and Socio-economic Factors (e.g. gender, age, income, education, car ownership), b) Psychological Factors (e.g. attitudes, values, norms, desires, risk perception) c) travel-related factors (e.g., travel purpose, travel cost, travel distance, etc.) d) Built environment (Saha, 2010). For instance, those who have higher socioeconomic status generate more trips per day (Douglas, 1973). Again, an individual with an attitude of showing power and pleasure might continue to drive because they get the sense of control and freedom by the act of driving even though driving is not a suitable mode of travel for the particular trip (Paulssen et al., 2013). In context of built environment, people who live in pedestrian-oriented neighborhoods are inspired to drive less and use other modes of transport such as public transport, cycling and walking (Larrañaga et al., 2015). In a Norwegian context, it is found that the people who live in the outer parts of a city travel significantly more by motorized transport compared to people who live in the city centre (Engebretsen and Christiansen, 2011). However, these factors do not influence the travel behavior separately. Travel behavior is affected by various combination factors all together.

## 2.2 Travel Behavior in Dhaka

Dhaka is one of the most densely populated areas in the world, with a density of 23,234 people per square kilometer within a total area of 300 square kilometers (World Population Review, 2021). Yet, a very few transportation related studies have been conducted relating trip specific factors and individual related factors with travel behavior in Dhaka.

People's socioeconomic characteristics have a significant impact on mode choice, trip frequency and travel distance for different travel purposes in Dhaka. It is found that higher income people generally travel more than lower income people and ownership of vehicles is

directly related to the income of the households (Rahman, Ali & Hossain, 2015). Less educated people usually make fewer trips and they prefer walking, rickshaws or transit other than personalized motorized vehicles. On the other hand, high income people usually use cars and taxis and they like to have residential locations nearer to workplaces. (Rahman, 2008). In terms of mode choice, the four major factors primarily responsible for influencing mode choice are- travel cost, security, comfort, travel time. Among them, comfort is the most significant. Rickshaws have been used as the primary mode of transport because of travel time and cost (Raida, Mehnaj & Murshed, 2020). Again, rickshaws are dominantly used for education trips and have significant shares in home-based trips other than non-work trips. Women are more likely to use rickshaws for work trips and make fewer trips than men.

Land use parameters such as accessibility and entropy, have significant contribution on trip production, trip attraction and household kilometers travelled. Large proportion of residential spaces creates a high amount of trip production rate. On the other hand, the zones which attract the highest amount of trip have the highest amount of commercial space availability (Haque, Rahman, Khan, & Parvez, 2013). People who live in housing-rich neighborhoods have to make longer trips. There is an exponential relationship between job housing ratio and commuting time; job housing ratio and travel distance (Rahman & Ashik, 2020).

### 2.3 COVID-19 Situation in Dhaka and Her Response to the Pandemic

Dhaka is the epicenter of the COVID19 outbreak in Bangladesh (Siam et al., 2020). First three cases of COVID-19 were confirmed on 8 March, 2020 in Bangladesh which included two men returning from Italy (Islam et al., 2020). Though various restrictions such as international flight, educational institutions etc. were imposed after the identification of the first case, the diseases started to transmit through community. The distribution of COVID-19 confirmed cases in Dhaka in shown in **Figure 2.1**.

**First Wave of Covid-19 Pandemic:**

Lockdown was declared throughout the nation on 23 march 2020 2020 and extended to 30 may 2020. Bangladesh government enforced strict restrictions on the movement of people and vehicles in April and May (Rahman, 2021) resulting in decrease in road traffic volumes and mobility activities in general. Human mobility was drastically declined during the lockdown. The highest decreases in mobility are seen in the locations of Transit Stations, Workplaces and Retail & Recreation indicating these places were shut down first (Light Castles Analytics

Wing, 2020). According to the "Community Mobility Report" of google, Bangladesh has reduced a higher percentage of mobility in Workplaces than any of the other countries (Light Castles Analytics Wing, 2020). On June 1, 2020, public transportation services resumed with minor restrictions. Passengers were authorized to be carried at 50% of the seating capacity by the service providers. They were authorized to charge 60% more than pre-COVID-19 prices to compensate for the income loss owing to lower passenger numbers. On September 1, 2020, the passenger restriction was eliminated, and ticket costs reverted to normal.

**Second Wave of Covid-19 Pandemic**

From the beginning of the year 2021, COVID-19 situation started to get worse again. 5,358 new Covid-19 cases were reported in Bangladesh on 1st April, 2021 which was the highest-ever daily jump since the pandemic unfolded in March last year. The major reason behind this second wave of pandemic is uncontrolled human movement. More than 50% of people don't wear masks. People are reluctant to maintain any rules of social distancing. However, people have less fear in their mind than the first wave and act haphazardly. (The Daily Star, 2021).

The mobility of the people got back to its previous state and people got used to the new normal in the period of 2$^{nd}$ wave of pandemic. According to a new Google report, people's mobility has reached the pre-pandemic level in Bangladesh in spite of the coronavirus pandemic still being prevailing in the country (Rahman, 2021). Mobility trends for recreational activities rose 13 percent on March 2 compared to the baseline. In light of infection and fatality rates of the virus showing a sudden surge from March 29 to 31, the government again has imposed a new set of restrictions to control the second wave of COVID-19 pandemic including carrying 50% of the passengers than the seating capacity. With most of the offices, companies and factories operating in full swing, the decision of operating public transport with 50% occupancy caused immense suffering to Dhaka dwellers during the second wave (Commuters suffer for transport curbs, 2021).

However, people were visiting "Ekushey Book Fair". These indicates the risk perception of people has changed from the period of first wave of COVID-19 pandemic. Shopping centers were crowded with people rushing to complete their shopping ahead of Eid-ul-Fitr (Antara, 2021) whereas the shops did not get any customer in previous Eid-ul-Fitr during the first wave of pandemic. In short, it can be said that from the end of March, 2020 to Mid of April, 2021 the government has taken several restriction initiatives to lessen the COVID-19 transmission

which has altered mobility, and somehow affected travel behavior. Reaction of people to these initiates varied from first wave to second wave of the pandemic.

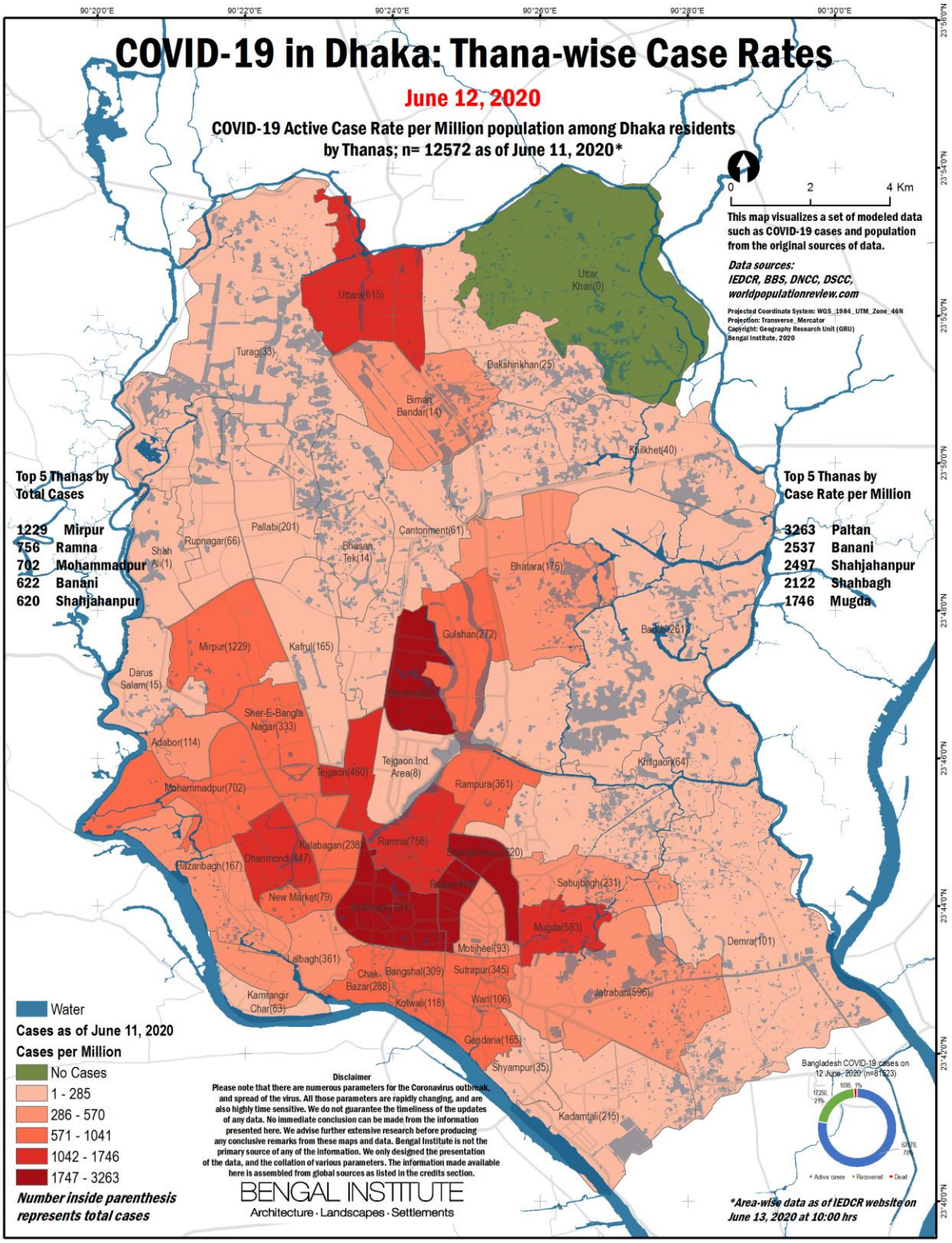


**Figure 2.1**: Thana wise distribution of COVID-19 cases in Dhaka (Source: Bengal Institute, 2020).

## 2.4 Risk Perception during COVID-19

Risk perception is considered as the subjective judgment that people make about the characteristics and severity of a risk. Severity and latency are significant factors in perception. Leaving risk perception purely as a subjective judgment increases possibilities of amplifying risk. In a study, risk perception index is calculated with severity divided by latency. It will be desirable to keep both severity and latency as indices on a scale of 1–10, so as to have meaningful parameter after having ratio (Rehani, 2015). SARS-CoV-2 being a deadly virus, Covid-19 pandemic has a crucial impact on risk perception. Perception of individuals about risk has reached a new level such as people are now more concerned about getting infected, thus worrying about going out and so taking full precautions before going out, afraid of crowded places and so on. Risk perception significantly influenced travel behavior change during the COVID-19 pandemic in different countries. Some of these behavioral changes are in response to restrictive measures imposed by the Government (full or partial lock-downs), while others are driven by perceived risk and fear of infection (Bhaduri et al., 2020).

## 2.5 Studies related Travel Behavior during COVID-19

Different countries have adopted different degrees of restrictions to prevent and control the spread of the virus which in return affected peoples' lifestyles, social interactions, and economic conditions resulting in change in travel behavior during pandemics. There was an unprecedented growth in car usage in the modal share from 43% to 65% (2018 to 2020), while the share of public transport reduced from 43% to 18% while declining in ridership was highest in public transport which was about 90% having a positive trend in the growing popularity of cycling (Abdullah et al., 2020).Teixeira and Lopes (2020) provided evidence on a possible modal shift from the subway to the bike sharing system in New York, USA by doing statistical analysis. Bucsky (2020) analyzed daily transport volumes by mode of transport during the month of March to compare changes made to patterns of transport by movement restrictions in Budapest. Again, the recovery of transit use was lower than that for general traffic and shared bicycles during returning to a new normal situation after gradual removal of restriction in Spain (Orro et al., 2020). Brough, Freedman & Phillips (2021) identified that though the use of public transit has reduced due to pandemic and policy responses in the USA, travel intensity and usage of public transit have not declined as much as among less educated and low-income individuals. However, there is a probable closed loop scenario, a reduction in reported new cases and deaths, which leads to people thinking it is safer now to go out as the risk of contracting COVID-19 is

lower between residents' travel behavior and COVID-19 infections in the United States (Truong & Truong, 2021). In terms of travel choice, people considered personal vehicles, private bicycles and walking having low association with perceived risk of exposure in Chicago (Shamshiripour, 2020). On the other hand, transit, taxi and ride-hailing services (e.g., UberX), as well as pooled ride-hailing (e.g., Uberpool) are the first three highest risky modes in people's risk perception. Risk perception has significantly decreased participation frequency of no work activity trips during the outbreak in Japan (Parady et al., 2020). In the developed countries, there has also been significant reduction in public transport (36% to 13%) during COVID-19 and an increase in private car usage and walking from 32% to 39% and 8% to 15% respectively during Covid-19 in the developing countries (Abdullah et al, 2020). Nguyen (2021) found that teleworking being a new concept in developing countries was positively correlated with the fear of COVID-19 in Hanoi, Vietnam, indicating that people with more fear of the dangers of COVID-19 were more likely to telework to avoid traveling outside. Other discretionary trips such as commuting, eating outside, sightseeing and social trips decreased almost by half in Indonesia (Irawan et al., 2021). In Bangladesh, there is an overall decrease in mobility, mostly among youth, in the form of reduced trip-making frequency by all modes in Bangladesh though changes are not uniform across modes. The loss of mobility is more noticeable for bus, rickshaw, and CNG auto-rickshaw in particular during COVID-19. There is comparatively more adoption of walking than regular situations (Jamal and Paez, 2020). Travel patterns for work-based trips are significantly influenced by age, city type, income and frequency of travel, while safety perception towards different modes in addition were significantly associated with the frequency of travel to non-work-based trips. Young people had higher probability of shifting to no-travel during the transition to lockdown indicating they might have higher opportunities of working from home (Pawar et al., 2021).

