IMPACT OF COVID-19 ON THE TRAVEL BEHAVIOR OF DHAKA CITY DWELLERS

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURE

LIST OF FIGURES

IMPACT OF COVID-19 ON THE TRAVEL BEHAVIOR OF DHAKA CITY DWELLERS

Abstract

Since the outbreak of coronavirus disease (COVID-19), travel behavior has been impaired around the world. Several industries, including the transportation industry, have been hit hard by pandemics. The virus spreads through close contact with infected people, reducing the number of outdoor trips and reducing road and public transport congestion. To develop global transportation guidelines for COVID-19 and beyond, we need to find out how pandemics have affected travel behavior. This study used a questionnaire survey to examine the impact of the COVID-19 pandemic on Dhaka Bangladesh's travel patterns and transportation preferences. The results show that during the pandemic, the main purpose of travel has shifted significantly from work and study to shopping. The number of non-commuter trips was also significantly different before and during the pandemic.

The government recommends or imposes various measures to curb the spread of COVID-19. Travel behavior is greatly influenced by such measures. However, people have a variety of travel needs, from grocery shopping to work. This study examines changes in travel behavior due to the COVID-19 pandemic. The data was collected through an online survey that included questions about the purpose of the trip, choice of transportation, distance traveled, and frequency of trips before and after COVID-19. 1217 responses were collected from different age, profession people around Dhaka. The results showed that the main trips before and during the pandemic differed significantly in purpose of travel, choice of transportation, distance traveled, and frequency of travel. In addition, most of the trips during the pandemic were for shopping. There was a clear transition from public transport to private non-electric transport. When choosing a mode during a pandemic, people prioritized pandemic-related concerns over general concerns. Gender, car ownership, employment status, distance traveled, the main purpose of travel, and the underlying pandemic-related factors in COVID 19 have been found to be important predictors of transportation choices during a pandemic. The results of this survey may be useful in pandemic transportation planning and policies based on people's travel needs. Government agencies can use such insights to plan smart and partial blockades.

CHAPTER-1

1.1 Introduction:

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by coronavirus 2 (SARS-CoV-2) that causes severe acute respiratory syndrome. The first known case was identified in Wuhan, China, in December 2019. The disease has spread around the world, resulting in an ongoing pandemic. COVID19 is spread when people breathe air contaminated with droplets and airborne particles that contain the virus. The risk of inhaling them is higher when people are nearby, but they can be inhaled at greater distances, especially indoors. Transmission can also occur by splashing or spraying contaminated liquid into the eyes, nose, or mouth, and rarely through contaminated surfaces. People remain contagious for up to 20 days and can spread the virus even if they do not develop symptoms (Covid-19 2020).

The spread of the virus in Bangladesh was confirmed in March 2020. The first three known cases were reported by the National Institute of Epidemiology (IEDCR) on March 8, 2020. Since then, pandemics have spread nationwide every day, and the number of affected people is increasing. Bangladesh is the second most severely affected country in South Asia after India (Trip Generation). The COVID-19 infection rate in Bangladesh in March and April 2020 was about 2. This means that two out of one person can be infected with the virus. However, the infection rate of COVID-19 in Japan has decreased over time. As of June 26, the domestic coronavirus infection rate is 1.05, which is a very good sign. Model-based simulations suggest that the 95% confidence interval for time-varying reproductive counts was less than 1.0, a decline from December 2020 to February 2021.

Health Minister Zahid Maleque said the situation in Bangladesh improved as the rate of increase in infections slowed and the duration of infection doubling increased, and the minimum number of daily COVID-19 tests in the country also improved to 15,000. He also said that the maximum growth rate of domestic infections dropped to 2.5% on July 3, the day after the number of COVID-19 cases exceeded 150,000. On July 3, the increase in infection was less than 2.5% in Bangladesh. The Minister of Health said the minimum doubling time for domestic infections had improved by 25th by 10th July. As of July 10, it will take more than 25 days for the number of cases of Bangladesh's coronavirus to double. During Covid-19, it drastically affected the travel, transport system and trip numbers reduced but, in some cases, it increased because of various reasons.

Trip number mean the predicted number of trips made by the travelers by purpose or generated by and attracted to each zone in a study area. A trip is defined as the one-sided movement of people by mechanized means of transportation with both ends of the trip. The purpose of trip generation is to estimate the number of trips ends for each zone in the target year. The end of the journey is calculated for various travel purposes within the zone. These trips are represented as non-housing trip attractions obtained by predicting the production or land use of home trips extracted from a household-based autoclassification table. Frequently used trip generation models include multiple linear regression models, autoclassification models, or a combination of both.

The process of estimating the amount of traffic is Trip generation and a proposed development will have once it will start operating after build properly. Trip distribution is the process by which we can take the raw projected traffic for a development (trip generation) and add it to the existing volumes on the transportation network. The step in-between is determining whether all the trip generation will be new to the roadway (Shaik et al., 2021).

Due to covid-19 a drastic change has taken place in transport system as long as in passengers too. As we know the use of public transport has become very dangerous in this contagious epidemic. Because of this we all have faced many difficulties still facing. Various steps are being taken to prevent it from spreading. Global measures like lockdown, putting limitations on different kind of public transits, entertainment, closing all the educational institutes for years also religious activities or practices have been imposed in early 2020. We have suffered a lot of gains and losses too in every cases.

Due to COVID-19, citizens' behavior and mobility are changing dramatically in all parts of the world. This change was primarily the result of strict segregation and social distance measures implemented by various governments in most countries around the world. Certain measures taken in each country, combined with certain characteristics of virus spread, have resulted in similar but different behavioral changes. This article presents an analysis of a survey conducted in Dhaka, Bangladesh. Here, we asked the public about their preference for movement before, during, and after Covid-19. Then there was a question about the preferred mode of transportation in each situation and the perception of public transport safety in the current situation. Mobility questions were categorized by commuting, studying, shopping, and leisure. The results show that local public transport is the most affected mode of transportation and that the use of bicycles and sidewalks has

increased significantly. At the same time, changes in shopping behavior were seen, such as a significant decrease in the use of large supermarkets (Bhaduri et al., 2020). To understand the situation in a better way we analysis the situation to gather more information.

Specifically, statistical analysis is the process of integrating and analyzing different samples of data to uncover patterns or trends and predict future events / situations to make appropriate decisions. This is the science of collecting, researching, and presenting large amounts of data to discover underlying patterns and trends. Statistics are used daily in research, industry and government to make more scientific decisions. More specifically, statistical data analysis involves the collection, interpretation, and presentation of data. You can approach it when processing data to solve complex problems. statistical analysis provides meaning for non-essential / irrelevant data or numbers.

A statistical model is a mathematical model that use on a set of statistical assumptions about the generation of sample data. Statistical models often represent the data generation process in a highly idealized form. Statistical modeling is the use of mathematical models and statistical assumptions to generate sample data and predict the real world. A statistical model is a set of probability distributions for all possible sets of outcomes of an experiment. The goal of statistical modeling is to summarize test results so that evaluators can observe patterns in the data, draw conclusions, and ultimately answer the questions that triggered the test (Statistical model).

1.2 Aims and Objective:

We have chosen this topic "IMPACT OF COVID-19 ON THE TRAVEL BEHAVIOR OF DHAKA CITY DWELLERS" because we want to present a model Infront of the world to make it easy to understand the covid-19 situation at its peak or at a normal day at any time. Now writing this thesis report on this topic will help us to what we want to present Infront of everyone. According to us this is the best way to explain the clear concept about transport and passengers. Until this report, that was tough to know about the accurate information about Covid-19 situation. After this model or code, it will be a lot easier to know the results from day-to-day life if we have the required data as input. This will change the scenario totally; it will be very fortunate for us to get a model like this. Many people can use this model and by the results they can take proper steps to take precautions to handle the situation or they figure out what they can do or cannot perform at this time. It will be a lot easier to find out for us or for the government to understand if we are doing tor taking every steps right or not, what need to change or what need to add in here. Beyond that our purpose for writing this report is, by using available data variable knowing the rate of using transport system or making trips, mainly confirming its decreasing or not.

CHAPTER-2

LITERATURE AND REVIEW

Background on COVID 19

Coronavirus Disease 2019 (COVID-19) is a virus that was first discovered in December 2019 in Wuhan, Hubei, China. Since then, the virus has spread swiftly throughout the world. On January 13, 2020, Thailand announced the first worldwide case of COVID-19 (Andersen et al., 2021). It was first known as Novel Coronavirus, and the World Health Organization (WHO) recommended the following terminology to describe the virus. The virus that causes the infection has been identified as SARS coronavirus 2 (severe acute respiratory syndrome coronavirus 2).

Bhutan announced the closure of schools and institutions, as well as a reduction in business hours, in the second week of March 2020 (Kuensel, 2020, 6 March). From August 1, 2020, the entire country was put on lockdown. In the interim, people were allowed to roam around, offices reopened, schools and colleges reopened for a limited time, and life went on.

Scenario in Bangladesh and her response to the pandemic

On March 8, 2020, Dhaka, Bangladesh's capital and most populous city, verified the country's first coronavirus case. Bangladesh postponed mass congregations until the first week of March, banned international flights, imposed thermal scanner checks, and closed educational institutions in response to the virus's arrival. Unfortunately, offices continued to operate on a regular schedule until the government imposed a nationwide lockdown on March 26, 2020. Closures and movement restrictions were gradually lifted by the government beginning on May 31, 2020. On a case-by-case basis, the administration imposed partial lockdowns (2005) (Ministry of Health and Family Welfare, 2020). Partially lockdowns were in effect around the country during the study period. Bangladesh wants to recover while limiting COVID-19 transmission because the country has already suffered economically.Consequently, Bangladesh prepared a COVID-19 response plan following International Health Regulations. The main guidelines set forth in the plan that were followed during the study period, and the subsequent measures taken by the government to ensure compliance with the guidelines, are presented below:

Outside the home, including the job, school, and public transportation, mandatory mask-wearing and safe hygiene habits are enforced:

The government's law enforcement agencies have banded together to make mandatory mask wearing. To enhance awareness and sustain behavior change, enforcement of mask-wearing and access to water and soap/sanitizers to enable safe hand washing/sanitizing has been complemented by a communications campaign on mask-wearing, social distancing, and good hygiene practices. To avoid relying on more expensive imports and disposable masks, local industry has been given permission to produce reusable masks.

Zoning approach to containment: COVID-19 hotspots were identified using technology-enabled epidemiological health surveillance. To show the intensity of cluster infections, such hotspots were coded as red, yellow, or green. To prevent virus transmission, each zone was subjected to a variety of restrictions. As a result, without the necessity for a full national lockdown, protectionist restrictions were implemented in geographically limited areas. For example, full lockdown, partial lockdown, and no lockdown were applied to red, yellow, and green zones, respectively. On a monthly basis, infection rates in these zones were assessed to determine the need for a change in restrictive practices in a given area.

Community-based prevention practices, case identification, and quarantining by utilizing local community health capacity and digital platform to reduce virus transmissions and sustain behavior change after lockdown:

1. Full family quarantine for individuals with symptoms of COVID-19 for 14 days.

2. Targeted food distribution for 14 days to vulnerable households under isolation. Zoned containment and quarantine is important for supporting those families most in need and ensuring quarantine compliance;

3. Supportive monitoring of home quarantine via telemedicine and by local community health service providers.

4. Strong nationwide communications to empower symptomatic individuals and their families to report symptoms. The government felt that destigmatizing the disease was essential for people to feel safe in divulging symptoms and seeking necessary assistance.

5. Effective community engagement strategies to empower communities to support and enforce safe behaviors of mask wearing, social distancing and safe hygiene practices are essential for ensuring and sustaining safe behaviors and practices.

6. Locally managed isolation centers for dwellers of slums and other congested areas where home quarantine or isolation are not possible because of shared facilities.

Maintenance of social distancing regulations based on latest expert and industry guidance as developed and enforced by the government:

Social distancing measures were applied based on epidemiological evidence with the primary objective of ensuring that virus transmission does not cause hospital beds to be exceeded. Regulations for public transportation, factories, offices, markets, shops, including in the informal sector, were developed and reviewed regularly based on epidemiological assessments. Measures were introduced at local and national levels to decelerate virus reproduction rate while minimizing the broader negative impacts to the economy.

Empowerment of frontline health workers and other essential workers through communications and behavioral change:

The government realized that ensuring safety of essential frontline workers is vital to maintaining morale and preventing disease transmission by the workers themselves. The healthcare workers were equipped with necessary information and guidelines. Moreover, periodic reporting of symptoms and tracking of worker statuses helped health supervisors make timely management decisions like withdrawing workers from field duty.

Specific actions regarding COVID-19 taken in the transportation sector and for travel in Bangladesh during the study period of 01 May to 30 June 2020 are presented as follows:

1. All passenger flights coming into and going out of Bangladesh were cancelled until 16 May 2020. Cargo, special flights, air ambulances, relief carrying flights and emergency landing aircrafts were outside the purview of the ban.

2. All travelers arriving in Bangladesh were required to undergo mandatory 14-day quarantine, regardless of nationality and traveler type.

3. While most forms of transportation such as intercity and commuter busses and trains and ferries were shut down, public transport operations resumed gradually from 31 May 2020, depending on the situation of that place. Buses were limited to only 50% of capacity to ensure passengers could travel while maintaining physical distancing.

4. The country was in full lockdown until 30 May 2020. During that time, only essential services such as shops and banks were open at fixed times during the week. Besides, emergency services including hospitals were exempt from lockdowns. From 31 May until 15 June 2020, movement was not allowed outside from 8 pm until 8 am. Outside these hours the people were allowed to leave their homes only in case of an urgency. Non-compliance risked legal actions. From 16 June 2020, the curfew hours were restricted to the period of 8 pm to 6 am.

5. Starting from 15 June 2020, the government designated COVID-19 affected spots as red, yellow or green. The government declared a 21-day general holiday for the people living or working in red zones. People were asked to work from home. All forms of transport were barred from operating in such places. However, emergency services were exempted. People living in yellow zones have slightly relaxed restrictions, with offices and factories allowed to run physically with a limited number of workers. People were allowed to visit places of worship while maintaining social distance inside those places. Most shops except pharmacies and departmental stores would remain closed. Restaurants could only operate by providing parcel deliveries. Only public transport was barred in yellow zones. Green zones faced the least restrictions, as they were the least infected. All forms of activities except recreation were allowed. However, people had to wear masks and maintain physical distancing while outside (Ministry of Health and Family Welfare, 2020).

Travel pattern

"Travel pattern changes" has been defined as "abrupt, substantial, and persistent changes in the underlying pattern of travel behavior" (Zhao et al., 2018). This topic has received extensive coverage in the literature focusing on relation of travel incidence variation with climate change (Urry, 2008), lifestyle change (Zhao et al., 2018), public transit induced change (Combs, 2017), residential location (Buchanan and Barnett, 2006), telecommunication (Salomon, 1998), and transport policy changes (Keuleers et al., 2006).

Travel is one of the main factors spreading infectious diseases worldwide, which has been exacerbated in recent times (Gezairy, 2003). Hence, several researchers have paid attention to travel pattern changes caused by COVID-19 and other outbreaks. Studies on previous outbreaks reveal that travel had been reduced considerably during Ebola (Peak et al., 2018), SARS, MERS (Joo et al., 2019) and Zika Virus (Widmar et al., 2017) outbreaks. However, the impacts of previous outbreaks were limited to specific geographic areas, while current COVID-19 pandemic eclipses all previous outbreaks.

The COVID-19 has significantly changed people's activity-travel behavior around the world. Public transport is one of most affected transport modes by the COVID-19 pandemic, mainly due to its consideration as one of the most likely transmission channels. This pandemic can be compared to a life-changing event that can significantly change the travel pattern. For example, many people consider public transport as a major source for COVID-19 spread and have hence shifted to private modes in Bangladesh, India, Pakistan, USA, Turkey, Canada, and China. However, this can also increase traffic congestion and air pollution in the future. Although most of these studies reported decreased physical travel, they were carried out in developed countries where socio-economic conditions are divergent from developing countries like Bangladesh. According to several COVID-19 travel impact investigations in Bangladesh, people continue to travel for work, and use bus because of its cheapness. The specific modes presented as options in the questionnaire survey are based on consultation with transportation experts. A wide variety of modes run in the streets of Dhaka City, including rickshaw and leguna.

Chapter-3

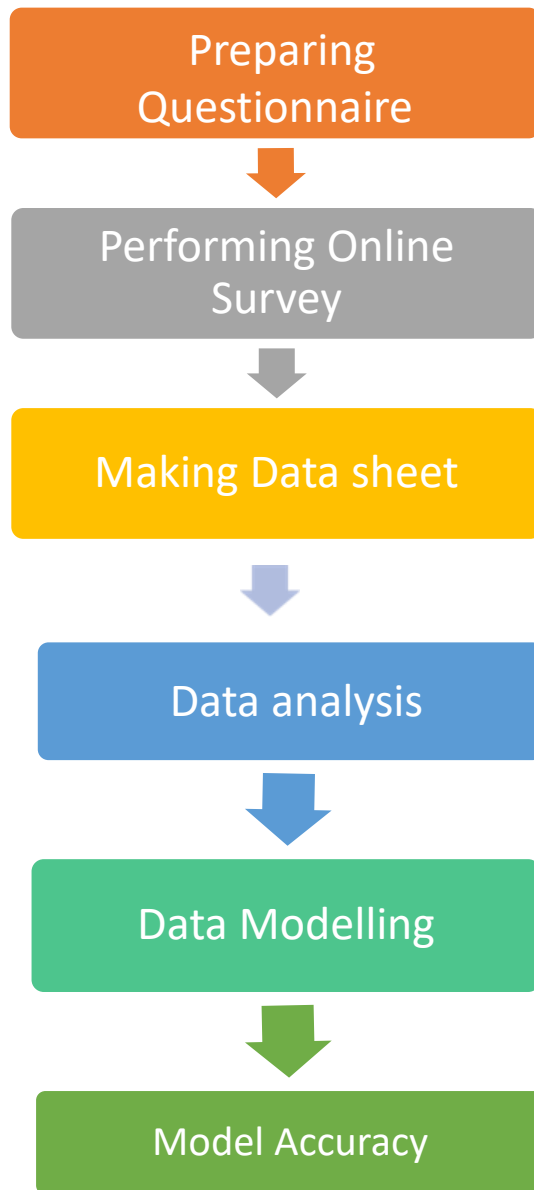## 3.1 Defining the idea:

Figure 1: flowchart of the overall idea

3.2 Explaining the idea:

For the further discussion first, we must know about the definition of model. A model provides logical and simplified, useful approaches which copes well with partial knowledges. Modeling is something else, usually small. The military commander plans an attack using physical and computer models. Modeling is useful because you can often see things that are too big or impractical to look at in other ways. Data modeling is the process of creating a simple diagram of a complex software system, using text and symbols to represent how data will flow. Diagrams can be used to ensure efficient use of data as a template for building new software or to refactor an existing application.

A regression model is used to investigate the relationship between two or more variables and estimate one variable based on the others. In regression analysis, variables that can be independent, used as predictive inputs, or causal and dependent, used as response variables. In experimental studies, the independent variable X is the controllable variable, and the variable Y is the variable that reflects changes in the independent variable X.

A statistical model is a mathematical model that contains a set of statistical assumptions about the generation of sample data. Statistical models often represent the process of data generation in a very ideal format. Statistical models usually include parameter estimates from some form of regression. The statistical model takes the form of a regression where the variable "Y" is the environmental characteristic of interest, and the predictor is a known input. The regression parameters are then estimated using standard regression methods. Parameters do not necessarily represent a mechanism, as they do not necessarily have a direct environmental or biological interpretation. Statistical models usually have descriptive goals rather than mechanical goals.

Statistical Models

A statistical model is a family of probability distributions, the central problem of statistical inference being to identify which member of the family generated the data currently of interest.

From: International Encyclopedia of the Social & Behavioral Sciences, 2001

The parameters in these models are estimated directly by choosing to be optimal for a particular dataset. Therefore, certain statistical models are usually less common in various system

applications. The structure of such a model is useful in many situations. Regression models are widely used that assume specific mathematical relationships between variables and assume that data errors take a specific form. A statistical model exists because we are looking for relationships between two or more variables. In essence, all statistical models exist to draw conclusions between different types of variables, and because there are different types of variables, there are different types of statistical models. The goal of statistical modeling is to summarize the test results so that the evaluator can observe the data patterns, draw conclusions, and finally answer the questions that triggered the test. The model provides snapshots of changes in system behavior across different test factors and levels.

The advantage of using model is that they are accurate. Parameters such as mean and standard deviation are accurate measurements of the population (as opposed to statistics, which are just estimates).

The disadvantage is that it is expensive and time consuming to determine the parameters of a large population. In the case of a census, it is reasonably impossible to count or measure the entire population, so it is inaccurate anyway. It is much more efficient to estimate the parameters from the sample. Now we will talk about travel or trip forecasting models.

Trip forecasting models are used to predict changes in commuting patterns and transportation system usage in response to changes in regional development, demographics, and transport supply. Modeling travel demand is a difficult task but requires proper planning and assessment of transport systems. Transportation planning involves decision making for potential improvements to a community's road infrastructure. To facilitate the decision-making process, several computer tools and manuals have been developed. Two of these key tools are:

 a) Travel demand forecasting models to implement the four-step urban planning process

 b) Travel rate indicators to provide traffic congestion information congestion and traffic delays for the community.

The four-step urban planning process includes the following elements:

1. Trip generation,
2. Trip distribution,
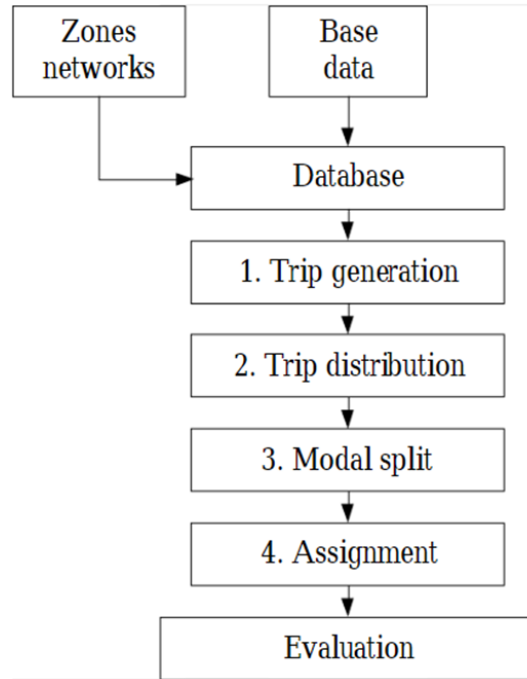3. Modal split and
4. Traffic assignment

Figure 2: The four-stage transport planning model.

