Mode Choice Modelling for Educational Trips in Abbottabad Pakistan

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THESIS ACCEPTANCE CERTIFICATE

Certified that final copy of the thesis titled "Mode Choice Modelling for Educational Trips in Abbottabad Pakistan" written by Ms. Rida Hameed Lodhi (Registration No. 00000206918), of Urban and Regional Planning (NIT-SCEE) has been vetted by the undersigned, found complete in all respects as per NUST Statutes/Regulations, is free of Plagiarism, errors and mistakes and is accepted as partial fulfilment for the award of MS degree. It is further certified that necessary amendments as pointed out by GEC members of the scholar have also been incorporated in the said thesis.

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Date: _____

DEDICATION

This thesis is dedicated to my beloved parents and brother for always being an unending source of love and encouragement.

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All praises to the Allah Almighty, the merciful and the most beneficent who showers his blessings upon us every day. He beholds all the knowledge of the universe and beyond.

I would like to thank my supervisor **Dr. Irfan Ahmad Rana** for all the help, guidance, inspiration, and support throughout the research project. His assistance and valuable feedback enabled me to achieve a solution-oriented research experience. Intellectual input and assistance at every stage enabled me to gain valuable knowledge and a better solution to the problems faced during the research phase.

Rida Hameed Lodhi

ABSTRACT

Educational-related trips are a major component of usual traffic in peak hours on a typical day. For proper transportation planning, the dynamics and preferences of educational trips must be understood. Educational trips have been broadly studied in European and North American countries. But limited studies are available in developing countries. This study identifies gender-based model choices, preferences, and travel characteristics among school-going children and investigates the satisfaction level of respondents with public transport and also developed a mode choice model for educational trips in Abbottabad, Pakistan. Descriptive analysis, chi-square tests, independent and paired sample t-tests were conducted to find out significant differences between genders and other travel characteristics. For modelling, the multinomial logit model (MNL) was conducted in SPSS. Using Slovin's sampling method, a total data of 370 samples were collected from which 310 samples were used for model calibration and the remaining 60 were used for validation purposes. Results show significant difference between mode choices and preferences of both male and female students. There was no significant difference in travel time, travel distance, and travel cost, but males tended to make more trips than females. The satisfaction level shows that females having a more negative opinion about public transport than males. Significance difference between actual and perceived satisfaction was also observed, which implies students are more dissatisfied with public transport and the result of the Multinomial Logit Model shows that gender, age, household income, total travel time, cost, and distance are the influential factors that affect mode choice of students and it is also found that

travel time by school bus and public transport affect the utilities of these two modes positively.

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Chapter 1

INTRODUCTION

1.1 Background

Travel is can be defined as “any transporting activity from one location to another using any transportation mode” (McGuckin & Nakamoto, 2004). A person normally travels to a specific location, with a reason to participate in an activity (Susilo, 2013). Due to urbanization, population growth, and migration to urban areas, travel demand in urban regions have rapidly increased, which has led to difficulties in handling the situation effectively. Educational and work trips are the most common daily trips that take place from home to campuses and workplaces. Traffic congestion has occurred because of an imbalance between demand and supply, which in turn has affected urban mobility. For the facilitation of car users only, building more road infrastructures is quite unfair and neglecting the mobility of non-motorized and public transport users (Muhammad A Javid, Okamura, Nakamura, Tanaka, & Wang, 2014). In developing countries, the main reason for traffic congestion is urbanization and an increase in car ownership and its usage. Other variables that play an important role in traffic congestion are disorderly driving behaviour, absence of traffic enforcements, inadequate infrastructure, and mismanagement of existing facilities. The rapid increase in automobiles and using private vehicles make the cities auto dependent. Increased traffic congestion has not only affected travel delays and the driver’s stress level, but it is also imparting negative consequences to the environment by increasing air pollution and greenhouse gas emission (GHG). An

effectual solution for reducing automobile dependency is to encourage public transport ridership (Eluru, Chakour, & El-Geneidy, 2012).

Children's travel behaviour varies from that of adults, and the mode preferences of school children are still uncertain in developing countries. Most school going teen students are involved in making decisions about their travel mode for school, while on other side younger children's school travel modes are only decided by their parents. Therefore, school-going teen students should be taken as a key stakeholder in transport policies and study of the travel patterns for addressing transportation planning concerns (Singh & Vasudevan, 2018). Travelling to school is a regular, estimated flow of people. In Pakistan, the cities are facing severe challenges in mobility and accessibility. With vehicular traffic, roads are congested, while public transit is infrequent and unsafe. The increase in travel by private vehicles and two-wheelers is contributing to traffic congestion (HAIDER, 2013).

In Pakistan, the cities are facing severe challenges in mobility and accessibility. With vehicular traffic, roads are congested, while public transit is infrequent and unsafe. The increase in travel by private vehicles and two-wheelers is contributing to traffic congestion (HAIDER, 2013). In transportation planning mode choice of commuters plays a vital role. Adequate mode choice analysis is needed, to address to forecast demand for new transportation modes, procuring and allocating resources, minimizing traffic congestion, and assessing the travel efficiencies. Many factors affect the mode choice decision of a commuter, e.g. gender, age, income car ownership, etc (Ashalatha, Manju, & Zacharia, 2012). Thus, understanding mode choice behaviour is integral to reduce traffic congestion in the built environment.

Educational trips have different characteristics as compared to other trips like shopping, work-based, and recreation. Various studies were carried out in the Western countries to understand the traveling behaviour of school going students; the latest studies in developed countries have focused mostly on a decrease in the propensity of school children to walk and bicycle and the resulting obesity (Ewing, Schroeer, & Greene, 2004). However, in developing countries, like Pakistan, basic patterns of educational trips (school trips) are still unclear. Educational trips have been broadly studied in western European countries and North American, but limited studies are done in the South Asian context, let alone incorporating gender-based preferences (Singh & Vasudevan, 2018). Studies on gender-based travel behaviour have been conducted in developed countries, (Transportation Research Board, 2004). The importance of gender in travel behaviour cannot be ignored as the literature implies significant difference in mobility patterns of both genders (Rosenbloom, 2004). Therefore, to work out proper transportation planning, a gender perspective is imperative to understand travel behaviours, choices, and preferences. In this context, this study aims to ascertain gender-based preferences in modal choice and satisfaction with public transport, with respect to educational-based trips. For this purpose, Abbottabad city of Pakistan is used as a case study.

1.2 Justification

This study is going to analyze the educational trip data, identifying the important variables which affect mode choice, identifying important mode choices, identify transport priorities and needs of high school students, and developing models for the utility of modes.

The study attempts to develop a mode choice model for Abbottabad city for educational trips, in order to identify the factors that can influence the travel bahaviour or choices of school going children. Abbottabad is a developing city so that it is facing traffic congestion and needs to find policies for the traffic problem. Developing infrastructure is a tough job and transportation planning is a better policy.

1.3 Problem Statement

Due to the involvement of the multiple modes, and the amount and variety of traffic in urban areas transportation is highly complexed. Moreover, due to a rapid increase in urbanization that is taking place across the world has increased the number of trips in major cities. Traditionally, urban transportation has focused on travelers because cities are seen as places of extremely human interaction, including travel, commercial transactions, and recreational activities with complex modes of traffic. In definition, the urban transport channel is intricately interwoven with urban form and local infrastructure (Rodrigue, Comtois, & Slack, 2016).

In the past decade, Abbottabad has undergone significant land use changes because of expedited developments, urbanization, and educational advancements (Raza, Raja, & Raza, 2012). Because of urbanization demand for both public and private transport has been increasing. There is a need to fulfill the increase in travel demand instead of increasing the traffic congestions it is essential to escalating the use of high capacity vehicles and also encouraged the citizens to use non-motorized modes. This couldn’t be possible without knowing the needs and requirements of the travelers to use the mode. The traffic congestion problem is increasing because of

rapid urbanization and increasing economic growth, congestion problem can be reduced by adopting a suitable transport policy, which could not be done without bettering planning process of transport in Abbottabad city. In four-step planning process, one step must be significantly improved that is modal split, because it is taken as extremely crucial for projecting future growth, along with determining the factors leading to the use of any mode and switching from one mode of travel to the other.

Usually the developing countries used those models which are developed by the developed countries and these models are not appropriate and usable for developing countries because the circumstances and conditions of developed and developing countries are not similar. Therefore, developing countries need to develop their models because it will help in forecasting future demand for a rising mode of transport and in implementing effective transport policies to tackle the problem of congestion in developing countries.

1.4 Objectives of the study

Abbottabad city is experiencing fast development and it demands higher connectivity. For solving current traffic problems, the city needs to be planned. This study has the following four objectives:

1. To identify gender-based modal choices, preferences, and travel characteristics among students.
2. To determine the gender-based satisfaction level with public transport among students.

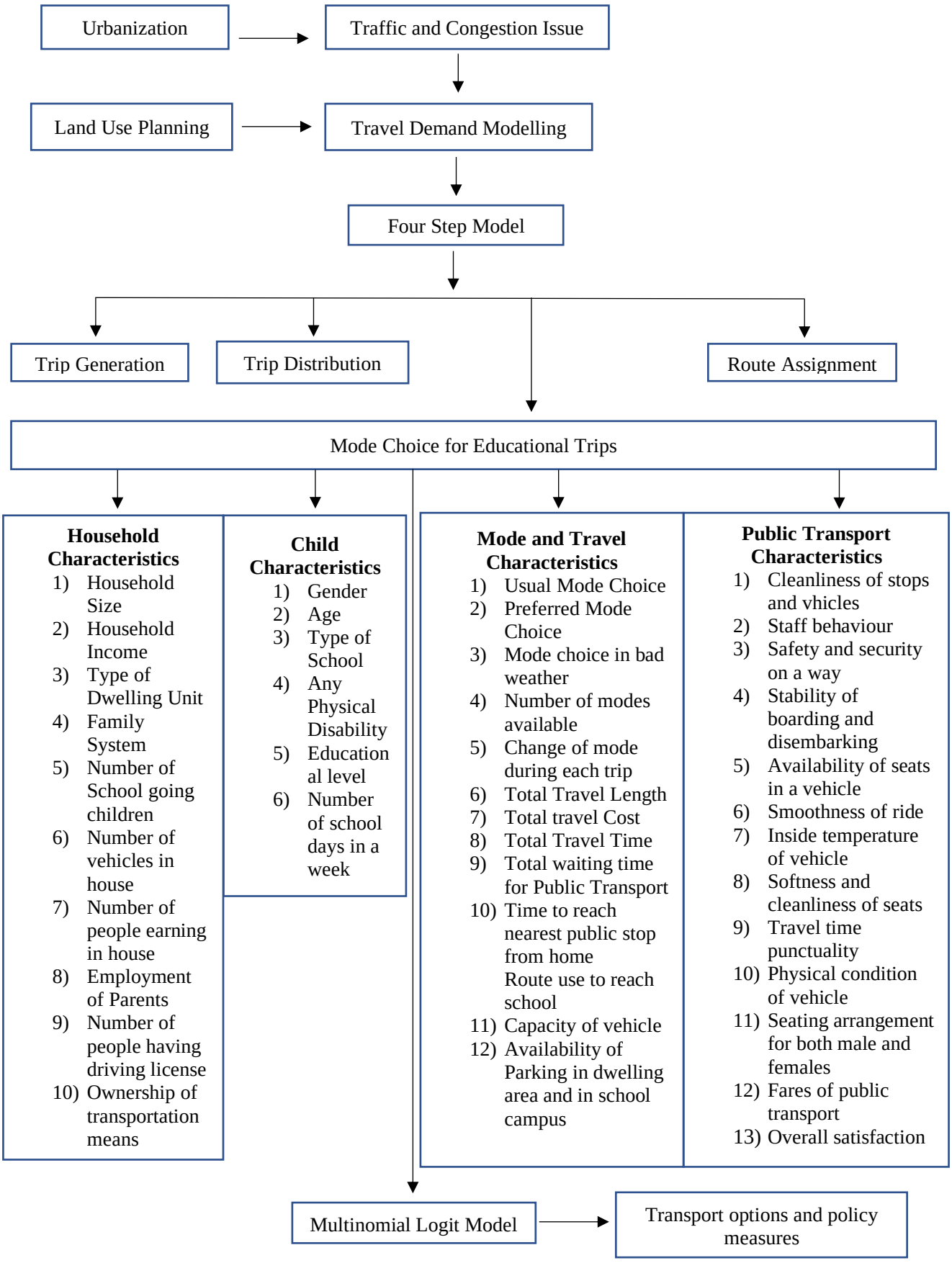
3. To develop a mode choice model for Educational trips and identify the factors that affect travelling behaviour of school-going children.
4. To recommend strategies for improving transportation alternatives for students.

1.5 Scope of the study

The primary purpose of this study is to be identifying the factors affecting mode choice behaviour of school-going children and their satisfaction level with public transport.

This study is only limited to the educational trips that are: home-based school trips. These types of trips cause congestion at peak hours. The study does not consider any other trips for example work-based, shopping, or recreational trips. The data collected during the household survey has been limited to children of middle, secondary, and high secondary schools. Primary school and University going students were not considered in this study. This study considered household characteristics, child characteristics, mode and travel characteristics, and psychological variables.

1.6 Conceptual Framework



1.7 Summary of the Chapter

This chapter explains transportation modelling and its significance in transportation planning. As the number of motor vehicle increases in urban areas causes the environmental and the heavy traffic issues that result in interrupted traffic conditions such as delays, accidents, etc., which trigger significant economic losses. In order to reduce such declining transportation conditions, research has been carried out different studies that help to comprehend the relationship between travel modes and various variables influencing it. This study considers school trips only and these types of trips cause congestion at peak hours and focuses on the socio-economic variables, travel characteristics, and psychological variables.

Chapter 2

LITERATURE REVIEW

2.1 Background

Numerous studies were performed under transportation planning and specifically on mode choice behaviour, multi-model integration, Intra-city level characteristics, and attitudinal behaviour. Understanding the behaviour of mode choice is important; the interconnectivity and complexity of mode choice behaviour are the backbones of mode choice modelling. The study on the integration of multi-modes helps to find behaviour of modes and its interconnectivity. Attitudinal behaviour of travelers is one of the important elements of modelling and helps to identify the decision making by the traveler. Attitudes to modes are related to the dominance of modes.

2.2 Travel Demand Modelling

Travel forecast models have been used to forecast changes in travel patterns and the use of transport system in reaction to shifts in dynamics, regional growth, and transport availability. Modeling travel demand is a demanding challenge, but one that is needed for sound planning and management of transportation systems (Kadiyali, 2013).