# Chapter 3: Methodology

## 3.1 Data Collection:

The data for this study was collected through an online questionnaire survey using snowball sampling technique. Online survey has been chosen for this study like many other studies during this period for ensuring the safety of both the surveyors and respondents (Bhaduri et al., 2020; Shakibaei et al., 2020; Zafri, Khan, Jamal, & Alam, 2021). The explanation for selecting snowball sampling technique is that other sampling approaches carried a substantially larger risk of COVID-19 transmission (Zafri, Khan, Jamal, & Alam, 2021). Based on the literature review, a draft questionnaire and coordination schema have been constructed. After pilot testing, the draft questionnaire has been finalized (Appendix A). A total of 448 people from all over Dhaka participated in the survey which was completely voluntary. There is some sample and selection bias in the data collected for this study where most of the respondents are students. It has lower level of generalization of research findings due to non-probabilistic sampling compared to probability sampling. The questionnaire consisted of three sections: 1) Travel related information for three periods - Before COVID-19 Pandemic (Before March 2020, **T1**), during the 1st wave of the COVID-19 Pandemic (March-August, 2020, **T2**), and during the 2nd wave of COVID-19 Pandemic (March 2021- now, **T3**); 2) Risk perceptions and information about COVID-19; 3) General information about the respondents. Collected data was screened to exclude outliers after data collection.

## 3.2 Data Analysis:

This study examines both descriptive and statistical analysis to fulfill the objectives of this study. We used descriptive analysis to explore the trip wise change in trip frequency and mode preferences before and during the pandemic. Nonparametric tests were mostly used in this study for inferential statistical analyses as they can be applied with ordinal and ranked data as they require fewer assumptions (Abdullah et al., 2020). McNemar-Bowker test and Wilcoxon signed-rank test were conducted in this regard. Again, Chi- square test and Spearman Correlation were conducted to identify correlation between risk perception and travel behavior. A risk perception index was developed to measure risk perception about COVID-19 (Appendix B). The 5-point Likert scale and ranking related questions have been converted to scores to develop an aggregated ranking system for identifying respondents' preference about mode and purpose for traveling. All the analysis was performed in Statistical Package for the Social Sciences (SPSS) software.

# Chapter 4: Impacts of COVID-19 on Travel Behavior

Impact on travel behavior has been analyzed focusing three aspects including trip purpose, trip frequency and modal choice.

## 4.1 Trip Purpose

**Table 4.1** shows the changes in importance of various types of trips according to their purpose among people before and during the pandemic. Before the pandemic, people considered education, work and shopping primary outdoor trips. During the 1st wave, medical purpose became prime reason for making trip. However, primary reason of traveling replaced from medical to work during 2nd wave. Increase in safety feeling during 2nd wave compared to 1st wave can a possible reason for the replacement. People do not consider shopping as an important trip purpose during the pandemic. Shopping trips have been converted to online trips as sales of goods through electronic platforms grew 70% year-on-year in 2020 amid the pandemic (The Daily Star, 2021).

**Table 4.1**: Change in importance of trip purpose

| Phase | Most Important | Important | Less Important |
|---|---|---|---|
| Before pandemic (T1) | Education | Work | Shopping |
| During 1st wave (T2) | Medical | Work | Education |
| During 2nd wave (T3) | Work | Medical | Education |

(Source: Online Survey, 2021)

## 4.2 Trip Frequency for Primary Trips

In this study, a trip was defined as a one-way journey from an origin to a destination. Friedman's ANOVA test explained that there are statistically significant changes at 99% confidence level ($p = 0.000$) in the number of trips undertaken for the primary purpose trips (work, education and shopping) before and during 1st and 2nd wave of COVID-19. From Friedman ANOVA test, it remained indistinct in which phase the change is significant. For example, it is not possible to determine whether change in the number of work trips is significant for before and during 1st wave or for during 1st and 2nd wave. As a result, Wilcoxon signed ranked test has been done to describe in more details. The test has concluded the changes are significant at 99% confidence level ($p = 0.000$) for all phases and all trip purposes.

Following pie charts (**Figure 4.1, Figure 4.2, Figure 4.3, Figure 4.4, Figure 4.5** and **Figure 4.6** ) shows the result in terms of increase, decrease and no change in frequency for primary

trips before the pandemic (T1) and during 1st wave of pandemic (T2) and for during 1st (T2) and 2nd wave (T3) of the pandemic. Notable changes can be seen in Figure 5.1 to 5.6 that trip frequency has been lessened drastically (64%) from T1 to T2 which has been increased from T2 to T3. Trip frequency for work purpose has been increased from T2 to T3 from T1 to T2. No significant change can be seen for education purpose which may be a reason of shift in online platform.

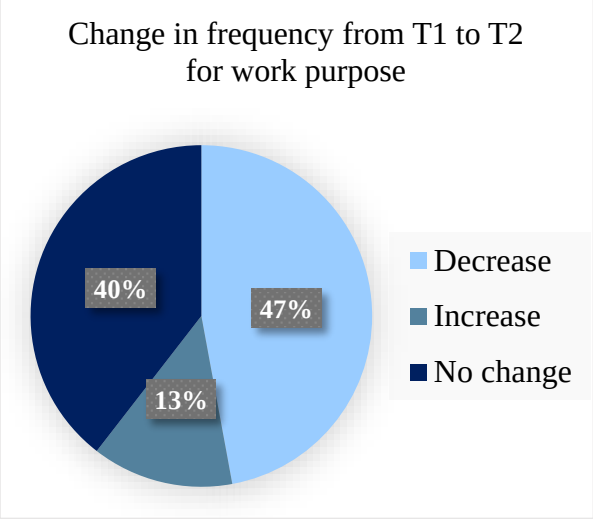


**Figure 4.1**: Change in frequency from T1 to T2 for work purpose (Online survey, 2021)

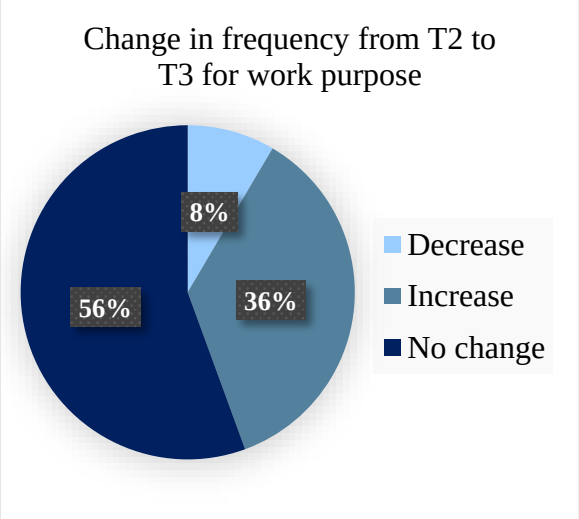


**Figure 4.2**: Change in frequency from T2 to T3 for work purpose (Online survey, 2021)

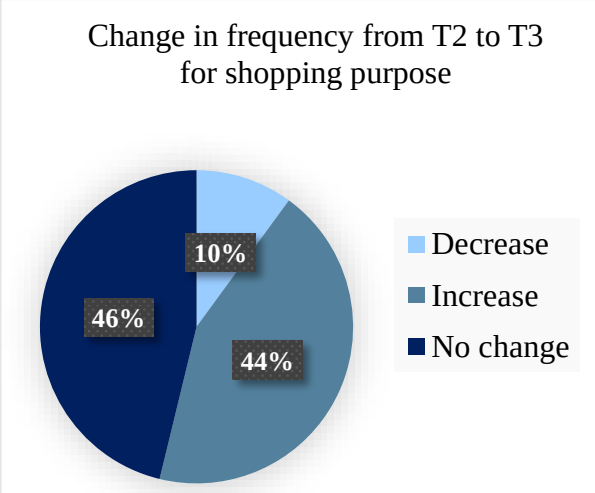


**Figure 4.3**: Change in frequency from T1 to T2 for education purpose (Online survey, 2021)

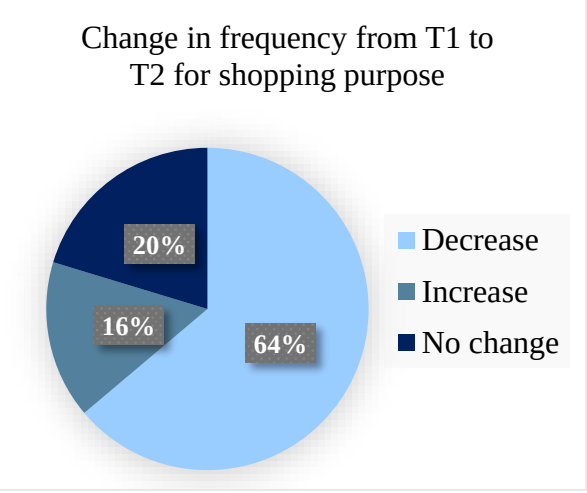


**Figure 4.4**: Change in frequency from T2 to T3 for education purpose (Online survey, 2021)

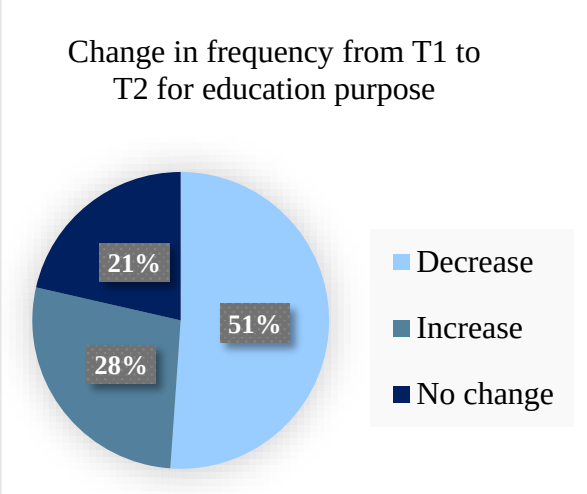


**Figure 4.5**: Change in frequency from T1 to T2 for shopping purpose (Online survey, 2021)

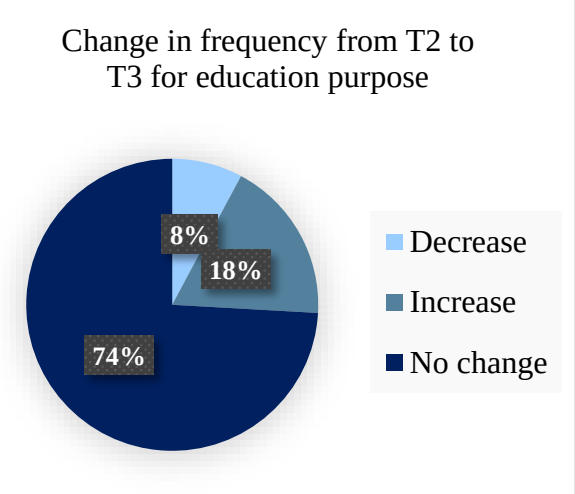


**Figure 4.6**: Change in frequency from T2 to T3 for shopping purpose (Online survey, 2021)

Socio-demographic factors that could affect the number of trips before and during pandemics were examined. However, no significant difference was found between trips performed by males and females for the primary trip purpose before COVID-19. Gender wise change in trip frequency illustrates different result for work and education trip (**Figure 4.7**).