Trip generation is the first step in a four-step trip simulation. It gives an idea of the total number of trips made and attracted to different parts of the study area. Travel can be predicted using growth factor modeling and regression methods.
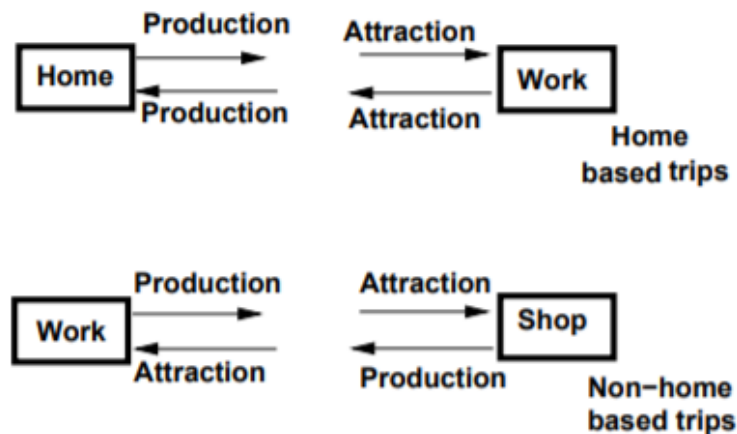

Figure 3: trip types.

Travel can be categorized according to the purpose of the trip, the duration of the trip, and the type of person. travel creation model. If you use a separate model for your travel purpose, it will be considered accurate. Travel can be categorized as:

The purpose of travel is business travel, study trip, shopping trip, leisure trip and other trips. Among them, commuting to work and school excursions are often called compulsory, and the rest are random travel. All the trips are typically home trips and range from 80-85% travel. The rest of the trip, not the home trip, because a small part of the trip is usually not considered separately. The second classification method is based on the time the trip takes place large. The classification is divided into rush hour travel and off-peak travel. The third classification method depends on the type of a person who travels. This is important because travel behavior is highly socially dependent. A traveler's economic attributes, usually classified by income level, car ownership and the size of the household.

The main factors influencing personal travel production are income, vehicle ownership, household structure and family size. Factors such as land value, population density and availability are also considered when modeling at the district level. On the other hand, factors such as the availability of indoor space for industrial, commercial, and other services affect the attractiveness of personal travel. At the zone level, zone occupancy and availability are also used. In addition to personal travel, cargo travel is also of interest when modeling business trip creation. Although the latter accounts for about 20% of trips, their contribution to road congestion is significant. Freight travel is affected by the number of employees, the number of sales and the size of the commercial company (Travel forecasting resource).

Travel is typically distributed using an allocation model that divides travel from each zone of origin into different destinations. That is, there is a matrix that correlates the number of trips starting in each zone with the number of trips ending in each zone. Shows a typical placement.

In this four-step trip making model, mode choice is the third step in the process, after trip distribution and before network assignment. This model shows the outputs as the trip distribution as person trip tables, by using matrices of trips and here the rows and columns represents some mixed geographical, known as transportation analysis zones (TAZ).

Mode selection is the process of determining the means of transportation. Transportation is a mode of transportation that can be done by private car, public transport, walking, biking, or any other way. The travel mode is usually expressed through utilities. In most travel models, mode selection applies to trips that have already been estimated. The mode selection applies group of trips or tours for which the origin and destination are already known.

Transport mode selection is an important part of the model used for the following analyses:

 A large transportation investment project that can attract travelers not only from competing facilities but also from competing transportation modes. Changes to transit services that may encourage or prevent travelers from using transit. Long-term forecasts where changes in demographics or travel conditions (e.g., increased traffic congestion) can change the relative value of different modes of transportation for some or all travelers. Analysis of pricing policies that may discourage travelers from using increased transportation. When Land use planning analysis where changes in development patterns can make certain modes of transportation attractive compared to other modes. If the model is based on vehicle movement (that is, vehicle movement is generated and distributed rather than passenger movement), no mode selection or vehicle occupancy modeling functionality is required.

The characteristics of individual travelers influence the choice of transportation. These are observed characteristics such as age, gender, driver's license status, worker or student status, and unobserved characteristics such as awareness of transportation options, consideration of specific transportation modes, attitudes, personal preferences etc. The characteristics of a traveler's depends on household, income level and availability of vehicles, can also influence the choice of transportation. To select a mode, of course, the traveler must have access to the mode. Availability is not always well defined. For example, driving modes are usually not available to young children, but may also be available to people with disabilities, unlicensed people, or those who do not have a vehicle. You may not be able to observe these features. For example, people whose household does not own a car can rent a car or use car-sharing services. In general, there are no restrictions on a traveler being a passenger in a car. If this characteristic is simulated in the model, driver mode can be restricted to those who are older than the legal minimum age and, in some cases, those who can be defined as permitted to drive, such as the owner of a driver's license. Such features are more likely to be known in the decomposed activity-based model than in the household-based aggregate

model. However, many models do not distinguish between drivers and passengers, and the definition of vehicle mode is based on vehicle occupancy (for example, driving alone, sharing a trip with two people, etc.). In this case, all restrictions typically apply only to drive-only mode.

The availability of t modes is theoretically unlimited unless the model clearly identifies a person with a motor disorder that can impair gait. However, for practical reasons, walking mode is rarely used on very long trips and tours, and many models assume that walking mode is not available when driving a certain length. The same type of restrictions may be implemented in bike mode (especially if the maximum ride length is long). The availability of public transport is generally not restricted. However, depending on the combination of origin and destination, there may not be a reasonable transportation route.

Transportation is generally divided into those that allow you to walk in and out of the edge of the house and those that allow you to enter and exit automatically. Pedestrian access modes are often subject to the same maximum aisle length restrictions as those used in pedestrian mode. Therefore, there may be a combination of origin and destination that does not have a valid transit route (for example, if the origin is not within the maximum walking distance of each stop). Theoretically, there is no limit to the range of automated access, but some models may have practical limits. Transit mode is generally considered to be available if the transit path construction process can find a valid path from the starting point to the destination (Chow, 2007).

the last or fourth stage of traffic demand model flowchart is traffic assignment. There are some different types models of traffic assignment. These are

1. All-or-nothing - This model is an impractical model because only one path is used between each pair of ODs, and they can only give satisfactory results when the network is least congested.
2. User-equilibrium - The assignment of user equilibrium is based on the first principle of Wardrop, and its conditions are based on certain assumptions.
3. System-optimum assignment model- The second principle of Wardrop is used by the System-optimum method and it tries to reduce congestion by providing drivers with advance information about the respective routes to choose from.

These are some commonly used traffic assignment models.

The traffic assignment model aims to estimate how traffic flows through the road system and how it affects the system. This effect can be measured using a variety of criteria such as distance traveled, time traveled, delays, fuel consumption, and pollution. You can also use the traffic allocation model to investigate how traffic reacts to system changes. B. Changes in travel demand, information from travelers, road capacity, signal times, tolls. The formulation of the traffic allocation model and the solution require three types of information. The second is the demand for travel and the characteristics of the transportation system. Trip demand, estimated by the first three steps of a four-step model, represents trip decisions tourists are likely to make, based on the performance of the transportation system. After the first three steps of the four-step model, travel decisions are taken into account including choices about destination, mode, frequency of travel, and even travel (IHT, 1997, p91). It should be noted that although population, land use, and other factors may change over time, travel needs also vary. Conventional planning models only consider travel demand during a particular time period, and demand is considered to be time independent throughout that time period. The second component of the traffic assignment formula is a network model of the traffic system characteristics. The function of this network model is to determine the relationship between travel demand and the performance of the transportation system. For example, travel time is described as increasing with travel demand, due to a decrease in vehicle travel speed (IHT, 1997, p91). Considering the travel demand and the characteristics of the transport system, the third type of information is a means of estimating the corresponding distribution of the travel demand on the transport system. The most widely accepted method is of the two traffic allocation principles proposed by Wardrop (1952).

The COVID-19 pandemic has brought about unprecedented changes in activity patterns and travel behavior around the world. Some of these behavioral changes correspond to government-imposed restrictions (e.g., total or partial lockdown), while others are obligations to delay reassurance and / or spread (e.g.). lockdown). Travel behavior within these stricter means is fairly easy to predict due to the very limited options, but without restrictive means it is more difficult to predict behavioral changes. Limited studies to date have shown that different socio-demographic groups in different countries are changing travel behavior in different ways depending on COVID-19.

However, so far, to,

(a) investigate changes in travel behavior in the context of the Global North and Global South, and

(b) quantify the associated heterogeneity, changes in transportation and the characteristics of travelers.

There are no studies that model relationships. In this paper, a Statistical R model that quantifies the effect of traveler's socio-demographic characteristics on mode-specific travel frequency before the spread of COVID-19 in Bangladesh (January 2020) and in the early stages (March 2020). Address these two gaps by developing. Using primary data from 1217 respondents who participated in the online survey, we estimated multiple discrete choice extremum models (MDCEVs) in this regard. The results are

(a) fairly slow to continue using pre-COVID mode, and

(b) a tendency to move from shared (buses, etc.)

to virtual (working from home, online shopping, etc.) and private cars, motorcycles, etc. Indicates that is high. (Change and carpool) The degree of inertia depends on the purpose of the trip (commuting and freely selectable trips) and the duration of the trip. The results also show significant heterogeneity based on respondents' age, income and employment status. The result is that planners and policy makers in India and several other countries in the Global North and Global South more accurately predict mode-specific demand levels and make investment and operational decisions in the event of similar disruptions. Is used directly to do better.

3.3 Summary of the Concept

The COVID-19 pandemic has caused a great deal of disruption to lifestyles, daily activities and travel behavior around the world. The domestic or quasi-national level impact of COVID-19 may have occurred at several stages. In particular, it occurs in countries such as India and Bangladesh, where the virus spreads faster and much slower than in the west. As a result, these countries were early aware of the finality of the virus and the need for social distance. This is in turn, some "natural" against the spread of the virus, mainly due to self-defense concerns, even before a strict government travel ban (i.e., partial or complete lockdown) is imposed. It led to an action reaction. Understanding these "natural" changes in travel behavior is important for transportation planning. It is especially important when planning the mitigation phase of the blockade and planning targeted interventions in the event of similar future disruptions. Mathematical modeling of these changes in travel behavior is also essential to anticipate future needs for different modes of transport and to guide infrastructure investment and operational decisions-road space reallocation, public transport. Quantifying changes in nature is also important in understanding potential long-term changes. The short-term changes caused by urgent regulation can be difficult to maintain over the long term. In addition, information about differences in travel responses between different socio-demographic groups helps to understand and address potential inequality in the travel-related effects of such pandemics. Given the importance of understanding travel behavior in COVID-19, the results are still sparse, but much research is being done in this area. In particular, there was a descriptive data analysis of how different socio-demographic groups in different countries changed travel behavior in response to COVID-19. However, as far as we know, there are no studies dealing with changes in Bangladesh's travel behavior, and the modal and socio-demographic characteristics of travelers can cause significantly different reactions. More importantly, all previous studies have mathematically modeled the relationship between migrant characteristics and changes in transportation usage to quantify the heterogeneity associated with mode-switching behavior. In this report, we develop a mathematical model that quantifies the relative impact of travelers' various socio-demographic characteristics on mode-specific travel frequency before and during the early stages of COVID-19 in Dhaka, Bangladesh. By addressing these gaps. We use primary data from online surveys to estimate the R model and quantify the heterogeneity associated with travel behavior.

Chapter-4

4.1 Methodology

The first time we make forty questions individually. To make this questionnaire, we keep in mind the current situation of the people of Bangladesh, their economic status, need for travel, transport situation, and others. We divide the questionnaire into two parts. In the first part, there are questions related to travel making decision, reason of travel, mode of transport and some other questions related to travel. There are personal questions like age, gender, number of persons in the family, and so on in the second part. Then we give the questionnaire to our honorable supervisor to check and finalize the questionnaire. Then he gives us the questionnaire back in google form format with some corrections. Then we start our surveying. Corona is not at peak at this time but has not finished also. So, we were not able to interview them face to face. We use social media and email to contact them.

Then we make a database in Microsoft excel by inputting the data individually. After that, we used the filter option to identify the data with misinformation. After filtering, we use some graphs and charts to see the relations. We see some interesting relationships among the questions.

Then we think to model the data. To model the data, we use R software. It is free statistical software with many options for modelling or other things. We choose the negative binomial regression model. We find that the variance is greater than the mean for our data, so we cannot use the Poisson regression model. We check the number of zero in our data. The number of zero is much but not as much that we use zero-inflated negative binomial. So, we use negative binomial regression model. As the variance is greater than the mean, our data are over dispersed. After that, we search a negative binomial regression model code of R. By this code, we start our work. We choose a dependent variable. Then we find the independent variable using their significant z value—We use independent variables with a statistically significant value greater than 1.6. Our dependent variable is the number of changes in travel before and after Corona. That means before Corona, how many times a person travels outside, and is there any change after Corona. We take only the positive number from the subtraction of before and after Corona. In general, people will travel less than they used to travel before Corona because this Corona is a contagious disease. The less they interact with people physically, the less likely they will get the disease. There were also various government restrictions. So, we choose positive numbers that mean there is less travel after Corona. Moreover, we choose this as a dependent variable because, at that time, the government

of Bangladesh imposed restrictions on the movement of mass people. There were many opinions for and against it. We try to find out the actual scenario of mass people and their need for travel. According to the statistical significance value, we find eight independent variables. Do you or any of your family members have any following diseases? Corona is a contagious disease and very crucial for sick people. Corona virus can attack healthy people, but its mortality rate is much lower than sick people. This is especially true for those who suffer from lung or heart problems. So, it is expected that those who have this kind of sick people in their house can go outside very little. On the other hand, those who do not have sick people at home are more likely to go out. So, it makes sense for this question to be an independent variable. What was your way of shopping grocery during Covid19? Shopping, especially grocery shopping, is essential. Everyone needs food to live, and for food, there is no option other than going to a bazaar or online shopping. Moreover, it is not possible everywhere to shop grocery online. So, the people need to go outside. So, this question is also making sense for being an independent variable. What is your reason for not doing online shopping? Even if there is an opportunity for online shopping, people will not shop. Many more factors influence this decision-making. Lack of trust, untimely delivery, delivery charge plays a significant role in making online shopping decisions. The rice in the house is over. If it takes two days to complete the order after placing an order from an online shop, they will think twice before placing the next order online. How has covid-19 affected your work /education activity? This question shows the horror of Corona. There is no more tremendous hardship for an earning man than to lose his means of earning. Losing a way of earning means that he must find another way. And to find a way, he must go out, travel from one place to another. On the other hand, the students' main job is to study. If this study is stopped, they will become mentally weak. We came to know about these issues later through various newspaper reports. If they do not have study, they are more likely to go out of the house since they have no job. If they are not allowed to go out, their mobile phone or computer addiction will increase. We have also received this information in various media. We have even received reports of suicides at extreme levels of addiction. So, this is also a valid question to be an independent variable. Have online meetings through (zoom, Google meet, BdREN) reduced you're travelling during Covid-19? During the Corona period, we became acquainted with work from home. If someone does not have a job, he can no longer work from home. This means that those who are familiar with work from home have not lost their employment. They are less likely to go out of the house. So, the question indicates

the number of people who are unlikely to go out of the house. In the context of Bangladesh, men are more likely to go out of the house than women. Most households have male earners. The fact that women do not have to go out at all, they do, but it is deficient in the number of men. So, gender is another indicator of travelling. So, gender is another indicator of travel. Young people tend to go out of the house more than older people. Again, children are more prone to go out, but it depends entirely on their parents. If they let go, they can go out. This shows how conscious their parents are. If their parents allow them to go out even in this critical time, then it can be assumed that their parents are also more likely to go out.

4.2 Survey Design

The information used in this survey was collected through an online survey with responses from 1,218 people in the city of Dhaka. Respondents were asked about weekly commuting and voluntary travel habits before COVID (normal days) and during early COVID (early March), with one panel data observation for each respondent. I was commuting. Respondents were recruited through various social media platforms (Facebook, WhatsApp, Instagram) to expand the scope of the survey and keep sampling bias as low as possible. Such dissemination techniques were considered the most viable option in terms of a national lockdown that made personal research options unrealistic. The questionnaire consists of two main sections.

(A) Weekly frequent travel types in normal daily situations, weekly frequent travel types in early COVID situations, and

(B) Individual and household levels. The survey asked respondents (aged 13+) to provide both commuting and leisure information.

4.3 Questionnaire Design

To understand the current situation, we planned a survey on the traffic habit system before corona, during peak hours, and after the situation normalized or overcame fear. The Questionnaire is a survey tool consisting of a series of questions or other types of prompts to collect information from respondents. Questionnaires are usually a combination of open and open questions. Open and long questions give respondents the opportunity to clarify their thoughts. The data collected in the context of the questionnaire can be both qualitative and quantitative in nature. Questionnaires may or may not be submitted in the form of surveys, but surveys always consist of questionnaires. Surveys are only valid if the respondent has knowledge of the topic and is capable of answering the question. The question must be relevant to the respondent, who must have the information and ability to answer.

Benefits of a well-designed survey questionnaire

- Surveys are a great way to collect large amounts of data in a short amount of time.
- survey bias is less likely to creep in if your target audience has standard question phrases. You can apply logic to the question based on the respondent's answer, but the questionnaire remains the default for groups of respondents that fall into the same segment.
- Survey software for online surveys is fast and inexpensive. It provides a wide range of capabilities for designing, distributing and analyzing response data.
- You can compare answers to historical data to understand respondent choices and changes in experience.
- Respondents can complete the questionnaire without revealing their identities. In addition, most of the research software complies with important data protection and data protection regulations.

To do so we around 40 students made 40 types of survey questionnaire according to their own choice related to this topic. Then we submitted it to our honorable course instructor Dr. Md. Tawfiq Sarwar sir. First, he saw and verified the entire question and selected the accurate question from all of the submitted questions. We made questions about everything related to what was going on in transportation system or habit system or using system due to corona. After sorting out the questions our respected sir made a survey questionnaire.

Sociodemographic characteristics include gender, age, country of residence, marriage status, monthly income (BDT), car ownership, motorcycle ownership, number of household members, education level, employment status, and service employees where respondents are essential. It consisted of whether it was a member.

The main purpose for which people travel is defined as the purpose for which they travel. During a pandemic, people may be able to reduce other less important trips but may be forced to travel for certain major travel purposes. Therefore, it is important to focus specifically on the main purpose of the trip. This is to determine regular or major trips, distance traveled, and the mode selected. One section of the questionnaire contained questions about the main purpose of the trip before and during the COVID 19 pandemic. Information was also requested regarding the distance covered, the number of trips made, and the choice of means of transportation for the main purpose of the trip.

 In addition to these questions, respondents' priorities, safety, comfort, cleanliness, cost, travel time savings, personal and social status, risk of infection, passengers with face masks, social Distance,

Door-to-Select door service while using transport mode.

 At the time of this investigation, the virus had spread considerably around the world. Respondents generally already have the experience of surviving the COVID 19 pandemic. In addition, there is evidence that voluntary social distance played an important role alongside a compulsory ban during COVID 19. Therefore, the data collected can be analyzed as a whole, regardless of the embargo period.

Providing the final look of the survey questionnaire.

DEPARTMENT OF CIVIL ENGINEERING

An undergraduate class at EWU is undertaking a survey in an attempt to gain a better understanding of public opinions on effect of Corona on transportation habit. We appreciate your time in completing this survey – Your responses will be strictly confidential.

Survey ID: CE451/Fall20/_____   **Source ID:**

Group: **Date:**

Section A

1. How often did you use to travel (number of trips) in a week before Corona (before March 2020) (for example, home to work is considered 1 trip, again, office to shopping mall is another trip)?

   (1) zero (2) 1 to 3 times   (3) 4 to 6 times (4) 7 to 9 times   (5)   10   times

   (6) More than 10 times

2. How often did you travel in a week during peak of Corona (April to August 2020)?

   (1) zero (2) 1 to 3 times   (3) 4 to 6 times (4) 7 to 9 times   (5)   10   times

   (6) More than 10 times

3. How often are you traveling in a week in the last three months (September to November 2020)?

   (1) zero (2) 1 to 3 times (3) 4 to 6 times (4) 7 to 9 times (5) 10 times (6) More than 10 times

4. What was your most common travel mode before Corona (before March 2020)?

   (1) Personal car (2) Personal bike (3) Public transit   (4) Ride sharing app (Uber/Pathao etc.): Car

   (5) Ride sharing app (Uber/Pathao etc.): Bike   (6) CNG (7) Rickshaw (8) Shared CNG/rickshaw

   (9) Bicycle   (10) Walking

5. Which travel mode did you use during peak of Corona (April to July 2020)?

   (1) Personal car (2) Personal bike (3) Public transit(4) Ride sharing app (Uber/Pathao etc.): Car

   (5) Ride sharing app (Uber/Pathao etc.): Bike   (6) CNG (7) Rickshaw (8) Shared CNG/rickshaw

   (9) Bicycle   (10) Walking

6. Which travel mode did you use in last three months (August to October 2020)?

   (1) Personal car (2) Personal bike (3) Public transit (4) Ride sharing app (Uber/Pathao etc.): Car

   (5) Ride sharing app (Uber/Pathao etc.): Bike   (6) CNG (7) Rickshaw (8) Shared CNG/rickshaw

   (9) Bicycle   (10) Walking

7. Do you or any of your family members have any of the following diseases?

   (1) Blood Pressure (2) Asthma (3) heart disease (4) Diabetes (5) Liver disease

   (6) Low immunity (7) Others _____ (8) None of the above

8. "Covid19 is a Dangerous life-threatening disease" – Did you agree with this statement during beginning of the outbreak in Bangladesh?

    (1) Strongly disagree (2) Disagree

    (3) Neutral   (4) Agree   (5) Strongly agree

9. "Covid19 is a Dangerous life threatening disease" – Do you agree with this statement now?