A Travel Demand Forecasting (TDF) model is a computer program that imitates traffic levels and travel patterns for a specific geographical area. The program contains import files that summarize the land use of the area, street networks, travel features, and other important factors.

While using this data, the model undergoes a series of calculations to calculate the number of trips generated, the location of each trip starting and ending, and the route

the trip has taken. The model's output includes projections of traffic volumes on main highways, and peak hour turning movements at certain key intersections (PEERS, 2011).

The TDF model can be used for several purposes in conjunction with the planning and design of the City's transport network. A partial list of the possible uses of the TDF model is as follows:

- To update the elements of land use and mobility in the General Plan
- To carry out a city-wide traffic impact fee program
- To evaluate the effect of area-wide land use policies on traffic alternatives
- To measure traffic changes due to road improvements
- To determine the effect of land use plan on traffic
- To evaluate trip distribution patterns of huge land development proposals (PEERS, 2011)

2.3 The Four-Step Model

Following are the steps in the four-step model:

1. Trip Generation
2. Trip Distribution
3. Mode choice
4. Route Assignment

People who travel for separate purposes have different behaviours, the four-step model divide trips by trip purpose. The description of trip purposes, in the model depend upon the type of information that the model requires to provide for planning research, the region's characteristics being modeled, and the data availability to get

model parameters and model's input. In most models following are the trip purposes: home-based nonwork, home-based work, and non-home based.

The objective of **trip generation** is to calculate the number of trips of each category starting or ending in each area. Based on the number of activities in a field of analysis. In some models, trips are combined with a particular geographic unit (for example, a traffic analysis area). Travel generation models contain several explanatory factors in relation to travel making, and also some features that calculate the number of trips depending on such explanatory factors. Traditional variables included the percentage of households categorized by characteristics, such as number of individuals, employees, vehicle availability, income level, and type of specific employment opportunities. The result of travel generation is the production and attraction of travel by area and reasons of traffic analysis

Trip distribution tackles with the question of how many trips travel between geographic units (for example; areas for traffic analysis). As an impact, it connects travel products and attractions from the travel generation stage. The distribution of trip requires a dependent variable in relation to the cost (including time) of travel between areas, as well as the ratio of travel to both the area of origin and the destination. The results of the trip distribution are according to the tables of travel motives for the withdrawal of production.

Modal choice is the third phase in four-step process. Definitions of the mode differs based upon type of transport options available in the model's geographic area. and the types of planning analysis required, but can usually be grouped into transportation, motor, and non-motorized modes. Transit modalities can also be

described by means of access, such as walking, vehicle or type of service, for example express bus, local bus, railway, heavy rail, passenger rail, etc. Non-motorized modalities that have not yet been included with certain models, especially in smaller or medium-sized cities, include cycling and hiking. Almost always, automatic modes are described by usage levels (car, joint ride with two people, etc.). The results of the mode selection process include the travel and fashion person travel maps and the automatic vehicle travel maps. Daily routes are divided by the day modelling into different periods, such as rush hour mornings and evenings, between day and evening. The segment between travel generation and trip scheduling can occur at any stage.

In four step modelling process, **trip assignment** is the last step. This phase comprises separate processes for road and transit assignments (Systematics, 2012).

2.4 Types of Mode Choice Models

Mode choice models basically consist of two types, namely aggregate and disaggregate approach. Disaggregate approach, also known as discrete approach. It depends on the option taken by an individual passenger, and generally considers the person individually in model mode selection (Nisarg Desai, 2018). Generally, aggregate models are being used to select individual traveler behaviour; however, aggregate models have had the drawback of predicting and calculating the option of travel with the aggregated zone area (Almasri & Alraee, 2013).

Disaggregated models of behavioural demand that became common during the 1980s provide significant advantages over aggregate counterparts. Disaggregated behavioural models are based on individual travelers' observed choices behaviour.

Such models were of the opinion that the demand is the product of several individual traveler decisions. The approach used to evaluate and forecast the traveler's choices is a discrete choice analysis. Computational models that calculate the likelihood of individual travel choices depend on the theory of maximisation of utility or relative attractiveness of competing substitutes identified and reported survey preferences data containing data sets of individual choices, features and alternative travel choices are the discrete choice model. (Almasri & Alraee, 2013).

The disaggregate approach has many key benefits over the aggregate approach to modelling the decision-making behaviour of a group of individuals (Ben-Akiva, Lerman, & Lerman, 1985). There are several disaggregate mode choice models. For Example; Multinomial Logit, Multinomial Probit, Nested Logit, Mixed Logit, Generalized Extreme Value, etc. Among these types of models, the logistic regression model is the most commonly used for mode choice modelling. Model Formation of the Multinomial logit model is simple and accurate as compared to other models (Almasri & Alraee, 2013). This research uses the Multinomial Logit Model because of its efficiency, simplicity, and accuracy.

2.5 Mode Choice Modeling

In four step modelling, it is the third step. Several cities have been affected by a gradual increase in traffic congestion contributing to frustration among commuters, loss of productivity, longer travel times, higher injuries and automobile insurance premiums, higher fuel usage, higher freight costs, and a decline of air quality. Understanding of such grave repercussions of congestion, urban areas are analyzing and implementing Transportation System Management (TSM) policies. Mode

selection modals for the urban areas are used to examine the efficacy of Transportation Congestion Management policies in switching solitary-occupancy vehicle (SOV) passengers to high-occupancy vehicle (HOV) modes (Lawton, 1989).

(Ben-Akiva et al., 1985) described the mode choice model as a model that represents the choices of consumers when providing alternative modal choices. Such decisions must be made in accordance with the circumstances in which the different modes of travel are offered, including travel time, costs and other quality characteristics of the alternative modes of travel,

in addition to relevant socio-economic and land use characteristics.Transport modes cover the private automobile, public transport (including bus, light rail, tram, metro, shared taxi, and taxi), Walking and cycling, and they can also include air, sea, and freight transport at the other end of the scale.

The size of the defined choice set facilitates selecting an acceptable mode choice model to predict the study area's travel behaviour. Depending on the number of transportation options, a mode choice model is categorized into two different models that are; binary and multinomial models; Binary mode choice model only used when a traveler has two alternative traveling modes. Contrary to this, a binary modal can be implemented in multinomial modes. Conversely, MNL models could be chosen for larger choice sets.

2.6 Discrete choice model

Models that usually represent the travel behavior of individuals when they are equipped with a particular set of travel alternatives are generally referred to as discrete choice models.

However, according to the study of (Koppelman & Bhat, 2006) Discrete models are helpful to evaluate and predict a commuter's preference for a limited range of mutually exclusive and inclusive alternatives. Since multiple behavioral responses are specific in nature or contextual, these models have different applications; that is, they agree with the choice of several groups of alternatives. A person is visualized by choosing a way that maximizes its usefulness (Ben-Akiva et al., 1985). Travel mode utility is characterized as an attraction associated with choosing the maximum attraction mode due to various features such as vehicle travel time, waiting time, exchange time, travel costs, parking fees, etc. (Willumsen, 2001).

There are numerous types of mode choice model (e.g., Probit or logit or general extreme value), but the logit models are by far the most common one, the key reasons for choosing these models are their simplicity and accurecy. In mathematical structure and numerical estimation, other models of mode choice such as Probit and general extreme value models are costing more and are more complex. The logit models, therefore, tend to predominate in the transport modeling field (Khan, 2007).

2.7 Logit Models

Logit models are the most widely used models in the field of transport planning, as they can manage the complex travel behaviour of any population using a simple mathematical system of logit models based on the principle of utility maximization theory, which implies that the choice of an individual calculated from the indirect services of each alternative and the person. Logistic regression models have been found to accompany the most specific modeling framework of all modal choice models, even though they are based on the Independence of Irrelevent Alternatives (IIA) feature, meaning that all modes of travel used in the group of choices are

unique. However, this condition is relaxed by using a tree structure that combines the ways connected in a nest (Ben-Akiva et al., 1985).

The logit model is composed of two types; (a) binary logit model (b) multinomial logit model (MNL). The binary logit model is only able to model the two discrete choices, that is the person only has two possible selection alternatives, in contrast, the multinomial logit model can model more than two discrete choices. The MNL is commonly used in the context of several transport-related choices. The multinomial logit model is especially appealing in many modeling scenarios relative to the other option models as it is related to decision-making actions by maximizing (or minimizing) utility (Li, 2011). MNL models are classified into simple, nested logit models based on the characteristic of the traveling alternatives available in the set of choices. Simple MNL presume all alternatives are independent and should be evaluated separately.

2.8 Multinomial Logit Model

A multinomial logit model (MNL) is commonly used to analyze the relationship between polytomous variables (dependent variable) and a set of regressor or independent variables (So & Kuhfeld, 1995). In the multinomial logit model, travelers are believed to have somewhat non-observable, latent choices or utilities for different modes of transport, and they use a mode that provides a higher utility level (Schwanen & Mokhtarian, 2005). The model provides the best possible solution to the problem of multiclass pattern recognition; it is a common and convenient way to analyze the potential impact of explanatory variables on the dependent variable category (Hussain, Mohammed, Salman, Rahmat, & Borhan,

2006). The model can also deal with both categorical and continuous variables, and this model is widely used in mode choice researches with respect to travel behaviour (Li & Zhao, 2015) (Du & Cheng, 2018). Low technical threshold, simplicity, easy implementation, generality, and robustness are few of its benefits. Other than that, the model is specified for its low sample requirements, low error rate, and mature technology.

This study adopts the Multinomial Logit model to thoroughly identifies multiple explanatory variables and factor levels are more rationally explored (Can, De, Wei, & Shan, 2015). The utility of a school going child (n), choosing travel mode (i) is given as:

$$U_{in} = V_{in} + \varepsilon_{in}$$

$$V_{in} = \beta_1 X_{in}^1 + \beta_2 X_{in}^2 + \cdots + \beta_k X_{in}^k$$ (Du, Cheng, Li, & Yang, 2020)

where ε_{in} is a random term, V_{in} is related to household, child, and travel characteristics. It is assumed that for the above variables, $X_{in}^k$is a linear function and β_k is the parameter determined by the maximum likelihood method. The probability of a school going child (n), selecting travel mode (i), is given as:

$$P_{in} = \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}}$$

Where,

P_{in} = probability of child selects mode "n"

Cn = set of all available alternatives including walk, bicycle, family car, private school van, school bus, and public transport.

V_{in} = utility of selected mode "n" and

V_{jn} = utility of all available alternative modes.

2.9 Factors Affecting Mode Choice Modeling

Earlier studies had clearly shown that socio-demographics of both individuals and households have a significant effect on choices of travel mode. In particular, gender, income, employment status, and car ownership affect decisions on the mode of travel (Bhat & Sardesai, 2006). Nevertheless, it may not be true for all, it has been suggested that there will be others who would be willing to pay this cost, in reality finding a measure of pleasure and usefulness in the act of travel (Whalen, Páez, & Carrasco, 2013). The public transport system is high passenger occupancy vehicles, typically given in the form of fares by government and other governmental and non-governmental entities at the expense of the users. In some countries, however, the private enterprise provides the services of public transport.

For the following reasons, the formal public transport network is considered significant (Aworemi, Salami, Adewoye, & Ilori, 2007):

1. The increase in private car usage seems to exacerbate congestion costs and environmental hazards.
2. The energy costs are unacceptable socially and politically.
3. Because of age, disability, or deprivation, a significant proportion of the population that never own private cars, and thus public transport needs to be provided for them.

Differences between socio-economic factors of identical groups of individuals is generally overlooked in practical modeling research (Willumsen, 2001). Even though this approach makes the entire process generally simple, there is a possibility that large differences between different groups of people may occur. This can be achieved by dividing the whole group of individuals into different utility functions

for each similar group of individuals, so that individual features of the utility function are removed (Kilburn & Klerman, 1990).

2.10 Case Studies on Mode Choice Modelling

(Ghareib, 1996) have compared the Probit and logit models. The Database is the socio-economic characteristics, mode choice, and trip-related variables (like purpose, length, time, cost, etc) of each person. Checking a single co-efficient estimate, outlier prediction test, the goodness of fit measure, and market segment prediction test are used for the evaluation for cities. The calibration of the model has been conducted by using the GLIM software package. Both binary and Probit models have the same mathematical effort. For the mode selection, income has an important role.

(Jang, 2003) is related to simple and complex travel patterns to travel modes. The study concept is that data of household attributes and activity data can be accumulated which are interconnected which helps picture travel patterns. The automobile transit and non-automobile transit are compared, and the three-stage least square method and covariance structure model are used. The study surmised that men prefer automobiles and female prefer public transit, and the majority prefers public transit and walking.

(Lo, Yip, & Wan, 2004) formed State-Augmented Multi-model (SAM) network, framing nested structure of SAM network and doing a case study. Nested logic is made by considering the combined-mode choice, route choice, and transfer mode choice. He discussed combine mode trips with transfers and mode segment overlaps.

(Srinivasan & Rogers, 2005) identified the itinerary of poor residents of two different areas in the city of Chennai, India. The main focus of this study is to analyze the relationship between travel behaviour and urban form. The study examines changes in travel patterns due to changes in access and availability of work and services between two different settlements. The results show that accessibility in terms of travel behavior was strongly influenced. Most of the residents that are settled in the central area of the city used non-motorized modes for travel e.g. walking and cycling. However, residents that are settled in the peripheries of the city mostly used motorized modes. They suggested that the policymakers of developing countries during the planning process should consider the location of employment of low-income households.

(Gebeyehu & Takano, 2007) analyzed the modalities of residents' choice of modes and bus status in Addis Ababa, Ethiopia. The main public transport in the city are buses and taxis. Due to the lack of mass transit in the city, the current public transport quality is very poor because of poor management, unethical staff behaviour, and a limited number of seats. A logit model was conducted to analyze the resident's perception of public transport. The result revealed that fare, bus condition, frequency, and convenience have a significant effect on residents in selecting public transport as their mode choice.

(Beirão & Cabral, 2007) evaluated comfort across different genders and age groups of users. They regarded comfort in terms of comfortable and clean seats, pleasant temperatures, a small number of passengers on board, smoothness and ride quality, low vibrations, and noise levels. Meanwhile, comfort at stops means having proper shelters and benches, special facilities for persons with disabilities, facility of

vending machines, proper lighting, information board, trash receptacles, phone booths, etc.

(McDonald, 2008) identified Whether the duration of the journey, person and household characteristics affect the choice of walking towards school. They get the data from NHTS, and the variables used in this study were Age, Income, Walk travel time, Trip Distance, Number of Siblings, Auto Travel time, Residential Density. For analysis, this study used the Multinomial Logit approach (SPSS).