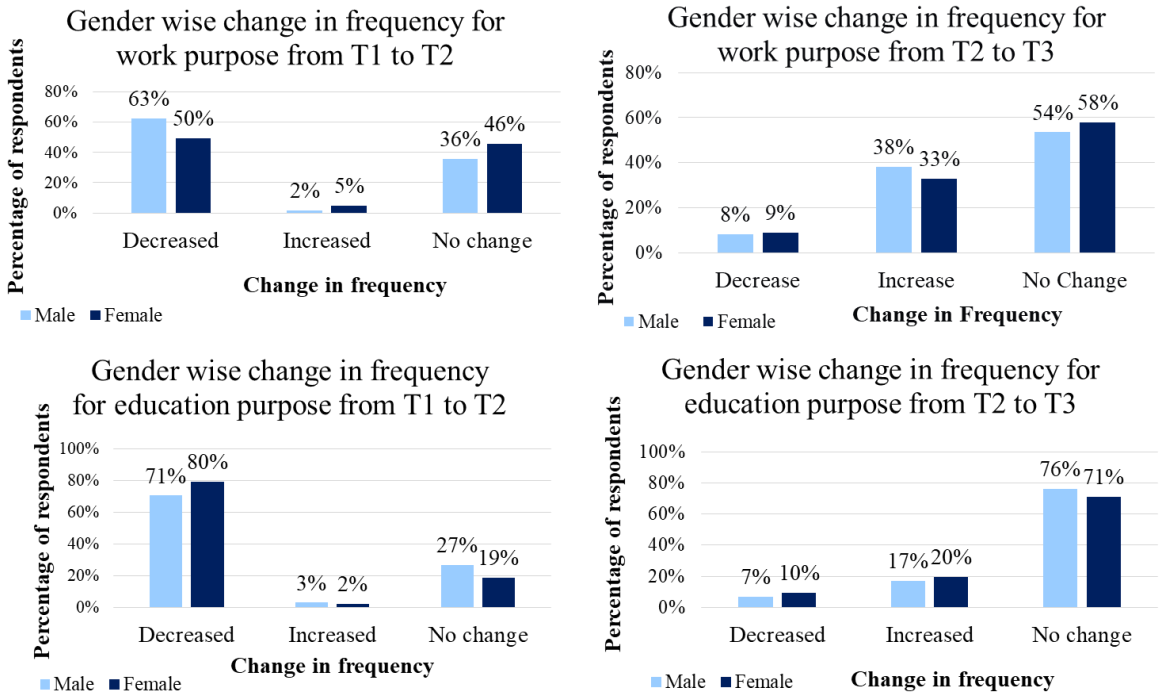


**Figure 4.7**: Gender wise change in frequency (Source: Online survey, 2021)

### 4.3 Mode for Primary Trips

**Figure 4.8** compares the travel mode shares for work trips before and during COVID-19. The majority of respondents (37%) declared that they used bus for their work purpose trips before COVID-19 which shifted to rickshaw and private car during 1st wave and to only rickshaw during 2nd wave. A sharp decline in public bus use was observed during COVID-19, for instance, only 15% of respondents used bus. In contrast, the use of private cars increased from 16% before COVID-19 to 24% during COVID-19. It is interesting to note that the scenario got reserved during the 2nd wave of COVID-19. The use of bus increased by 7% where the use of private cars decreased by 6%. Increase in safety feeling during 2nd wave compared to 1st wave can a possible reason for this. However, though studies conducted in other countries concluded increase in use of active transport modes during the pandemic (Irawan et al., 2021), there is no significant increase in use of active transport modes for work trip in Dhaka.

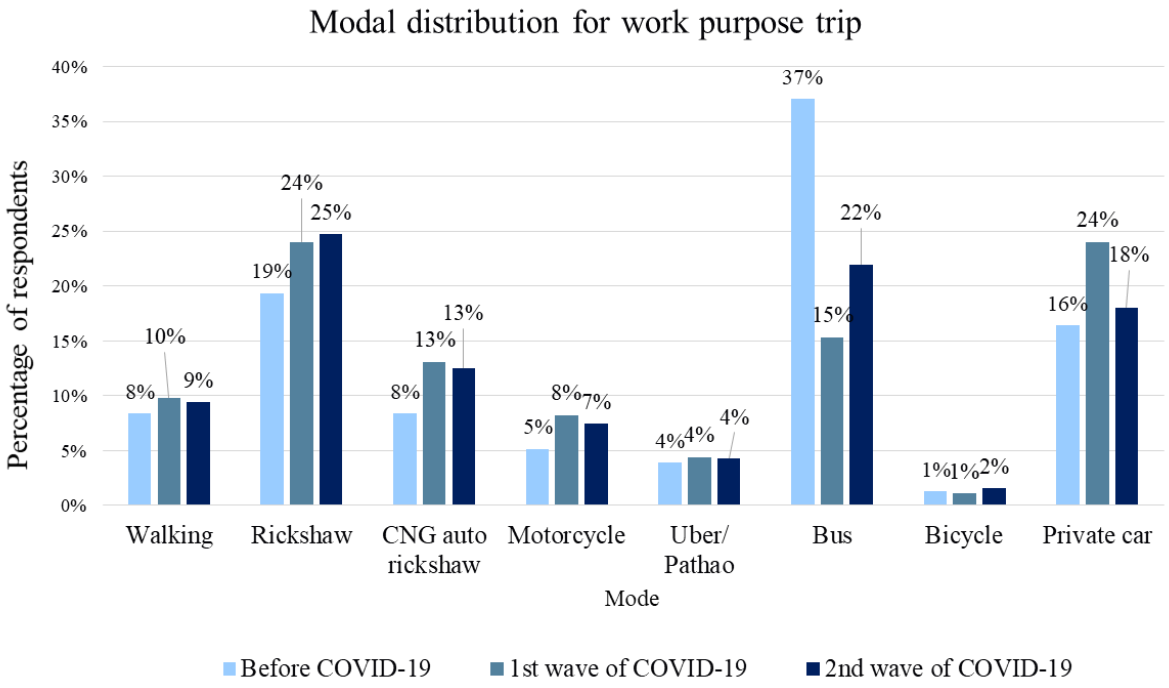


**Figure 4.8**: Change in mode choice for work purpose due to COVID-19 (Source: Online Survey, 2021)

For education purpose and shopping purpose trips, the main mode of traveling has not changed over the time period (**Figure 4.9** and **Figure 4.10**). Bus and rickshaw were the main mode for education and shopping purpose trips respectively before and during the pandemic. Similar with the work trip, the highest decrease in use was of bus for education and shopping trips during 1st wave. In general, people tend to avoid public transport during pandemics (Abdullah et al., 2020). Walking as a travel mode gained attention of people for shopping trip during the

1st wave and was increased by 9%. However, people shifted from walking to other modes during 2nd wave decreasing the use by 7% because people becoming less worried about COVID-19 in 2021.

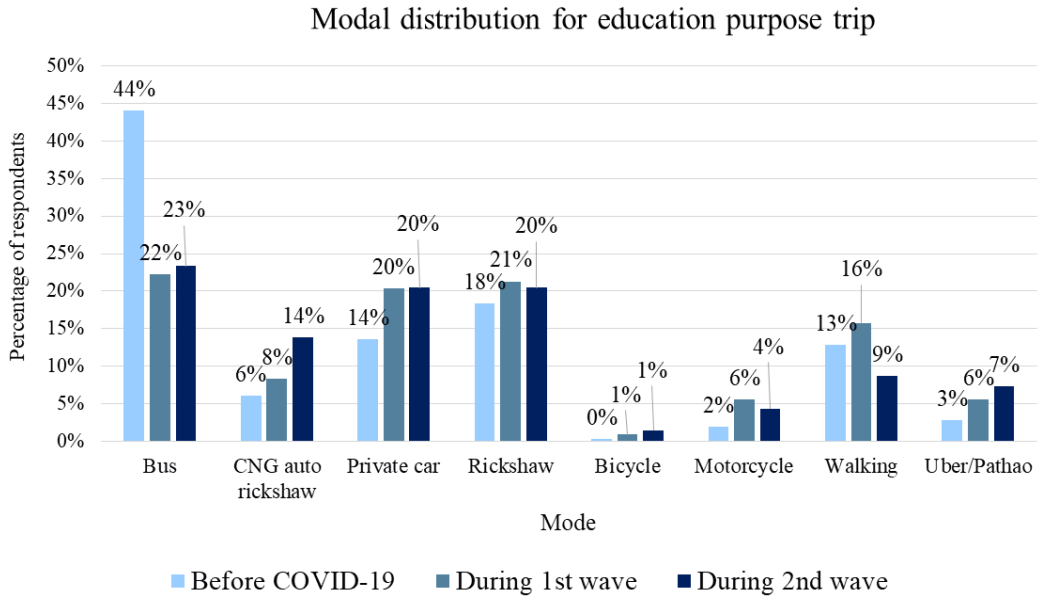


**Figure 4.9**: Change in mode choice for education purpose due to COVID-19 (Source: Online survey, 2021)

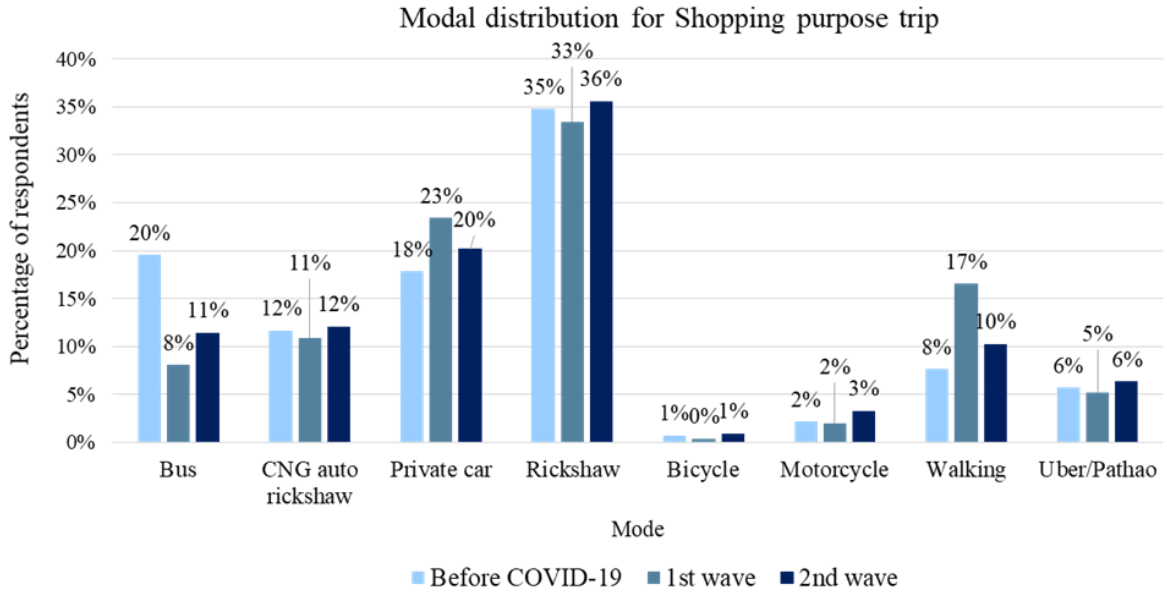


**Figure 4.10**: Change in mode choice for shopping purpose due to COVID-19 (Source: Online survey, 2021)

The McNemar-Bowker test showed that there are significant differences at 99% confidence level (p = 0.000) for mode choice with work purpose and shopping purpose from T1 to T2 and T2 to T3. For education purpose, the confidence level is 95% (p = 0.047) from T2 to T3.

### 4.4 Shift from Bus for Work and Shopping Purpose Trips

Before pandemic, 37% people has been found using bus as main mode for work trip (**Figure 4.11**). During pandemic, a significant change in modal shift has been seen. 57% of typical bus users has been shifted to other modes during 1st wave of COVID-19. 25% people shifted to other modes during 2nd wave who used bus during 1st wave. The main mode of preference for shifting- has been found rickshaw (35%), private car (18%) and CNG auto rickshaw (12%).

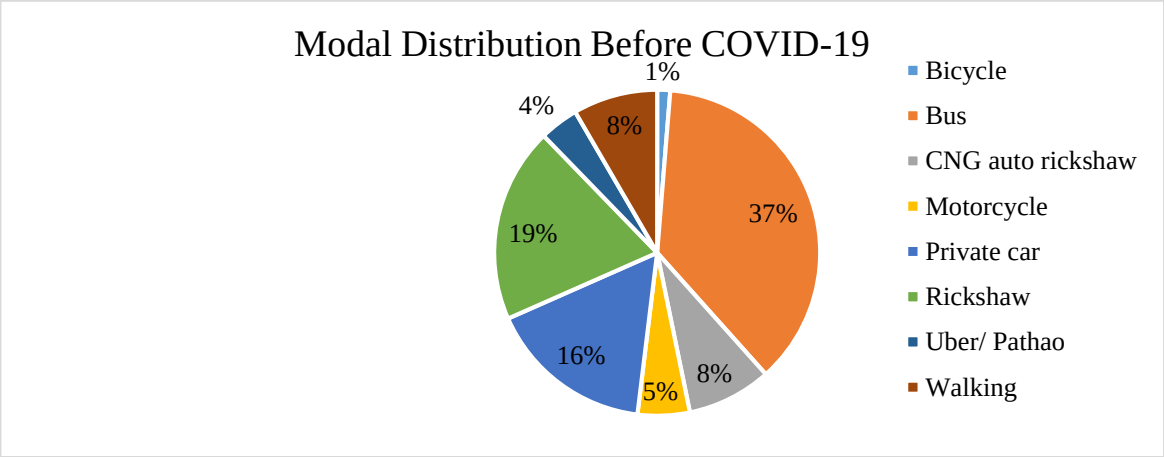


**Figure 4.11**: Modal Distribution Before COVID-19 for work purpose (Source: Online survey, 2021)

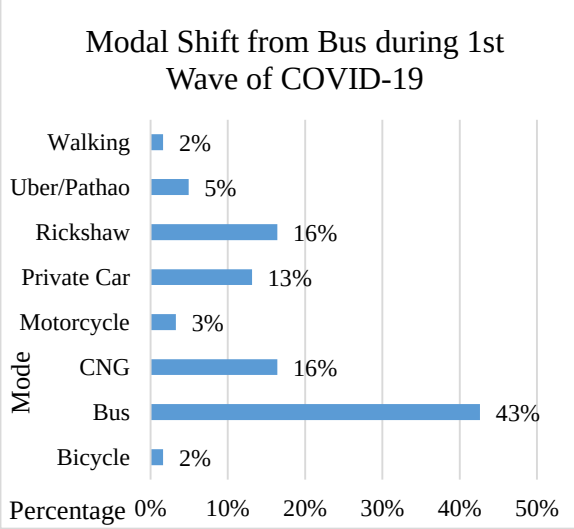


**Figure 4.12**: Modal Shift from Bus for work purose during 1st Wave of COVID-19 (Source: Online survey, 2021)

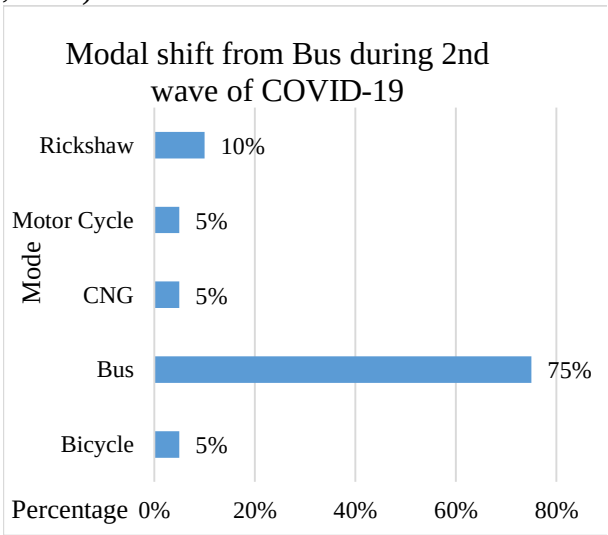


**Figure 4.13**: Modal Shift from Bus for work purpose during 2nd Wave of COVID-19 (Source: Online survey, 2021)

Again, before COVID-19, 35% people used to choose rickshaw for shopping purpose where 19%, 18% and 12% have been in choosing bus, private car and CNG or auto rickshaw respectively (Figure 5.16). 58% of typical bus users has been shifted to other modes during 1st wave of COVID-19 where 21% people has been shifted to other modes during 2nd wave who used bus during 1st wave. In this purpose, the main mode of preference for shifting has been seen rickshaw (During 1st wave) and motor cycle (During 2nd wave). This shift from bus was caused by people perceiving bus as the most risky mode during the pandemic.