    (1) Strongly disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly agree

10. Was any body of your family or close ones affected by Covid-19?   (1) Yes (2) No

11. Was any body of your family or close ones died by Covid-19?   (1) Yes (2) No

12. What was your way of shopping grocery during covid19?

    (1) Online shopping

    (2) Shopping from bazaar (3) Other _____

13. What is your reason for not doing online shopping?

    (1) Trust   (2) delivery charge

    (3) Expensive product (4) delay in delivery   (5) I do shop online

14. How frequently did you visit your relatives/friends during April to October 2020?

    (1) Never (2) less than 5 times (3) 5 to 10 times (4) 11 to 15 times (5) 16 to 20 times

    (6) More than 20 times

15. What is the primary or main purpose of your travelling during covid-19?

    (1) Social activities (2) Work (3) Shopping (4) Studying (5) Recreation

    (6) Others _____

16. How has covid-19 affected your work /education activity?

    (1) I do not go to office /school and I work/ study at home

    (2) I go to office few days per week and work from home for the rest of the time

    (3) I lost my job/I am not studying these days

    (4) Nothing changed

17. Have online meetings through (zoom, Google meet etc.) reduce your travelling during covid-19?

    (1) Strongly disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly agree

18. While choosing a transportation mode what is your priority that you place during covid-19?

    (1) Health safety (2) Cost (3) Comfort (4) Social distance (5) Other

19. Do you always use mask when you go outside?

(1) Always (2) Yes, but sometimes I forget

(3) Mostly no, but sometimes bound to wear (4) Never

20. Do you think lockdown has adversely affected your household income (income of all the family members)? (1) Yes (2) No

21. Do you think restriction on transportation was helpful to prevent the spread of covid-19?
(1) Yes (2) No

22. Do you currently own a smart phone? (1) Yes   (2) No

23. Do you have:
(1) An engineering background   (2) No engineering background

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Section B: Additional Questions About Yourself

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24. Are you?   (1) Female   (2) Male

25. Are you?   (1) Married   (2) Single   (3) Separated (4) Divorced   (5) Other

26. What is your age?   _____ years old

27. How would you classify the area in which you grew up?

(1) Urban   (2) Suburban   (3) Rural

28. Geographically, would you consider yourself to be originally from which division:

(1) Dhaka   (2) Chittagong (3) Rajshahi   (4) Khulna

(5)Barisal   (6) Sylhet   (7) Rangpur   (8) Mymensingh

29. What is your highest completed level of education?

(1) No schooling (2) PSC (class 5 pass) (3) SSC (Matric pass)   (4) HSC (Intermediatepass)

(5) Diploma   (6) Undergraduate (Bachelor) degree   (7) Post graduate degree

30. Are you a?

(1) Health professionals (2) Law enforcing agencies (Police) (3) Banker (4) Journalist

(5) others _____

31. Do you currently live with your family? (1) Yes   (2) No

32. What is the approximate monthly household income (BDT) (income of all the family members)?
(1) Under 5000 (2) 5000 – 10,000   (3) 10,001 – 20,000
(4) 20,001 – 30,000 (5) 30,001 – 50,000 (6) 50,001 – 75,000
(7) 75,001 – 100,000 (8) 100,001 – 150,000 (9) More than 150,000

33. Including yourself, how many people live in your family? _____

34. How many children, in your family, are under age 6? _____

35. How many children, in your family, are aged 6 to 18? _____

36. How many old people, in the household you consider home, are over age 60? _____

37. Did you lie about your response to any of the previous questions on this survey? (1) Yes (2) No

38. From the following Thana list, please tell us which belongs to your residence address at pre-Covid 19? _____

39. From the following Thana list, please tell us which belongs to your current residence address? _____

40. From the following Thana list, please tell us which belongs to your work address at pre-Covid 19? _____

41. From the following Thana list, please tell us which belongs to your current work address? _____

Appendix: Thana list

1. Demra	7. Keraniganj	13. Motijheel	19. Sutrapur
2. Dhaka Cantonment	8. Khilgaon	14. New market	20. Tejgaon
	9. Khilkhet	15. Palton	21.Tejgaon industrial area
3. Dhamrai	10. Lalbag	16. Ramna	
4. Dhanmondi	11. Mirpur	17. Sabujbag	22. Uttara
5. Gulshan	12. Mohammadpur	18. Savar	23. Outside Dhaka
6. Jatrabari			

The questions are arranged in such way that the maximum information can be collected, and the questions are related to each other. Doing so it will be easier for us to find if there any mistake or wrong input in survey by the responder. Also, can understand how accurate the survey results are and can share our opinions on it. Survey questions are made up with multiple choices. The questions and multiple choices have been made up precisely and concisely with simple language and have been translated into Bengali also. So that, these who will do the survey or participate in it do not have any difficulties to answering them.

4.4 Data Collection

After making a perfect questionnaire for survey. We have been asked to survey and collect responses according to our convenience. There are many types of survey system such as online survey it is one of the most popular survey, paper survey as the name suggests this survey users the traditional paper and pencil approach, telephonic survey researches conduct these over telephones one to one interview, cross-sectional studies etc. In person interviews are by far the most personable approach and can create trust and cooperative from respondent. Information collection is the method of gathering and measuring data on focused on factors in a setup framework, which then empower one to reply relevant questions and assess results. Information collection could be an inquiry about component in all ponder areas, counting physical and social sciences, humanities and trade.

Figure 4: Different methods for data collection

We can also collect data by interviewing, questionnaire, and surveys. But there have been a lot of obstacles for corona. We had to do everything from sitting at home. As maintaining social distance is mandatory. Mandated social distancing and lockdown have made physical survey a challenge and these physical limitations are likely, and these physical limitations are likely to remain in place for while online surveys are an ideal alternative.

Figure 5: Advantages of different methods of data collection

Our survey questions have been prepared in Google form for online survey; To collect responses responders had to provide authentic email address and given source id to keep track on survey number.

Figure 6: Online survey form

Chapter-5

5.1 Database preparation

Data preparation is the process of cleaning and transforming raw data prior to processing and analysis. It is an important step prior to processing and often involves reformatting data, making corrections to data and the combining of data sets to enrich data.

Figure 7: responder list

First of all, sir gave us the survey questionnaire to all of the students by Google form. As soon as we get the questionnaire our first concerned was to collect data from the close relatives & family members who are working outside on regular basis and facing difficulties during the time of covid-19 pandemic. After that we involved their friends and family who is also employee to another company or regularly going outside and facing difficulties due to corona. Lastly, we collect data from those who didn't have their own personal email and we fill out their forms physically by using our own private student emails and also have the raw data's written in our notebooks. When we finish surveying, as it was online based survey automatically all of the respond data already gone to our honorable course instructor.

Figure 8: Responder list with corrected source code

Then he checked the file, gave us the raw information's resend our individual files to us through our personal email.

Figure 9: data sheet (answer of responders)

Then we checked all the responses and found many people made mistakes in their source id by putting the wrong id or doubled it. After resolving the problem by discussing it with our faculty we again send the file,Then our teacher resend us the database excel file with raw data to fill out the database with the answer no. of each questions which was asked in the survey questionnaire.

After decoding we input the data in excel, we send the whole database file to our teacher.

1	X1	How often did you use to travel (number of trips) in a week before Corona (before March 2020)
2	X2	How often did you travel in a week during peak of Corona (April to August 2020)?
3	X3	How often are you traveling in a week in the last three months (September to November 2020)?
4	X4	What was your most common travel mode before Corona (before March 2020)?
5	X5	Which travel mode did you use during peak of Corona (April to July 2020)?
6	X6	Which travel mode did you use in last three months (August to October 2020)?
7	X7	Do you or any of your family members have any of the following diseases?
8	X8	"Covid19 is a Dangerous life threatening disease" – Did you agree with this statement during begi
9	X9	"Covid19 is a Dangerous life threatening disease" – Do you agree with this statement now?
10	X10	Was any body of your family or close ones affected by Covid-19?

Figure 10: Variable datasheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
299	3	1	1	3	1	1	4	5	5	1	2	2	3	2	1
300	2	3	3	1	1	1	8	5	5	1	2	1	5	3	2
301	2	3	3	1	1	1	8	5	5	1	2	1	5	3	2
302	6	6	6	10	10	7	2	5	2	1	2	2	3	2	5
303	5		6	2	2	2	8	3	1	2	1	3	5	6	6
304	2	1	1	1	1	1	8	1	5	2	2	1	5	1	2
305	4	2	3	3	7	10	4	5	4	1	2	2	5	1	1
306	2	4	4	2	2	2	1	5	5	1	2	1	5	2	1
307	1	2	2	7	7	7	4	4	4	2	2	2	4	2	2
308	1	1	1	8	8	8	4	5	5	1	2	2	1	2	2
309	6	6	6	3	3	3	7	5	5	1	2	2	1	2	6
310	6	1	6	3	6	10	3	5	5	1	2	3	5	1	2
311	6	3	6	7	1	7	5	4	4	1	2	1	5	2	1
312	2	2	2	2	2	2	8	4	5	2	2	2	1	2	1

Figure 11: Decoding data sheet

5.2 Data Analysis using Excel

Data analysis is the process of cleansing, analyzing, interpreting, and visualizing data to generate valuable insights that enable smarter and more effective business decisions. If you know how to do data analysis correctly, the possibilities for data analysis are almost endless. There are many analytical solutions and methods to get real insights from your data, either quantitatively or *qualitatively.
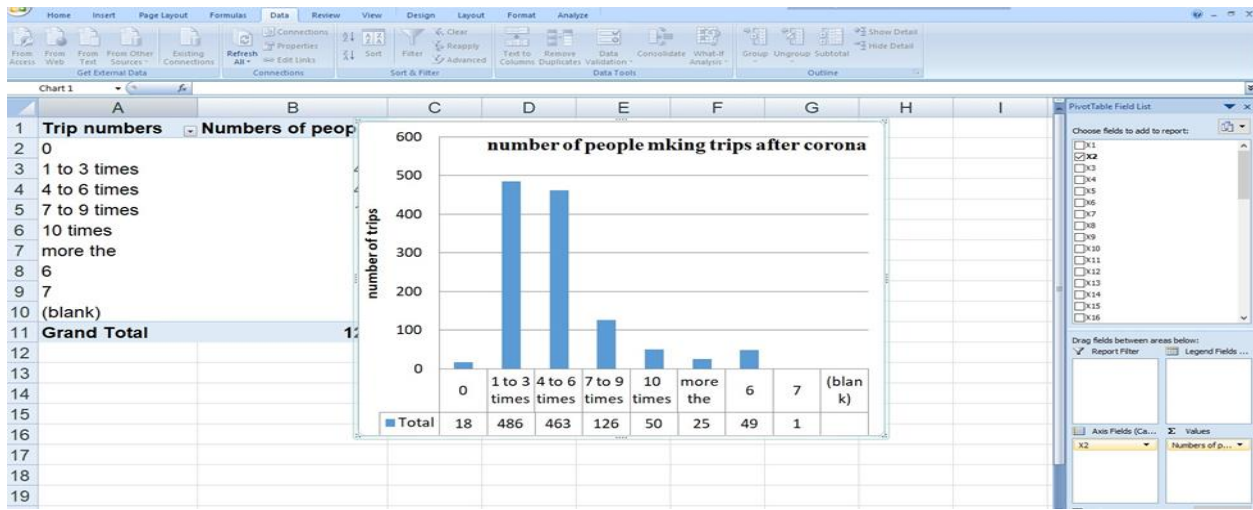
Figure 12: Making graphs using survey data

First, it's important to understand what you want to know about your work and your responders. Simply put, data analysis is the process of collecting and organizing data to draw useful conclusions. The process of data analysis uses analytical and logical thinking to extract information from the data. The main purpose of data analysis is to find the meaning of the data and use the knowledge gained to make informed decisions. We have collected total 1218 responds together. In 1218 responder's total female surveyor were 340 and 878 were men.
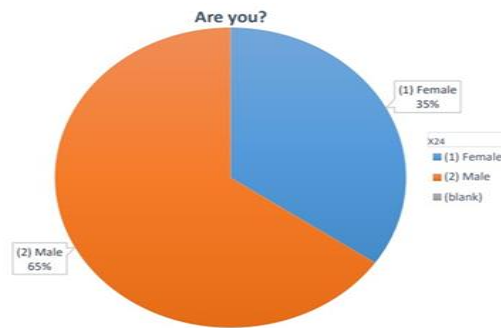
Figure 13: Graph of female and male responders' percentage

Meanwhile here total 123 people were between ages of eleven to twenty where 62 people were female and 61 were male. From the table and the graph, it would be clearer to Understand age and gender difference.

Table 1: Age classification with number of female and male.

Age classification	Total number of responders	Total number of females	Total number of males
11-20	123	62	61
21-30	815	236	579
31-40	139	0	139
41-50	74	27	47
51-60	48	10	38
61-70	16	4	12
71-80	1	0	1
81-90	0	0	0
91-100	1	1	0
-999	1	--	--
Total	1218	340	878

Using pie chart, we tried to divide the age in ranges.
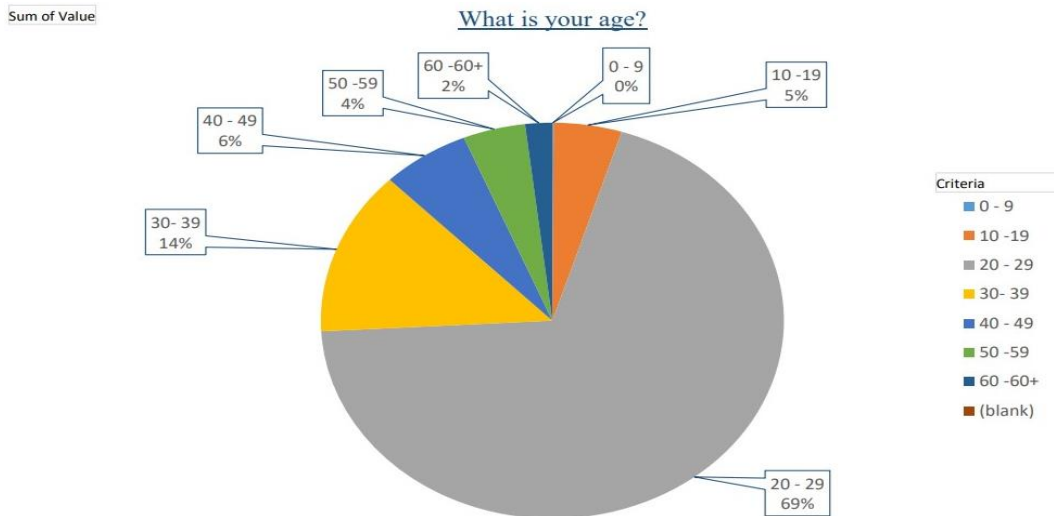
Figure 14: Graph of responders' age percentage.

Question 1, 2, 3 were asked to know about how often you used to travel (number of trips) in a week before Corona (before March 2020), during peak of Corona (April to August 2020) and last three months (September to November 2020). If we look at the excel data sheet of collected survey data then we can see the differences here.

Figure 15: Graph of number of trips (Before march)

Figure 16: Graph of number of trips (April to August)

Almost everyone and majority percent people used to go out and make trips before corona. Only 5% people used to stay at home, 27% of people used to make trips more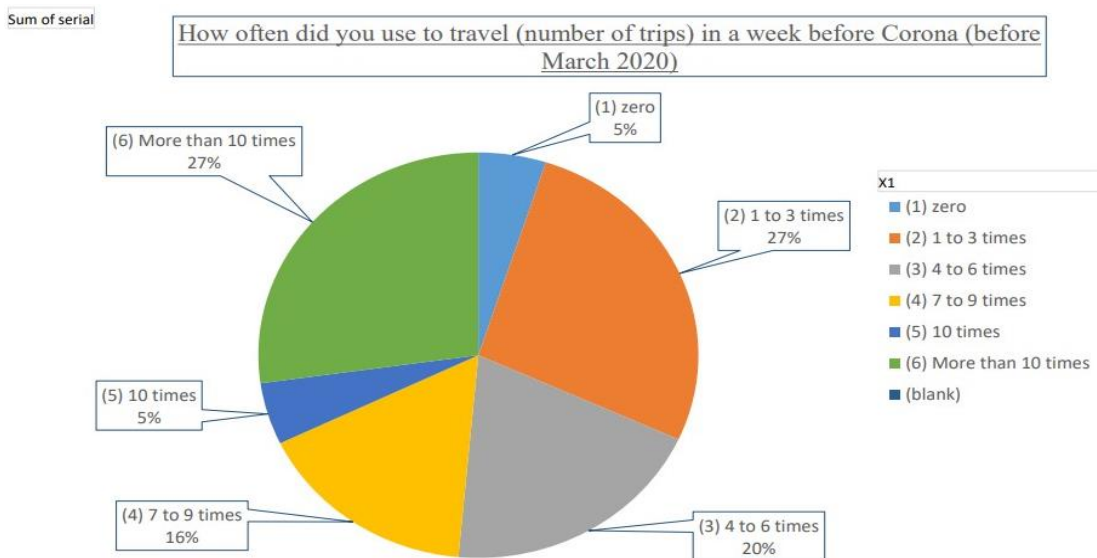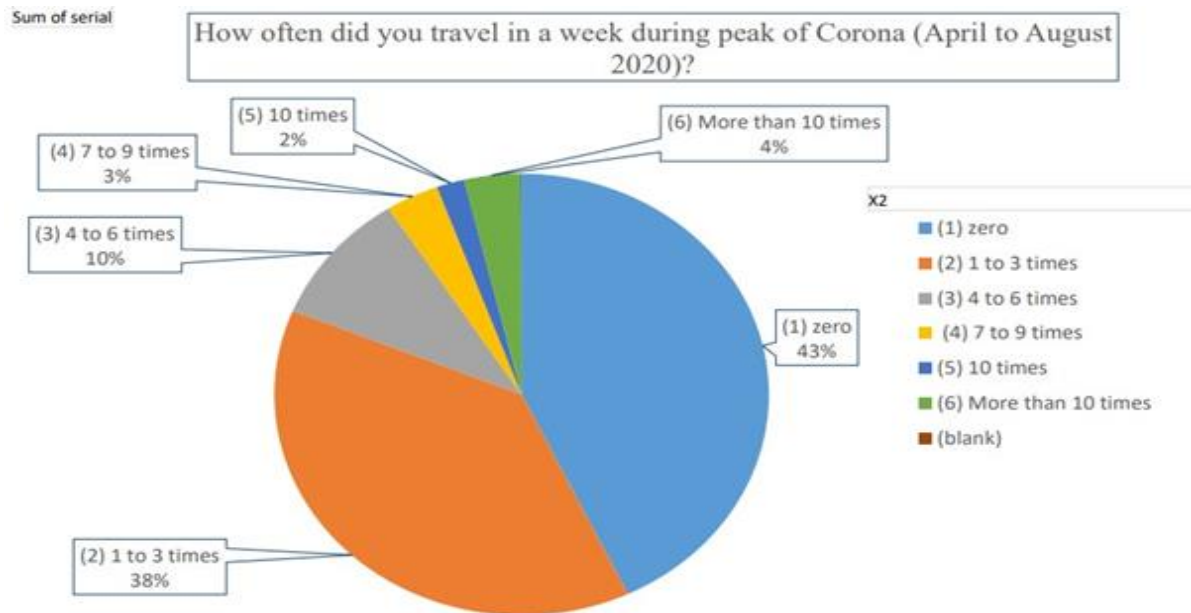 than 10 times. As it was normal before corona. When in March corona virus cases got confirm in Bangladesh and government decided to lockdown the whole country than the trip number got reduced and the number of people staying home got increased around 43% percent people made zero trips and the 38% people made trips around 1 to 3 times due to emergencies. During corona's peak period around 8 female responder and 41 male responders said that they used to make trips more than 10 times. In these 41 responders 26 of male responders said they agreed with that corona is a life taking disease disorder. (Srl no 1043) One of them did not used to wear musk and his family members and close ones got infected by corona virus also died because of it.

By analyzing question no 1 and 2 data we also noticed that 2 responders said they made zero trip in a week before corona but they made trips more than 10 times in a week, again we noticed that one of them stop making trip in last 3month (September-November) both of the responder were in between 20-25 age range and they used make trip at the peak time using 'others' reason. There was no one diseased in their family no one got infected or died due to corona.

But in Question no 3 we can see September to November the appearance of this people for going is changed. As mentioned in Question no 2, 43% of the people stayed at home during the peak

time of corona even though the virus is not vanished or in control yet but 33% of people from them are now do not stay at home on regular basis. Only 10% of the people are staying at home. People who are going out for 1 to 3 times are 40% and 10times during September to November is not changed at all. But the difference seemed when we saw the people who are going out for more than 10times, 7 to 9 times & 4 to 6 times. Because our government has canceled the lockdown and almost everything is becoming normal a people overcome the fear of getting infected by corona or dying.
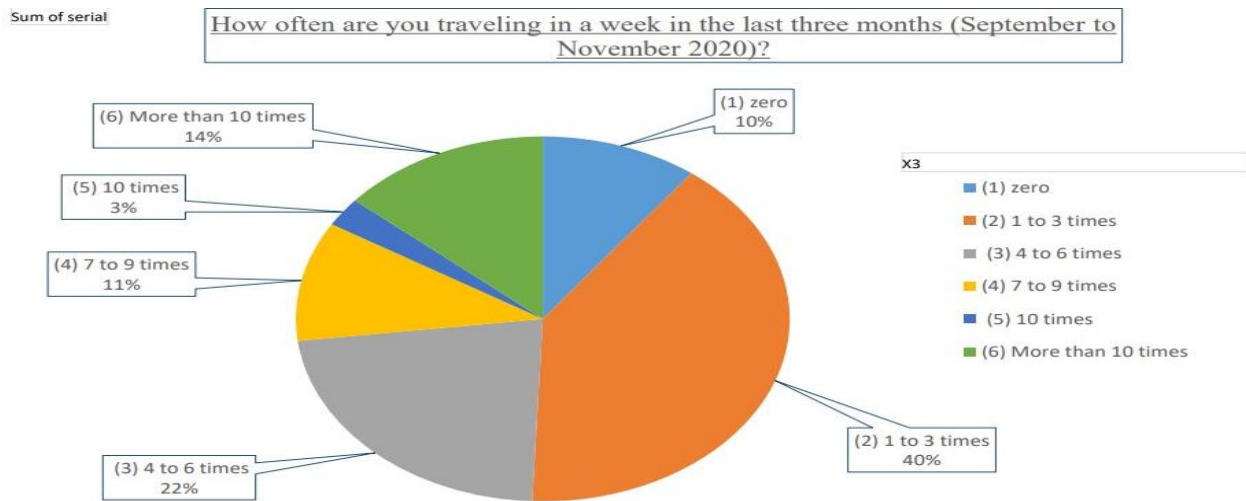
Figure 17: Graph of number of trips (September to November 2020)

Now Hence below, if we look at question no. 15 and it excel graph, majority of the people are going outside due to their work purpose, 15% people is doing social activities, 21% is also going out due various reasons and lastly 7% people are going out for studying and Recreation.
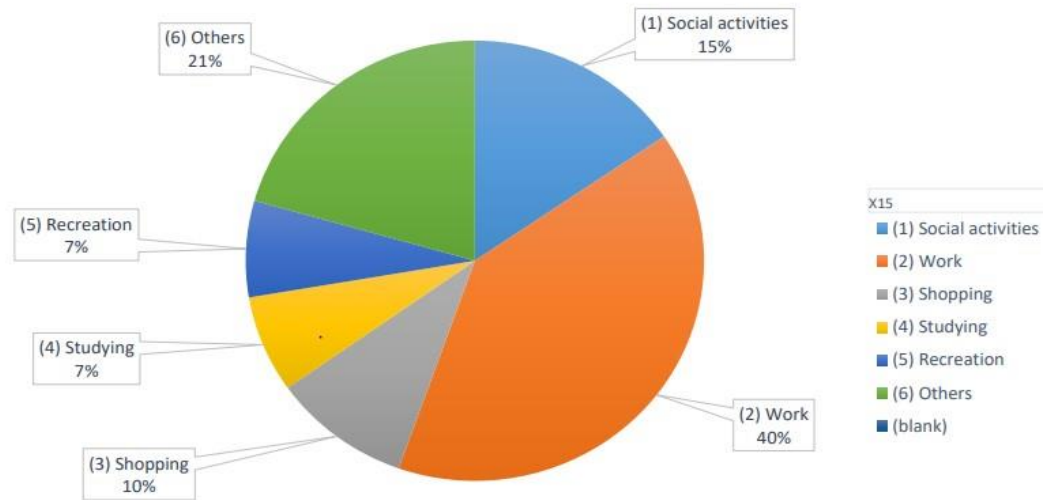
Figure 18: Graph of reason for making trips during covid-19

As we know the school, collage & university is closed due covid-19 Pandemic. But also Majority of the 7% people who are going out for study are 21-29 years maybe because many of the public university and national university are taking exams in this pandemic. Also 13-20 old students are going out for study because of their private tuition reopens after cancelation of lockdown as many of them are ongoing JSC, SSC &HSC Candidates.
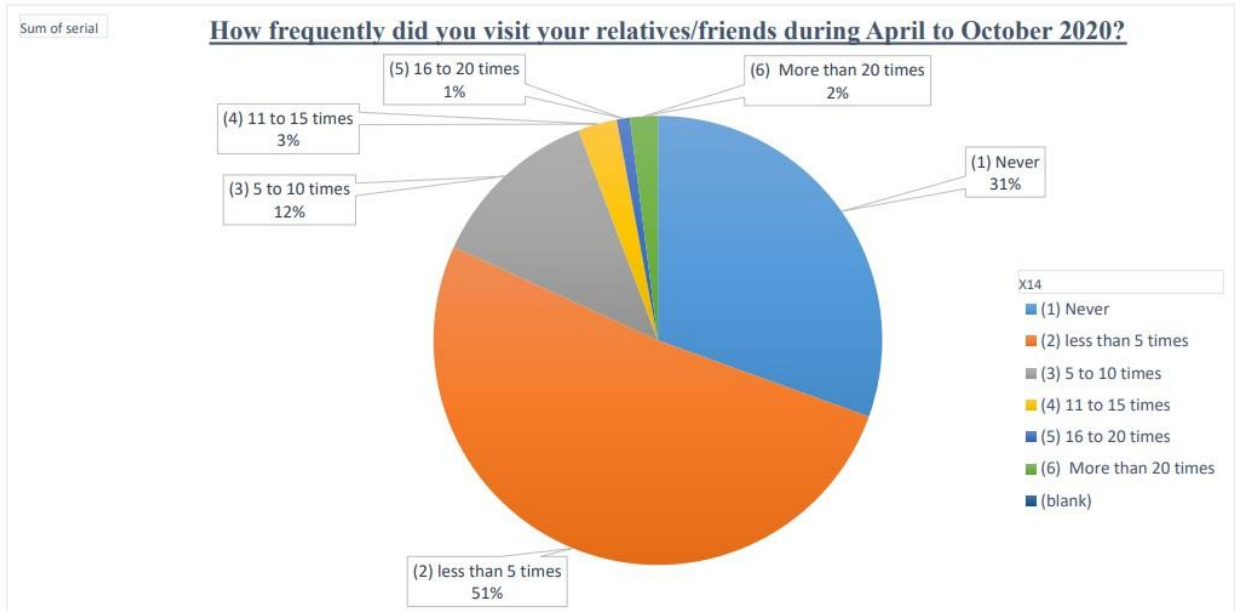
Figure 19: Graph of visiting relative/friends during April to October 2020

Now if we look above at the graph of question no14 we can see a lot of people have gone out for visiting their relatives during April to October. 51% of them are claiming they had visited their relatives house for less than 5 times and 31% people had never visited their relatives after the pandemic started. It's good see only 3% people visited their relatives/friends 11 to 15 times & only 1% people visited 16 to 20 times. Because they may have become more aware as the virus spreads from one person to another many times more then it harms the actual person.