(Beirão & Cabral, 2007) evaluated comfort across different genders and age groups of users. They regarded comfort in terms of comfortable and clean seats, pleasant temperatures, a small number of passengers on board, ride quality, low vibrations, and noise levels. Meanwhile, comfort at stops means having proper shelters and benches, special facilities for persons with disabilities, facility of vending machines, proper lighting, information board, trash receptacles, phone booths, etc.

(Müller, Tscharaktschiew, & Haase, 2008) Analyzed the negative impact of school closures on the choice of travel mode by using a multinomial logit approach. This study conducted a student survey and taken a sample of 4700. The results from the analysis showed travel distance, availability of a car at home, and weather were the most influential factors that affect the travel behaviour of children.

(ZHANG, FUJIWARA, & THEIN, 2008) attempted to analyze the mode choice behaviour and they get the data from the stated preference survey. In Yangan, four different transportation modes are available (private car, taxi, bus, and rail). In developing countries, socio-economic conditions, especially the income of people are changing rapidly, and thus, the effect of such a decision context must therefore

be expressed in both the survey approach and the modeling process. The first research study was designed and conducted to include the impact of future income and other service characteristics, and an RP study was also developed. Evaluating the SP Model, The RP / SP mode option that moves after the reliability of the SP data has been tested is defined as time and cost parameters according to future revenue performance. The effectiveness of the proposed model structure was proven. Personal analysis also indicates that future income will increase significantly in car ownership and consequently lead to a decrease in transportation systems.

(Zhou, 2012) analyzed factors influencing university going student's mode choice in a car-dominated city. Descriptive analysis is done and based on mode choice, multimodal behaviour, travel time, and the multimodal logit model is used. The paper highlighted using the study on universities as it predicts future generation behaviour and useful for reshaping.

(Ashalatha et al., 2012) discussed various factors about the selection of mode in the city of Thiruvanthpuram. As a study of the Thiruvananthapuram city, this has more important. The multinomial logit model is used. Factors considering for the study are mode of conveyance (Bus, Two-wheelers, car), age group, gender, monthly income, travel length, vehicle ownership, the distance by time, and distance by cost. That are variables like socioeconomic variables, transport system variables, and attitudinal variables are discussed. MNL analysis revealed that the people who own both two-wheeler and car mostly prefer cars for longer distances and two-wheeler for shorter. Age, gender, and income have a massive role in the mode of choice. The study concluded that as the age of the commuter people prefer cars than a two-

wheeler. In this paper, Modelling is helping to make policies in order to improve and to make the public transportation system more efficient.

(Tushara, Rajalakshmi, & Bino, 2013) study considered different categories of work trips as Government, private, and self. The data was collected from interviews and random sampling methods are followed. The multinomial logit method was used. The preliminary analysis was done and identified the different characteristics. Travel modes consider are car, two-wheeler, bus, auto, and car and the most influenced mode on the Calicut city is two-wheeler. Male commuters are dominant in the usage of total modes as well as a two-wheeler. In this study, the major concern is how usage of the employee mode would change as they grow older. That is why, age has been selected as an explanatory variable. Software SPSS 16.0 is used which is common in the development of models. Model fit is checked by pseudo R-square. The prediction of the prepared sample is 86% and validated successfully. The study is concluded that work trips can be used to identify the characteristics that influence travel behaviour of employees.

(Almasri & Alraee, 2013) studied factors influencing work trips mode selection choice in Gaza city. Improper transport sector planning in urban areas of developing cities, like Gaza, leads to a deficiency in the adoption of appropriate transport policies to significantly reduce the traffic issues caused by rapid urban development. This study aims to establish a model of choice for work trips in the city of Gaza and thus to find out the factors that influence the selection of transport modes of employed people. 552 questionnaires were used for the formation of model. Total travel time, total travel expense, employment, age, car ownership, distance, and

average household income are variables that significantly influence the choice of modes of transportation. The model developed can be used to predict employees' choice behaviour in Gaza City and is accurate at a confidence level of 95 percent. This research is useful for predicting the behaviour of the working people and for forecasting analysis of travel demand. The model developed is useful for predicting the future.

(Whalen et al., 2013) investigated travel behaviour of university-going students and identified the significant factors that affected their travel behaviour and mode of choice. The study indicated that mode selection is influenced by individual factors, environmental, and travelling costs. A major finding of this study was that travel time by bicycle and car positively affected the utilities of these two modes.

(Ponrahono, Bachok, Ibrahim, & Osman, 2016) studied factors influenced passenger's satisfaction level from urban and rural areas of Malaysia. The result showed that trip and socio-economic factors influenced the satisfaction level of commuters.

(Yadav, Rokade, & Jaiswal, 2017) determined the variables affect mode choice behaviour in Hyderabad, a metropolitan city. For the analysis, a 10 km stretch from Bachupally to Mallampet in Telangana state city of Hyderabad, was considered. Socio-economic data were gethered using sample-based home interview survey. When generating the model, factors such as age, employment, travel time and travel expenses are taken into account. The findings suggest that, in contrast to all other modes of transport, the affinity for public transport is greater. Increase in travel time

and costs to increase travel in operating costs, which is the main reason for switching from personal to public transport.

(Adeel, Yeh, & Zhang, 2017) examined gender differences in daily trip rates in Pakistan. Results from the analysis shows significant differences between male and female travel patterns. Women were less mobile as compared to men. On average, females make 50 percent fewer trips as compared to males and have 46 percent shorter travel times. The result indicates that demographic indicators oppositely affect gender mobility. For example, age, marital status, and household income significantly decrease women's mobility.

(Desai, Amin, & Zala, 2018) identified the behaviour of commuters to select the travel mode and the factors influencing their mode choice. This study also reviews the preference survey for trip modes and prepared a Multinomial Logit model for different modes of transport. A household survey was conducted, and the sample size was 388. Trip time range, trip cost range, trip distance, trip purpose were the variables that were used in this study.

(Ng & Acker, 2018) examined travel behaviour by gender in three different continents for this selected eight different cities. This study focused on mode choice, trip purpose, departure time, and travel distance in Auckland, Hanoi, Jakarta, Helsinki, Kuala Lumpur, Dublin, Manila, and Lisbon. The result shows that the following are the common trends found between cities; females travelled shorter distances, prefer public transports and taxi services to cars as compared to their counterparts.

The student's travel decisions in the Indian context were explored by **(Singh & Vasudevan, 2018)** Primary data was collected from the city of Kanpur, India. MNL

regression was performed to model the choice of school travel modes. To model the selection of school travel modes, MNL regression was performed. The findings imply that the absence of a public transport system and the shortage of better-quality bus survives for schools culminated in the reliance on other means, including domestic cars and paratransit for school children. In addition, the lack of adequate infrastructure adversely affected use of active means of transport.

(Sze-Siong & Aksan, 2018) investigated the users' perception with mass rapid transport and satisfaction was measured on the bases of gender and different trip purposes. The findings of the study revealed that there were significant differences in the level of satisfaction among commuters for different purposes of travel, but interestingly, no significant difference in the level of satisfaction among genders was observed.

(Scheiner, Huber, & Lohmüller, 2019) studied mode choice behaviour of primary school children and developed a model by using multinomial logit regression. The model was included sociodemographic characteristics, child characteristics, parental concerns, perceptions and attitudes, parents' mode use, travel distance, and the built environment and transport system. Results of the study found that gender, age, trip distance, parental concerns, perceptions, and attitude affected the mode choice of school-going children.

(Meena, Patil, & Mondal, 2019) developed a mode selection model for shopping trips in Mumbai, India, and determined factors influencing shopping activity using nested and multinomial logit approach. The findings indicated that travel time plays significant role in selection the mode for shopping trips. While the use of public

transport is primarily affected by walking time and access time. Factors such as the number of accompanying persons and the possession of a driving license also have a major impact on the usage of private modes. Socio-demographic factors such as age, sex, and occupation were also found significant.

(Du et al., 2020) studied the travel characteristics of elderly citizens in Fuzhou city, China, and investigated factors affecting mode selection of elderly citizens for healthcare activity in core and suburban areas. The results from the multinomial model and descriptive analysis show that the majority of the elderly citizens use bus and walking as a traveling mode. Elderly people from suburban areas have to travel long distances so they are more reliant on the bus as compared to those in the core area. The influence of household economic status on mode choice was found to be a significant factor in suburban areas.

2.11 Gap in Literature

There are many studies on mode choice modelling. Pakistani cities are developing cities. Most of them are not planned. A study of Abbottabad city shows the same characteristics of these cities. There are no research works for these developing cities. As an emerging city; Abbottabad is facing a lot of transportation problems. This study can analyze traffic problems facing the city. The city has traffic congestion, even though the city is having higher connectivity, so it demands a mode choice modelling study of the city.

2.12 Summary of the Chapter

Travel forecasting models are used to forecast changes in the patterns of travel and transport systems used in reaction to variations in regional growth, dynamics, and

availability of transportation. "Four-step model" consists of the following four steps: the first one is the generation of trips, the second step is the distribution of trips, the third step is the choice of mode and the last step is the assignment of routes. The modal split models consist essentially of two forms, namely aggregate and disaggregate approach. The disaggregated approach is also called the discrete approach. There are several disaggregate mode choice models. The Multinomial and Nested Logit, Nested logit Mixed Logit, and Generalized Extreme Value are examples of such models. Among all these models, MNL is used in this study since it is commonly used, simple and accurate model as noted in the literature. Modelling case studies have also been discussed in this chapter that shows most of the research studies use Multinomial Logit model and very few use other logit of probit models. Most of the studies have been conducted on shopping and work base trips, and very few on school or educational trips. Combined results show that mostly travellers relies on who wheeler or family cars and badly decline in public transit and active transport means. The concept of walking declined badly throughout the world.

Chapter 3

METHODOLOGY

3.1 Research Design

The research aims to seek a suitable model for educational trips to forecast future travel demand and also to identify essential characteristics. Its purpose is to identify factors contributing to the choice of a specific city mode. The research is limited to pure educational trips. MNL (Multinomial Logit) modeling was applied in this study because of its ability to estimate the mode shares where a commuter has more than two choices of travel modes available.

3.1.1 Research on Topic and Literature Review

Numerous studies were conducted under transport planning and preferentially on mode selection behaviour, multi-modal integration, intra-city level characteristics, and attitudinal behaviour.

3.1.2 Study Area

Abbottabad has undergone intense land use changes over the last couple of years due to rapid development, urbanization, and advances in education (Auriba Raza, 2011). The city of Abbottabad is one of the developing cities. It has become one of the country's worst cities known for constant traffic jams stretching for hours. After the earthquake of 2005 demographic trends of Abbottabad changed significantly due to the increase of migrants who shifted from surrounding areas of the city, The demographic changes multiplied, which is why an increase in the local population and vehicular traffic (Rashid, 2016). The city is facing traffic congestion and needs

to find policies for the traffic problem. Developing infrastructure is a tough job and transportation planning is a better policy.

Abbottabad City is a part of Khyber Pakhtunkhwa's province and is also the capital of the Abbottabad District. Islamabad, Rawalpindi, and Peshawar are nearly equidistant from the city. It is a mountain range with beautiful weather, high-standard educational institutions and is widely known because of the Kakul-Military Academy Pakistan. Major James Abbott founded the city in 1853, and the town was named after its founder. Abbottabad is considered to be home to well-educated people and has Pakistan's highest literacy rate. Hindko, which is close to Punjabi along with Urdu and Pashto, is the main language spoken by around 95 percent of the population. The city is revamping gradually.

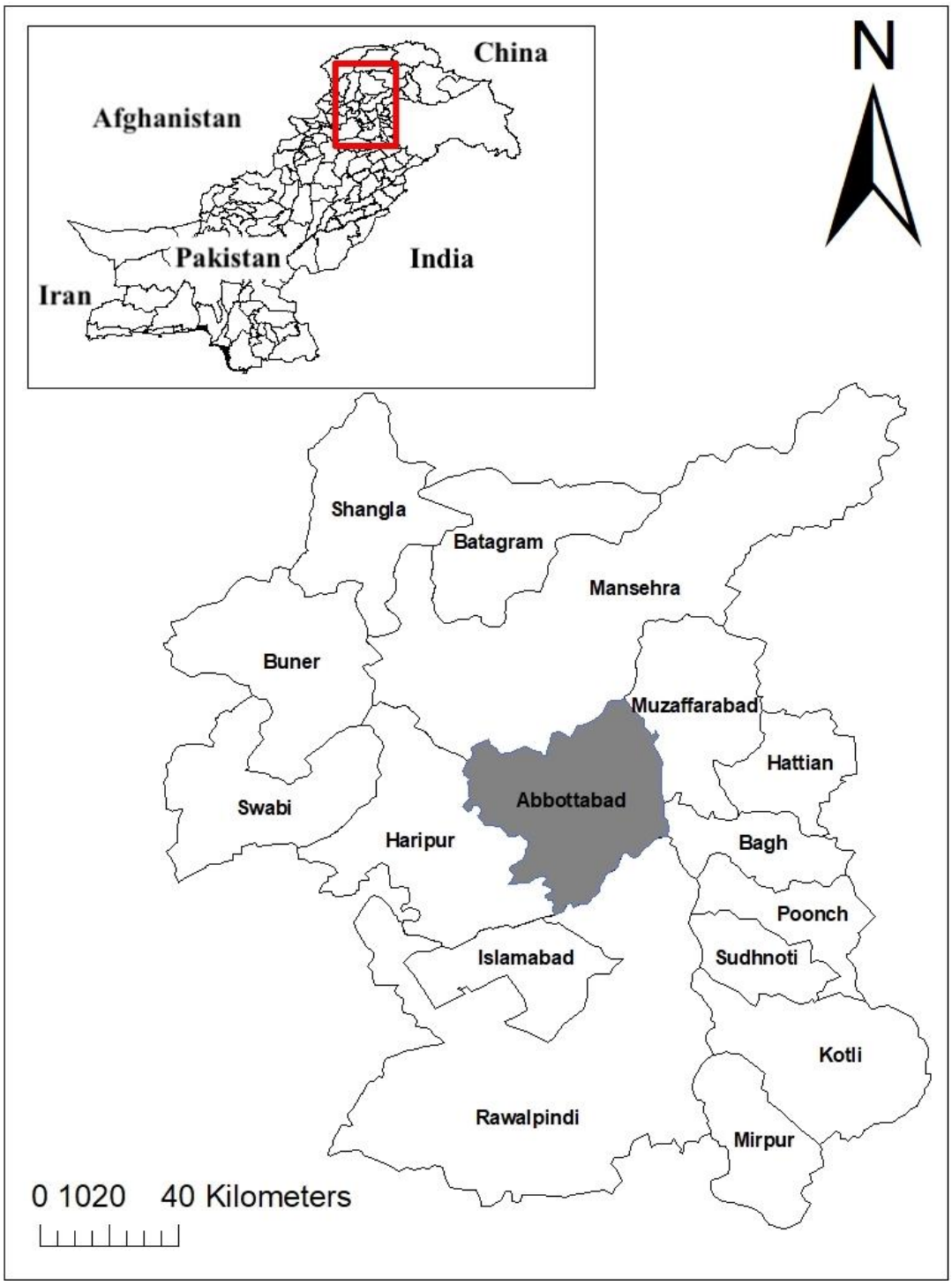


Figure 3.3.1 Study Area

Abbottabad is an educational city and is also known as the city of schools. Students from suburban areas and surrounding cities visit Abbottabad for education that

causes congestion in peak hours because the city is being served by a single arterial road and the traffic from the surrounding cities passes through Abbottabad. That is why. it is required to analyze the travel patterns and travel behaviour of school-going children as the study would also prove helpful for the other cities that face traffic congestion due to educational trips in Pakistan.