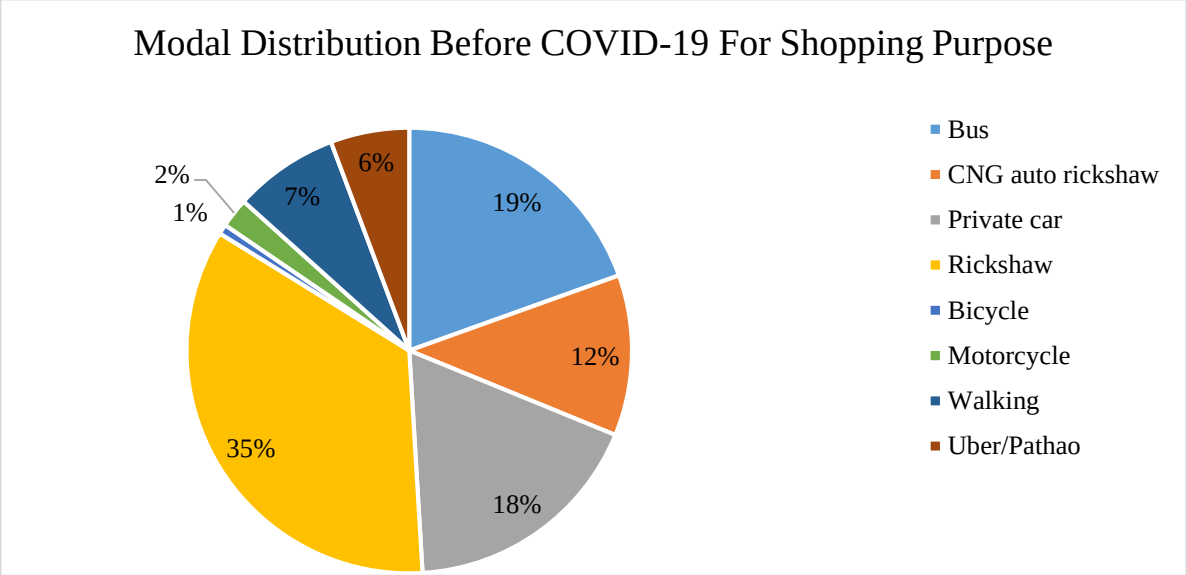


**Figure 4.14**: Modal distribution before COVID-19 for shopping purpose (Source: Online survey, 2021)

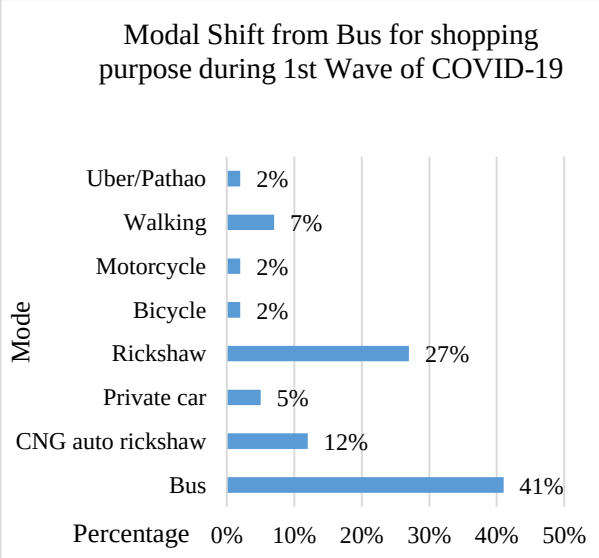


**Figure 4.15:** Modal Shift from Bus for shopping purpose during 1st Wave of COVID-19 (Source: Online survey, 2021)

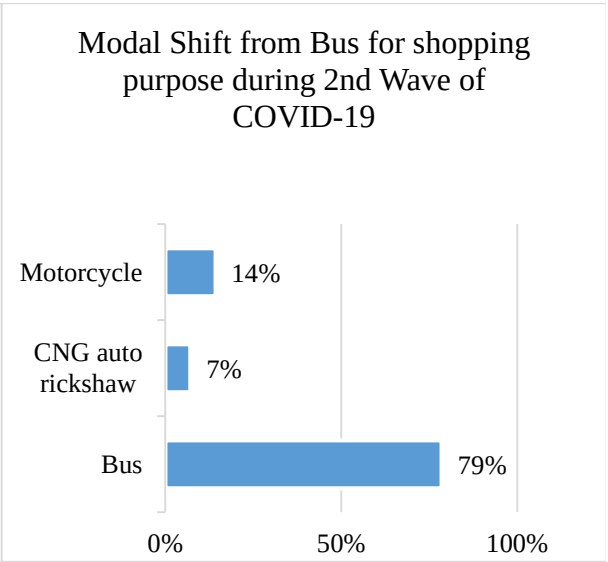


**Figure 4.16:** Modal Shift from Bus for shopping purpose during 2nd Wave of COVID-19 (Source: Online survey, 2021)

However, 43% people have been found using bus for work during 1st wave of COVID-19. Among them, 81% people do not own any private vehicle such as private car, motor cycle and 57% people have been faced decrease in income. 42% people have been found using bus for shopping during 1st wave of COVID-19. Among them, 83% people do not own any private vehicle such as private car, motor cycle. 60% people have been faced decrease in incomes. This can be said that a certain group of people continued to use bus for their economic condition who are defined as captive riders.

### 4.5 Captive and Choice Riders

Captive and choice riders can be defined by their ownership of any private vehicle. People who are able to choose mode from wide range of options are considered choice riders and who have to go with the mode left for them are captive riders. (Maitra, Dandapat and Chintakayala, 2015). In our study, Captive riders are chosen who has no private motorized vehicle (car, motorcycle) and choice riders are who has at least one private motorized vehicle. 55% people has been found as captive users in our study (**Figure 4.17**).

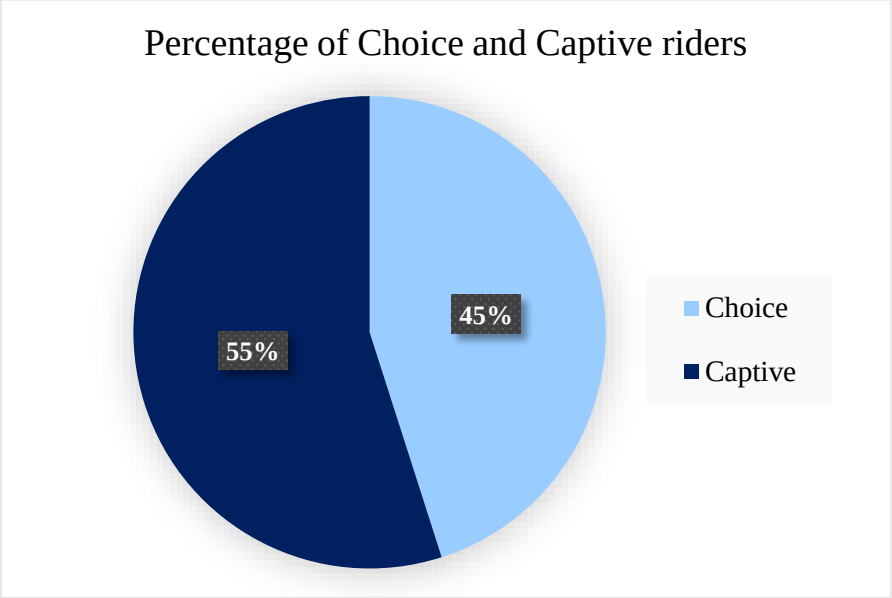


**Figure 4.17**: Percentage of Choice and Captive riders (Source: Online survey, 2021)

### 4.6 Socio-Economic Profile of Captive and Choice Riders

There have been found 54 % and 55% male respondents in captive and choice riders respectively **(Figure 4.18 and 4.19).**

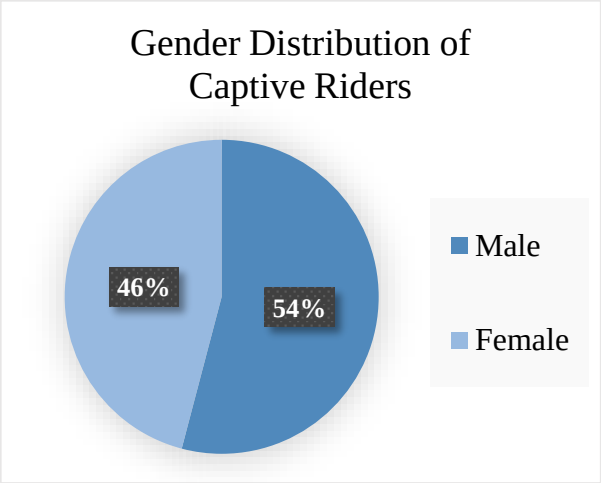


**Figure 4.18:** Gender Distribution of Captive Riders (Source: Online survey, 2021)

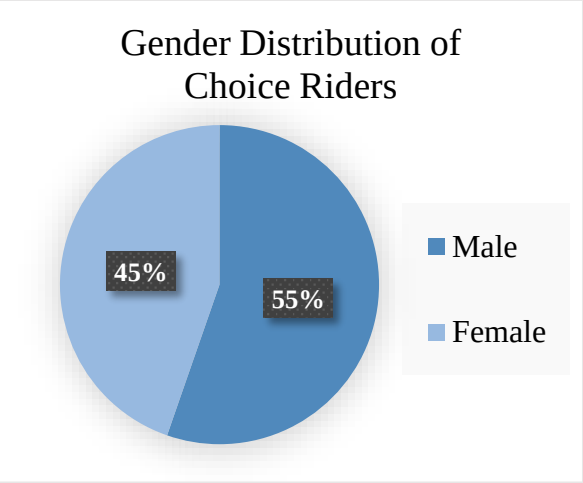


**Figure 4.19**: Gender Distribution of Choice Riders (Source: Online survey, 2021)

Almost 60% respondents of captive users' education level has been found graduation or equivalent. In the case of choice users almost 70% respondents have been found post graduate or equivalent.

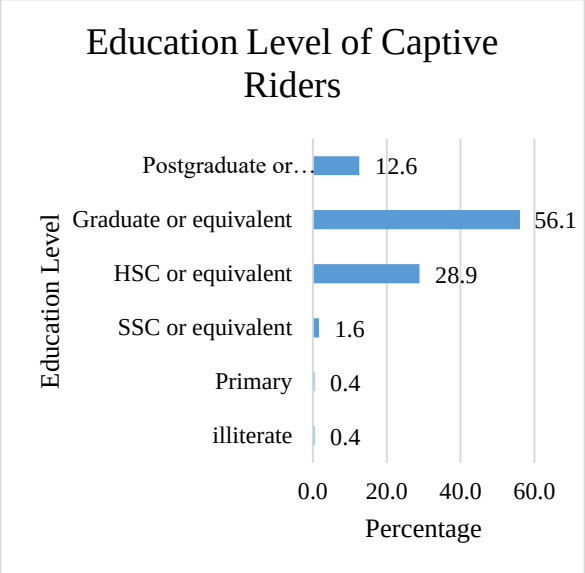


**Figure 4.20**: Education Level of Captive Riders (Source: Online survey, 2021)

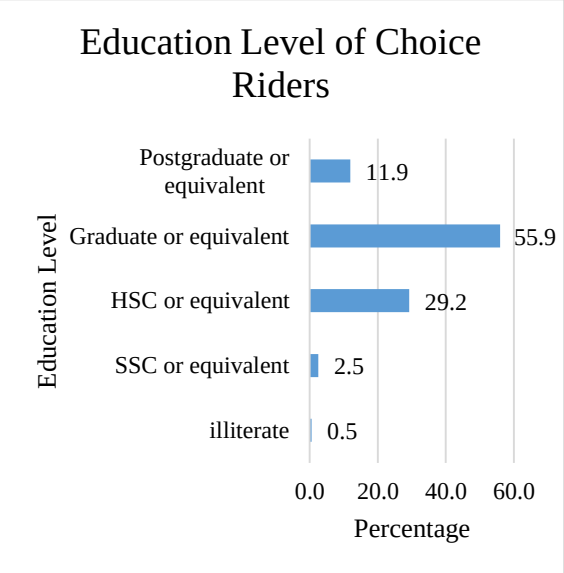


**Figure 4.21**: Education Level of Choice Riders (Source: Online survey, 2021)

Almost 62% and 66% respondents are students in choice and captive riders respectively. In captive riders the percentage of students is a bit high. Employment status plays a role in being captive and choice riders.