As per Question no. 4 we know 41% of the people used to travel with public transit due to low cost. Because majority of the peoples are student and their source of income is very low. 10% of people used to travel with cars and 10% of people used to travel with bikes. Usage of Bicycle and Shared CNG/Rickshaw was very low as only 4% people used to ride with bicycle and Shared CNG/Rickshaw. 5% people use CNG, 5% people used to walk at regular basis, 9% people use Ride Sharing app (Bike/Car) and 16% people use Rickshaw as a regular transportation.
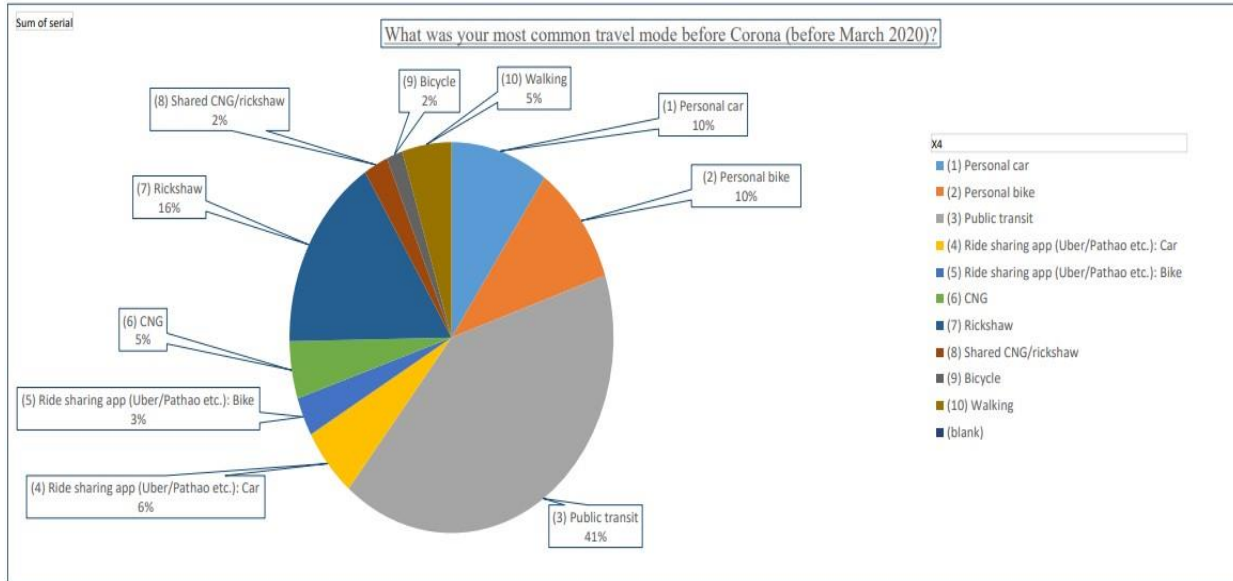
Figure 20: Graph for most commonly use travel mode (before March 2020)

According to Answer to the question no 5, when covid-19 hit strongly in Bangladesh their travel modes changed completely. Of those who went out at that peak time, 24% of people started riding with rickshaws, 14% people choose walking as the best travel method, 11% people started to use CNG, 6% people used Ride sharing app (Uber/Pathao etc.), 14% people started ride with personal car and 13% people started ride with personal bike. Usage of public transit decreased to 10% because we know that corona virus is more prevalent in public transit as lot of are traveling together. Usage of Shared CNG/Rickshaw and Ride Sharing app (Uber/Pathao etc.) remain same. One thing is for sure, for the middle-class people have had a hard time getting because of this pandemic as they could not use public transit and had to use alternate travel mode at a much higher cost
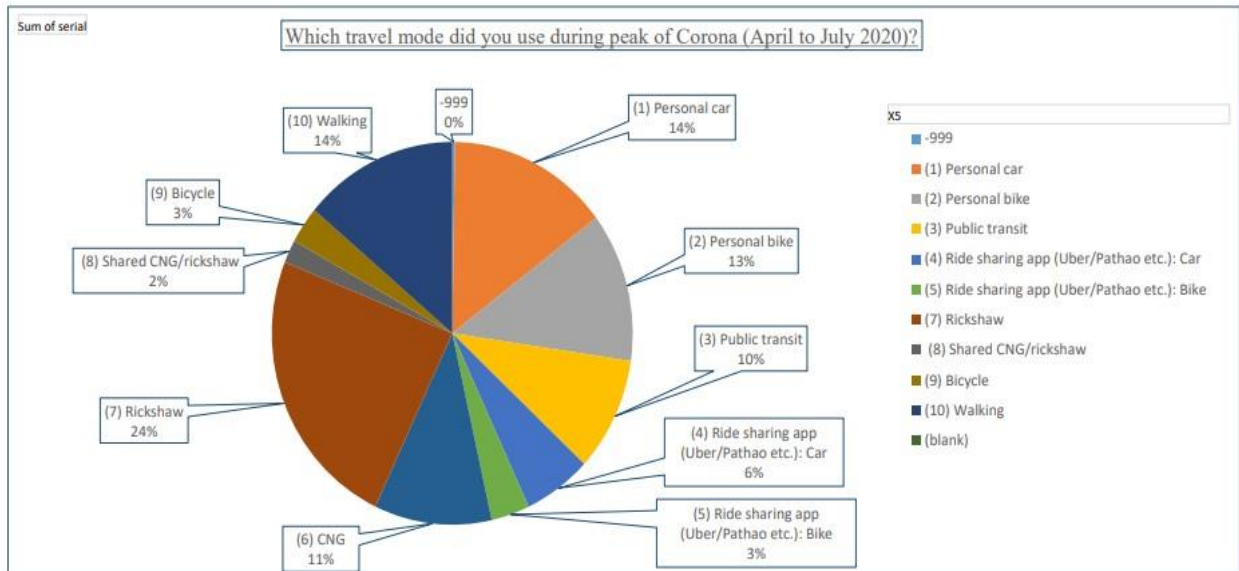
Figure 21: Graph for most commonly use travel mode (April to July 2020)

During time of august to October when the government canceled the lockdown and opened up everything fairly people again started to use public transit at the rate of 18%. Ride with Ride sharing app (Uber/ Pathao etc.) Bike and Uber increased to 4% & 7%. Usage of CNG decreased to 9%, walking method also decreased to 6%, Usage of Rickshaw slightly decreased to 23%, Usage of Bicycle, Personal Car, Shared CNG/Rickshaw remain same & lastly usage of personal bike slightly increased.
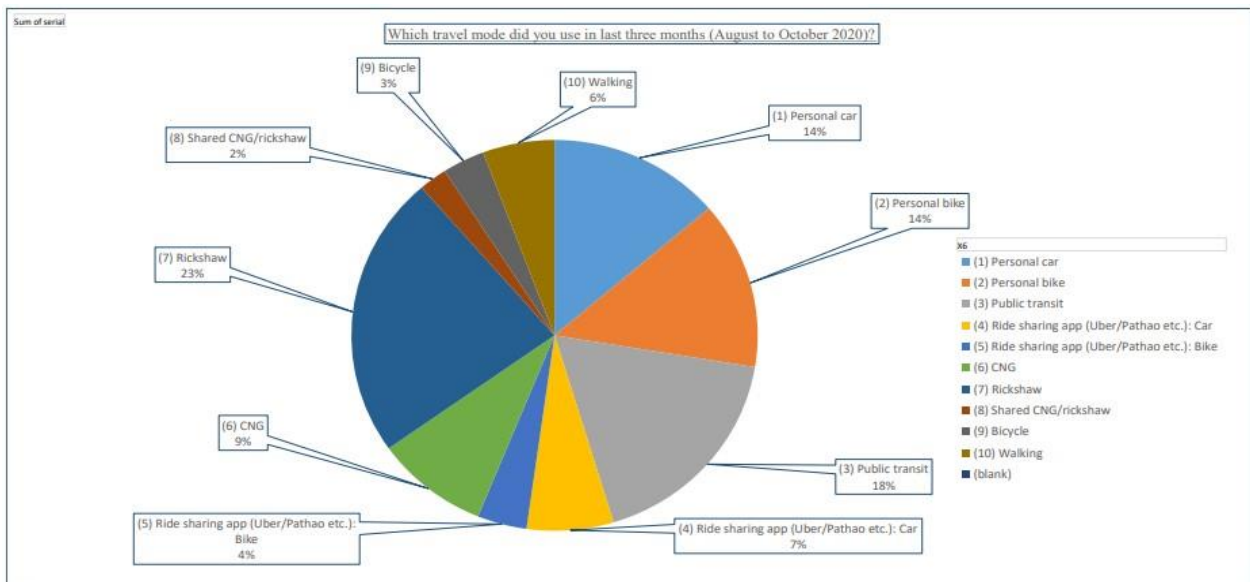
Figure 22: Graph for most commonly use travel mode (August to October 2020)

As per question 18 most of the people look at their health safety as the primary priority with the rate of 55% while choosing the transportation mode during the time covid-19. Again, it cannot be excluded that 29% of them choose social distance as the primary priority. Because they understood that these two methods are the main key to survive COVID-19. It is amazing that during these times 5% of people choose comfort in this peak time of COVID-19. 4% of people choose other options and 7% people choose cost which is also relevant.
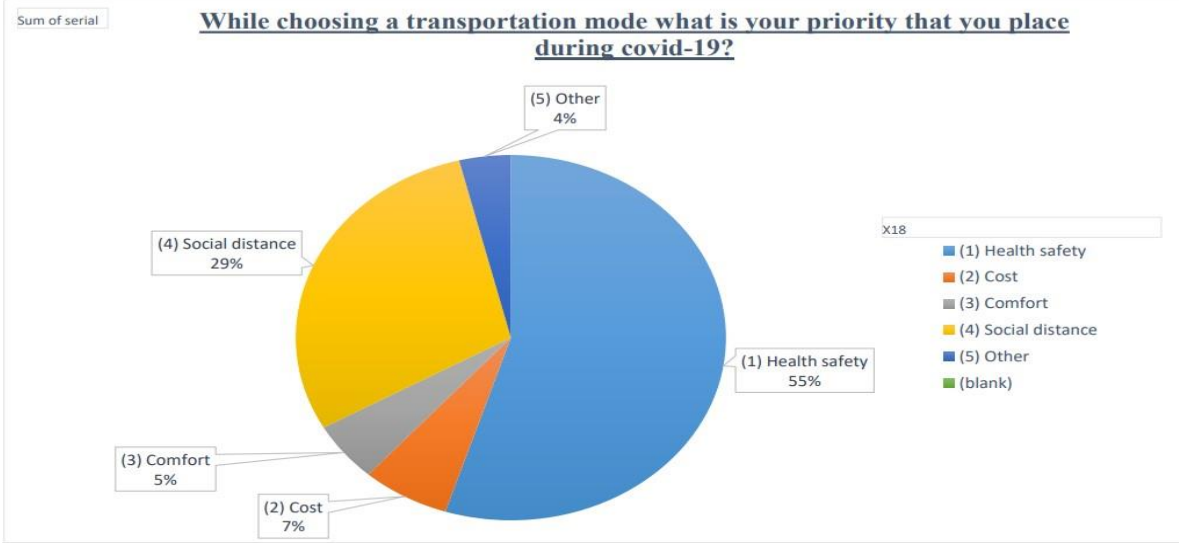
Figure 23: Graph for priority for choosing mode during covid-19.

We know that this COVID-19 virus is transmitted from person to person through human beings and we are told by WHO that if one person keeps their distance with another by three feet & wearing mask people can reduce the rate of spreading COVID-19 virus. So, most of the country has restricted their public transit because the virus is spread very fast in the crowds of people. Sadly, for Bangladesh it is quite difficult to control the local peoples with the solution gave by WHO Because we have a huge overpopulation in our country, it is not possible to keep every people to make three feet distance with each other and many do not believe that the virus can be removed by keeping a distance from one and another or by wearing mask. So, there are many different opinions here in the que no. 21. As 77% of people think restriction on transportation was helpful to prevent the spread of COVID-19& 23% people think it is not helpful at all.

Do you think restriction on transportation was helpful to prevent the spread of covid-19?
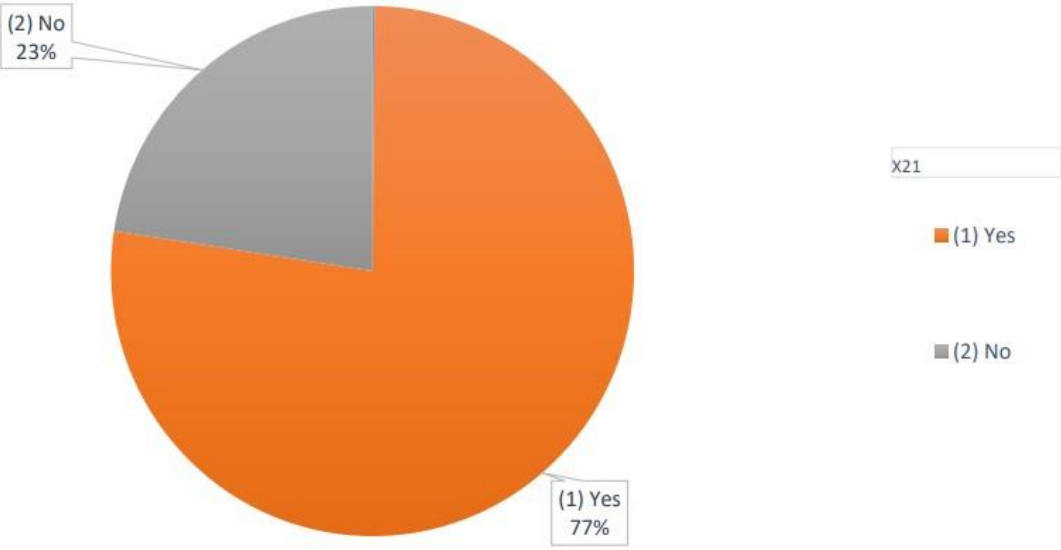
Figure 24: Graph for opinion about spread of covid-19.

By analyzing the que no. 7, we know that Blood pressure and Diabetics is the common decease for majority of the responder's family or their close ones. Thirdly 19% of them responded that none of deceases their family & close ones have. Among the family members or close ones 2% of them have low immune system, 1% of them have liver disease, 4% of them has other disease & lastly 6% of them heart disease. We all know that those people are in high risk who have low immune system and have Diabetics.
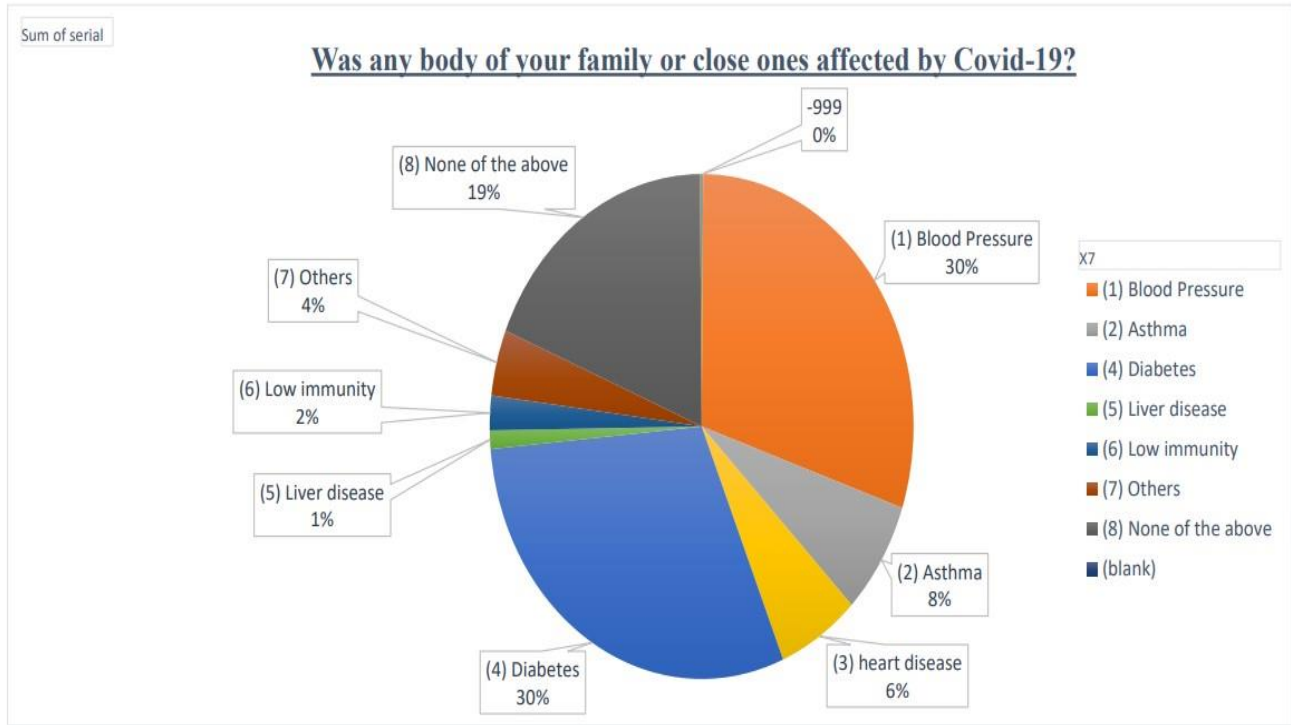
Figure 25: Graph of percentage of affected by covid-19 in family.

The virus that causes COVID-19 infects people of all ages. However, evidence to date suggests that two groups of people are at a higher risk of getting severe COVID-19 disease. These are older people (that is people over 60 years old); and those with underlying medical conditions (such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer). The risk of severe disease gradually increases with age starting from around 40 years. It's important that adults in this age range protect themselves and in turn protect others that may be more vulnerable.