3.1.3 Designing Survey Sample

A large sample size generally leads to increase precision when estimating unknown parameters, but it would be too expensive and a waste of time and effort, where a smaller sample size would save time and effort over accuracy. Therefore, between these two extremes lies the most efficient sample size for the given study objective. By using Slovin's formula, sample size was calculated (Slovin, 1960).

Slovin's formula

$$n = \frac{N}{1+Ne^2}$$

where,

n = sample size

N: = size of the population

E = error margin

According to the census of 2017, the total population of Abbottabad city was 208,491 and the household size was 161445. With a 95% confidence level the Slovin's formula gave the sample size of 400.

3.1.4 Data Collection

For a study on the mode choice behaviour of commuters, it should review through the relevant characteristics of traffic as well as commuters. Good data collection is required to create a better model. The model provides better results as data increases. This study contains Primary data. Data collection was carried out using a questionnaire through a face to face interview survey including two stages. Pilot survey was a first stage, that was carried out in order to improve the questionnaire's clarity, content, and validity. The questionnaires have been distributed to 22 households at this stage. During the second stage of the survey a final standard form of the questionnaire has been used, after receiving their inputs. The available household survey contains data on Household characteristics, Child Characteristics, Mode and travel characteristics, and psychological variables. 12 different areas were selected for the household survey which covers almost the entire city area. The following areas have been selected for the household survey:

1. Malikpura,
2. Kunj Kehal,
3. Iqbal Road Supply
4. Bilal Town Supply
5. Jhangi Syedan
6. Mandian
7. Sir Syed Colony
8. Mirpur
9. Murree Road
10. Nawanshehr
11. PMA (Pakistan Military Academy) Colony
12. Qalandrabad

According to the sample size, 412 questionnaires have been filled. 42 questionnaires were not filled due to the reluctance of the families to answer the questions. Therefore, the data of 370 questionnaires have been used for further analysis.

3.1.5 Data Analysis and Techniques

In order to achieve the objective of the study, different statistical tests were applied. For finding gender differences between mode choice, travel characteristics, and satisfaction level regarding public transport following statistical tests were applied by using SPSS: Chi-square test, Paired and independent sample t test.

In view of this, MNL model was applied. MNL is the discrete choice model that is the simplest and most common in action. The closed aspect of the MNL is to predict, interpret, and use (the highest likelihood estimation procedure).

3.2 List of Indicators

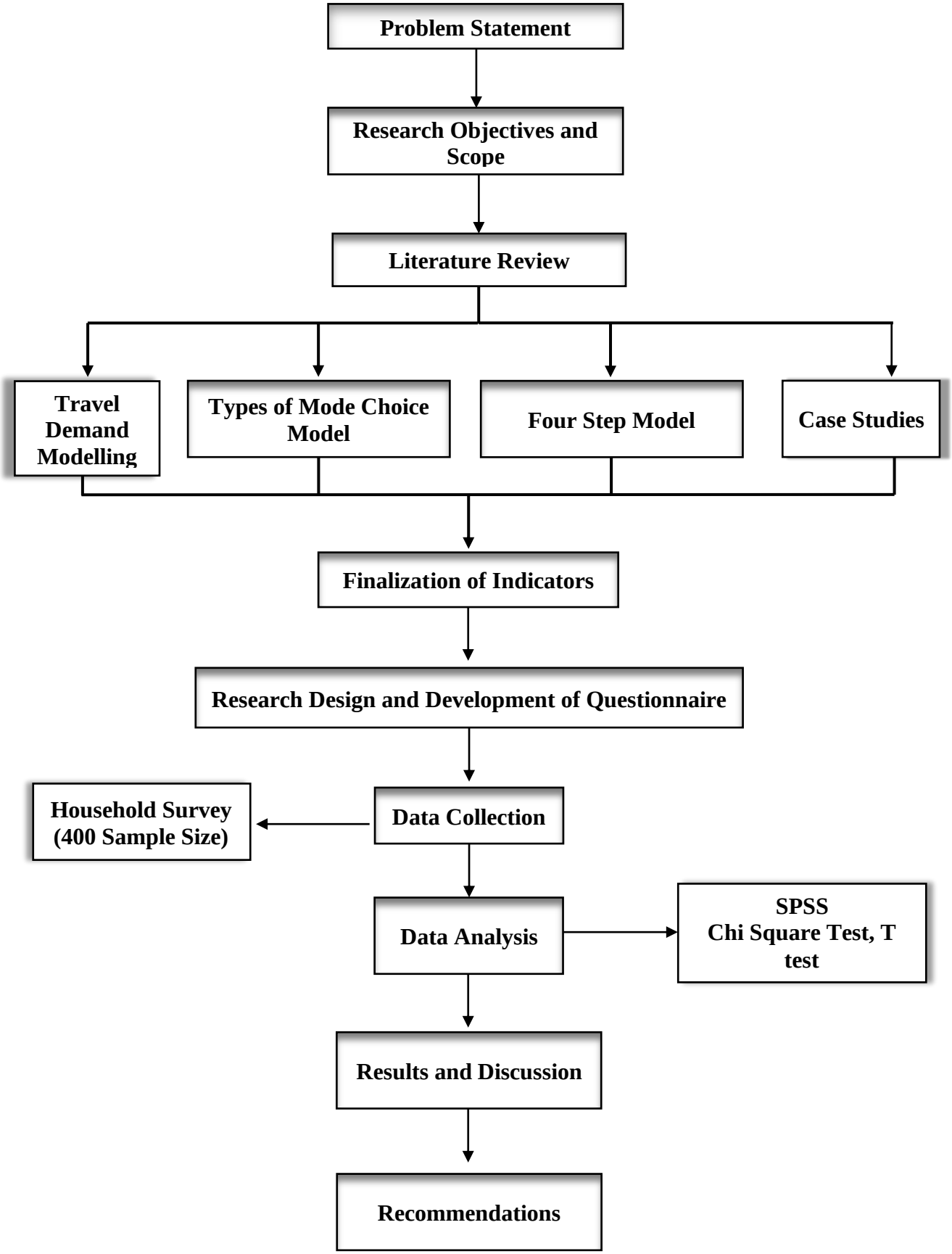
Sr. No	Indicators	Unit	References
Household Characteristics			
1	Household Size	Numeric	
2	Household Income	<=50000 50001 – 100000 100001 – 150000 150001 – 200000 200001 – 250000 250002+	(Kedia, Saw, & Katti, 2015), (Ermagun & Samimi, 2015)
3	Type of Dwelling Unit	Apartment/Independent House	
4	Family System	Single/Nuclear	
5	Number of schools going to children	Numeric	(Ding, Chen, Duan, Lu, & Cui, 2017), (Ermagun & Samimi, 2015)
6	Number of People earning	Numeric	

7	Number of Vehicles	Numeric	
8	Employment of Parents	Employed Unemployed Self-Employed Retired	(Singh & Vasudevan, 2018)
9	Number of Driving License	Yes/No	(Whalen et al., 2013)
10	Ownership of transportation means	Car Two-wheeler Bicycle No Means	(Almasri & Alraee, 2013), (SACHDEVA, 2016), (Muhammad Ashraf Javid, Okamura, Nakamura, & Wang, 2013)
Child Characteristics			
1	Gender	Male/Female	(Whalen et al., 2013) , (Müller et al., 2008), (SACHDEVA, 2016)
2	Age	= 9 10 – 12 13 – 15 16 – 18 19+	(Whalen et al., 2013), (Müller et al., 2008), (SACHDEVA, 2016)
3	Type of School	Public/Private	(Adom-Asamoah, Asare Okyere, & Senayah, 2015)
4	Any Disability	Yes/No	(Schmöcker, Quddus, Noland, & Bell, 2008)
5	Education	Middle Secondary High Secondary	(Whalen et al., 2013), (Müller et al., 2008), (SACHDEVA, 2016)
6	Number of School days in a week	5/6	
Mode and Travel Characteristics			
1	Usual Mode Choice	Walk/Cycle Motorcycle Car Carry Van Bus Suzuki Public transport Careem	(Kedia et al., 2015), (Desai et al., 2018), (Almasri & Alraee, 2013)

2	Preferred Mode Choice	Walk/Cycle Motorcycle Car Carry Van Bus Suzuki Public transport Careem	(Muhammad Ashraf Javid et al., 2013), (St-Louis, Manaugh, van Lierop, & El-Geneidy, 2014)
3	Mode Choice in a bad weather condition	Walk/Cycle Motorcycle Car Carry Van Bus Suzuki Public transport Careem	(Müller et al., 2008)
4	Number of modes available	Numeric	
5	Change of mode during each trip	Numeric	
6	Total travel length	Km	(Kedia et al., 2015), (McDonald, 2008), (Desai et al., 2018)
7	Total travel cost	Rs/Month	(SACHDEVA, 2016), (Desai et al., 2018), (Noland, Park, Von Hagen, & Chatman, 2014)
8	Total travel time	Minutes	(SACHDEVA, 2016), (Desai et al., 2018), (Noland et al., 2014)
9	Time to reach the nearest public stop	Minutes	(Miletić, Gašparović, & Carić, 2017), (Muhammad Ashraf Javid et al., 2013)
10	Total waiting time	Minutes	(Hu, Zhao, & Wang, 2015), (Weng, Di, Wang, Wang, & Mao, 2018), (Whalen et al., 2013)
11	Monthly fare	Rs	
12	Route used to reach school	String	
13	Capacity of vehicle	PAX	(Herbon & Hadas, 2015)
14	Availability of parking in the dwelling area	Yes/No	(Whalen et al., 2013)

15	Availability of parking in the school campus	Yes/No	(Whalen et al., 2013)
16	Total travel time per distance	Minutes/Km	(SACHDEVA, 2016)
17	Total travel cost per distance	Rs/Km	(SACHDEVA, 2016)
Psychological Variables			
1	Cleanliness of stops	Likert Scale (1-5)	(Hu et al., 2015) (Beirão & Cabral, 2007)
2	Staff Behaviour	Likert Scale (1-5)	(Hu et al., 2015), (Weng et al., 2018) (Muhammad Ashraf Javid et al., 2013)
3	Safety and Security on the way	Likert Scale (1-5)	(Hu et al., 2015) (Weng et al., 2018)
4	Stability of boarding and disembarking	Likert Scale (1-5)	(Hu et al., 2015)
5	Ability to find a seat in a vehicle	Likert Scale (1-5)	(Hu et al., 2015)
6	Cleanliness of Public Vehicle	Likert Scale (1-5)	(Hu et al., 2015), (Weng et al., 2018), (Anderson, Condry, Findlay, Brage-Ardao, & Li, 2013)
7	Smoothness of ride	Likert Scale (1-5)	(Hu et al., 2015)
8	Inside temperature of the vehicle	Likert Scale (1-5)	(Hu et al., 2015)(Beirão & Cabral, 2007), (Anderson et al., 2013)
9	Softness and cleanliness of seats	Likert Scale (1-5)	(Beirão & Cabral, 2007), (Muhammad Ashraf Javid et al., 2013)
10	Travel time Punctuality	Likert Scale (1-5)	(Weng et al., 2018),(Seco & Goncalves, 2007), (Muhammad Ashraf Javid et al., 2013)
11	Physical condition of the vehicle	Likert Scale (1-5)	(Muhammad Ashraf Javid et al., 2013)
12	Seating arrangement for males and females	Likert Scale (1-5)	
13	Fares of public transport	Likert Scale (1-5)	(Hu et al., 2015)
14	Overall Satisfaction	Likert Scale (1-5)	(Muhammad Ashraf Javid et al., 2013) (St-Louis et al., 2014)

3.3 Research Methodology



3.4 Summary of the Chapter

Abbottabad has undergone significant land use changes in the last decade because of rapid developments, urbanization, and educational advancements. Due to heavy traffic jams, the city has become one of the worst cities in the country. So, the city badly needs traffic policies. A household survey has been conducted. Slovin's Formula gave the sample size of 400. 412 questionnaires were filled through a household survey. The total number of discarded questionnaires was 42. The data from 370 questionnaires have been used for further analysis. In this study, for both analysis and modelling SPSS Statistics was used.

Chapter 4

STUDY AREA AND PROFILE OF THE RESPONDENTS

4.1 Study Area

Abbottabad is the capital of the Abbottabad District in the Eastern Khyber Pakhtunkhwa province of Pakistan.

4.1.1 The Landscape of District Abbottabad

District Abbottabad is located in Pakistan's Khyber Pakhtunkhwa Province (KPK) and covers an area of 1,967 sq. Kilometers. Abbottabad is surrounded by Mansehra District in the north, Rawalpindi District in the south, Muzaffarabad District in the east, and Haripur District in the west.

Abbottabad is the capital city of District Abbottabad. It is situated at 4120 feet above sea level, 101 kilometers from Rawalpindi, 217 kilometers from Peshawar, and 84 kilometers from Kohala Bridge. In b British times, Abbottabad was the headquarters of the Hazara District (later a division). The district was established in 1853 after the seizure of Punjab and Major James Abbott was the founder of this district and it was named after it. It stayed a major military cantonment and sanatorium.

4.1.2 Roads

District Abbottabad lacks a first-rate road network due to its hilly and mountainous terrain. The main towns and cities, however, are linked to metallic and rail connectivity that only exists up to Havalian and is connected to Rawalpindi (through

Taxila). According to the report of Pakistan Bureau of Statistics (2003-04), the total road network is 1443.44 km long.

4.1.3 Subdivisions

The district of Abbottabad is divided into three tehsils, Abbottabad, Havelian, and Sherwan Tehsil, as well as one urban area – Nawanshehr. The district has fifty-one Union Councils, 38 in Abbottabad tehsil, and 13 in Havelian.