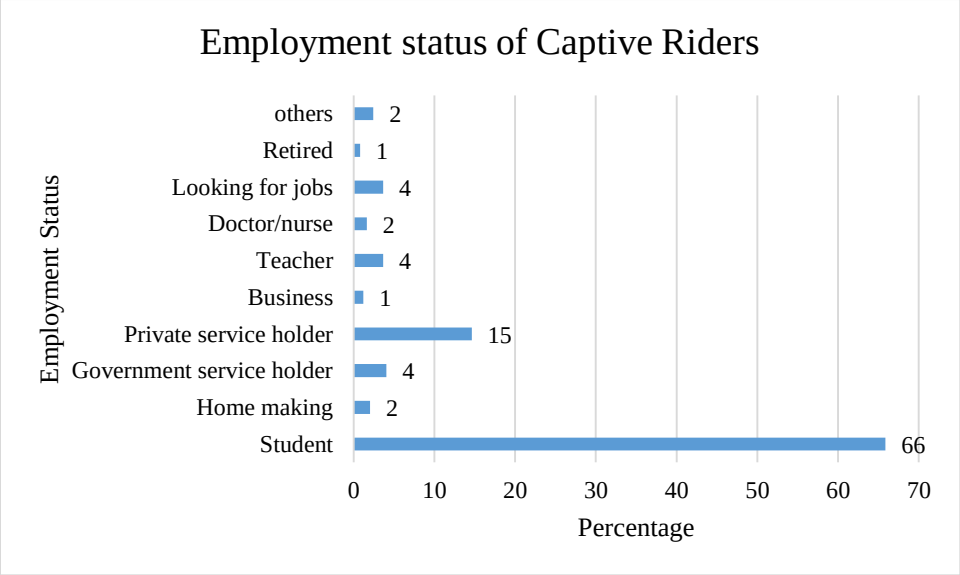


**Figure 4.22**: Employment status of Captive Riders (Source: Online survey, 2021)

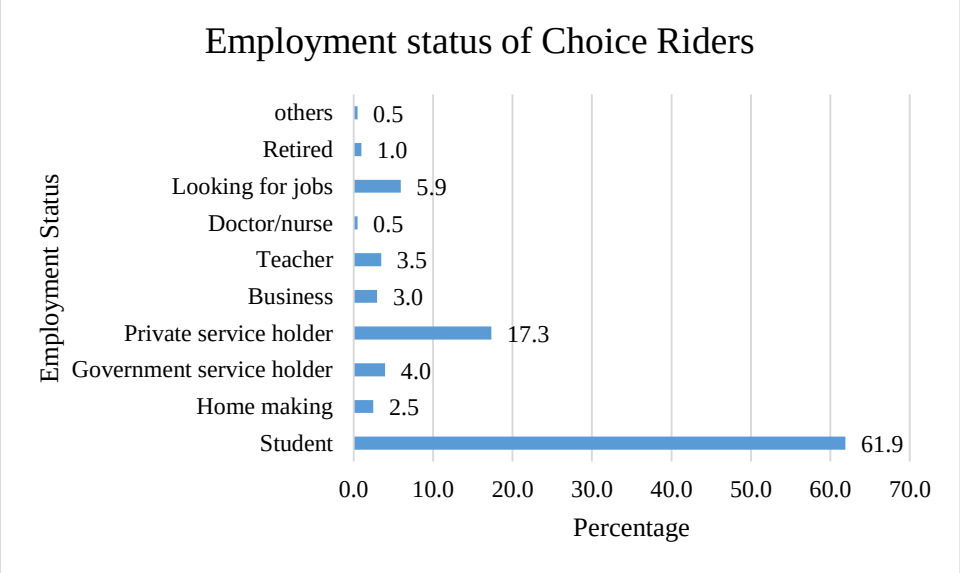


**Figure 4.23**: Employment status of Choice Riders (Source: Online survey, 2021)

# Chapter 5: Risk Perception of COVID-19 and Travel Risk

## 5.1 Risk Perception Index:

For Objective 2, the risk perception index has been calculated by scoring (**Table 5.1**) five indicators. The indicators are:

- Preventing the spread of COVID-19 is possible by measures like washing hands, mask, social distancing etc.
- Going out only for emergency/unavoidable circumstance during the whole pandemic.
- Preferring e-activities more than physical activities during pandemic.
- Reducing travel frequency every time COVID-19 cases started to increase drastically.
- Always taking necessary precautions before going outside

**Table 5.1**: Assigned score according to degree of agreement.

| Degree | Score |
|---|---|
| Strongly disagree | 1 |
| Disagree | 2 |
| Neutral | 3 |
| Agree | 4 |
| Strongly agree | 5 |

(Source: Online survey, 2021)

In this case, those who chose “strongly agree” or “agree”, their risk perception is higher.

With the risk perception index, a comparison of captive and choice riders has been made where it is found that most of the captive user’s perceived risk is "moderate" and most of the choice users perceived risk is "High" in **Figure 5.1** & **Figure 5.2.** The risk perception of captive riders got manipulated by their condition (not having any personal vehicle, decrease in income).

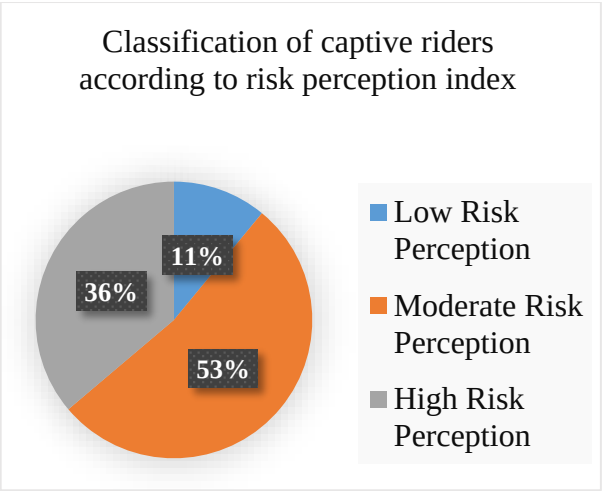


**Figure 5.1**: Classification of captive riders based on risk perception index (Online survey, 2021)

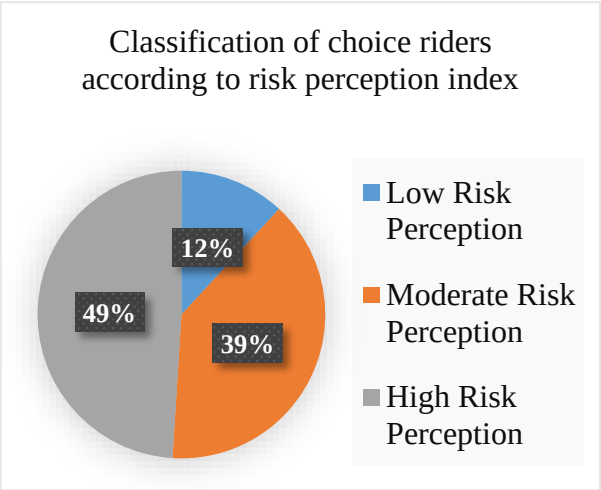


**Figure 5.2**: Classification of choice riders based on risk perception index (Online survey, 2021)

### 5.2 Change in Safety Feeling from First Wave to Second Wave:

Wilcoxon signed ranked test has been done to compare the first wave safety feeling with the second wave safety feeling. In this case, a significant change has been found at 99% confidence level ($p = 0.002$) where most people started to feel safe from the first wave to the second wave (**Figure 5.3**) which justifies the behavior of rushing to shopping centers, visiting Ekushey Book Fair even if during the lockdown of 2nd wave of COVID-19.

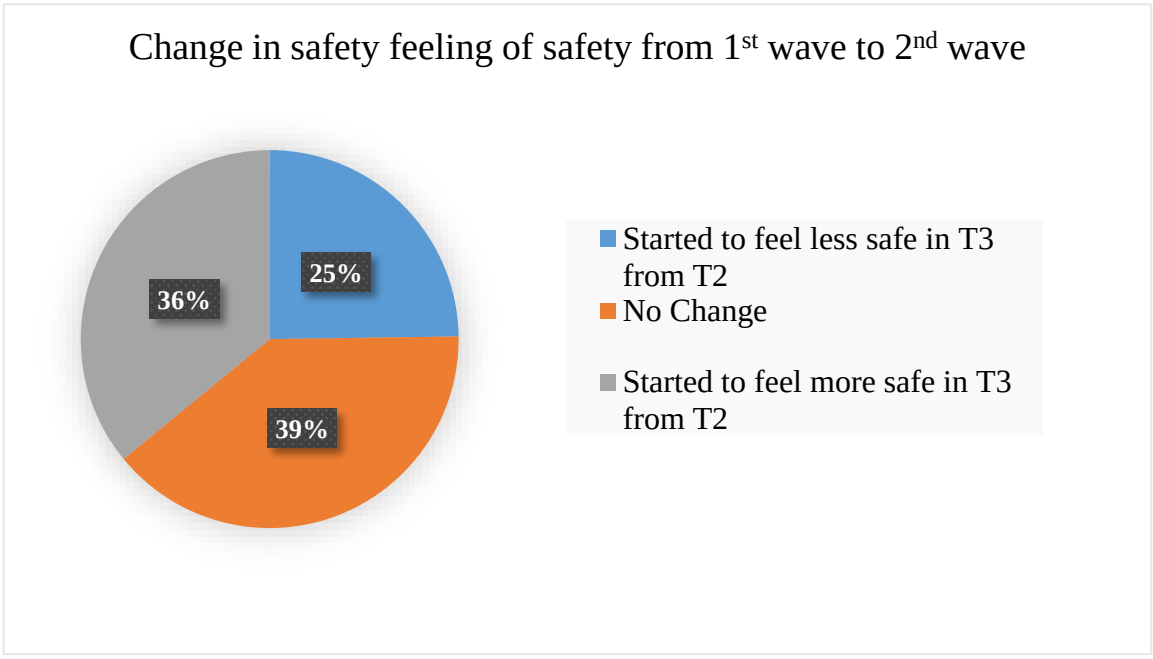


**Figure 5.3**: Change in safety feeling of safety from 1st wave to 2nd wave (Online survey, 2021)

### 5.3 Correlation between Safety Level Change and Change in Frequency for Work Purpose:

A Spearman Correlation has been done between the change in safety level and change in frequency for work purpose from 1st wave to 2nd wave. A significant correlation has been found at 95% confidence level (p = .049) where the Spearman Correlation value is 0.093. This positive value indicates that those who started to feel safer, have increased their travel frequency for work purpose on 2nd wave (**Table 5.2**). As a result, work trip has become the most important trip for people during the 2nd wave of the pandemic by replacing medical trip.

**Table 5.2**: Cross tab between change in safety level and change in frequency for work purpose from 1st wave to 2nd wave.

| Cross Tabulation | | **Change in frequency for work purpose in T3 from T2** | | | Total |
|---|---|---|---|---|---|
| | | Decreased | No Change | Increased | |
| **Change in Safety level** | Started to feel less safe in 2nd wave from 1st wave | 18 | 58 | 35 | 111 |
| | No Change | 11 | 101 | 64 | 176 |
| | Started to feel more safe in 2nd wave from 1st wave | 9 | 90 | 62 | 161 |

(Source: Online survey, 2021)

### 5.4 Correlation between Safety Level Change and Change in Frequency for Shopping Purpose:

In the same way, another Spearman Correlation has been done between the change in safety level and change in frequency for shopping purpose from 1st wave to 2nd wave. A significant correlation has been found at 99% confidence level (p = 0.000) where the Spearman Correlation value is 0.211. This positive value indicates that those who started to feel safer, have increased their travel frequency for shopping purpose on 2nd wave (Table 5.3). As a result, though the frequency of shopping trips reduced significantly from before pandemic to 1st wave, the frequency increased during 2nd wave.

**Table 5.3**: Cross tab between change in safety level and change in frequency for shopping purpose from 1st wave to 2nd wave

| Cross Tabulation | | Change in frequency for shopping purpose in T3 from T2 | | | Total |
|---|---|---|---|---|---|
| | | Decreased | No Change | Increased | |
| **Change in Safety level** | Started to feel less safe in 2nd wave from 1st wave | 18 | 58 | 35 | 111 |
| | No Change | 15 | 92 | 69 | 176 |
| | Started to feel more safe in 2nd wave from 1st wave | 12 | 57 | 92 | 161 |

(Source: Online survey, 2021)

### 5.5 Correlation between Safety Level Change and Trip Made outside Dhaka:

Another Spearman Correlation has been done between Trip made outside Dhaka and safety level change. But no significant correlation has been found (p = 0.488). Those who started to feel more safe or less safe, in both cases people are found to be made trip outside of Dhaka. Again, many of those who started to feel safer, haven't gone outside of Dhaka (**Table 5.4**).