From our perspective COVID-19 is a Dangerous life-threatening disease. Majority of them Strongly agree (44%) & agree (40%) with this statement. 9% of them was neutral. 7% of them was Strongly disagree & disagree with this statement from the beginning. After the Government put down the lockdown and when those people are started to live their life in a new normal way many turn down their statement about this matter. The portion strongly agrees decreased to 36% and the portion of agree increased to 45%. Neutral portion was also increased to 13% and strongly disagree and disagree remain quite same.
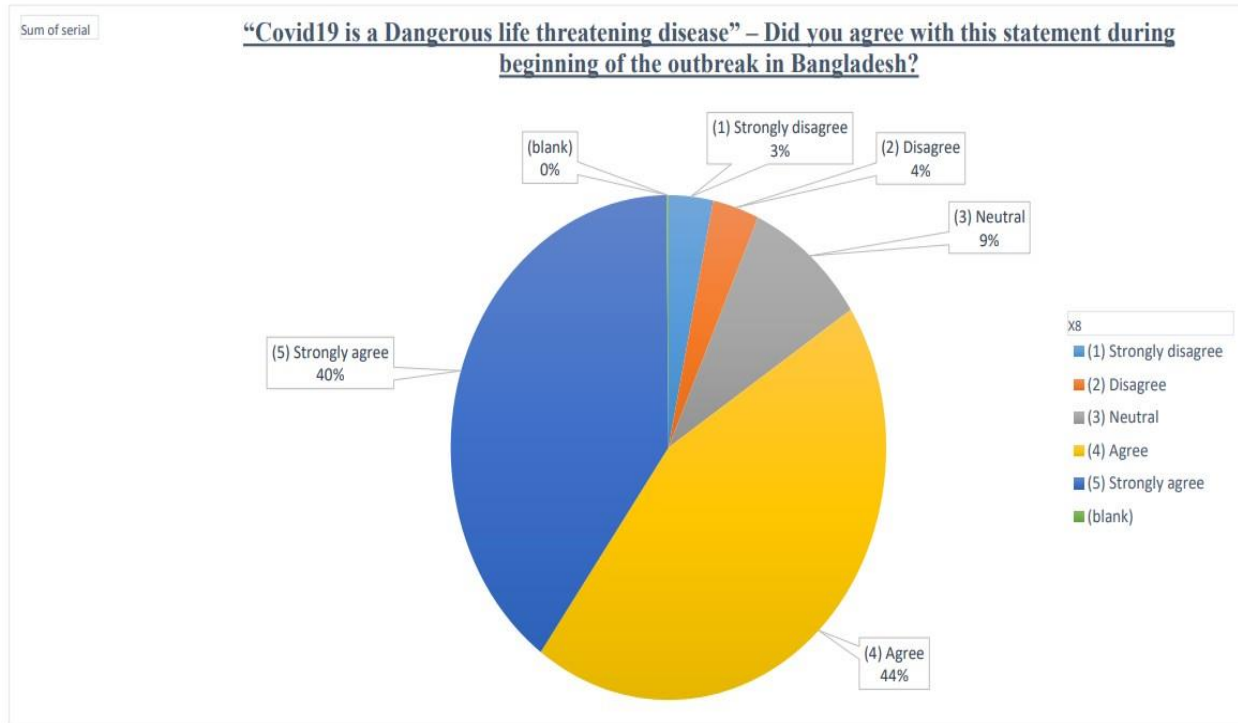
Figure 26: opinion on covid-19 threating statement during beginning of the outbreak
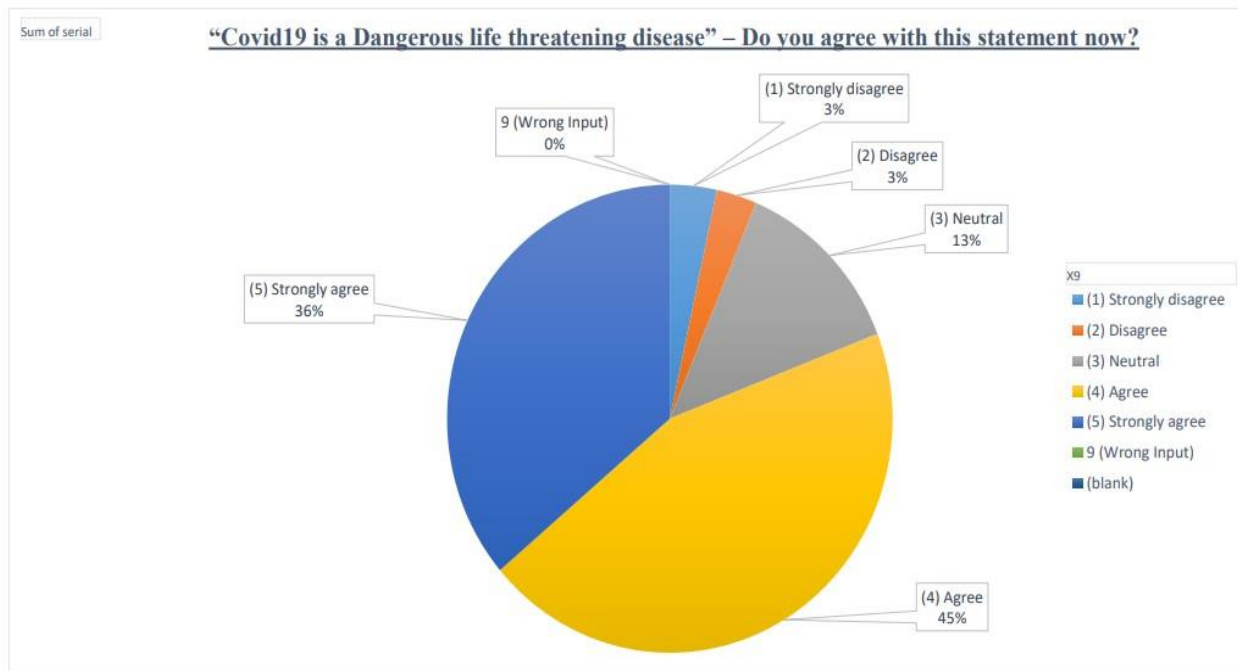
Figure 27: opinion on covid-19 threating statement during the time of survey

Though this table of question no. 10 we can see how terrible the COVID-19 really is 49% of the people's family or close ones was affected with this virus & 51% was not. It was quite close call for them. Also 17% of the responders lost their close ones as per question no. 11 we can see.
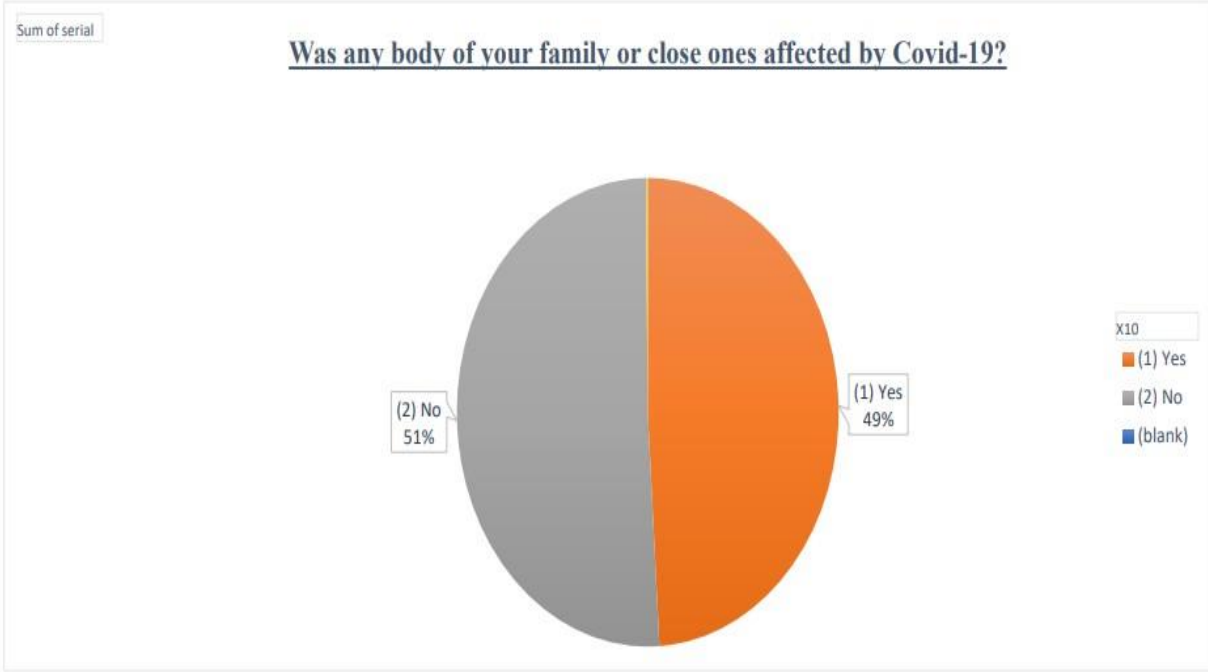
Figure 28: percentages of affected by covid-19 in family
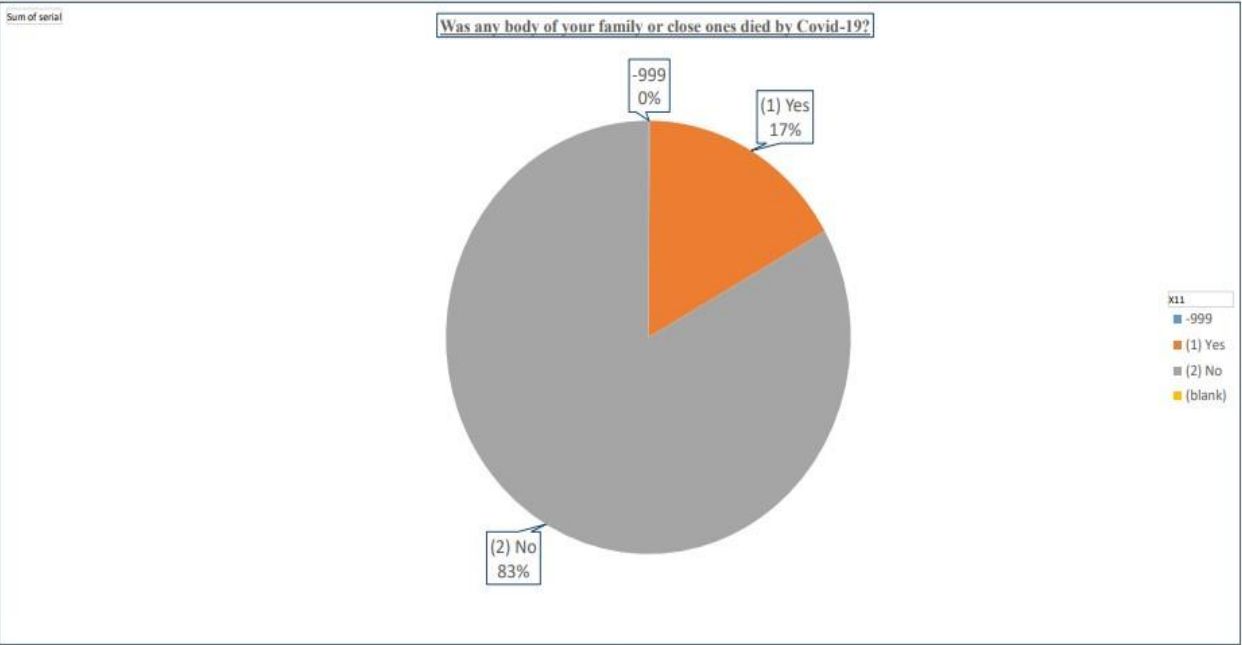
Figure 29: percentages of died by covid-19 in family

It's great to see that 74% of the people wear mask on regular basis as they are very aware about how dangerous the virus is while going out for various reasons. Because wearing a mask is now very important for not getting or spreading the virus. 19% people wear in usual manner but also forgot sometimes, 6% people think wearing mask is not good option but bound to wear & 1% people think wearing mask is useless and never wear it.
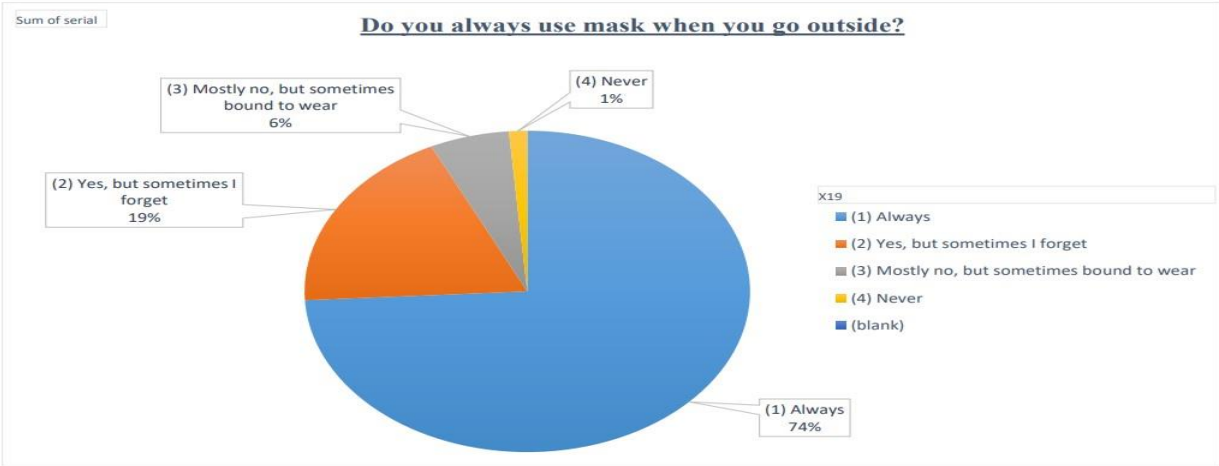
Figure 30: percentages about self-safety measurement (wearing musk)

During the time of covid 19 Shopping from Bazar was people's main priority as 53% of them are doing it. Online shopping was also main priory 33% of them it is safer as they didn't had to go to Bazar physically as it increase the chance to get covid-19. Many of them choose the others options to get the shopping done.
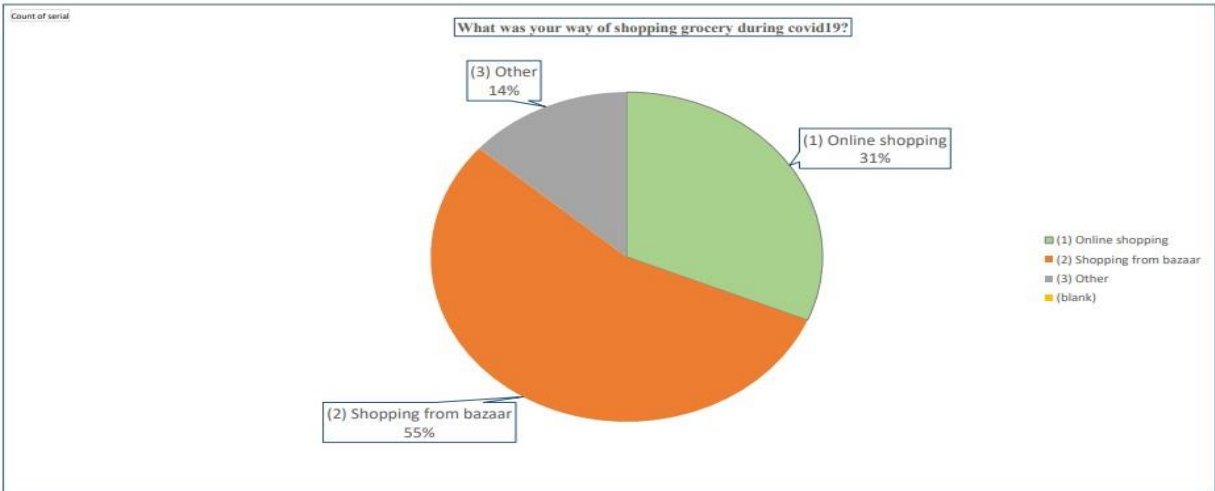
Figure 31: percentages of way of grocery during covid-19

According to the answer to the question no. 13 38% of the do shop online. Among them who do not do online shopping have 33% of trust issues as many of the delivery company turns into frauds, 7% for delay in delivery,13% for the expensive product & 7% for delivery charge.

What is your reason for not doing online shopping?
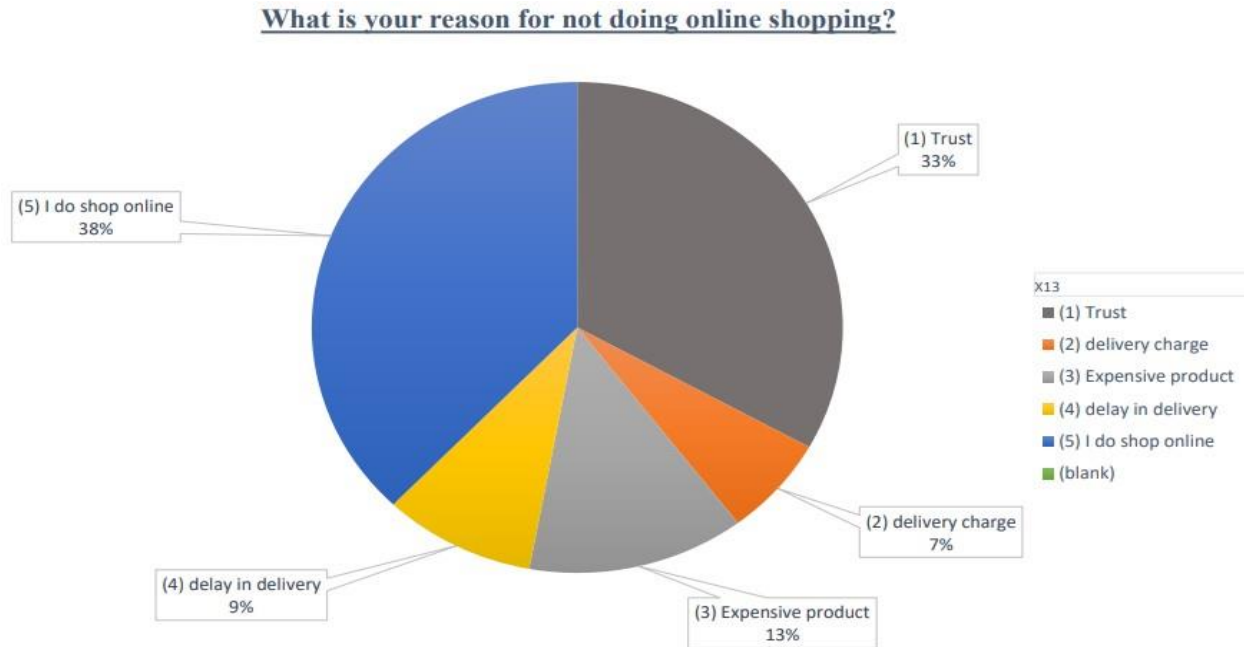
Figure 32: percentages of reason for not doing online shopping during covid-19

As per the answer of the question no. 22 90% of the responders use Smart phone and 10% of the responders don't use smart phone.

Do you currently own a smart phone?
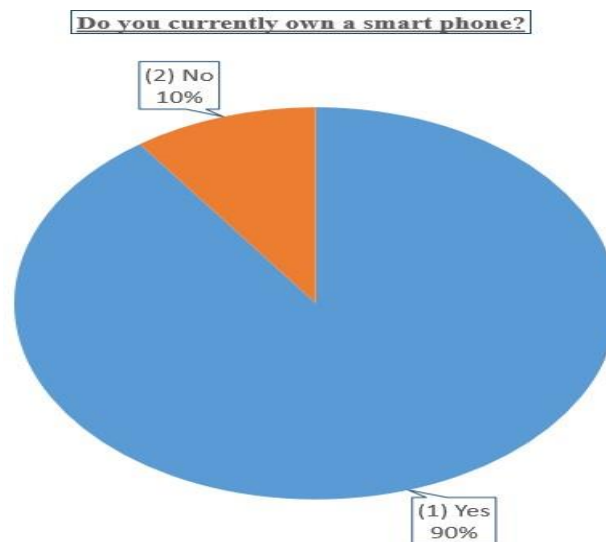
Figure 33: percentages of owing smart phone.

63% of the responders who responded in the survey questionnaire are not from a engineering background & 37% of the responder are from engineering background.

Do you have:
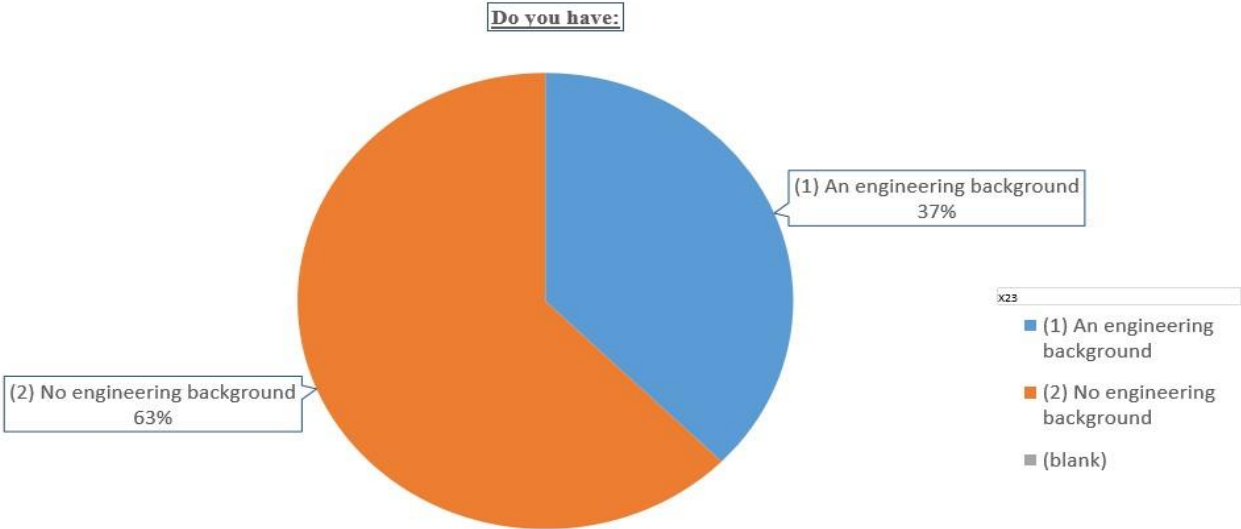
Figure 34: percentages of having or not having engineering background

Majority of the people who responded in the survey questionnaire are single (69%), 29% of them are married & 1% is separated and 1% is in others categories.