4.2 Respondent Profile

In social sciences study respondent's personal profile have a very major role to play in conveying and providing the responses about certain issue, keeping this in view, this research a variety of personal attributes such as age, gender, education, family income, etc. of the 370 respondents were analyzed.

4.2.1 Gender

In any social science studies, gender is a significant variable as it is influenced by any economic or social phenomenon. Table 4.1 presents data relating to the respondents' gender.

Table 4.1 Gender of Respondents

Gender	Frequency	Percentage
Male	169	45.7
Female	201	54.3
Total	370	100.0

In terms of gender, the survey shows that female respondents were more than males, 201 (54.3 percent) consisted of females and the remaining 169 (45.7 percent) were males. The disparity between male and female respondents may be attributed to the

sampling process and females were more likely to answer surveys compared with males.

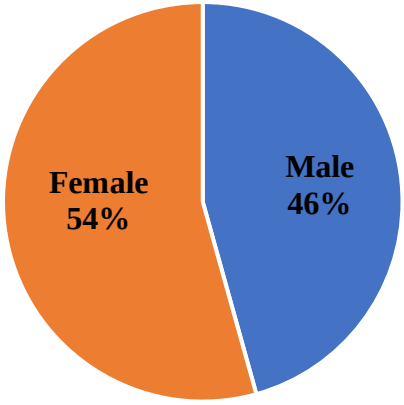


Figure 4.4.1 Distribution of Respondents by gender

4.2.2 Age

Respondents' age is the primary factor in understanding their views on specific issues; large age suggests the maturity level of individuals in that sense age has become more important to identify the response. Table 4.2 presents data relating to the respondents' gender.

Table 4.2 Age of Respondents

Age in Years	Frequency	Percentage
=9	4	1.1
10 – 12	63	17.0
13 – 15	109	29.5
16 – 18	172	46.5
19+	22	5.9
Total	370	100.0

From the table, it is evident that the majority of respondents (46.5 percent) fell between the 16-18 age group and only 5.9 percent of respondents were over 19 years.

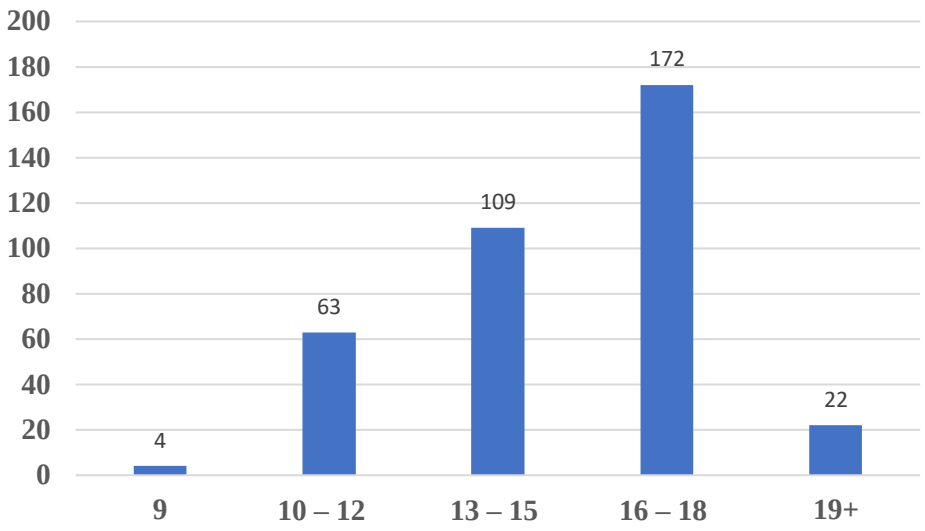


Figure 4.4.2 Distribution of Respondents by Age

4.2.3 Household Income

Household income plays a key role in forming an individual's financial conditions which, in turn, even affects children's model choices. This study, therefore, intended to examine the household income as a variable, and the data relating to the respondents' family income is presented in Table. 4.3.

Table 4.3 Household Income of Respondents

Household Income (Rs/Month)	**Frequency**	**Percentage**
< = 50000	70	18.9
50001 – 100000	152	41.1
100001 – 150000	52	14.1
150001 – 200000	54	14.6
200001 – 250001	13	3.5
250001 +	29	7.8
Total	370	100.0

From Table 4.3 it can be discerned that the majority (41.1 percent) of the respondents stated their monthly household income between 50001 – 100000. While 19 percent had a monthly household, income up to 50000. Only 8 percent of the respondents had their monthly household income above 250000. The data discern that the respondents largely hail from the middle-income group.

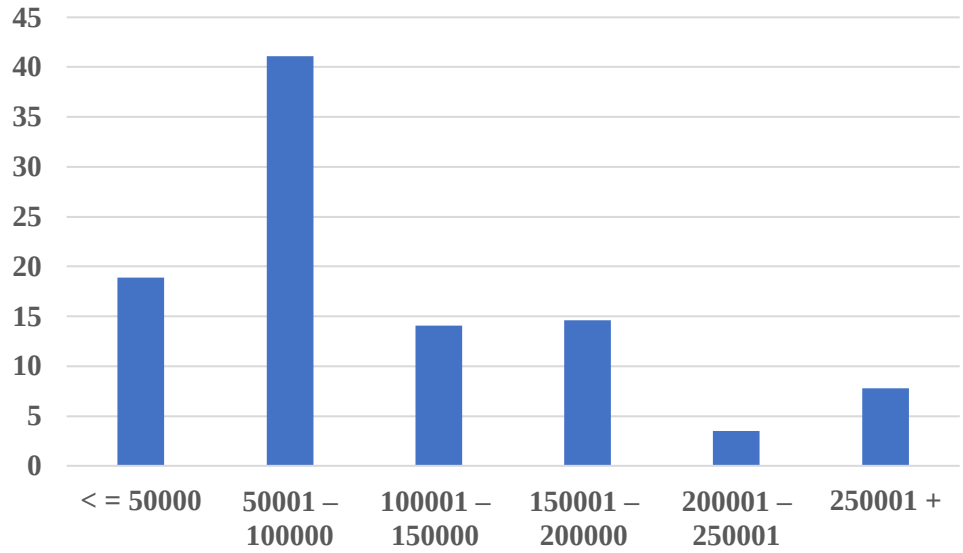


Figure 4.4.3 Household Income of Respondents

4.2.4 Education

Education is the significant aspects that could affect the person's attitudes as well as the way of viewing and understanding a certain specific social phenomenon. Data concerning education are summarized in Table: 4.4

Table 4.4 Education of Respondents

Education	Frequency	Percentage
Middle	89	24.1
Secondary	126	34.1
High Secondary	155	41.9
Total	370	100.0

Table 4.4 shows that about 41.9 percent of the respondents were in high secondary school. 34.1 percent were in secondary school and only 24.1 percent of the respondents were in middle school.

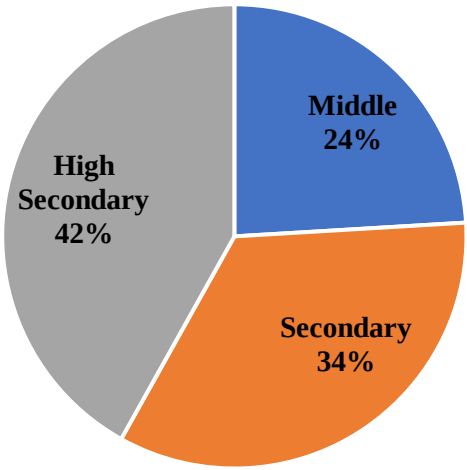


Figure 4.4.4 Education of Respondents

4.2.5 Household Size

The size of the household and its composition influence the distribution of financial and other resources between members of the household, which in turn affects the general well-being of those individuals. Household size data is set out in Table: 4.5

Table 4.5 Household size of Respondents

Household Size	Frequency	Percentage
< = 5	150	40.5
6 – 10	190	51.4
11 – 15	22	5.9
16+	8	2.2
Total	370	100.0

Table 4.5 shows that almost half of the respondents (51.4 percent) have 6 to 10 members in their family, whereas 40.5 percent of their family size comprises of < = 5 members and only 2.2 percent of the respondent's family size included 16+ members.

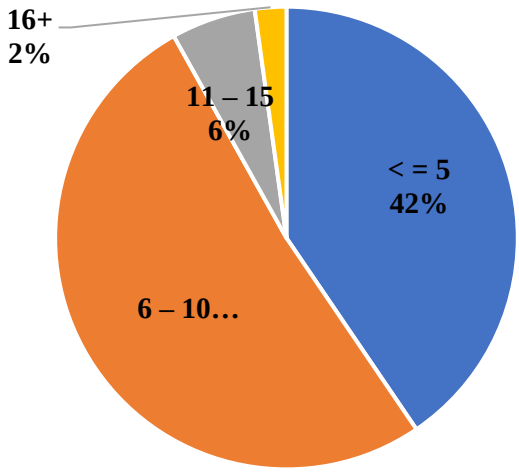


Figure 4.4.5 Household Size of Respondents

4.2.6 Type of Dwelling Unit

The form of the residence in which an individual's live and interacts is probable to have an effect on his/her belief system and in shaping his/her personality. This will have enormous importance in reacting to a question that he/she faces, and the data related to the respondent's type of dwelling unit is provided in Table. 4.6.

Table 4.6 Dwelling Type of Respondents

Dwelling Unit	Frequency	Percentage
Apartment/flat	59	15.9
Independent House	311	84.1
Total	370	100.0

Table 4.6 shows that most of the respondents (84.1 percent) lived in independent houses and only 15.9 percent of the respondents lived in apartments or flats. It could be because Abbottabad is not metropolitan of Pakistan therefore there is no concept of compact development among the citizens.

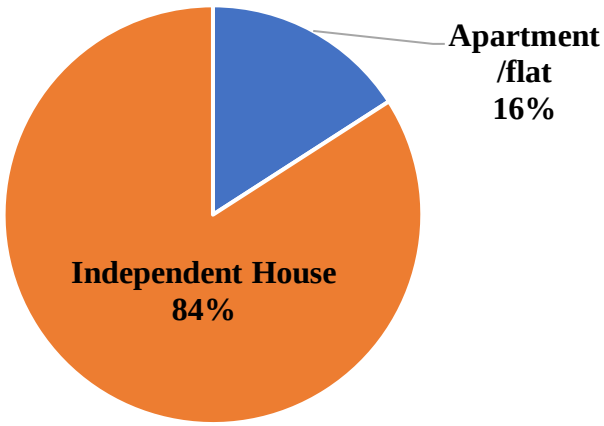


Figure 4.4.6 Dwelling Type of Respondents

4.2.7 Family System

The particular family where an individual resides and interacts has a tremendous importance in determining his/her values, opinions, and patterns of behaviour that will affect his/her attitudes towards a specific issue, hence the family system plays its part in determining the response of an individual and it was therefore considered significant to understand family system of a respondent. Table 4.7 lists family-related data.

Table 4.7 Family Type of the Respondents

Family Type	Frequency	Percentage
Joint	84	22.7
Nuclear	286	77.3
Total	370	100.0

Table 4.7 indicates that a vast majority (77.3 percent) of respondents were having nuclear family type, while the remaining (22.7 percent) were having joint family system. This shows the-trends in shifting families from the joint family to the nuclear family system, and changes in the family structure is being contributed to the process of urbanization.

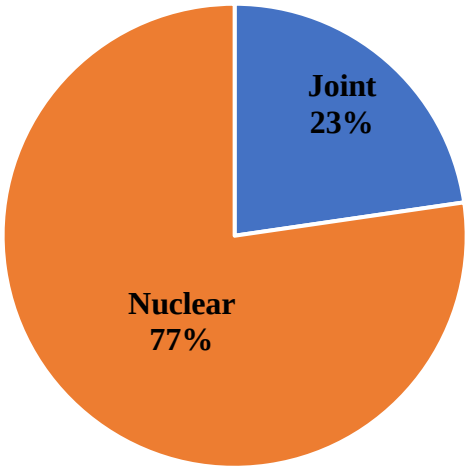


Figure 4.4.7 Family Type of Respondents

4.2.8 Number of People earning in a house

The number of people earning in a house is directly related to the financial condition. Table 4.8 shows the data related to the number of people earning in a household.

Table 4.8 Number of people earning in a household of Respondents

Number of People Earning	Frequency	Percentage
= 1	214	57.8
2 – 3	141	38.1
4+	15	4.1
Total	370	100.0

Table 4.8 indicates that more than half of the respondents (57.8 percent) have only one person in a house who earned. However, 38.1 percent of the respondents have 2 to 3 persons in a house who earned and only 4.1 percent of the respondents have 4+ people in a house who earned. From table 4.7 it has been established that the majority families based on the nuclear system, therefore, it is pertinent that only the earner is a male family member.

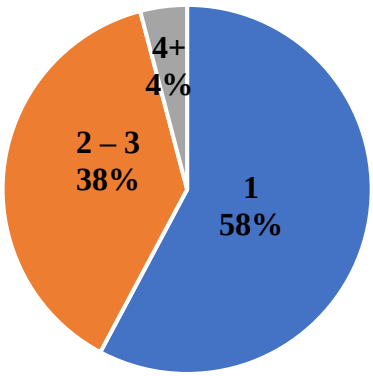


Figure 4.4.8 Number of people earning in a household

4.2.9 Number of Vehicles in a house

The number of vehicles in a house is the principal variable in mode choice modelling, because the model choice is mainly depending on the availability of the vehicle. Hence the variable “Number of vehicles in a house” was investigated for this study. Data related to the number of vehicles in a household of the respondents is presented in table 4.9.

Table 4.9 Number of vehicles in a household of Respondents

Number of vehicles in a household	Frequency	Percentage
< = 1	252	68.1
2 – 4	115	31.1
5+	3	0.8
Total	370	100.0

From table 4.9 it is clear that the majority of the respondents (68.1 percent) having one or no means. However, 31.1 percent of the respondents have 2 to 4 vehicles in a house and only 0.8 percent have more than 5 vehicles in a house. Mostly respondents hail from middle income group so they have only one or no personal vehicle in a house.