**Table 5.4**: Cross tab between change in safety level and trip made outside Dhaka for the last Eid-ul-Fitre

| Cross Tabulation | | Trip made outside Dhaka for the last Eid-ul-Fitre | | Total |
|---|---|---|---|---|
| | | No | Yes | |
| **Safety level change** | Started to feel less safe in T3 from T2 | 78 | 33 | 111 |
| | No Change | 138 | 38 | 176 |
| | Started to feel more safe in T3 from T2 | 121 | 40 | 161 |

(Source: Online survey, 2021)

### 5.6 Correlation between Safety Level Change and Vaccination:

A significant correlation has been found at 95% confidence level (p = .031) between vaccination and feeling of safety during second wave. Those who are not applicable to the vaccine are found to be perceived higher levels of unsafe (**Table 5.5**).

**Table 5.5**: Cross tab between feeling of safety during second wave and number of vaccine doses taken

| Cross Tabulation | | Number of doses of the COVID-19 vaccine taken | | Total |
|---|---|---|---|---|
| | | One | Two | |
| **Feeling of safety while travelling during second wave of the COVID-19 pandemic (April 2021- now)** | I don't bother about my safety | 2 | 3 | 17 |
| | I don't feel safe at all | 14 | 9 | 90 |
| | I feel quite unsafe | 15 | 20 | 134 |
| | I neither feel safe nor unsafe | 12 | 30 | 124 |
| | I feel quite safe | 10 | 16 | 65 |
| | I feel very safe | 3 | 2 | 18 |
| Total | | 56 | 80 | 448 |

(Source: Online survey, 2021)

### 5.7 Gender wise Worriedness:

A significant correlation has been found at 95% confidence level (p = .038) between gender and people who was more worried in the first wave than in second wave. The male are found to be more worried in the first wave, than the female (**Table 5.6**).

**Table 5.6**: Cross tab between Gender and people who was more worried in the first wave than second were

| Cross Tabulation | | Gender | | Total |
|---|---|---|---|---|
| | | Male | Female | |
| **I was more worried about COVID-19 infection during the first wave than I am in the second wave** | Strongly Disagree | 13 | 15 | 28 |
| | Disagree | 21 | 27 | 49 |
| | Neutral | 32 | 20 | 54 |
| | Agree | 87 | 81 | 172 |
| | Strongly Agree | 88 | 57 | 145 |
| Total | | 241 | 200 | 448 |

(Source: Online survey, 2021)

### 5.8 Correlation between Worriedness and Change in Travel Frequency:

A significant correlation has been found at 95% confidence level (p = .000) between who was more worried in the first wave than second wave and who travelled more frequently in second wave than first wave. In that case, those who have been found less worried in the 2nd wave, have traveled more on the 2nd wave (**Table 5.7**).

**Table 5.7**: Cross tab between who was more worried in the first wave than second wave and who travelled more frequently in second wave than first wave

| Cross Tabulation | | **I have travelled more frequently in 2021 than in the early phase of 2020 because of the ease in restrictions** | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | |
| **I was more worried about COVID-19 infection during the first wave than I am in the second wave** | Strongly Disagree | 13 | 4 | 2 | 1 | 8 | 28 |
| | Disagree | 10 | 13 | 6 | 12 | 8 | 49 |
| | Neutral | 7 | 7 | 13 | 22 | 5 | 54 |
| | Agree | 17 | 23 | 26 | 97 | 9 | 172 |
| | Strongly Agree | 8 | 13 | 6 | 58 | 60 | 145 |
| Total | | 55 | 60 | 53 | 190 | 90 | 448 |

(Source: Online survey, 2021)

### 5.9 Aspects Considered Most for Choosing Transport Mode:

Aspects considering most for choosing transport mode has been calculated by giving score which is shown at **Table 5.8**.

**Table 5.8**: Assigned score according to choosing transport mode

| Rank | Score |
|---|---|
| Rank 1 | 3 |
| Rank 2 | 2 |
| Rank 3 | 1 |

(Source: Online survey, 2021)

It is found that the most considered aspects for choosing transport mode is less crowded vehicle. The second most considered aspect is social distancing between passengers (**Figure 5.4**).

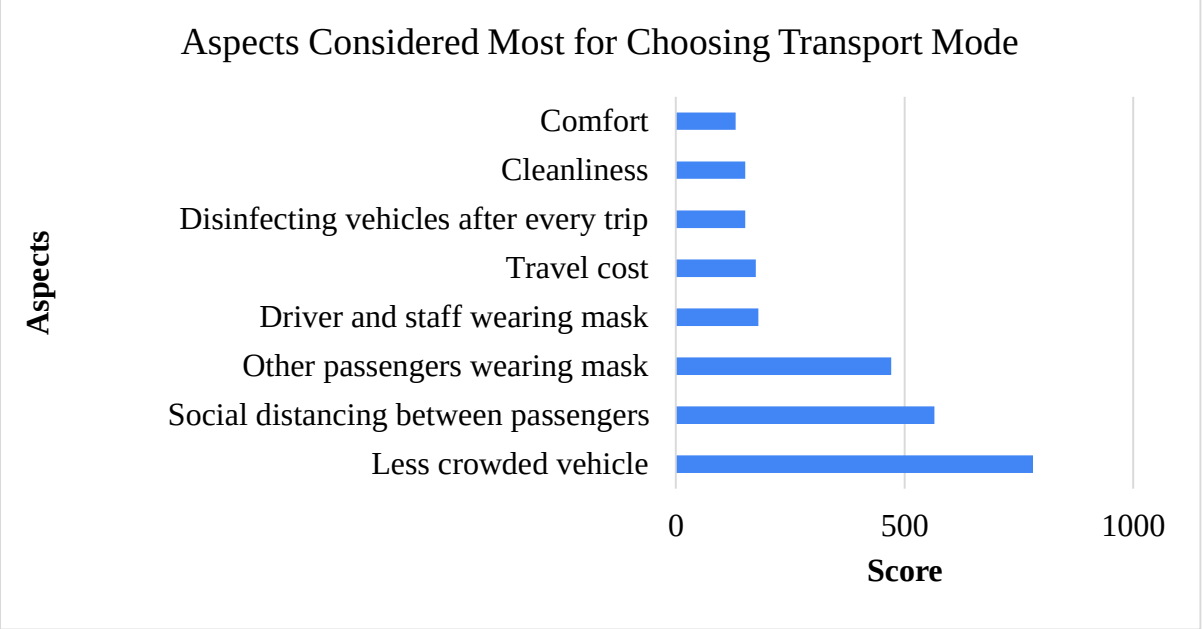


**Figure 5.4**: Aspects Considering Most for Choosing Transport Mode (Source: Online survey, 2021)

### 5.10 Perceived risk for modes:

Perceived risk for various modes are scored here from extremely low risk to extremely high risk in **Table 5.9**.

**Table 5.9:** Assigned score according to perceived degree of risk

| Degree | Score |
|---|---|
| Extremely low risk | 1 |
| Low risk | 2 |
| Medium risk | 3 |
| High risk | 4 |
| Extremely high risk | 5 |

(Source: Online survey, 2021)

After that score of various modes are calculated and presented in **Figure 5.5**. It can be interpreted that bus is the most risky mode where bicycle is the least risky mode and high risk perception for shared modes.

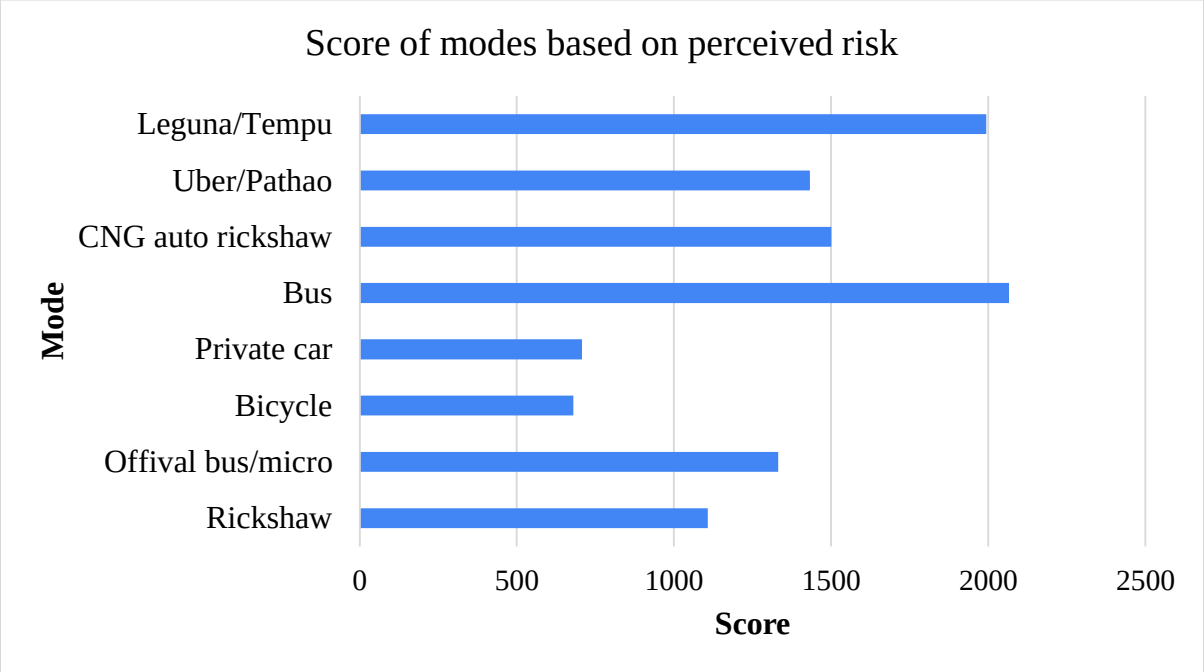


**Figure 5.5**: Scoring of modes based on risk perception (Source: Online survey, 2021)

### 5.11 Ranking of Modes for Sustainable Dhaka based on public Opinion:

Ranking of modes for sustainable Dhaka based on public opinion has been calculated by giving score which is shown at **Table 5.10**.

**Table 5.10**: Assigned score according to importance

| **Degree** | **Score** |
|---|---|
| Less important | 1 |
| Important | 2 |
| Most Important | 3 |

(Source: Online survey, 2021)

From **Table 5.11** and **Table 5.12** it is found that both captive user and choice user encouraged MRT and BRT.

**Table 5.11**: Ranking based on opinion of captive riders

| **Rank** | **Mode** | **Captive** |
|---|---|---|
| 1 | MRT | 403 |
| 2 | BRT | 290 |
| 3 | Minibus | 114 |
| 4 | Office Transport | 111 |
| (Source: Online survey, 2021) | | |

**Table 5.12**: Ranking based on opinion of choice riders

| **Rank** | **Mode** | **Choice** |
|---|---|---|
| 1 | MRT | 418 |
| 2 | BRT | 280 |
| 3 | Office Transport | 121 |
| 4 | Bicycle | 104 |
| (Source: Online survey, 2021) | | |

# Chapter 6:Major Findings, Policy Recommendations and Conclusion

## 6.1 Major Findings:

- People do not consider shopping as an important trip purpose during the pandemic. As a result, frequency of shopping trips have decreased highest.
- During 1st wave of the pandemic medical purpose trip was considered most important which is replaced by work trip during 2nd wave. Increase in safety feeling during 2nd wave compared to 1st wave can a possible reason for the replacement.
- Frequency of shopping trip have decreased highest from before COVID-19 period to 1st wave which increased highest from 1st wave to 2nd wave. Increase in safety feeling is also applicable here.
- Gender wise change in trip frequency illustrates different result for work and education trip. There is no significant correlation between change in trip frequency and gender.
- Change in mode choice across the three periods is only visible for work trip.
- Usage of bus has been decreased highest for all trip purpose from before COVID-19 period to 1st wave period. Perceiving bus as the most risky mode can be a possible reason for this.
- Usage of Bus has been increased during 2nd wave as safety feeling during 2nd wave has been increased.
- Shared modes have higher perceived risk than other modes.
- In spite of bus being the most risky mode, a group of people continued to use bus, because of having limited options of mode available for them. These people are captive riders.
- Captive riders have moderate risk perception whereas choice riders have high risk perception. Risk perception of captive riders got manipulated by their condition (not having any personal vehicle, decrease in income).
- Tendency of visiting outside Dhaka during last Eid-Ul-Fitre doesn't depend on Safety people. People who traveled outside Dhaka has almost equal share in increase or decrease feeling of safety in second wave.

- Male population are more likely to be worried about pandemic in first wave than female.
- There is positive significant correlation between change in level of worriedness from 2020 to 2021 and level in travel frequency from 2020 to 2021.
- There is significant correlation between change in safety level and vaccination. Those who haven't got vaccinated are felt more unsafe in the second wave of the pandemic.
- Most important aspect while choosing travel mode during the pandemic is less crowded vehicle whereas lest important aspect is comfort.
- There is no difference in the opinion between captive and choice riders about the mode encouraged in Dhaka.