Are you?
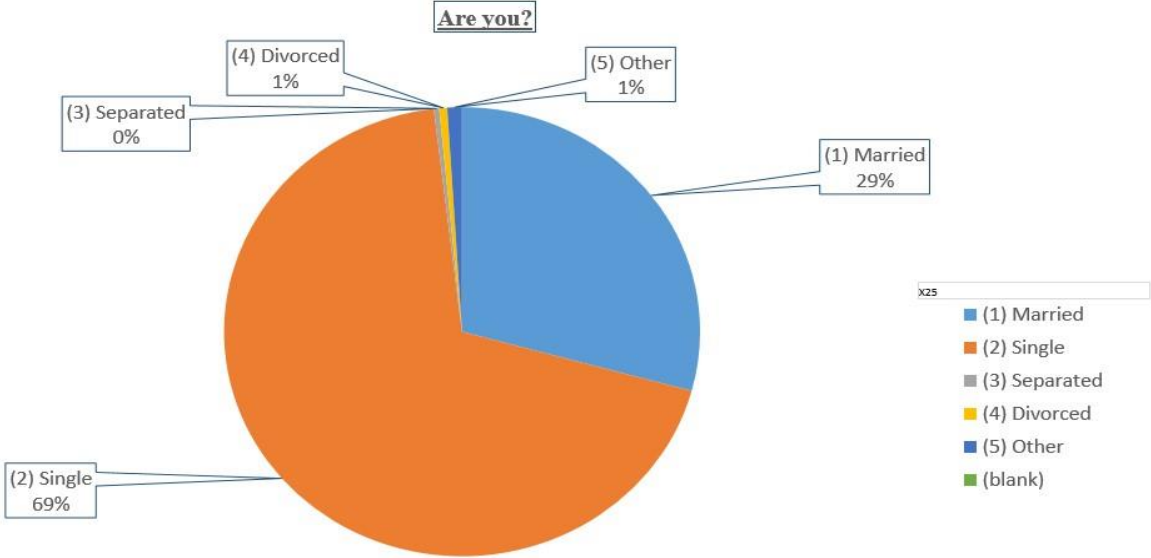
Figure 35: percentages of relationship status

61% of the responders are grown up in urban areas, 20% of them are in suburban area & 19% of them grew up in rural area.
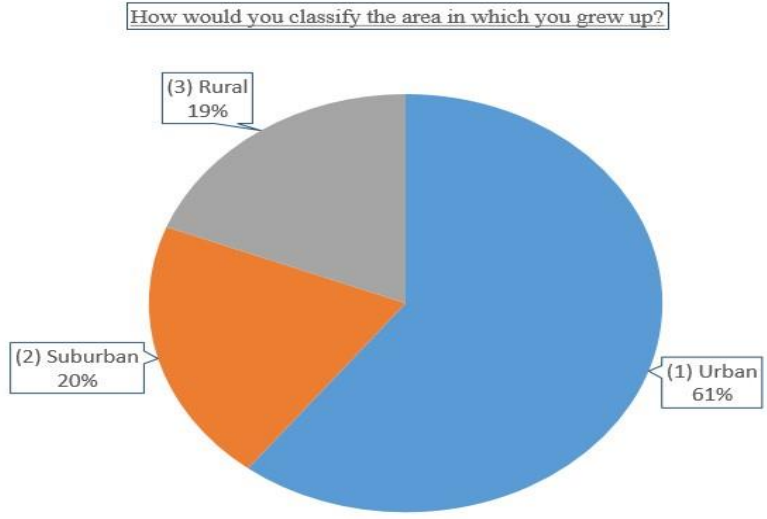
Figure 36: percentages of responders grew up area

53% of the responders are geographically from Dhaka division. 14% of them are from Chittagong division, 8% of them are from Barisal division, 7% responders are from Rangpur division 6% of the responders are from Khulna division, 6% of the responders are from Rajshahi division, 5% of them are from Mymensingh Division & lastly 1% of them are from Sylhet division.
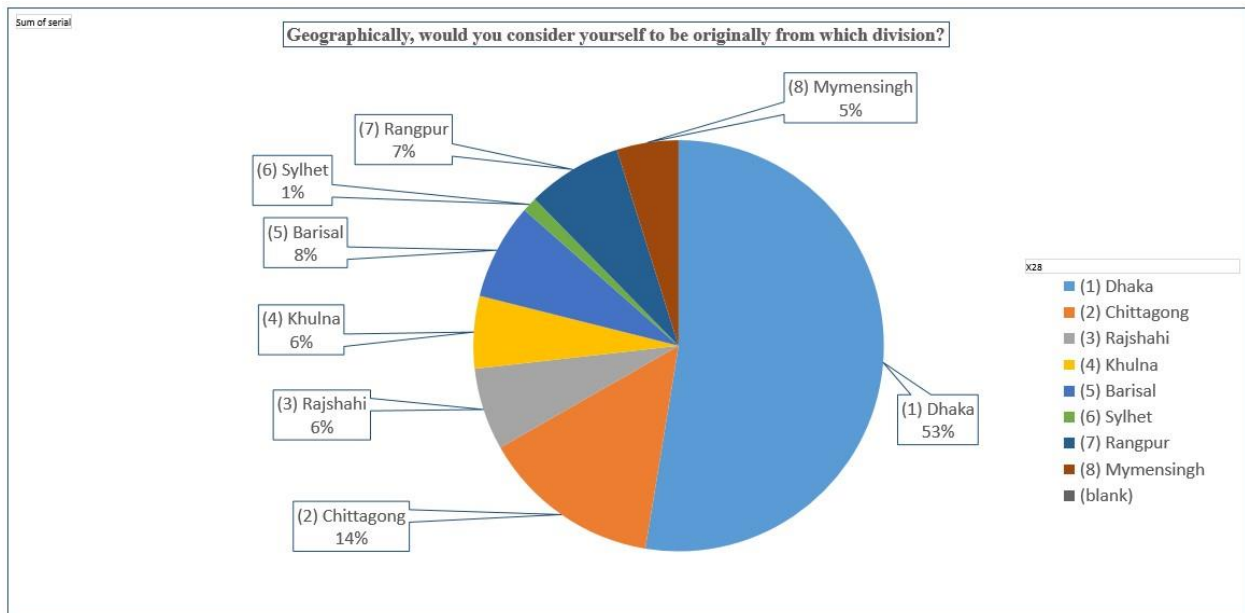
Figure 37: percentages about original division

Good to know 40% of our responder is Undergraduate, 33% of them are HSC (Intermediate passed), 16% of them are Post graduated, 4% of them are SSC Metric pass, PSC pass responders are 2% and last 1% responders have no academic education.
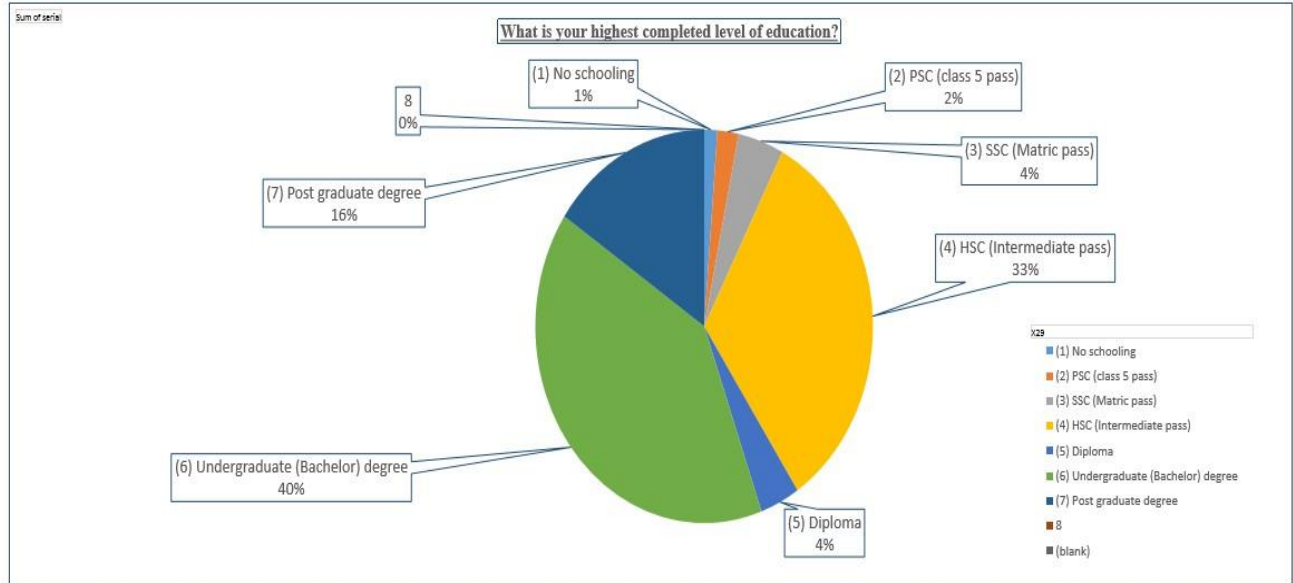
Figure 38: percentages of highest completed level of study

88% of the responders are now living with their family and 12% of them are not living with their family.
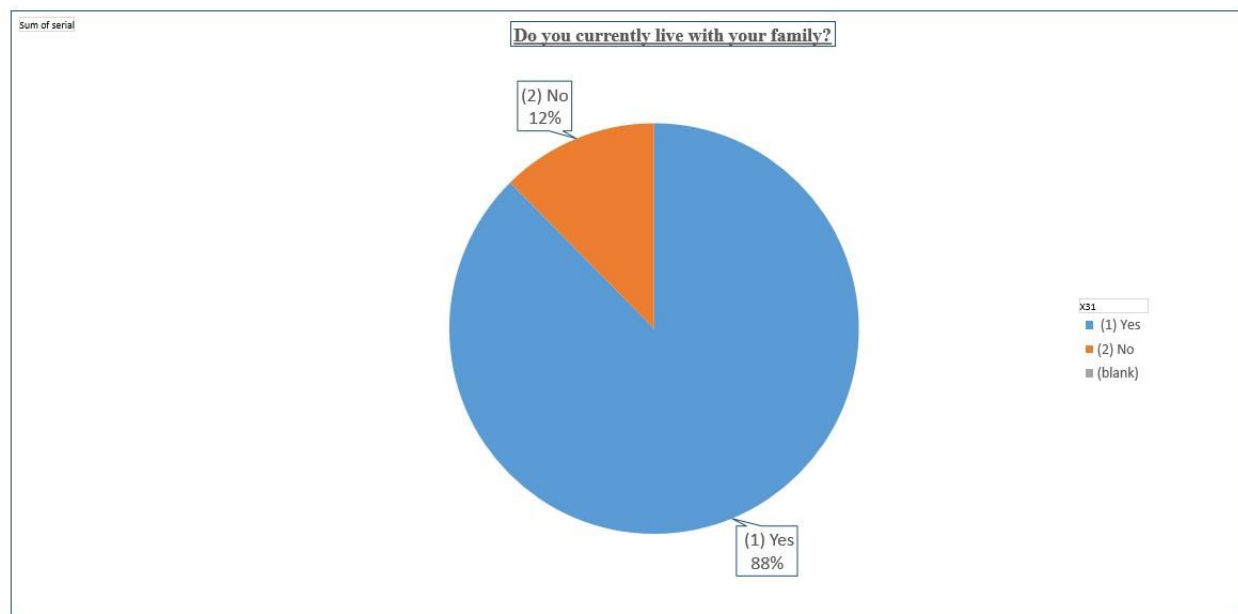
Figure 39: percentages about current living with family

50% responders have 5 - 9members in his/her family including himself/herself, 2% of the responders have 10- 14 members in his/her family including himself/herself & 1% responders have 15-19 members in his / her family including himself/herself.
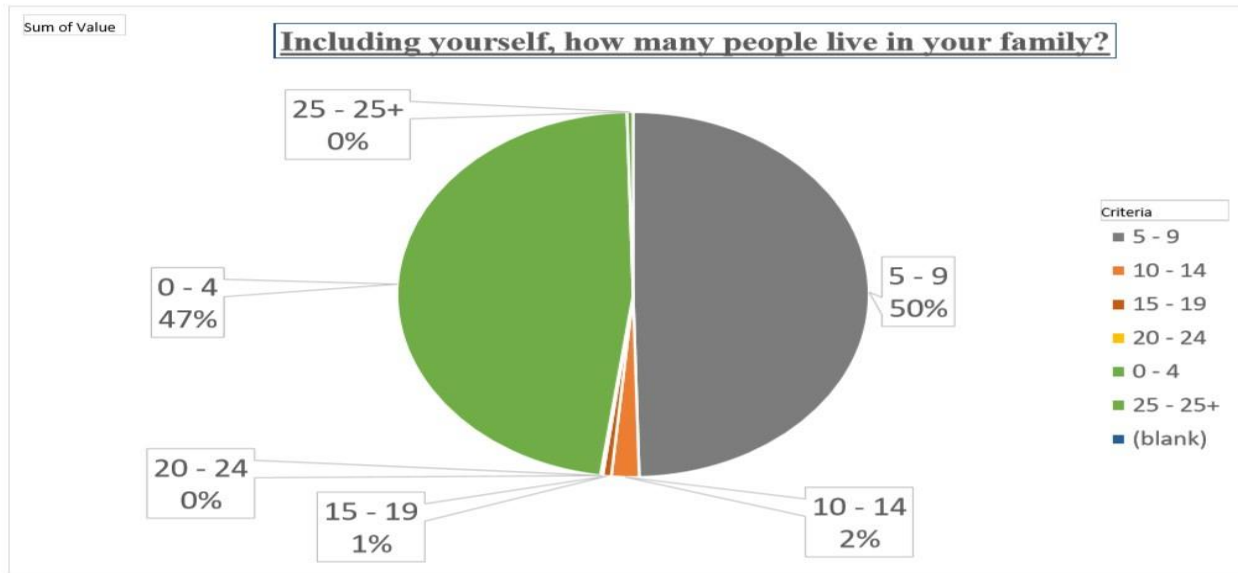
Figure 40: number of people in responders' family percentage

5% of the responders have 2 children's less than 6 years old, 1% of the responders have 3 children's less than 6 years old & 1% of the responders have 6 children's less than 6 years old.
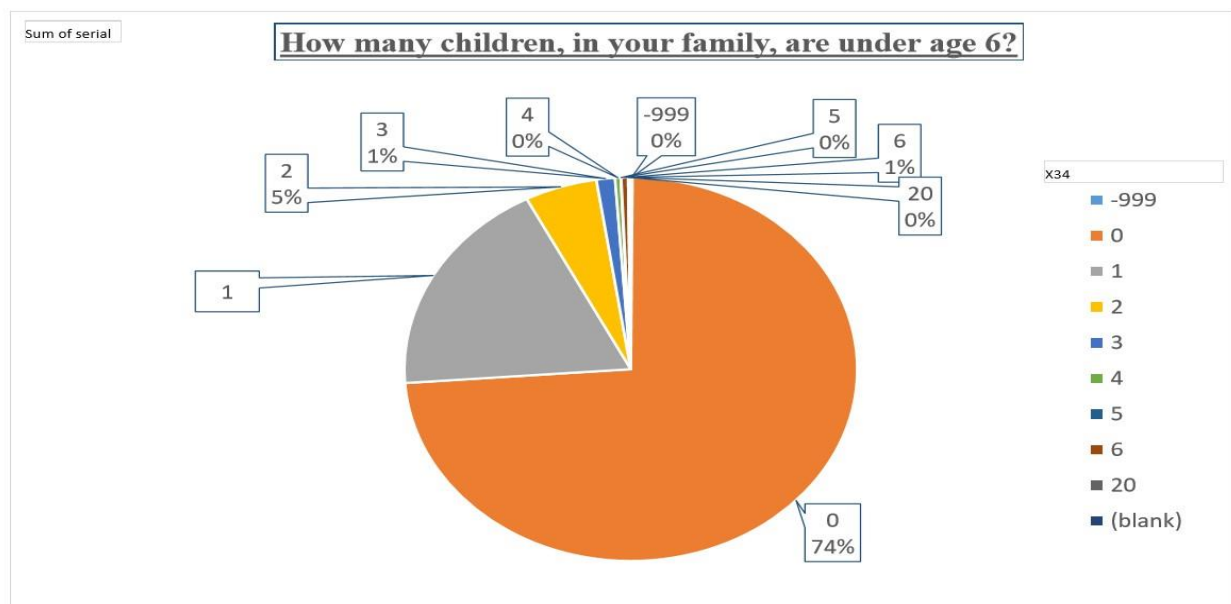
Figure 41: number of children in responders' family under age 6 percentage

34% of the responders have 1 member in their family who is 6 to 18 years old, 9% of the responders have 2 members in their family who is under 6 to 18 years old,3% of the responders have 3 members in their family who is 6 to 18 years old& 1% of the responders have 4 members in their family who is 6 to 18 years old.
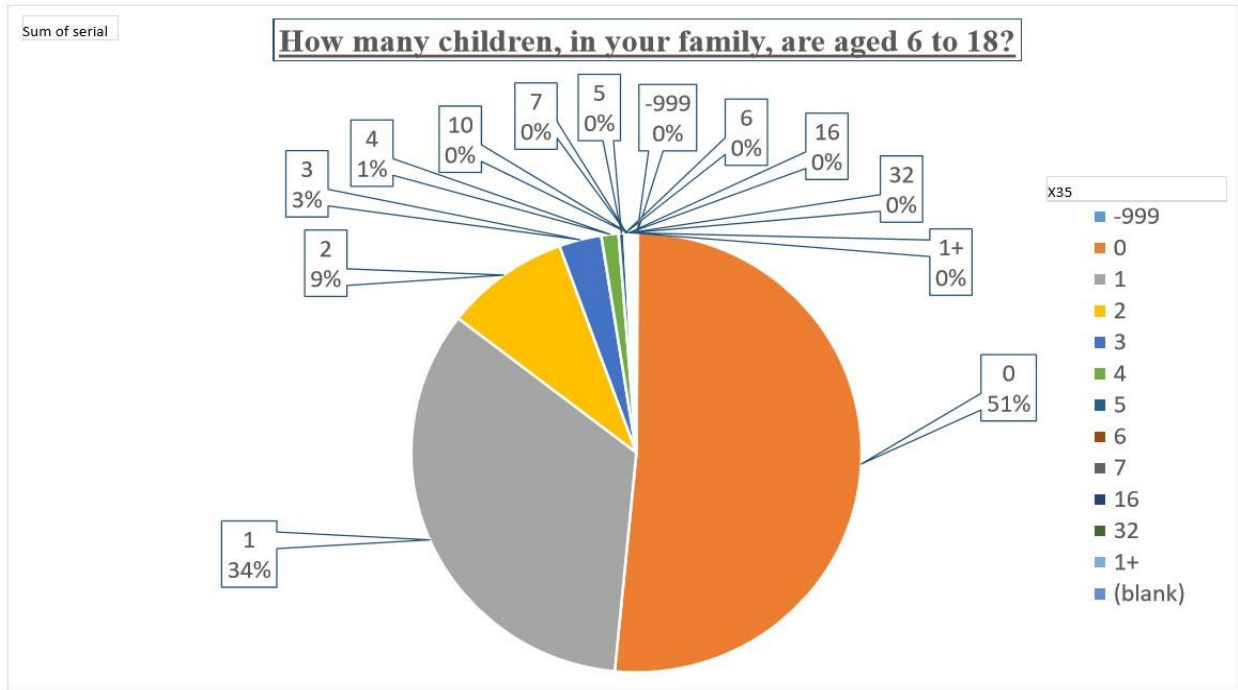
Figure 42: number of children in responders' family aged 6-18 percentage

32% of the responders have 1 member in their family who is over 60 years old, 10% of the responders have 2 members in their family who is over 60 years old,1% of the responders have 3 members in their family who is over 60 years old& also 1% of the responders have 4 members in their family who is over 60 years old.
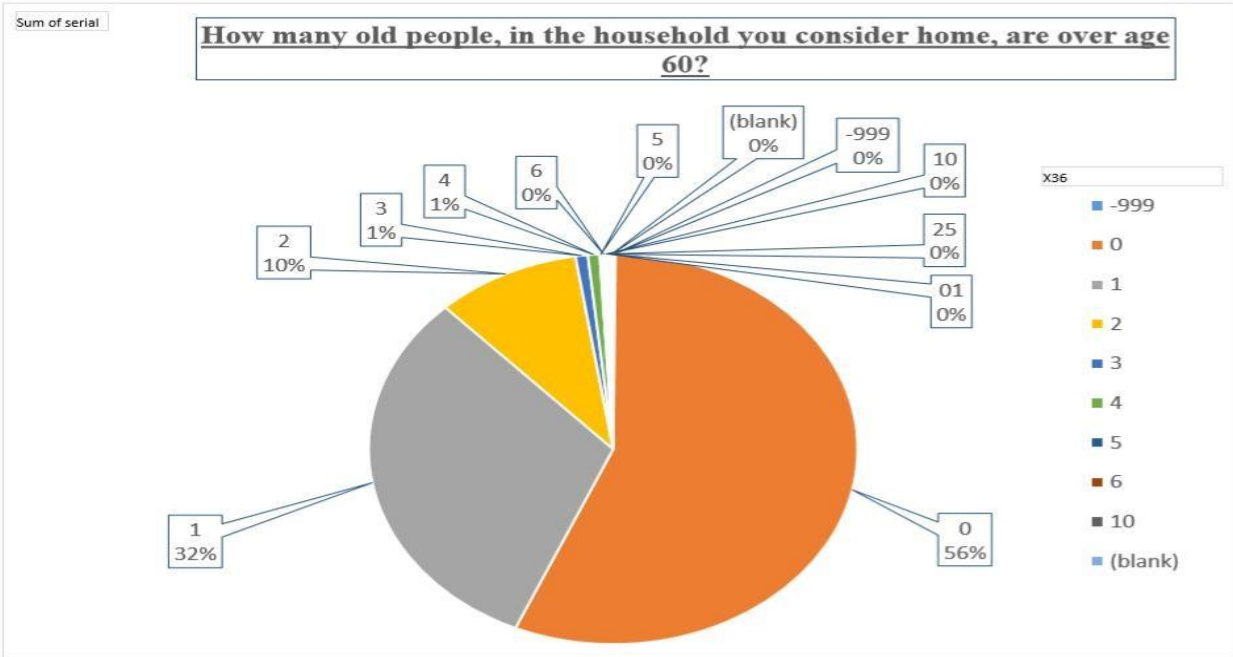
Figure 43: number of old people in responders' family aged over 60

96% of the responders are telling truth in all of question which was asked in this survey questionnaire and 4% of the responders are telling they lied in the question which was asked in this survey questionnaire.
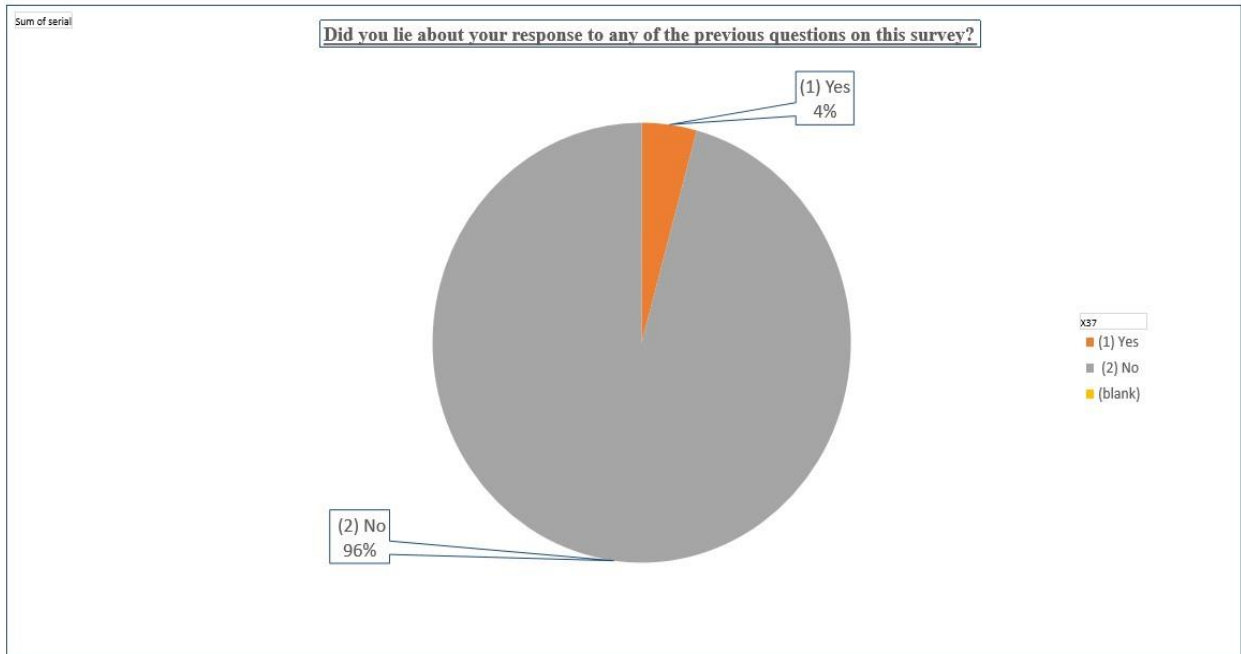
Figure 44: percentage about the accuracy of survey (did they lied or not)

In question no. 1 was asked to know about number of travel and trips before corona virus. About 5% of people who have given zero times means they wouldn't leave the house before corona. 18 people out of 5% are women 9 of them are married and rest are single. One of the single women who are 23 years old said through her responses that she did not leave the house before corona but she had left the house more than 10times during its peak period. Her responses seemed to be wrong so I noticed the rest of her answers. Again, I noticed that she reduced making trips of last 3months. if I think using various reasons, it may be correct it may also be that she answered without understanding the questions properly.

There are many more examples like this, at one point there was question about completed highest level of study, some 19–20-year-old surveyor replied that they have completed undergraduate program.

In question number 10, 11 it has been asked whether anyone in your family or close one has been infected with corona and has died because of corona. They answered that neither their family nor anyone close to them has been infected but they died due to corona virus. How is it even possible?