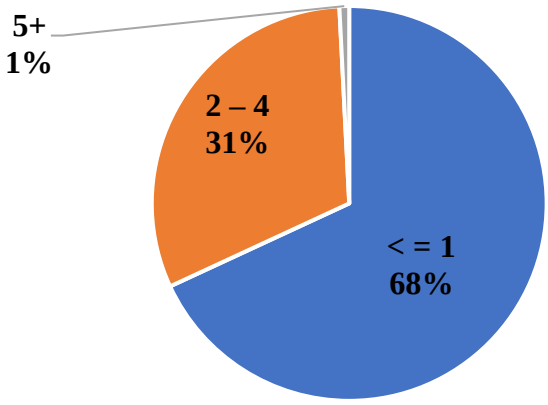


Figure 4.4.9 Number of Vehicles in a house

4.2.10 Employment of Parents

Parents' employment is also one of the very important variables because it is directly related to the financial conditions of the family which in turn affects directly to mode choice behaviour of children. So, this variable was investigated in the study, and data related to parent's employment is presented in table 4.10.

Table 4.10 Parents' Employment of Respondents

Status	Father's Employment		Mother's Employment	
	Frequency	Percent	Frequency	Percent
Employed	247	66.8	98	26.5
Self-Employed	82	22.2	15	4.1
Retired	28	7.6	8	2.2
Un-Employed	13	3.5	249	67.3
Total	370	100.0	370	100.0

From table 4.10 it is clear that in the majority of families (66.8 percent) fathers were employed and only 26.5 percent of mothers of respondents were employed. The self-employment ratio is low in both the cases of males and females and the ratio of unemployment is also very low (3.5 percent) in the case of males.

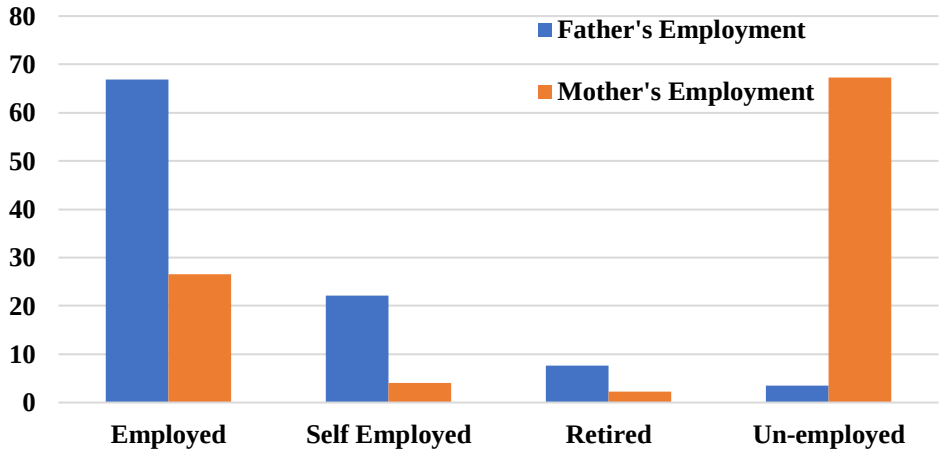


Figure 4.4.10 Parents' Employment of Respondents

4.2.11 Type of School

Data related to school type presented in table 4.11.

Table 4.11 School type of Respondents

Type of School	Frequency	Percentage
Public	202	54.6
Private	168	45.4
Total	370	100.0

It is clear from table 4.11 that respondents from public schools were more (54.6 percent) and 45.4 percent were from private schools. In the developing countries like Pakistan, Private schools having more fees than that of Public schools.

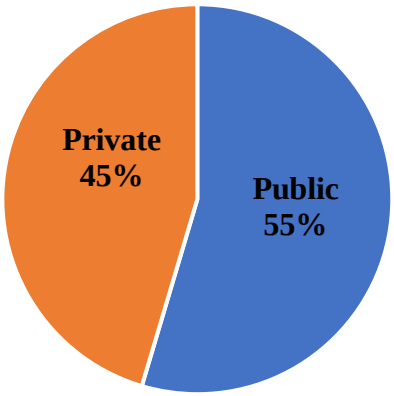


Figure 4.4.11 School type of Respondents

4.3 Summary of the chapter

Descriptive statistics of the sample revealed that there were slightly more females' respondents (n= 201, 54.3 percent) than males (n =169, 45.7 percent). Most of the respondents (46.5 percent) fell between the age group of 16 to 18 years, and only 5.9 percent of the respondents were above 19 years. The majority (41.1 percent) of the respondents stated their monthly household income was between 50001 – 100000. The data discerned that the respondents largely hail from the middle-income group. Most of the respondents (84.1 percent) lived in independent houses, and only 15.9 percent of the respondents lived in apartments or flats. Majority of the respondents (51.4 percent) having household size between 6 to 10 persons and 40.5 percent of the respondents having household size equals to or less than 5. Most of the respondents (41.9 percent) are from high secondary school. Majority of the respondents (77.3 percent) lived in nuclear family system and more than half of the respondents (57.8) reported only 1 person in the household is earning. 66.8 percent of the respondent's father are employed, and 22.2 percent are self-employed while on the other side 67.3 percent of the respondent's mother are housewife and only 26.5 percent are employed.

Chapter 5

MODE AND TRAVEL CHARACTERISTICS FOR EDUCATIONAL TRIPS

In this chapter mode choice preferences, and travel characteristics among school-going children were discussed. Students prefer different modes for educational trips depending upon different factors. Detail of all possible travel modes is below.

5.1 Mode Details

1. Walk: Walking plays a key role in enhancing the quality of life as it helps maintain and preserve the living natural resources and the environment. Improving the environment in turn brings added health benefits.	
2. Motorcycle: A motorcycle is a two-or three-wheeled motor vehicle, also called a bike, motorbike, or cycle. Owing to lower prices and a greater fuel economy, motorcycles are considered useful in developing countries.	
3. Car: car is a wheeled motor vehicle used for transport. As per the definitions of car, it runs mainly on roads, seat one to eight people, have four tyres and primarily transports people instead of goods.	

4. Minicab: In Pakistan minicab is locally called “Suzuki Bolan” or “Carry”. In Pakistan, it is a common wagon family that is designed specifically for offering a multi-purpose. It has a passenger capacity between 5 to 7 people.	
5. Van: Van is a form of vehicle being used for transporting people or goods. The smallest vehicles, microvans, are used for transporting in limited amounts, either goods or passengers. Large passenger seated vans can be used for institutional purposes like transporting students.	
6. School Bus: A school bus is a type of bus that is owned, rented, contracted, or operated by a school district. It is used daily to transport students to and from school or school events but does not include a shuttle bus or a public bus.	
7. Mini Pickup truck: A mini Pickup truck is locally called “Ravi Suzuki” in Pakistan. Plenty use of Suzuki Ravi is commonly found in the market. As it is a commercial vehicle it is used for many different purposes, for example, used to transport goods or passengers.	

8. Public transport: In Abbottabad city, the above mentioned "Ravi Suzuki" is used as a public transport. It can accommodate 6-8 persons under one roof.	
9. Ride-Hailing Service: Ride-hailing services are services that use platforms allowed online to connect passengers with local drivers using their personal vehicles. This is in most cases a convenient method for door to door transportation.	

5.2 Mode Choice

5.2.1 Usual Mode Choice by Students

Students were asked to choose from variety of choices, like walk, two-wheeler, car, minicab, school van, school bus, mini pickup truck, and public transport. All these options were coded as follows: 0 for a walk, 1 for motorcycle, 2 for car, 3 for minicab, 4 for van, 5 for school bus, 6 for mini pick up, and 7 for public transport. The distribution of mode split is shown in Fig 5.1.

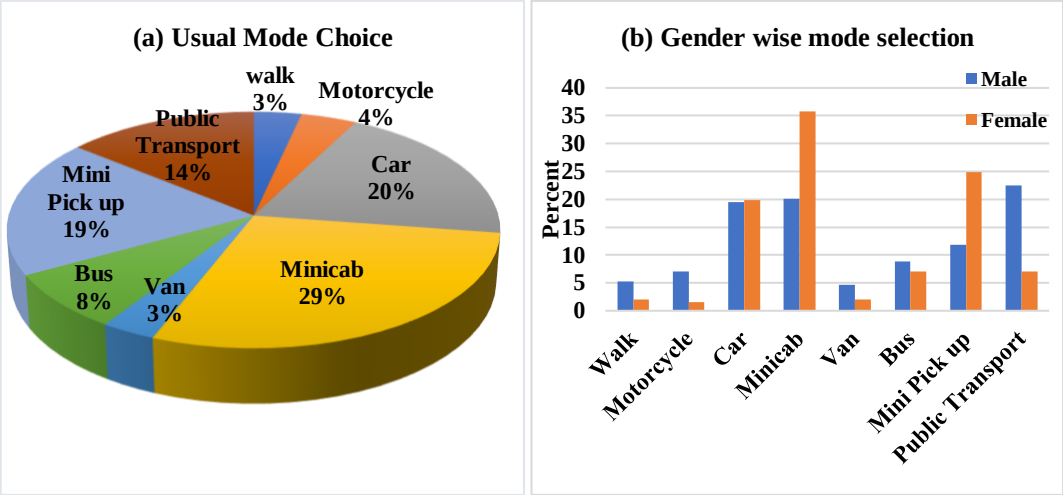


Figure 5.5.1 Model Split (a) Usual Mode Choice (b) Gender wise mode selection

Table 5.1 (a) shows that the usual mode choice of majority (29 percent) of the children was minicab. The obvious reason parents choose the minicab for their children is in its relative safety to other available modes of transport and another reason may be that Minicab is the most commonly used vehicle in the city of Abbottabad and its surroundings. Household car is the second most common mode selection (20 percent) among school-going children. The present study revealed that majority respondents and their parents are not satisfied with the public transportation available which is why they prefer their household car. Mini Pick-up trucks play an important role in public transportation within the city and are also easily accessible for school-going children as a pick-and-drop service, which is why 18 percent of students use this transportation as a school pick-and-drop service and 14 percent use public transportation (mini Pick-up trucks) as a school means. Only 4 percent of the children were traveled by walk this could be due to the lack of pedestrian safety infrastructure in the city. So, walking on or crossing the roads is a high-risk activity. According to (Ashfaq Ahmad Klair, 2017), Pakistan has one of the lowest rate of

footpaths prevalence among low and middle-income countries, and almost 84 percent of roads in the country has lack of footpaths.

Figure 5.1(b) presents a selection of gender-wise mode. For school-trips, the most popular mode of travel is the minicab primarily used by females. Females use 36 percent of overall minicab usage. Both male and female, used private cars equally. Public transport is often used by males (38 percent), as it was perceived by parents to be more convenient and safer for males than females. A Chi-square test has been conducted to check the significant difference between genders regarding usual mode choice. A used alpha level of 0.01 and the result shows P = 0.000, which is less than the alpha value so, accept the alternative hypothesis. The significant difference between genders regarding usual mode choice is because female students mostly used minicabs while male students used public transport. The results are summarized in Table 5.1.

5.2.2 Number of Modes Available

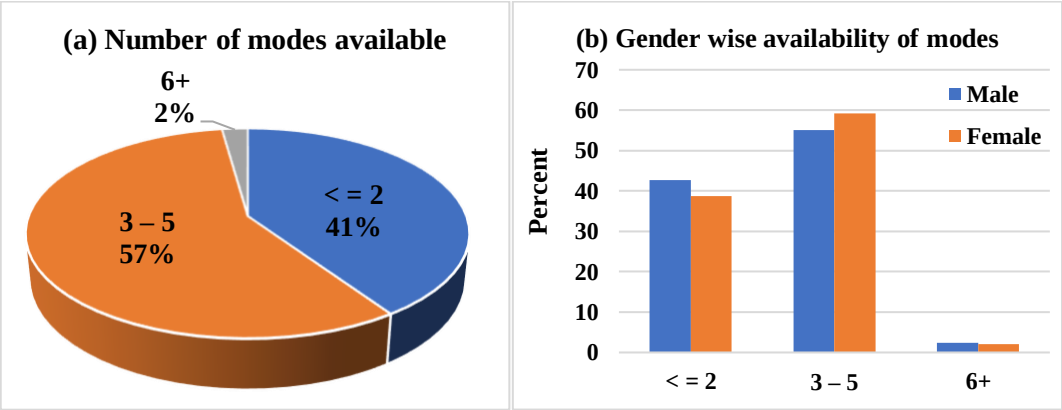


Figure 5.5.2 (a) Number of mode available to students (b) Gender wise distribution

Gender	Mean	Standard Deviation
Male	2.74	1.008
Female	2.82	0.968

Fig 5.8 (a) shows that almost 41 percent of respondents have two or less than two number of available modes. About 57 percent of respondents have 3 to 5 available modes on which they can travel to school and only 2 percent of respondents have more than 6 number of modes available. Fig 5.8 (b) shows the gender-wise availability of modes. The mean values of both males and females are very close, so it is concluded that there is no significant difference between genders in modes availability. Males and females have equal access to all modes.

5.2.3 Preferred Mode Choice

Figure 5.2(a) Reveals preferred mode choice for children going to school and Figure 5.2(b) describes gender-specific mode preferences for male and female respondents respectively.

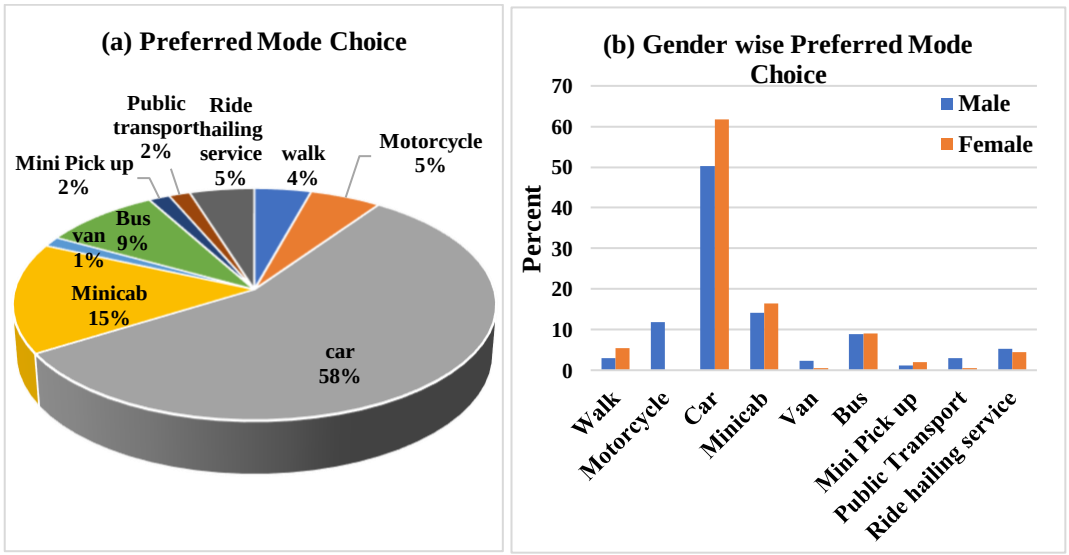


Figure 5.5.3 (a) Preferred Mode Choice (b) Gender wise distribution

Fig 5.3 (a) shows that the most preferred mode by the majority (58 percent) of the children is their personal cars Since parents found this convenient and efficient mode of travel for school-going children, 15 percent of respondents preferred minicab as it is also considered a suitable mode relative to other transportation modes available. Fig 5.2 (b) shows that 62 percent of females preferred mode choice is a car and almost 51 percent of males also preferred car. 12 percent of males preferred motorcycle as a travelling mode while no female preferred two-wheeler mode. 14 percent of males and 16 percent of females also preferred minicabs for school trips. A Chi-square test has been conducted to check the significant difference between genders regarding preferred mode choice. A used alpha level of 0.01 and result shows P = 0.000, which is less than the alpha value so, accept the alternative hypothesis, that is there is a difference between genders regarding preferred mode choice. The results are summarized in Table 5.1.