### 6.2 Conclusion and Policy Recommendations

COVID-19 has been created a great impact on the travel behavior all over the world. This research attempted to investigate the change in travel behavior in Dhaka, Bangladesh due to the COVID-19 pandemic with the comparison with before pandemic, 1st and 2nd wave of pandemic, identified significance level of the change and explored risk perception of people concerning COVID-19. The study found that there has been a significant change in shifting from bus to other modes among all modes for work and shopping purposes though bus has been considered as the most risky mode. The findings also suggest that having moderate risk perception, captive riders do not have much choice in modes due to their limitations (not having any personal vehicle, decrease in income). The study revealed that change in trip purpose according to importance, change in frequency, trip purpose wise change in trip frequency, the socio-economic condition of captive and choice riders, change in safety feeling, relationship between change in safety feeling and travel behavior, correlation between safety level change and vaccination. This study contributes to better understand the effect of infectious diseases on the change of risk perception and travel behavior over time.

Policymakers should take necessary measures to face this pandemic. As safety feeling is significantly related to vaccination, vaccine should be ensured for everyone. Less crowded vehicle is considered the most important aspect while choosing a mode. However, Dhaka having a large population, ensuring less crowd is not possible. Social distancing between passengers is the 2nd most important aspect. This distancing can assured by taking policies for

people attending office on alternate days. Other passengers wearing masks is also important. People should be more and more encouraged to wear masks through electronic and social media campaigning. Majority of the people prefer MRT and BRT for Dhaka. As the construction of MRT and BRT is already going on, importance should be given on management and maintenance of these two modes for making them sustainable .Official vehicle is also in the preferred list of mode. However, there is no importance given in this mode in any existing transportation plan and policies of our country. A clear guideline should be adopted for ensuring official vehicle. However, in developing countries like Bangladesh, resources are not plentiful which have to be managed efficiently, better tailoring the available resources where it is needed .We hope that this study can be of use to policy makers to proactively plan an effective, sustainable, safe transportation system .

## References:


Abdullah, M., Dias, C., Muley, D., & Shahin, M. (2020). Exploring the Impacts of COVID-19 on Travel Behavior and Mode Preferences. *Transportation Research Interdisciplinary Perspectives, 8,* 100255. doi: 10.1016/j.trip.2020.100255

Antara, N. S. (2021). Crowds return as shops, malls reopen. *The Daily Star*. Retrieved 26 May, 2021, from https://www.dhakatribune.com/bangladesh/2021/04/25/shops-malls-reopen-doors-amid-lockdown

Anwari, N., Ahmed, M. T., Islam, M. R., Hadiuzzaman, M., & Amin, S. (2021). Exploring the Travel Behavior Changes Caused by the COVID-19 Crisis: A Case Study for a Developing Country. *Transportation Research Interdisciplinary Perspectives* 9:100334. doi: 10.1016/j.trip.2021.100334

*Bengal Institute*. (2020). Retrieved from https://bengal.institute/research/covid19dhaka/

Bhaduri, E., Manoj, B. S., Wadud, Z., Goswami, A. K., & Choudhury, C. F. (2020). Modelling the effects of COVID-19 on travel mode choice behaviour in India. *Transportation Research Interdisciplinary Perspectives, Volume 8*. https://doi.org/10.1016/j.trip.2020.100273.

Brough, R., Freedman, M. and Phillips, D. (2021, March 22). Understanding socioeconomics disparities in TRAVEL behavior during THE COVID-19 pandemic. *Journal of Regional Science*. DOI: 10.1111/jors.12527

Bucsky, P. (2020). Modal share changes due to COVID-19: The case of Budapest. *Transportation Research Interdisciplinary Perspectives 8 (2020) 100141*. Retrieved from https://www.sciencedirect.com/science/article/pii/S259019822030052X

Commuters suffer for transport curbs. (2021). *The Daily Star*. Retrieved from https://www.thedailystar.net/frontpage/news/commuters-suffer-transport-curbs-2069793

*Google News*. (2021). Retrieved from https://news.google.com/covid19/map?hl=en-US&state=7&mid=%2Fm%2F0162b&gl=US&ceid=US%3Aen

Haque, B., Rahman, M., Khan, A. S. & Parvez, M. N. (2013). Impact of Land Use Parameters on Household Travel Behavior. *American Journal of Civil Engineering and Architecture, 1*(4), 70-74. doi:10.12691/ajcea-1-4-1

Irawan, M. Z., Belgiawan, P. F., Joewono, T. V., Bastarianto, F. F., Rizki, M., & Ilahi, A. (2021). Exploring Activity-Travel Behavior Changes during the Beginning of COVID-19 Pandemic in Indonesia. *Transportation*. doi: 10.1007/s11116-021-10185-5.

Islam, M. K., Ali, M. S., Akanda, S. Z. R, Rahman, S., Kamruzzaman, A., Pavel, S. A. L., & Baki, J. (2020). COVID -19 Pandemic and Level of Responses in Bangladesh. International Journal of Rare Diseases & Disorders. 3(1), doi: 10.23937/2643-4571/1710019

Jamal, S., & Paez, A. (2020). Changes in Trip-Making Frequency by Mode during COVID-19. *Transport Findings*. https://doi.org/10.32866/001c.17977

Li, J., Lo, K., & Guo, M. (2018). Do socio-economic Characteristics affect travel behavior? A comparative study OF Low-carbon and Non-Low-Carbon Shopping travel in shenyang city, China. *International Journal of Environmental Research and Public Health, 15*(7), 1346. doi:10.3390/ijerph15071346

Maitra, B., Dandapat, S., & Chintakayala, P. (2015). Differences between the perceptions of captive and choice riders toward bus service attributes and the need for segmentation of bus services in urban India. *Journal of Urban Planning and Development, 141*(2), 04014018. doi: 10.1061/(ASCE)UP.1943-5444.0000205

Neuburger, L. and Egger, R. (2020). Travel risk perception and travel behavior during the COVID-19 pandemic 2020: a case study of the DACH region. *Current Issues in Tourism, 24 (7).* Retrieved from https://doi.org/10.1080/13683500.2020.1803807

Nguyen, M. H. (2021). Factors influencing home-based telework in Hanoi (Vietnam) during and after the COVID-19 era. *Transportation (Amst).* doi: 10.1007/s11116-021-10169-5

Orro, A., Novales, M., Monteagudo, A., Pérez-López, J., & Bugarín, M. R. (2020). Impact on City Bus Transit Services of the COVID–19 Lockdown and Return to the New Normal: The Case of A Coruña (Spain). *Sustainability.* Retrieved from https://www.mdpi.com/2071-1050/12/17/7206/pdf

Parady, G., Taniguchi, A. and Takami, K. (2020). Travel behavior changes during the COVID-19 pandemic in Japan: Analyzing the effects of risk perception and social influence on going-out self-restriction. *Transportation Research Interdisciplinary Perspectives, 7,* 100-181. Retrieved from http://dx.doi.org/10.1016/j.trip.2020.100181

Pawar, D. S., Yadav, A. K., Choudhary, P., & Velaga, N. R. (2021). Modelling Work- and Non-Work-Based Trip Patterns during Transition to Lockdown Period of COVID-19 Pandemic in India. *Travel Behaviour and Society*, *24*, 46-56. Retrieved from https://www.sciencedirect.com/science/article/pii/S2214367X21000090#!

Rahman, M. (2008). *Understanding the Linkages of Travel Behavior with Socioeconomic Characteristics and Spatial Environments in Dhaka City and Urban Transport Policy Applications* (Unpublished master's thesis). Graduate School for International Development and Cooperation Hiroshima University, Japan. Retrieved from https://srmilan.tripod.com/Master_Thesis.pdf

Rahman, M. F. (2021). People's mobility surpasses pre-pandemic levels. *The Daily Star*. Retrieved from: https://www.thedailystar.net/business/news/peoples-mobility-surpasses-pre-pandemic lEvels-2056225

Rahman, M. H., & Ashik, F. R. (2020). Is neighborhood LEVEL JOBS-HOUSING balance associated with TRAVEL behavior of commuters? A case study on Dhaka CITY, BANGLADESH. *GeoScape, 14*(2), 122-133. doi:10.2478/geosc-2020-0011

Rahman, M., Ali, S.A., & Hossain, Q.S. (2015). Analysis of Travel Behavior in Khulna Metropolitan City, Bangladesh. *Civil and environmental research, 7,* 206-218. Retrieved from: https://www.iiste.org/Journals/index.php/CER/article/view/19876/20085

Raida, A., Mehnaj , R & Murshed, M. N. (2020). *Travel Behavior of Female University Students and Impacts of Ride-Sharing on Mode Choice: a Case Study*. Easy chair: the world for scientists. Retrieved from:https://easychair.org/publications/preprint_download/QXTt.

Rehani, M. M. (2015). Radiation effects and risks: overview and a new risk perception index. *Radiation protection dosimetry*, *165*(1-4), 7-9.

Saha, D. (2010). *Development of a Mode Choice Model Considering Heterogeneous Traffic of Dhaka City*. (Master's Thesis, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh). Retrieved from http://lib.buet.ac.bd:8080/xmlui/bitstream/handle/123456789/384/Full%20%20Thesis%20%20.pdf?sequence=1&isAllowed=y

Shakibaei, S., De Jong, G. C., Alpkökin, P., & Rashidi, T. H. (2021). Impact of the COVID-19 pandemic on TRAVEL behavior in Istanbul: A panel data analysis. *Sustainable Cities and Society, 65*, 102619. doi:10.1016/j.scs.2020.102619

Shamshiripour, A., Rahimi, E., Shabanpour, R., & Mohammadian, A. (2020). How Is COVID-19 Reshaping Activity-Travel Behavior? Evidence from a Comprehensive Survey in Chicago. *Transportation Research Interdisciplinary Perspectives, 7*. doi: 10.1016/j.trip.2020.100216.

Siam, M. H. B., Hasan, M. M., Tashrif, S. M.. Khan, M. H. R., Raheem, E., & Hossain, S. M. (2020). *Insights Into the First Seven-Months of COVID-19 Pandemic in Bangladesh: Lessons Learned from a High-Risk Country*. Dhaka, Bangladesh. Retrieved from https://assets.researchsquare.com/files/rs-89387/v1/b9a3548d-9d71-44ac-942c-d27161652c1e.pdf

Truong, D., & Truong, M. (2021). Projecting daily travel behavior by distance during the pandemic and the spread of COVID-19 infections – Are we in a closed loop scenario? *Transportation Research Interdisciplinary Perspectives, Volume 9*. https://doi.org/10.1016/j.trip.2020.100283.

World Health Organization (WHO). (2020). *Coronavirus disease 2019 (COVID-19) Situation Report – 71*. Retrieved from https://www.who.int/docs/default-

source/coronaviruse/situation-reports/20200331-sitrep-71-covid-19.pdf?sfvrsn=4360e92b_8

World Health Organization (WHO). (2020). *Coronavirus disease 2019 (COVID-19): Situation Report – 94.* Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf

World Health Organization Bangladesh. (2020). *COVID-19 Situation Report No. #4 24 March 2020.* Dhaka, Bangladesh. Retrieved from https://www.who.int/docs/default-source/searo/bangladesh/covid-19-who-bangladesh-situation-reports/who-ban-covid-19-sitrep-04.pdf?sfvrsn=69b6d931_8

World Health Organization Bangladesh. (2020). *COVID-19 Situation Report No. #5 31 March 2020.* Dhaka, Bangladesh. Retrieved from https://cdn.who.int/media/docs/default-source/searo/bangladesh/covid-19-who-bangladesh-situation-reports/who-ban-covid-19-sitrep-05.pdf?sfvrsn=23b90f3c_8

World Population Review (2021). Retrieved from https://worldpopulationreview.com/world-cities/dhaka-population

Worldmeter. (2021). Retrieved from https://www.worldometers.info/coronavirus/country/bangladesh/

Zafri, N. M., Khan, A., Jamal, S., & Alam, B. M. (2021). Impact of Covid-19 pandemic on MOTORCYCLE purchase in Dhaka, Bangladesh. *Frontiers in Future Transportation, 2*. doi:10.3389/ffutr.2021.646664

Zafri, N.M., Khan, A., Jamal, S., & Alam, B.M. (2021). Impacts of the COVID-19 Pandemic on Active Travel Mode Choice in Bangladesh: A Study from the Perspective of Sustainability and New Normal Situation. *Sustainability, 13*, 6975. https://doi.org/10.3390/su13126975

# Appendix A: Questionnaire

Assalamualaikum/ Adab. We are the students of Level-4/ Term-I of the Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology (BUET). We are conducting a survey as a part of our class project titled "Impacts of COVID-19 Pandemic on Travel Behavior of People in Dhaka". As a part of collecting data and information, we are going to ask the participants regarding the changes in the transport mode used, cost, time, and frequency of their work / education / shopping trips before and during the 1st and 2nd wave of COVID-19 pandemic. We would like to invite you to participate in our survey. The survey will take approximately 15 minutes to complete. This is an anonymous survey and collected data will be used for academic purposes only. Your cordial cooperation will be highly appreciated

## A. Travel related information

In this section, your trip-related information focusing on COVID-19 will be collected. In some cases, the same questions have been asked for three periods - Before COVID-19 Pandemic (Before March 2020), during the 1st wave of the COVID-19 Pandemic (March-August, 2020), and during the 2nd wave of COVID-19 Pandemic (March 2021- now). This information is required to detect any changes in travel behavior during these periods. You are requested to answer these questions accurately by reflecting on your past and present travel behavior.