Again, some of them have replied that they made trips more than 10 times during its peak and

September to November didn't use musk, because of corona they are working from home, doing online shopping never get infected but died in corona.

(Serial no 302) one of the 23-year responder said he had personal bike he used to travel more than 10 times in a week before and after happening corona he also said he never agreed that corona is a deadly disease, he ensure that he or his family member don't have any kind of sickness. He said no one of his family or close one affected by corona but later he said that someone from his family died due to corona.

There are some more examples like this, one of the 60+ year old lady said that he traveled using ride share app (bike) she doesn't own any smart phone.

Again, in a question we noticed that around 24 of the responders strongly disagreeing with that corona is a life threatens disease from the beginning even though 13 of the responders' family or close ones got affected by Covid-19. Among them one of the responders thinks that he was making bound to wear musk, sadly 4 of those responders lose their close ones but still they are disagreeing

about the statement. Many of the responders said they don't use musk but they are strongly agreeing with the fact that corona virus is dangerous. Again, a certain percentage of people don't use musk but they are getting affected by this virus also losing their family and close ones. These examples clear out that many people have responded unknowingly which is why we got the wrong data and its quality gone down. Many of the responder said that they have total 5-10 people in their family again the same responders are saying that they have 9 people who are aged less than 6 and 10/12 people who are aged more than 60. Again, one of the responders said he/she had 125 people in his family, another responder is saying that he had 20 people under 6year old where they said earlier their total family number is around 5-10.
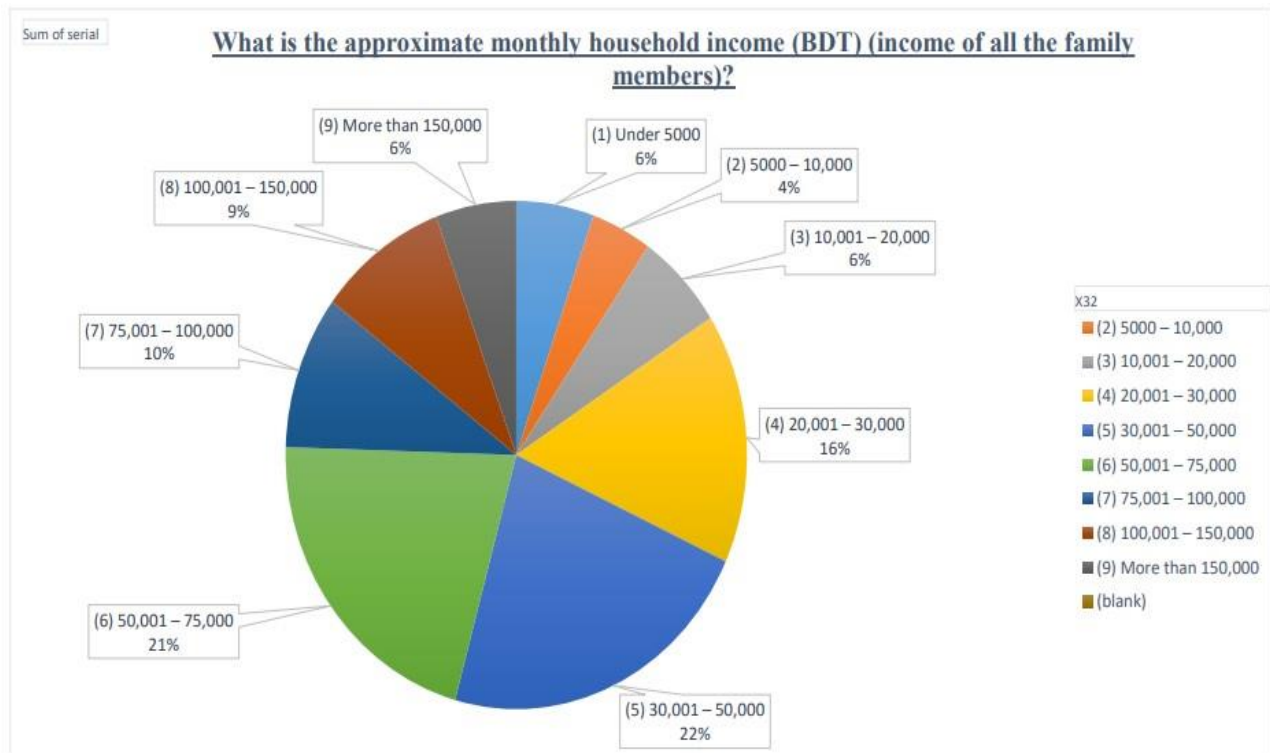

Figure 45: percentage about monthly household of all the family members

Some of our friend and relatives answered question number no 32 without understanding it properly some of them answered about their own monthly income and some of them were not ready to share their total family income so they answered randomly.

5.3 Modelling using "RStudio"

First, we installed "R" software from the website. R is a software which is free for every environment for computing and graphics of statical situation.
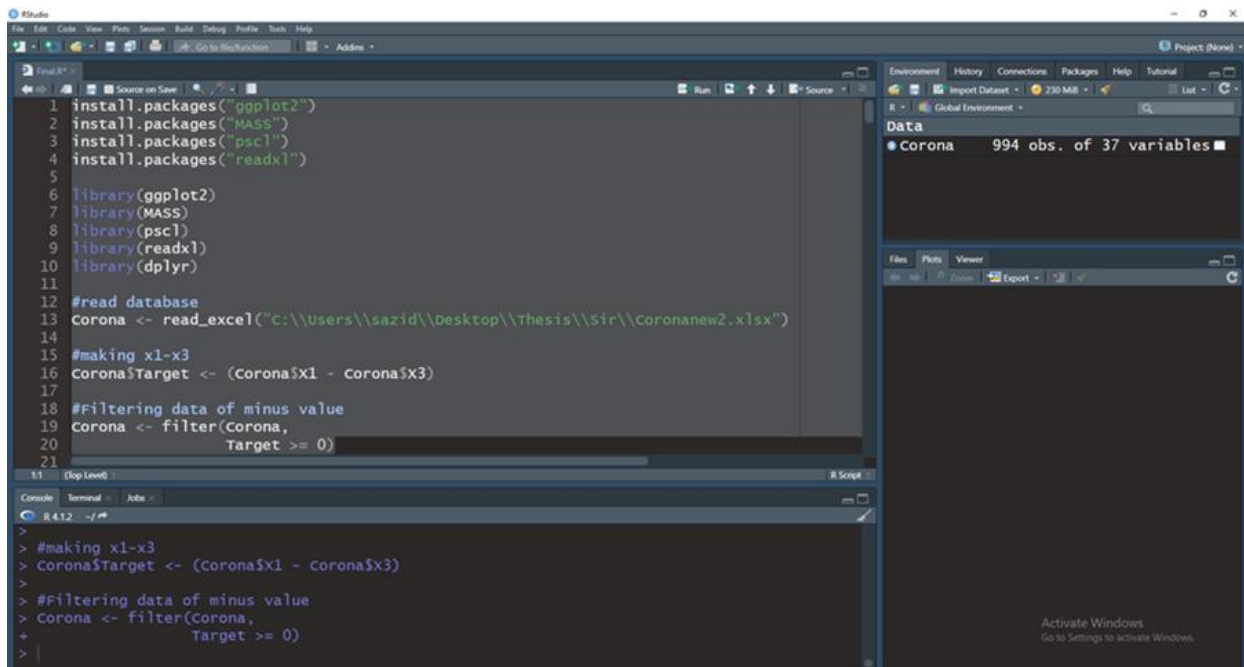
It provides a wide variety of statistical which includes linear and nonlinear modelling, time-series analysis, classification, classical statistical tests, clustering etc. and graphical techniques. R software is highly extensible, integrated suite of software which provides facilities for data manipulation, calculation, and graphical display. It also includes

- A workable data handling and provides facility about storage,
- huge operators for calculations on arrays in particular matrices,
- a massive, compatible, integrated collection of intermediary tools for data analysis,
- To data analysis there is Graphical facilities and display (on-screen or on hardcopy),
- a simple, well-developed, and useful programming language. It includes conditionals, loops, user-defined recursive functions and input and output facilities. 12

Then we need "RStudio", which can also be installed from the website. RStudio's target is to create free open-source software for data science, scientific research, and technical communications. It improves the production and consumption of knowledge for all, regardless of economic means, and provides essential collaboration and re-producible research for the complete and effective work in science, education, government, and industry. After installing, we need to start RStudio. We can use R software, but RStudio is much more user-friendly. RStudio is an integrated development environment (IDE) for R. We need to install R packages. the most popular language RStudio is for Data Science. There are many packages and libraries that you can use for different tasks. For example, "dplyr" and "data.table" are for data manipulation, "ggplot2" is for data visualization, and the "tidyr" library is for data cleansing. There are also libraries such as "Shiny" and "knitr" for creating web applications. In this library, "mlr3", "xgboost" and "caret" are used in machine learning. We use install.packages("packagename") function to install. Packages are the fundamental units of reproducible R code. They include reusable R functions, the documentation that describes how to use them, and sample data. Writing a package can seem overwhelming at first. So please start with the basics and improve it over time. It does not matter if your first version is not perfect as long as the next version is better (Wickham & Bryan). We need to call them after

installing our desired packages. We use the library(packagename) function for calls. We need packages given below:

- Package name= ggplot2 for making graph
- Package name= MASS for using Modern Applied Statistics with S
- Package name= readxl for reading excel file in R
- Package name= dplyr for data manipulation

Figure 46: packages used in R for the whole process

After finishing downloading and calling libraries, we started coding. First, we read excel file and to do so we used 'read_excel' code with the path of the excel file. Then we needed to choose our dependent variable. We subtracted our first and third columns from the database. Subtracting the first and third columns means the value of travelling before Corona - the value of travelling after Corona. Then we filtered the data so that there is no negative value. A negative value means the participant increases their travel number after Corona. After filtering we have omitted the negative values.

Figure 47: Checking mean and variance

Then we need to find the mean and variance for our target variable. We used mean () for calculating mean and var() for calculating variance. We found that the mean and variance were not equal that means we cannot use the Poisson model. Then we checked the number of 0 value in our target. We found that 611 values from 999 are not zero. So, zero-inflated model is not good enough. We decided to use the negative binomial model. We divided every option of every individual independent variable and applied negative binomial. To do negative binomial, we used glm.nb() function. After so many permutations and combinations, we got four significant independent variables, and their log likelihood value was also good enough.

First, "onlinemeetingsDisagree" means those who disagree with online meetings reduce their travel. -2.172 is the significant value for this variable. We use ±1.6 as the minimum significant value (Washington et al., 2003). So the value is significant. Now + or - means less travel or more travel after Corona, respectively. -2.172 indicates that the person is not reducing his travel after Corona.

Second, "sickornotNot Sick" means those who haven't any sick person in their family. -2.216 is the significant value for this variable. So the value is also significant. - before the value means as they haven't any sick person in their family they tend not to reduce their travel.

Figure 48: Final code and output

Third, "AgreewithcoviddangerousnowStrongly agree" those who strongly agree with Covid-19 is a dangerous disease. 2.234 is the significant value for this variable. The value is greater than ±1.6. So this is also significant. Now + before the value means the persons reduce their travel after Corona.

Fourth, "affectedbyCovid19Yes" means those who are affected by Corona. -1.732 indicates that they are not reducing their travel after Corona. In the first time of Corona, there is some rumor that if infected once, they will not be infected a second time (Gallagher, 2021). So there is a possibility that they do not reduce their travel. Finally, we find the log likelihood value is -616.285. Our theta by standard error value is 2.21.

Figure 49: Zero loglikelihood value

Our zero-log likelihood value is -3014.577. The final log likelihood value is better than the zero-log likelihood value.

Figure 50: Finding correlation between two variables

We use cor.test (1st variable, 2nd variable, method = "pearson") to find a correlation between two variables in the Pearson method. For this, we use ggpubr and devtools packages.

Chapter-6

6.1 Discussion on Excel Findings

We have learned a lot from the 1218 survey. We have got very good answers in this regard, which will help us a lot to find the current situation and what we should do in the future is to be able to avoid corona and get better idea of transportation system. The main purpose of the survey was to report the situation before starting of corona, at the peak of its and when everyone overcome corona's fear. Hence below by some graph we would like to explain to scenario. Here in this graph which is informing us about the differences of trip making before and after corona. People of Dhaka city to make trip a lot before march as we can see in this bar chart blue is portion is for trip generation number before finding any case of COVID-19 means before march around 60%-70% + people used to make trips more than 10 time in week where in April to august period it decreases drastically. It happened because of maintaining strict lockdown and various health and social reasons.
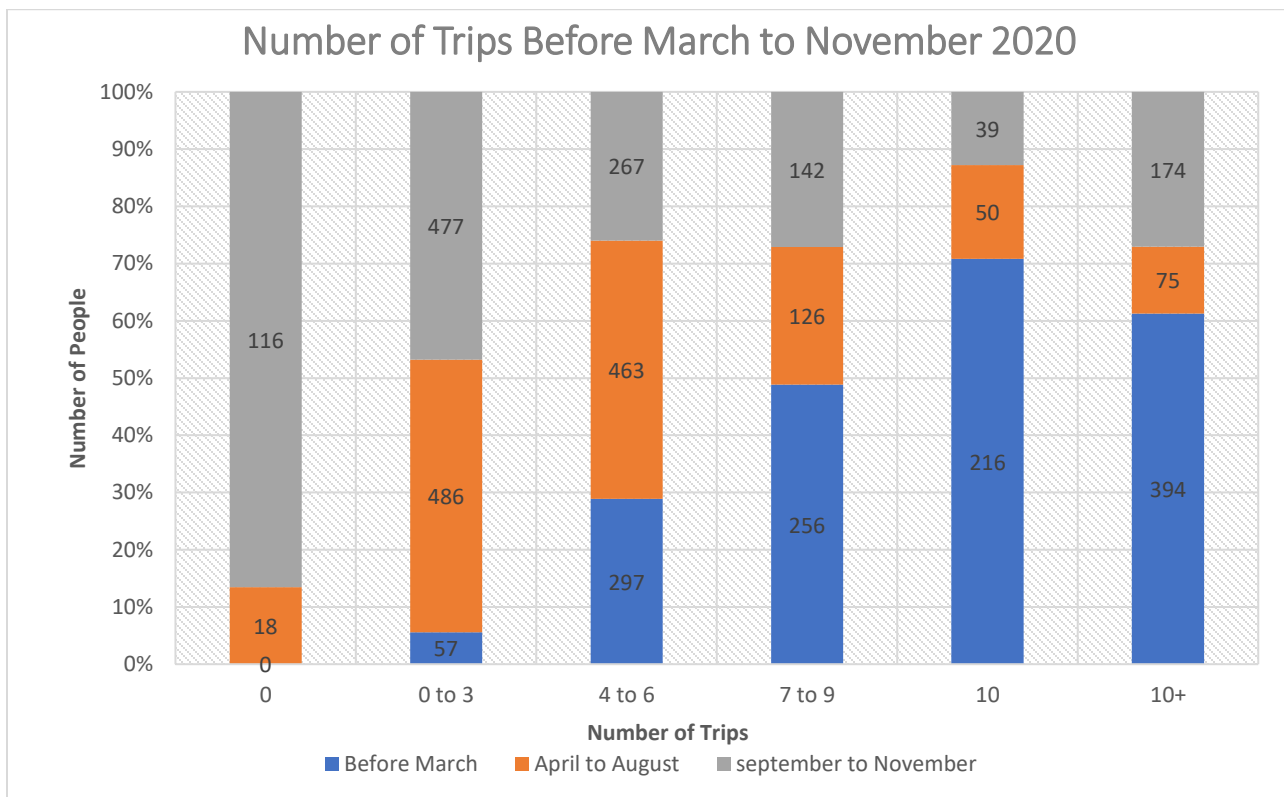
Figure 51: Difference in number of trips before March to November 2020

Again, from this chart we can see that around 10% people make zero trips in April to august where else only 2% people did not go outside of the house while COVID-19 was in its peak. It might

happen because they need to go out of house in many important reasons like shopping and to go the hospital or others. Overall, we can say that people of Dhaka reduced their trip making or travelling after COVID-19 pandemic.

Again, from this chart we can see the huge difference in choosing modes before and after corona.

The rate of using personal car, bicycle, walking, rickshaw, CNG, ride sharing cars etc. increased. People priories their health and followed every rule that applied on transportation system for health safety purpose and reduced or more likely avoided using public transit where they used to travel using public transit the most before march.
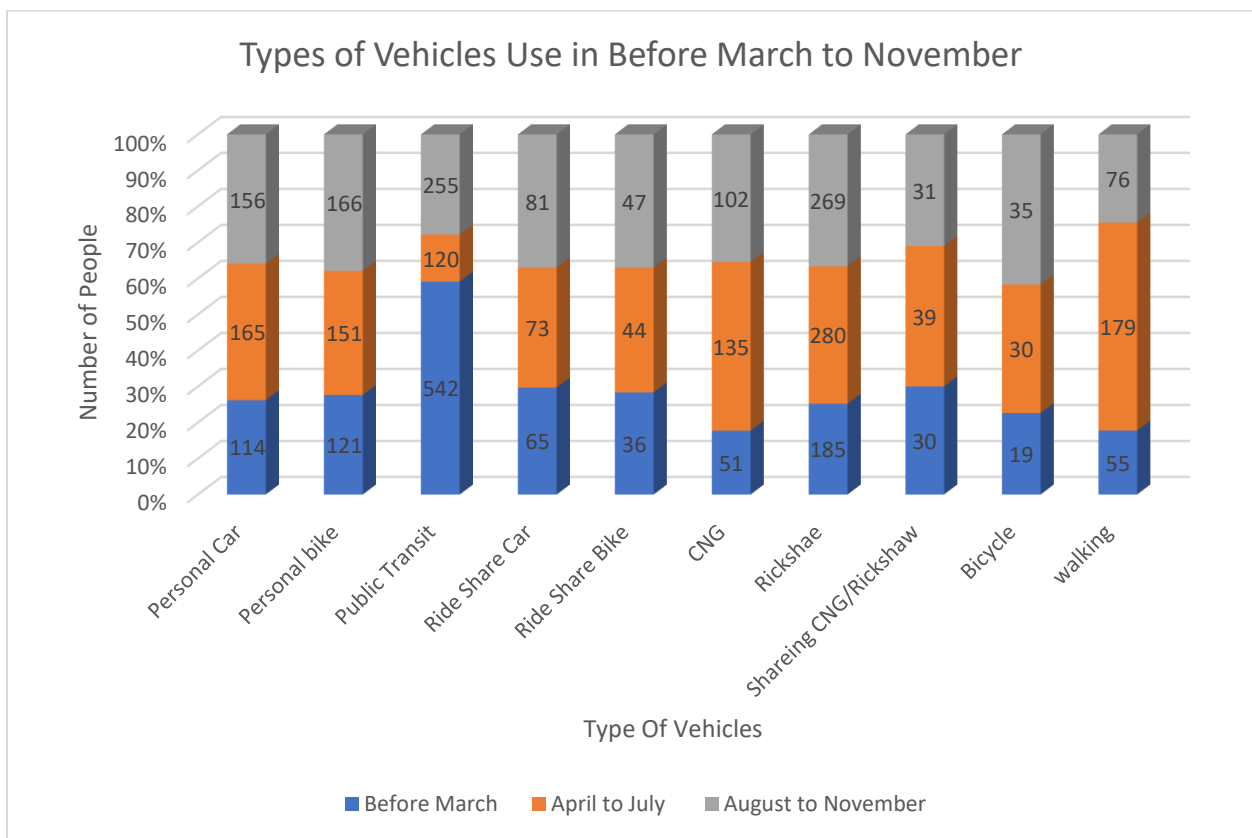
Figure 52: Difference in mode choice before March to November 2020

the graph about difference in thinking about covid-19 then v/s now below its clear that in the starting of this pandemic people used to strongly agree that it's a life threating disease. but now day by day people are overcoming its fear.
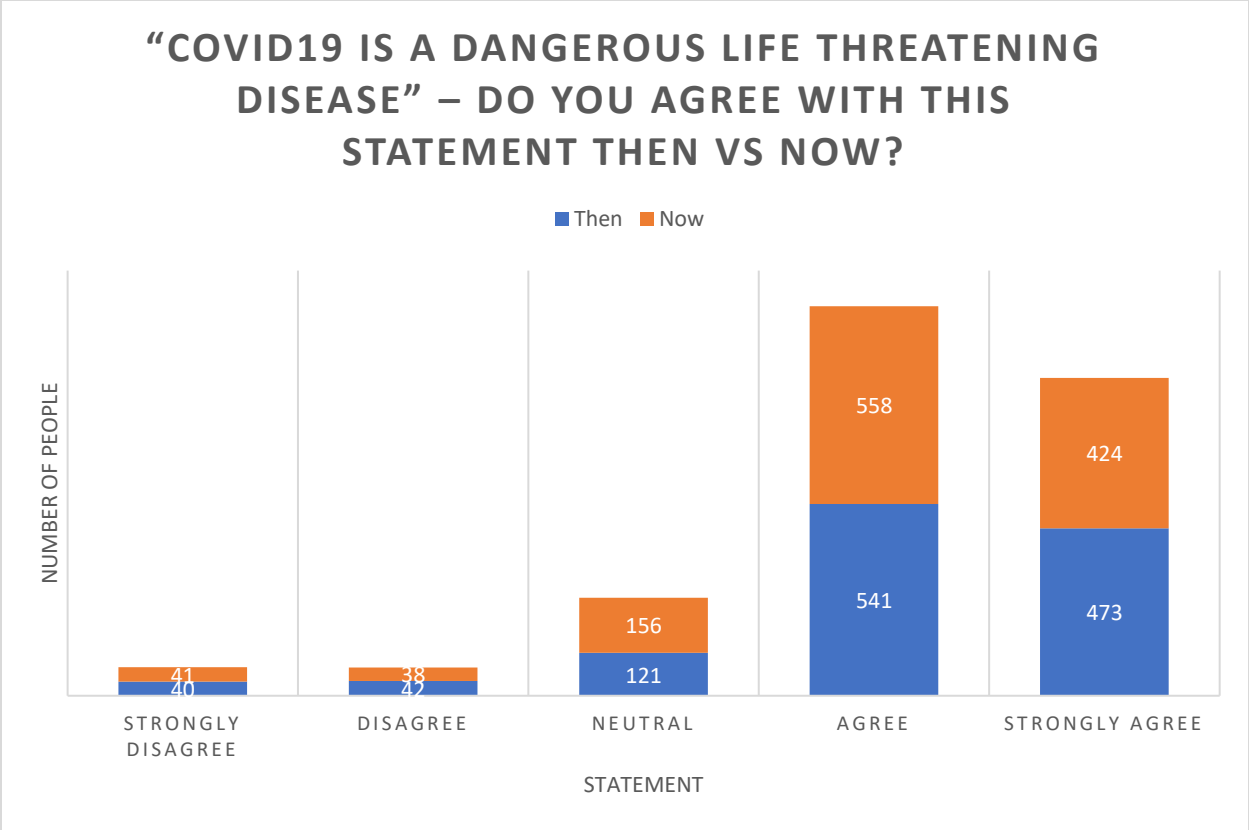
Figure 53: difference in thinking about covid-19 then v/s now

During COVID19, the use of cars increased, the use of active transportation (e.g., walking and cycling) increased, and the use of public transport and paratransit decreased. It suggests that people tend to be safer when it comes to health issue. In addition, there are some implications for future traffic trends after COVID 19 and in the new normal era in connection with the findings.