5.2.4 Preferences vs Actual Behaviour

Fig. 5.4 shows the comparison between the preferred mode and actual behaviour of male respondents.

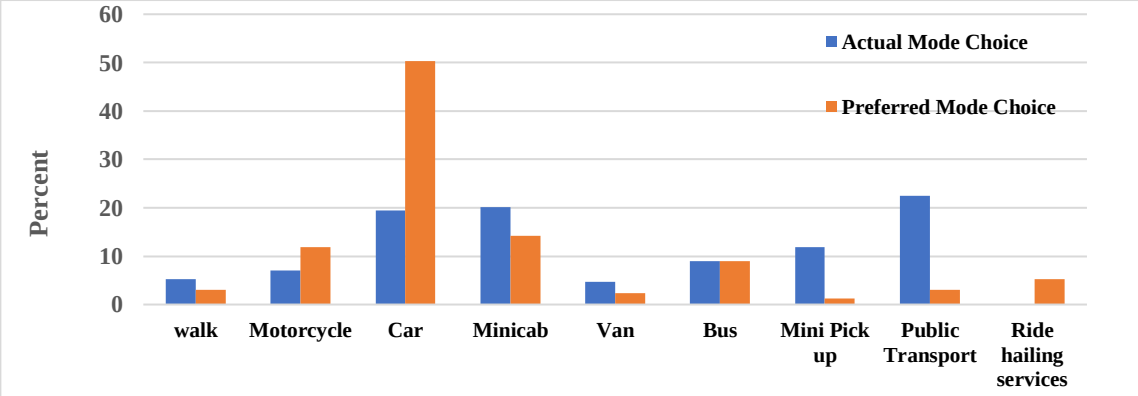


Figure 5.5.4 Actual vs Preferred mode choice of males

Fig 5.4 shows that not every male respondent uses the preferred mode. 50 percent of males with a car as preferred mode use another way to travel from home to school. 23 percent of the males' travel by public transport but only 3.0 percent preferred it because most of the respondents were not satisfied with the punctuality of travel time and ride quality of public transport. 12 percent of male respondents preferred two-wheeler and 14 percent preferred minicab.

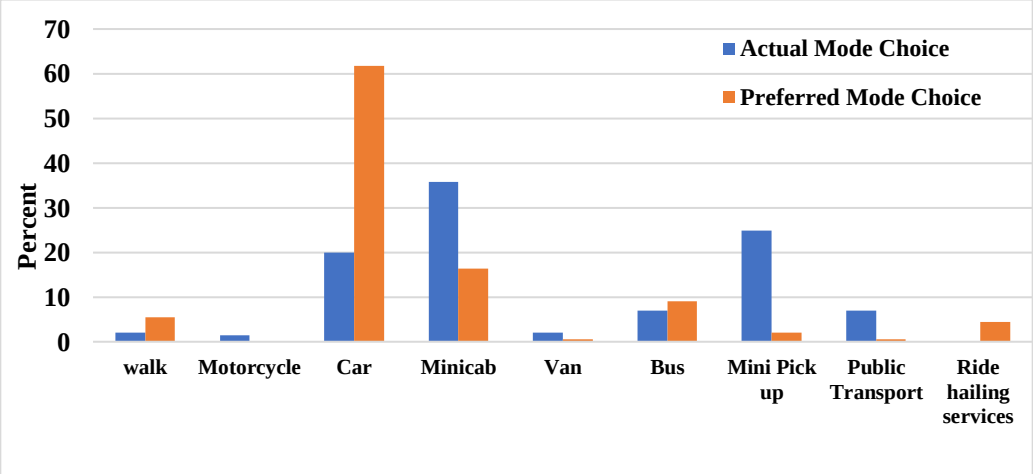


Figure 5.5.5 Actual vs Preferred mode choice of females

Fig 5.5 shows the difference between actual behaviour and preferred mode choice of school-going children. 62 percent of the female respondents with a car as preferred mode use other modes to travel from home to school. Female preferred private car because it is considered a comfortable and safe mode of transport. 17 percent of the female respondents also preferred their regular minicabs. 5 percent of female respondents also preferred ride-hailing services.

It has been observed that not every respondent uses the preferred mode. To prove this statistically chi-square test has been conducted and the following hypothesis was considered. H_0 = Usual and preferred mode choice of students are the same. Alternative Hypothesis H_1 = usual and preferred mode of students are different. The

p-value from the chi-square test is equal to 0.000 < 0.01; reject the null hypothesis and accept the alternative hypothesis i.e. usual and preferred mode of students are different because the majority of the respondents preferred their own family cars but use another way to travel from home to school. The results are summarized in Table 5.2.

5.2.5 Mode Choice in Bad Weather Condition

Due to the mountainous region, rainfall is high in Abbottabad. So, bad weather affects the travel behaviour of school-going children. Fig 5.6 (a) shows the mode choice behaviour of students in bad weather conditions.

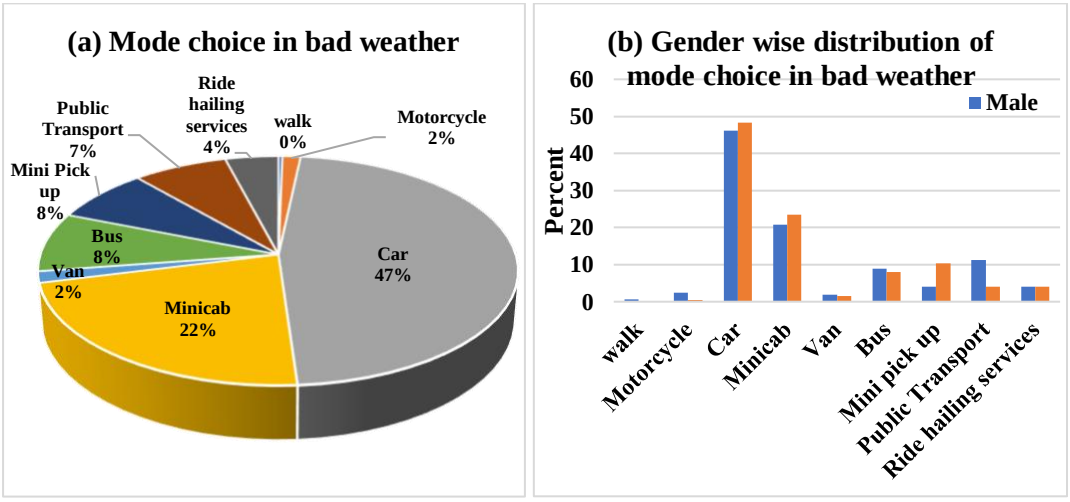


Figure 5.5.6 (a) Mode Choice in bad weather condition (b) Gender wise distribution

In case of bad weather about half of the respondents (47 percent) travelled by car and 22 percent of the respondents travelled by using their regular minicabs. 27 percent of respondents switch over to their private cars in bad weather.

Fig. 5.6 (b) shows gender-wise mode choice in rainy weather. It is evident from the fig about half of both the male and female respondents use their family cars. About

21 percent of males and 24 percent of females' respondents use their regular minicabs. None of the respondents walk on foot on rainy days. Only 2 percent of the male respondents use a motorcycle in case of bad weather. Almost 4 percent of male and 4 percent of the female respondents use ride-hailing services in case of bad weather while no respondent uses these services in normal days.

A Chi-square test has been conducted to check the significant difference between genders regarding mode choice in bad weather conditions. A used alpha level of 0.01 and the following hypothesis were considered: H_0 = there is no significant difference between genders regarding mode choice in bad weather conditions. H_1 = there is a significant difference between genders regarding mode choice in bad weather conditions. The result shows P = 0.049, which is more than the alpha value so, accept the null hypothesis, that is there is no significant difference between genders regarding mode choice in bad weather conditions because both genders switch towards their family cars in bad weather. The results are summarized in Table 5.1.

Table 5.1 Mode choice and preferences

Variables	Frequency		Percentage		Association between gender and mode choice	
	Male	Female	Male	Female	Chi-Square	P-value
Usual Mode Choice						
Walk	9	4	5.3	2.0		
Motorcycle	12	30	7.1	1.5		
Car	33	40	19.5	19.9		
Minicab	34	72	20.1	35.8	44.484	0.000
Van	8	4	4.7	2.0		
Bus	15	14	8.9	7.0		
Mini Pick-up truck	20	50	11.8	24.9		
Public transport	38	14	22.5	7.0		
Preferred Mode Choice						
Walk	5	11	3.0	5.5		
Motorcycle	20	0	11.8	0		
Car	85	124	50.3	61.7		
Minicab	24	33	14.2	16.4	33.840	0.000
Van	4	1	2.4	0.5		
Bus	15	18	8.9	9.0		
Mini Pick-up truck	2	4	1.2	2.0		
Public transport	5	1	3.0	0.5		
Ride-Hailing Services	9	9	5.3	4.5		
Mode Choice in Bad Weather						
Walk	1	0	0.6	0		
Motorcycle	4	1	2.4	0.5		
Car	78	97	46.2	48.3		
Minicab	35	47	20.7	23.4	15.548	0.049
Van	3	3	1.8	1.5		
Bus	15	16	8.9	8.0		
Mini Pick-up truck	7	21	4.1	10.4		
Public transport	19	8	11.2	4.0		
Ride-Hailing Services	7	8	4.1	4.0		

5.2.6 Usual Mode Choice vs Mode choice in Bad Weather

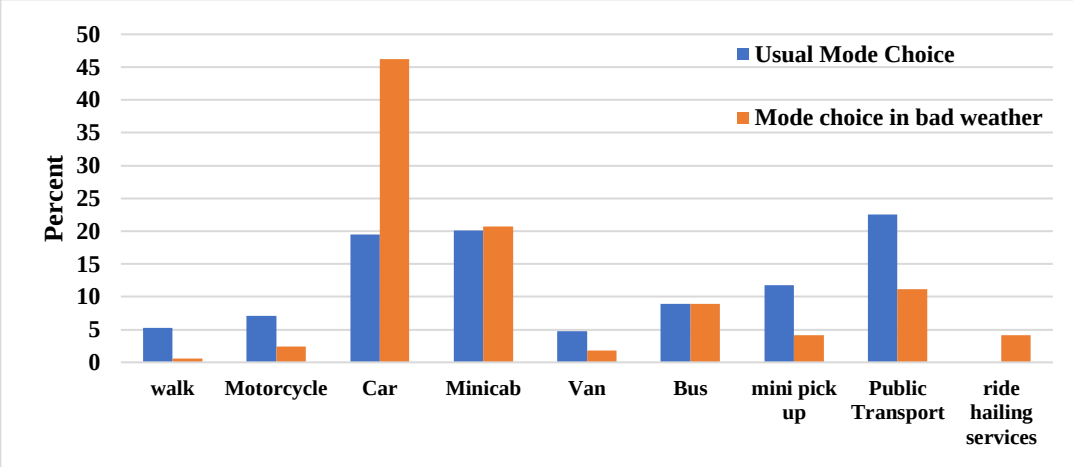


Figure 5.5.7 Usual mode choice vs mode choice in bad weather of males

Fig 5.7 shows that not every respondent uses the usual mode in bad weather conditions. Most of the respondents switch to their private cars. In the case of male respondents, rainfall does not have a significant effect on carry users. Respondents who use public transport on normal days mostly switch towards other modes because they were very dissatisfied with the punctuality and ride quality of public transport especially in bad weather. Rainfall has a significant effect on two-wheelers and Pedestrians; they switch towards other travelling modes. Bad weather has an insignificant effect on respondents travelled by school buses. For school buses percentage of mode choice in bad weather conditions is almost the same as that of usual mode choice.

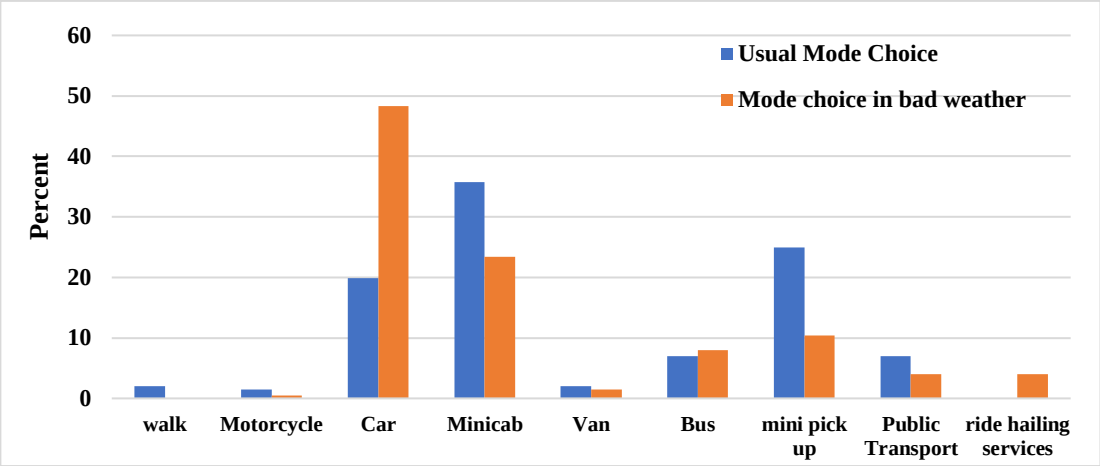


Figure 5.5.8 Usual mode choice vs mode choice in bad weather of females

The pattern of mode choice in bad weather for educational trips are completely changed from that of normal days. Fig 5.8 shows that in normal days only 20 percent of female respondents travelled by private cars but in case of rainfall about 50 percent of female respondents switch to private cars. Respondents travelled by minicab or mini pick-up also switch towards other modes. 4 percent of female respondents use ride-hailing services in bad weather whereas no female respondents use such services in normal days. From table 5.6 and 5.7 it is concluded that bad weather or rainy season has a significant effect on the mode choice behaviour of school-going children.