***Before COVID-19 Pandemic (Before March 2020)***

1. Please select how frequently you traveled for the following purposes before COVID-19 pandemic (before March 2020)

| Purpose | Never | Rarely | Once in a month | Once in two weeks | Once in a week | 2-3 times in a week | Daily | Online |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

2. Select the main mode that you mostly used for the following purposes before COVID-19 pandemic (before March 2020). [For example: If you used both walking and public bus, select bus]

| Purpose | Not applicable | Bus | CNG auto rickshaw | Private car | Rick shaw | Bicycle | Motorbike | Walking | Uber/ Pathao | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

3. Select the time spend on the mode that you mostly used for the following purposes before COVID-19 pandemic (before March 2020). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 30 mins | 30 min-1 hour | 1-1.5 hour | 1.5-2 hour | 2-2.5 hour | 2.5-3 hour | 3-3.5 hour | >3.5 hour |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ |

4. Select how much you spent (in taka) on the mode that you mostly used for the following purposes before COVID-19 pandemic (before March 2020). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 50 | 50-100 | 101-150 | 151-200 | 201-250 | 251-300 | >300 |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

***During the 1st wave of COVID 19 Pandemic (March-August, 2020)***

5. Please select how frequently you traveled for the following purposes during the 1st wave of COVID-19 pandemic (March-August, 2020)

| Purpose | Never | Rarely | Once in a month | Once in two weeks | Once in a week | 2-3 times in a week | Daily | Online |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

6. Select the main mode that you mostly used for the following purposes during the 1st wave of COVID-19 pandemic (March-August, 2020). [For example: If you used both walking and public bus, select bus]

| Purpose | Not applicable | Bus | CNG auto rickshaw | Private car | Rick shaw | Bicycle | Motorbike | Walking | Uber/ Pathao | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

7. Select the time spend on the mode that you mostly used for the following purposes during the 1st wave of COVID-19 pandemic (March-August, 2020). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 30 mins | 30 min-1 hour | 1-1.5 hour | 1.5-2 hour | 2-2.5 hour | 2.5-3 hour | 3-3.6 hour | >3.5 hour |
|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ |

8. Select how much you spent (in taka) on the mode that you mostly used for the following purposes during the 1st wave of COVID-19 pandemic (March-August, 2020). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 50 | 50-100 | 101-150 | 151-200 | 201-250 | 251-300 | >300 |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

***During the 2nd wave of COVID 19 Pandemic (March 2021- now)***

9. Please select how frequently you travel for the following purposes during the 2nd wave of COVID-19 pandemic (March 2021- now).

| Purpose | Never | Rarely | Once in a month | Once in two weeks | Once in a week | 2-3 times in a week | Daily | Online |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

10. Select the main mode that you mostly use for the following purposes during the 2nd wave of COVID-19 pandemic (March 2021- now). [For example: If you used both walking and public bus, select bus]

| Purpose | Not applicable | Bus | CNG auto rickshaw | Private car | Rick shaw | Bicycle | Motorbike | Walking | Uber/ Pathao | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

11. Select the time spend on the mode that you mostly use for the following purposes during the 2nd wave of COVID-19 pandemic (March 2021- now). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 30 mins | 30 min-1 hour | 1-1.5 hour | 1.5-2 hour | 2-2.5 hour | 2.5-3 hour | 3-3.7 hour | >3.5 hour |
|---|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ |

12. Select how much you spend (in taka) on the mode that you mostly use for various trip purposes during the 2nd wave of COVID-19 pandemic (March 2021- now). [Consider only one way trip, for example trip from your home to office only]

| Purpose | Not applicable | < 50 | 50-100 | 101-150 | 151-200 | 201-250 | 251-300 | >300 |
|---|---|---|---|---|---|---|---|---|
| Work | □ | □ | □ | □ | □ | □ | □ | □ |
| Education | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ |

13. Rank only three aspects that you consider most to choose a transport mode during the COVID-19 pandemic? [For example select Rank 1 for the reason you consider most, Rank 2 for the next important one, and so on, and leave others as blank. If two aspects are equally important for you, you can give them the same ranking]

| Aspects | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Less crowded vehicle | □ | □ | □ |
| Social distancing between passengers | □ | □ | □ |
| Other passengers wearing mask | □ | □ | □ |
| Driver and staff wearing mask | □ | □ | □ |

| | | | |
|---|---|---|---|
| Disinfecting vehicles after every trip | □ | □ | □ |
| Cleanliness | □ | □ | □ |
| Comfort | □ | □ | □ |
| Travel cost | □ | □ | □ |
| Other | □ | □ | □ |

Other (Specify)……

14. Rank the following trip purposes (only the top 3) according to the importance to you before COVID-19, during the first wave, and during the second wave. [For example: select Rank 1 for the most important trip purpose, Rank 2 for the next important one, and so on, and leave others as blank].

| Trip purpose | Before COVID-19 (Before March 2020) | | | During the first wave (March-August 2020) | | | During the second wave (March 2021-now) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rank 1 | Rank 2 | Rank 3 | Rank 1 | Rank 2 | Rank 3 | Rank 1 | Rank 2 | Rank 3 |
| Work (office/business) | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Education (university/college/ school) | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Shopping | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Recreation | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Social | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Medical | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Work from home | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Other | □ | □ | □ | □ | □ | □ | □ | □ | □ |

Specify others (before COVID-19 pandemic):

Specify others (during the 1st wave of COVID-19 pandemic):

Specify others (during the 2nd wave of COVID-19 pandemic):

## B. Risk perceptions and information about COVID-19

15. Please state your feeling of safety while travelling during the COVID-19 pandemic

| During the 1st wave of COVID-19 Pandemic (March-August, 2020) | During the 2nd wave of COVID-19 Pandemic (April 2021- now) |
|---|---|
| □ I felt very safe<br>□ I felt quite safe<br>□ I neither felt safe nor unsafe<br>□ I don't felt safe at all<br>□ I didn't bother about my safety | □ I feel very safe<br>□ I feel quite safe<br>□ I neither feel safe nor unsafe<br>□ I don't feel safe at all<br>□ I don't bother about my safety |

16. Please specify how you perceive risk for the following travel modes during the COVID-19 pandemic.

| Mode | Extremely low risk | Low risk | Medium risk | High risk | Extremely high risk |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Walking | □ | □ | □ | □ | □ |
| Rickshaw | □ | □ | □ | □ | □ |
| Institutional transport (office bus/ microbus) | □ | □ | □ | □ | □ |
| Bicycle | □ | □ | □ | □ | □ |
| Personal Motorcycle | □ | □ | □ | □ | □ |
| Private Car | □ | □ | □ | □ | □ |
| Bus | □ | □ | □ | □ | □ |
| CNG auto rickshaw | □ | □ | □ | □ | □ |
| Uber/Pathao/similar car | □ | □ | □ | □ | □ |
| Uber/Pathao/similar motorcycle | □ | □ | □ | □ | □ |
| Leguna/Tempo/similar | □ | □ | □ | □ | □ |

17. Rank the modes according to the chance of getting infected by COVID-19. Select the ranks (1, 2, 3, 4 or 5) in the boxes. For example, select Rank 1 in the box next to a mode if you think it is the riskiest for COVID-19 transmission among the five.

| Mode | Rank 1 | Rank 2 | Rank 3 | Rank 4 | Rank 5 |
|---|---|---|---|---|---|
| Public transport (bus/minibus/laguna/tempo etc.) | □ | □ | □ | □ | □ |
| Shared transport (rickshaw/CNG/uber/pathao etc.) | □ | □ | □ | □ | □ |
| Office transport (bus/minibus etc.) | □ | □ | □ | □ | □ |
| Private transport (private car/personal motorcycle etc.) | □ | □ | □ | □ | □ |
| Individual transport (walking/cycle etc.) | □ | □ | □ | □ | □ |

18. Please indicate the degree to which you agree with the following statements.

| Subject | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I think the spread of COVID-19 can be prevented by measures like washing hands, mask, social distancing etc. | □ | □ | □ | □ | □ |
| I think only rich people are infected with COVID-19 | □ | □ | □ | □ | □ |
| I think only urban people can be infected with COVID-19 | □ | □ | □ | □ | □ |
| During the whole pandemic, I only went out for emergency/unavoidable circumstances. | □ | □ | □ | □ | □ |
| I had reduced my travel frequency every time COVID-19 cases started to increase drastically | □ | □ | □ | □ | □ |

| | | | | | |
|---|---|---|---|---|---|
| I always take necessary precautions before going out. | □ | □ | □ | □ | □ |
| I had registered for a 'movement pass' at least once (in 2021) before going out. | □ | □ | □ | □ | □ |
| I have travelled more frequently in 2021 than in the early phase of 2020 because of the ease in restrictions. | □ | □ | □ | □ | □ |
| I was more worried about COVID-19 infection during the first wave (March-August 2020) than I am in the second wave (March 2021- now) | □ | □ | □ | □ | □ |
| Attending social and religious events are important to me, even during pandemic | □ | □ | □ | □ | □ |
| I prefer e-activities more than physical activities during pandemic | □ | □ | □ | □ | □ |
| I prefer telecommuting but my job does not fit into the 'Work from home' format (tick 'neutral' if this option does not apply for you) | □ | □ | □ | □ | □ |

19. Has any of your family members got infected with COVID-19?

□ Yes

□ No

If yes, mention the number of infected family members…….

20. Did you make a trip outside Dhaka during the last Eid-ul-Fitr?

□ Yes

□ No

If yes, what mode did you use for your trip?.....

**C. General information**

21. Please mention the Thana of your residence.

…….

22. Please select your gender?

□ Male

□ Female

□ Prefer not to answer

23. Please select your age in years?

□ 18-25

□ 26-30

□ 31-35

- 36-40
- 41-45
- 46-50
- 51-55
- 56-60
- 61-65
- 65+

24. Please select your educational qualification.
    - Illiterate
    - Primary
    - SSC or equivalent
    - HSC or equivalent
    - Graduate or equivalent
    - Postgraduate or equivalent
25. Please select your current employment status.
    - Student
    - Homemaking
    - Government service holder
    - Private service holder
    - Business
    - Teacher
    - Doctor/ Nurse
    - Looking for job
    - Retired
    - Other (specify)
26. Please select your monthly household income in BDT?
    - Less than BDT 20,000
    - BDT 20,000 – 39,999
    - BDT 40,000 – 59,999
    - BDT 60,000 – 79,999
    - BDT 80,000 – 99,999
    - BDT 100,000 – 119,999
    - BDT 120,000 – 139,999
    - BDT 140,000 and above
27. Did your household income change during the pandemic?
    - Yes, increased
    - Yes, decreased
    - No
28. How many members are in your household in total?
    - 1
    - 2
    - 3

- □ 4
- □ 5
- □ >5

29. In the following table, please specify how many members for each age group are present in your household (If there is none, mention 0).
    - 29.1. Members below 18 years:.....
    - 29.2. Members of 18-25 years:……..
    - 29.3. Members of 26-65 years:……..
    - 29.4. Member with 65+ age:……..
30. How many vehicles of these types does your household own (If there is none, mention 0)?
    - 19.1 Bicycle:…….
    - 19.2 Motorcycle:……..
    - 19.3 Car:……..
    - 19.4 Other (please specify):……

31. In your opinion, which three modes should be encouraged in Dhaka city? [For example: select Rank 1 for the most important mode, Rank 2 for the next important one, and so on, and leave others as blank].

| Mode | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Metro rail | □ | □ | □ |
| Bus Rapid Transit (BRT) | □ | □ | □ |
| Bus/ minibus | □ | □ | □ |
| Laguna/Tempo/ similar | □ | □ | □ |
| Office transport | □ | □ | □ |
| Taxicab | □ | □ | □ |
| CNG Autorickshaw | □ | □ | □ |
| Uber/Pathao/ similar car | □ | □ | □ |
| Uber/Pathao/ similar motorcycle | □ | □ | □ |
| Rickshaw | □ | □ | □ |
| Private car | □ | □ | □ |
| Personal motorcycle | □ | □ | □ |
| Bicycle | □ | □ | □ |
| Walking | □ | □ | □ |
| Other | □ | □ | □ |

Specify other……..

32. How many doses of the COVID-19 vaccine have you received so far?
    - □ Two
    - □ One
    - □ None
    - □ Not applicable (e.g., age below 40 years)
33. Do you have anything else to share with us about the discussed issues?

**……**

## Appendix B: Risk Perception Index

The list of indicators to measure risk perception is given below-

1. Going out only for emergency/unavoidable circumstance during the whole pandemic
2. Preferring e-activities more than physical activities during pandemic
3. Reducing travel frequency every time COVID-19 cases started to increase drastically
4. Always taking necessary precautions before going outside
5. Preventing the spread of COVID-19 is possible by measures like washing hands, mask, social distancing etc.

Each statement was measured using a 5-point Likert scale where strongly disagree was scored as 1 and strongly agree was scored as 5. The average of the score represented the index value of the respondents.

Appendix 1: Risk perception wise index value

| Index value | Risk perception |
|---|---|
| <2.5 | Low risk perception |
| 2.5-4 | Moderate risk perception |
| >4 | High risk perception |

Source: Online Survey, 2021