We have been able to get a lot of information through this survey which was correct but there were some answers that harmed the survey data quality. If we think from both sides then it can be seen that there may have been wrong two sides, such as we may have done wrong coding or gave wrong input in the database sheet file or those who did the survey did not understand the questions or options properly or did not respond seriously. We have seen a lot by observing the survey data individually.

There are many reasons why we got poor quality data. There were so many reasons behind this and some of them are

- Inability to explain the question properly

- Inability to explain the multiple choices properly

- Answering question without understanding

- Neglect and not giving importance to the survey

- Not properly evaluating the work

- Unaware of the value of the survey results

- Not responding responsibly

- Not enter the data in excel sheet

If we look at the survey questionnaire then we will find some question which are not well understandable as a student or a surveyor I misunderstood some question. There was a question implanted where responder was asked to know about their family's monthly income. Many of the responders answered the question according to their own income; in question number 1,2,3 responder were asked about their trip numbers in a week before after and during peak period of corona virus I can assure that we did not get the accurate answer here too because even understand the meaning of trip number, they don't even know how to count trip numbers properly although example was provided with the question but many of them do not noticed and filled the form with wrong answer that is how data quality got harmed. Many have answered without reading the questions.

This survey is very important for me, that is why I have spent a lot of time but those who participated in this survey did not respond as we wished because it was not so valuable to them, and they were not willing to waste their time to understand the questions first and then respond. They have somehow completed the survey. Here one responder said there were 125 people in his family.

Figure 54: Example of responders' fault

Is it possible? Here the question was asked about their own family not about their clan. He or she answered in that way maybe he answered the question without understanding properly or he deliberately or jokingly gave the wrong answer. Again, it may be that person who responded, answered correctly but we made mistake inputting or decoding the data in excel sheet.

Figure 55: Example of surveyors' fault to input data

6.2 Discussion on RStudio Findings

While using Rstudio to analysis the data sheet and modelling process we discarded the wrong data input also such type of data which affected the results on excel data graph. Those inputs might also have impact on accuracy of Rstudio findings. After elimination all the wrong inputs we analysis the collected survey data by using Rstudio and build the model.
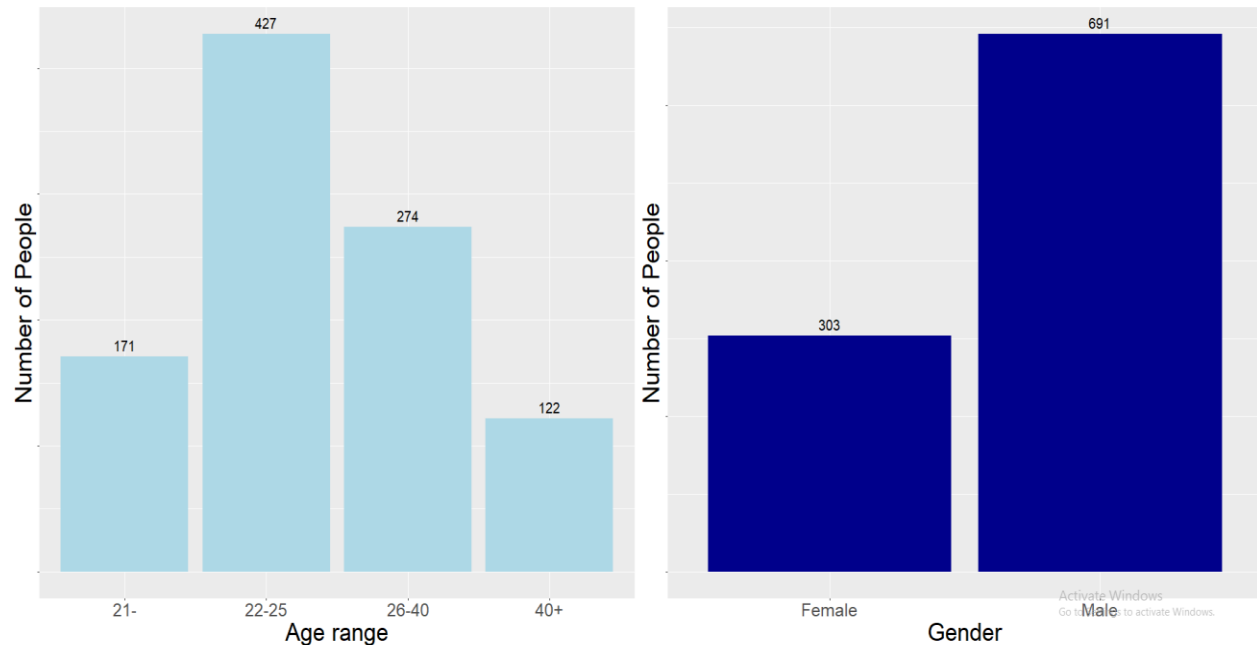
Figure 56: Age and Gender of Our Survey Participants

From the graph, we can see that most of our survey participants are male. In general, most of the family has male earners. In Bangladesh, in most families, the earner is a man. That is, their role is crucial in determining the number of journeys. But yes, the number of women students is almost equal to that of men. So, in the case of education, we have no way of saying that this survey is dependent on men.

We find that most survey respondents are between 22-25 and 28-40. By this, we can say that most of our respondents were university students or employees. Now in the case of students, we know that the educational institution was closed for almost two years, so the amount of their travel is very low (Closure of educational institutions extended till 31 August 2021). Employees have traveled more. However, some people can go out for daily market or other activities.
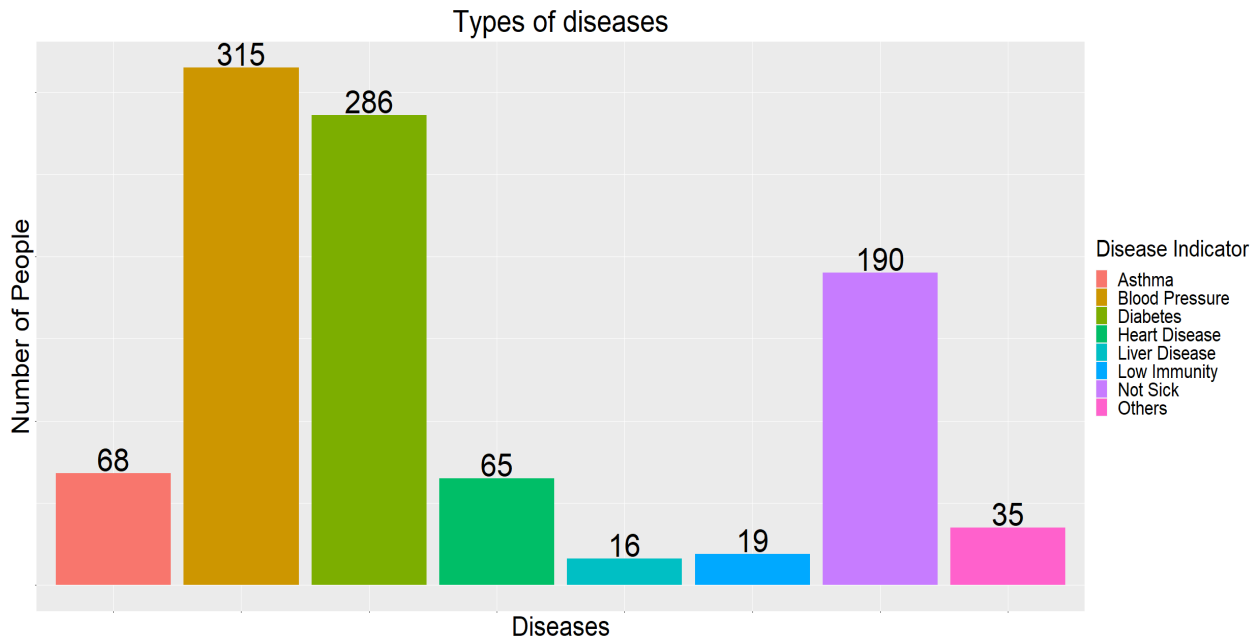
Figure 57: Types of diseases

From the above chart, we can see the number of sick people and the type of diseases. Most of the responders have blood pressure and diabetes patients in their houses. According to a government study, per capita oil consumption or consumption of edible oil in Bangladesh has increased by about 5 kg in the last four years (BBC News Bangla 2021). Saturated fats in animal oils easily increase LDL or bad cholesterol in the blood, and these fats cannot be easily eliminated from the body. This increases the risk of heart disease, high blood pressure, diabetes, and obesity. In addition, there is a tendency among urban citizens in Bangladesh to eat fast food, fried, deep-fried food. These foods contain a lot of saturated fat. From this, it is easy to understand the reason for the prevalence of diabetic patients in our survey. In the port city Chittagong, one out of every five people infected with coronavirus (Covid-19) is a diabetic patient. Among these patients, those between the ages of 31 and 50 face the most physical complications. Seventy-five percent of diabetic patients suffer from some form of long-term reaction. Researchers have identified diabetes in about one percent of every 100 Covid patients after recovery. This has been confirmed by the HbA1c test (Seventy-five percent of corona-free diabetic patients have long-term reactions 2020). HbA1c is a blood test used to help diagnose and monitor people with diabetes (HbA1c test).

High blood pressure is known as a silent killer worldwide, and like many other countries, many people in Bangladesh suffer from high blood pressure. According to 'Bangladesh Demographic

Health Survey 2016-17', one out of every four adults in Bangladesh suffers from high blood pressure (BBC Bangla News 2020). In our survey, we also see that most patients have blood pressure. In number one-third of people have blood pressure.
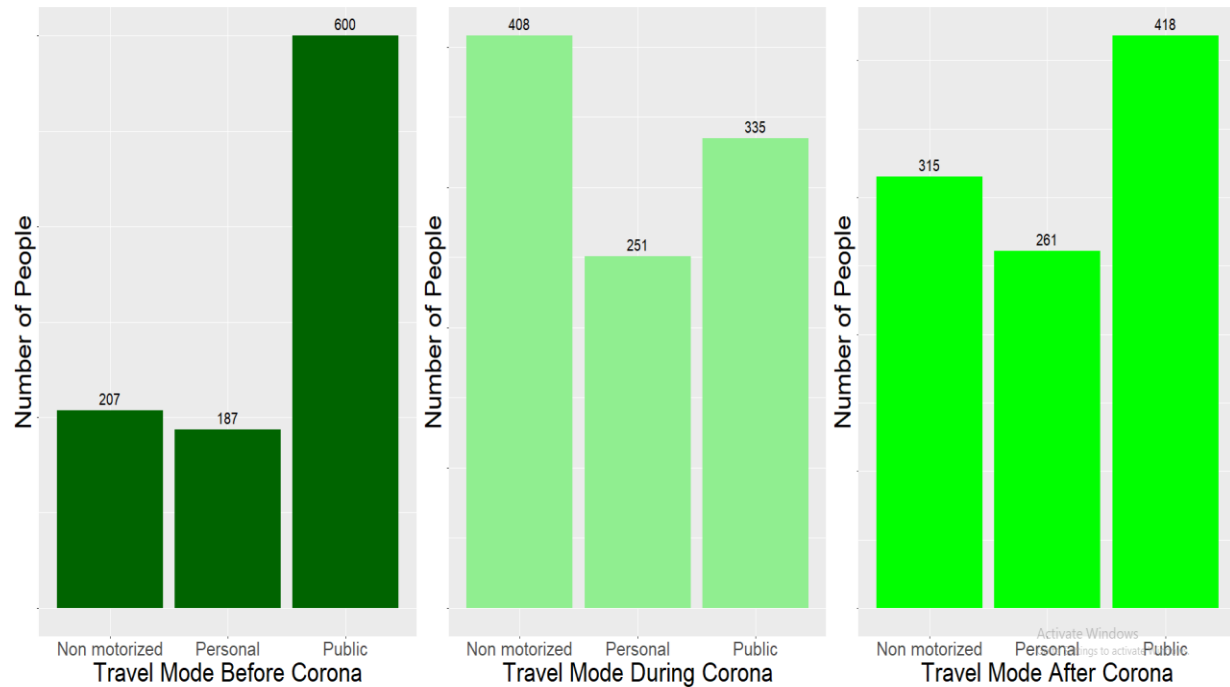
Figure 58: Travel Mode Before, During, and After Corona

We can see from the above graph the change in travel mode before, during, and after Corona. Before Corona, the public transit user was high relatively personal and non-motorized transit user. The number of public transit users was 600, and the sum of both non-motorized and private transit users was 394. Public transit is relatively cheap and convenient.

During Corona, the number is significantly reduced. On the other hand, the number of non-motorized transit users increased and the number of personal transit users. Corona is a contagious disease, so it makes sense. However, personal transit usage needed to be the highest, but the number of non-motorized transit users has increased. This is because non-motorized transit is comparatively less expensive than personal transit.

After Corona, the number of public transit users again increased, and the number of non-motorized transit users decreased. Although there is not as much different now as before, but there is some

difference. In the end, we can say that most of our responders are accustomed to traveling on public transport. Their travels decreased a bit during the Corona period but later increased again. As personal vehicles are expensive, the improvement in this mode was not much significant, although the improvement was continuous.
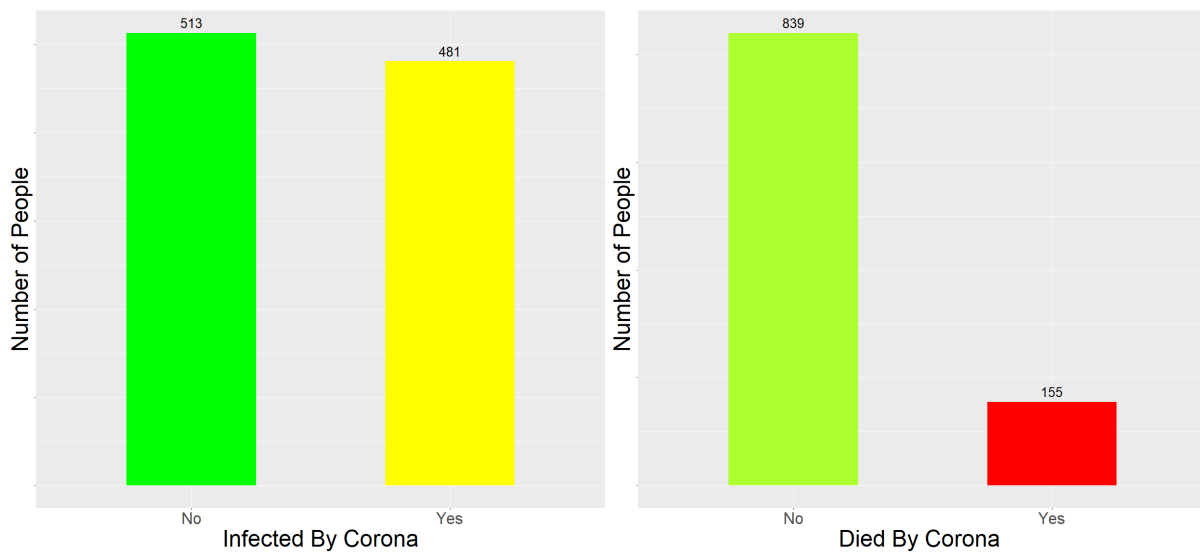
Figure 59: Effect of Corona

The graph shows the number of having Covid-19 affected patients and dies in Covid-19 patients in the family. We see 481 people have Covid-19 patients, and only 155 died. Others recovered successfully. COVID-19 can be deadly for some people. Older adults and people with existing health conditions are more at risk of serious complications, which can be life-threatening. According to the World Health Organization (WHO), about 80% of people who develop the disease have mild to moderate symptoms and fully recover without needing treatment in a hospital. Roughly 1 in 5 people experience serious illness (Sissons, How deadly is COVID-19? What the research says 2020). We get almost the same idea from the data we have. Repeated transfusions of the corona complicate matters. Vaccines made for one variant appear to be less effective in other variants.

Chapter-7

7.1 Modelling results

Table 2: Descriptive statistics of key variables of the negative binomial regression model (NBRM) of travel number change

Variable Description	Mean	Standard Deviation	Minimum	Maximum
Dependent Variable Change in number of travel before and after Corona	1.200	1.303	0	5
Independent Variable Online meetings through (zoom, Google meet, etc.) reduce travel (1 if disagree, 0 otherwise)	0.061	-	0	1
Disease Indicator (1 if not sick, 0 otherwise)	0.191	-	0	1
Covid-19 is dangerous (1 if strongly agree, 0 otherwise)	0.351	-	0	1
Affected by Covid-19 (1 if yes, 0 otherwise)	0.484	-	0	1

Table 3: Measures of accuracy

Measure	Equation[a]	Negative Binomial Regression Component
MAD	$MAD = \frac{\sum_{i-1}^{n}|\varepsilon i|}{N}$	1.27
ρ^2	$\rho^2 = 1 - \frac{LL(\beta)}{LL(0)}$	0.79

[a] εi = error term for observation i; n = number of observations;

Table 4: Model estimation results of the proposed model

Variable Description	Mean	Std. Deviation	Minimum	Maximum
Constant	0.2768	0.1351	2.049	0.0405
Independent Variable Online meetings (through zoom, Google meet, etc.) reduce travel (1 if disagree, 0 otherwise)	0.6342	0.2919	2.172	0.0298
Disease Indicator (1 if not sick, 0 otherwise)	0.3512	0.1585	2.216	0.0267
Covid-19 is dangerous (1 if strongly agree, 0 otherwise)	0.3312	0.1483	2.234	0.0255
Affected by Covid-19 (1 if yes, 0 otherwise)	0.2597	0.1499	1.732	0.0832
Number of observations	994			
Restricted log likelihood	-2992.684			
Log likelihood at convergence	-616.285			
ρ^2	0.79			

7.2 Overall Thesis Result

This specific mathematical model required in-depth knowledge of a complex program and definitive mathematical authorization for reaching the final goal of this project with accuracy and proper execution of programming and data input.

This model required numerous formulas, processes, and tools to gain the result. This is an issue which involves public health and safety, economy, and dramatic lifestyle change. The model had to be accurate regarding statistics of the spread of virus affecting lives in different areas in different numbers. The knowledge of geography and public health was also important.

Usage of Microsoft Excel was very important in gathering and sorting data for attaining the goal. Data input, data collection and finally creating the model required different software and programs in every step. R programming was used to create the model where knowledge and implementation of the conveyed surveys had to be unambiguous. Attaining opinion was also challenging due to the nature and current sociodemographic condition of the country and so designing the model needed proper knowledge of R programming and correct perspective to the problem.

Creating a model which can provide correct outcome required serious investigation of public opinion, using the correct application, proper communication for intended result and multiple inspection of data and steps was required. Understanding travel behavior for short term and long-term effect of the virus among people from different places was vital. The effect of the virus depending on the population of different places is substantial and so proper investigation of opinions and statistics were significant parts of the process.

The model for this public oriented transportation programming had to be modern and convenient due to the nature of the problems we are facing. Covid19 is a virus which has dramatically changed lives. The way of the model had to be time, place, and people relative where unexpected results can occur and thus the usage of proper tools could not be overstated. Microsoft excel and R programming have been the most important tools in the creation as well as usage of social media and survey websites was vital.

The cultural and social standings of the people have been a huge part of this project. Different variable in different stages of the research had to be used due to the nature of the people. The reluctancy in following law and order as well as the lack of knowledge of the severeness of the

virus among people effected the studies in a wrong way and thus the conclusion was hard to achieve as the valid result needed proper opinion and accurate data for the model to work.

The execution of knowledge and ideas varied hugely due to the environment and way of life depending on the region. The spread of the virus is different here than other countries and the socioeconomic structure played a pivotal role in implementing professional approach to the solution. So, the team had to be very in depth and accurate to get the sustainable outcome of this problem.

Attaining accurate data, opinion, and current state of the spread of the virus was hard as well as the implementation of data. There were issues regarding accurate survey results as people are reluctant to read through the process. A lot of the answers were provided without context and gaining the interest of people was challenging. There was also issue of accurate data input due to the inaccuracy of implementation although we were able to filter out the intended outcome through trial and error and being honest to the task.

This was a team project which needed skills from every individual which were unique in every way and the proper allocation of task was necessary. Every individual had to carry out their part and finally by putting all the work in a single model resulted into a successful team effort.

The project greatly depended on team communication and public relation. The survey tool was the most important in gathering data which involved real time communication with the people at times for valid result and implementation required the team to be on the same page.

The project needed to be handled with accuracy and proper usage of resources. The team was managed in a way where everyone was comfortable in handling the designated task and was provided with proper resources which indicates financial management as a project involving public opinion and lives needs a proper budget to work out.'

In every step of the project, the team learned more and more about the terms involved in the project and the public relation has great impact in this case. The model is designed for long term implementation for any time and any place. The studies had to be thorough, and the works needed to be correct. The project involved teachings of engineering as well as social affairs which will remain unique and stay with everyone involved as a lifelong experience.

Conclusion

Overall, this report shows that COVID-19 has had a significant impact on changes in Dhaka's urban transportation system and civil behavior. This part of COVID-19 is mainly described in various sections of this report. In this working mode, the selection behavior was estimated in the context of Dhaka in two dimensions: pre-COVID or before March 2020 and Early-COVID. The purpose was to investigate the impact of such a pandemic on daily transportation and travel in Dhaka at its discretion without legal restrictions. The impact was significantly estimated in terms of transport mode selection and weekly trip counts for all transport modes, including virtual and traditional media. The overall impact of the results was highlighted in the data analysis part. The only safe option during a pandemic was online research. We couldn't get a completely representative sample. However, while descriptive and simple statistical analysis of the data requires sample representativeness, a reasonably "balanced" sample is sufficient for the estimation phase. However, adjustments need to be made during the forecast. It should be noted that there are some limitations associated with this study. Firstly, this survey was based on the data collected through an online survey. Secondly, the people, who had access to the internet and who could understand and communicate in English, responded to this questionnaire beside this there were many reasons mentioned earlier in this report . Thus, generalizing outcomes for an average population in this society might not be practical. Further, social, economic, and health inequalities also play a vital role, and the behaviors and responses depend on such factors as well. In addition, it is likely that the reported behavior might not be a true representative of their actual travel behavior, particularly before the pandemic. Certain demographic variables such as monthly household income and marriage status and other independent variables could not be included in the multinomial logistic regression model because some variabales did not show frequency. Future research to address this issue recommends increasing sample size and sample diversity. Nevertheless, the results of this study may affect transportation planning in the COVID or New Normal era. In addition, it is possible to identify user needs, requirements and concerns, which are important in meeting public transport needs, especially in situations of potential future pandemics. Other than all of this using this data sheet value we build an regression model using variables like "did they agree with that online meetings during this pandemic reduced trip generation" , "they get sick or not", "do they agree that COVID-19 is life threating disease", "was anybody in family affected by covid"- using these variable we able to prove that during COVID-19 it decreases the

trip making number. This model can be used in the purpose of our social and health benefit. By spending time to working on this it will turn into more accurate and efficient.

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