The following hypothesis was considered to check whether bad weather effect usual mode choice or not. H_0 = Usual mode choice is unaffected by bad weather and H_1 = Usual mode choice is affected by bad weather. $P = 0.000 < 0.01$; shows that the usual mode choice of students is affected by bad weather because firstly, the availability of public transport is diminished in bad weather. Secondly, the pick and drop services (e.g. minicabs, mini pick-up trucks, and vans) for the students are hindered due to

stagnant water on roads and this results in delayed reaching time to their pick-up locations. Moreover, two-wheeled and pedestrians do not have any choice but to shift their mode of transport. The results are summarized in Table 5.2.

Table 5.2 Usual mode choice vs preferred mode choice and mode choice in bad weather

Variables	Chi-Square	P-value
Usual mode choice vs preferred mode choice	407.029	0.000
Usual mode choice vs mode choice in bad weather condition	813.004	0.000

5.3 Travel Characteristics

5.3.1 Total Travel Length in Kilometers

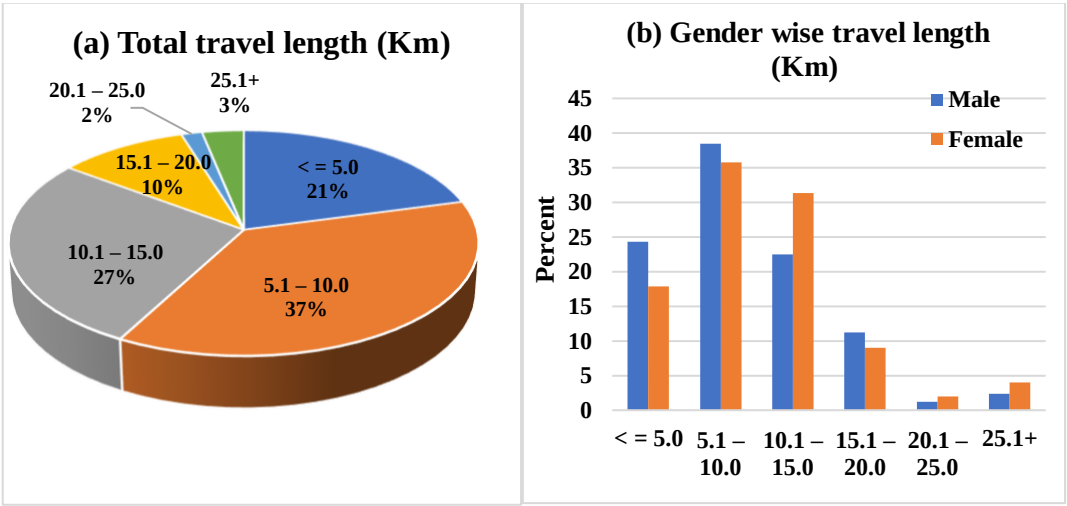


Figure 5.5.9 (a) Total travel length in Km (b) Gender wise distribution

Fig 5.9 (a) shows that most of the students (37 percent) travelled between 5 to 10 km daily for school. 21 percent of the respondents travelled less than 5 km and the travel length of 27 percent of the students is between 10 to 15 km. 15 percent of the

respondents travelled more than 15 km per day. Fig 5.9 (b) shows that male students do more very short trips to a school than female students that are less than 5 km. For both male and female students, trips to school are more likely to be between 5 to 10 km. Students who travelled more than 20 km mostly come from suburban areas of the city. There is a difference between the mean values of male and female respondents, the mean value for female respondents is greater than that of male respondents so it is concluded that females travel more as compared to males. To check the significant difference between genders regarding travel characteristics, an independent sample t-test has been conducted. The following hypothesis was made for total travel length: Null Hypothesis H_0 = Both, male and female, travel equal distance for school. Alternative Hypothesis H_1 = Male and female don't travel equal distance for school. P-value from the independent sample t-test is equal to 0.260 > 0.01; reject the alternative hypothesis and accept the null hypothesis; i.e. male and female travel equal distance for school. The results are summarized in table 5.3.

5.3.2 Total Travel Cost in Rupees per Month

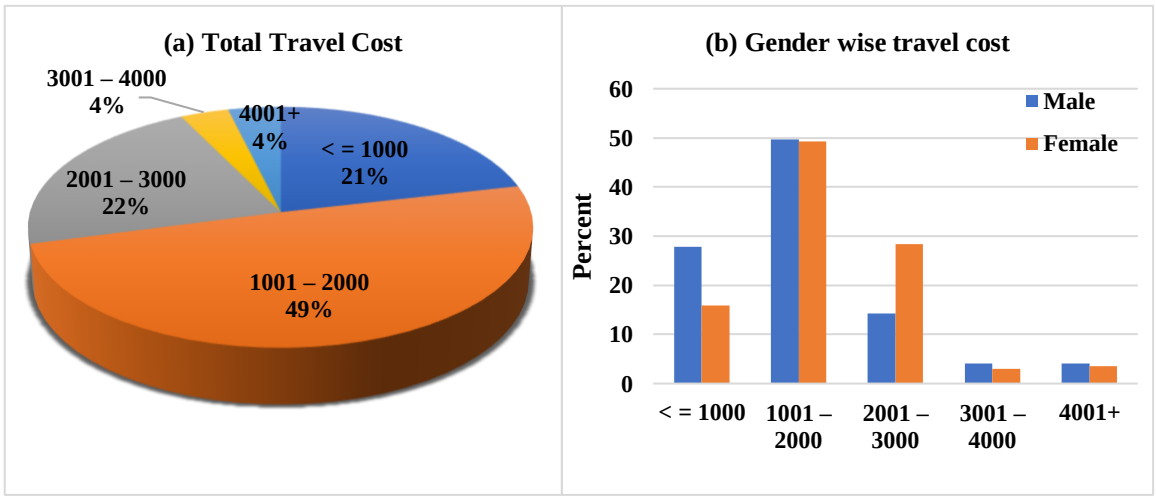


Figure 5.5.10 (a) Total Travel Cost (b) Gender wise distribution of travel cost

Fig 5.10 (a) shows that the travel cost of half of the respondents is between Rs 1000 to 2000 whereas 21 percent pay less than 1000 and 22 percent of the respondents spend between 2000 to 3000 Rs per month. Only 8 percent of the respondents spend above Rs 3000 per month. Fig 5.10 (b) shows that male students spend less travel cost as compared to female students. It could be because of two reasons, more male students travelled by public transport (public transport have less fares) and the other reason is male students do more very short trips to a school than female students. Females spend more cost on school trips because most of the female students travelled by their domestic cars and having long trips as compared to male students. For total travel cost following hypothesis were made; Null Hypothesis H_0 = Both males and females spend equal travel costs per month. Alternative Hypothesis H_1 = Male and female doesn't spend equal travel cost per month. Test results shows, P = 0.081 > 0.01; accept null hypothesis i.e. both male and female spend equal travel cost per month for educational trips. The results are summarized in table 5.3.

5.3.3 Total Travel Time in Minutes per Day

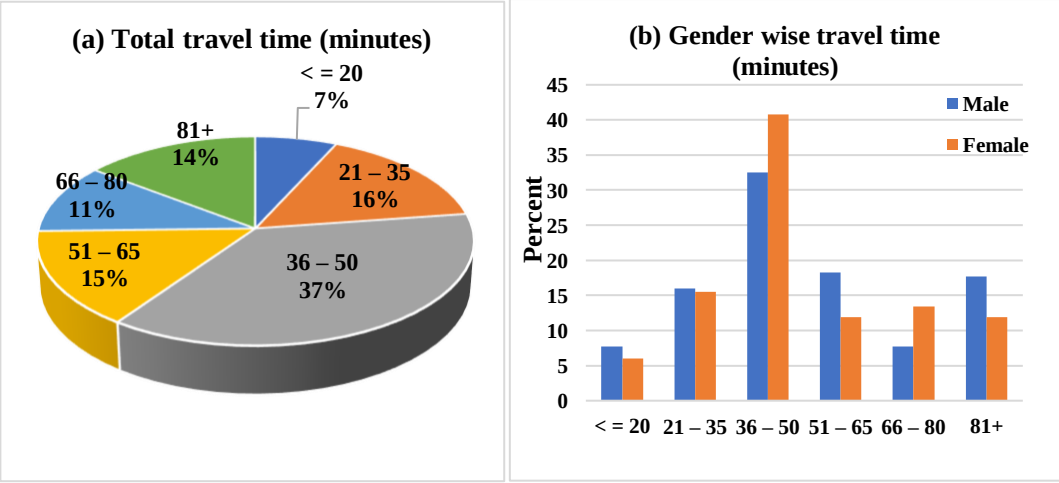


Figure 5.5.11 (a) Total Travel time in minutes (b) Gender wise distribution

Fig 5.11 (a) shows that 37 percent of the students travelled 35 to 50 minutes per day. Only 7 percent of the students travelled less than or equals to 20 minutes per day. On average, the students travelled 54 minutes per day. The minimum and maximum time travelled per day are 4 minutes and 210 minutes respectively. 41 percent of females travelled between 35 to 50 minutes per day. The average value of total travel time for the male respondents is 55.71 minutes per day which is greater than that of female respondents (52.55 minutes per day). This means that male students having more travel time than that of female students, the reason is that most of the male students use public transport (it takes more time as compared to other available modes). The following hypothesis was made for total travel time; Null Hypothesis H_0 = Travel time for both males and females is equal. Alternative Hypothesis H_1 = Male and female don't have equal travel time. Test results shows, P = 0.286 > 0.01; accept null hypothesis i.e. for educational trips travel time for both male and female is equal. The results are summarized in Table 5.3.

5.3.4 Total Travel Time in bad weather conditions (Minutes per day)

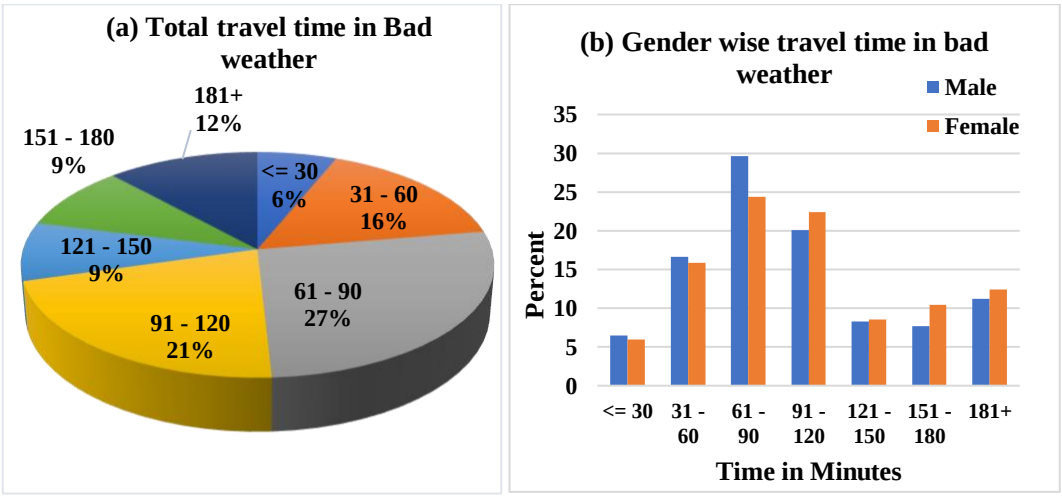


Figure 5.5.12 (a) Total Travel Time in Bad Weather (Minutes) (b) Gender wise distribution

Fig 5.12 (a) shows the travel time of most of the respondents (27 percent) in bad weather is between 61 to 90 minutes per day. Only 6 percent of the children were having travel time less than 30 minutes on a rainy day while 12 percent were having travel time of more than 181 minutes per day in bad weather. An average of about 110 minutes per day has been observed. Gender wise distribution of travel time in bad weather shows no significant difference among both genders. For travel time in bad weather conditions following hypothesis was considered; Null Hypothesis H_0 = Travel time for both males and females is equal in bad weather conditions. Alternative Hypothesis H_1 = Male and female don't have equal travel time in bad weather. Test results shows P = 0.592. which is greater than 0.01; accept null hypothesis i.e. Travel time for both males and females is equal in bad weather conditions. The results are shown in Table 5.3.

Table 5.3 Travel Characteristics

Variables	Frequency		Percentage		Mean		Standard Deviation		Difference between gender and travel characteristics	
	Male	Female	Male	Female	Male	Female	Male	Female	T-test	P-value
Total travel length in km										
< = 5.0	41	36	24.3	17.9	9.692	10.492	6.9721	6.5464	-1.129	0.260
5.1 – 10.0	65	72	38.5	35.8						
10.1 – 15.0	38	63	22.5	31.3						
15.1 – 20.0	19	18	11.2	9.0						
20.1 – 25.0	2	4	1.2	2.0						
25.1+	4	8	2.4	4.0						
Total travel cost in rupees per month										
< = 1000	47	32	27.8	15.9	1693.85	1931.04	1445.38	1102.22	-1.748	0.081
1001 – 2000	84	99	49.7	49.3						
2001 – 3000	24	67	14.2	28.4						
3001 – 4000	7	6	4.1	3.0						
4001+	7	7	4.1	3.5						
Total travel time in minutes										
< = 20	13	12	7.7	6.0	55.71	52.55	29.811	26.385	1.069	0.286
21 – 35	27	32	16.0	15.5						
36 – 50	55	82	32.5	40.8						
51 – 65	31	24	18.3	11.9						
66 – 80	13	27	7.7	13.4						
Total travel time in bad weather condition										
< = 30	11	12	6.5	6.0	108.40	112.19	69.960	65.062	-0.536	0.592
31 – 60	28	32	16.6	15.9						
61 – 90	50	49	29.6	24.4						
91 – 120	34	45	20.1	22.4						
121 – 150	14	17	8.3	8.5						
151 – 180	13	21	7.7	10.4						
181+	19	25	11.2	12.4						
Total number of trips per day					2.51	2.16	0.927	0.612	4.196	0.000
2	128	187	75.7	93						
4	39	13	23.1	6						
6	2	2	1.2	1						

5.3.5 Usual Travel Time vs Travel time in bad weather

A paired sample t-test has been conducted to check a significant difference between usual travel time and travel time in bad weather. (Tsapakis, Cheng, & Bolbol, 2013) the study found that rainfall affects the total travel time of commuters, total travel time increases with the intensity of rainfall.

Variables	Mean	Standard Deviation	Significant Difference (P)
Usual travel time	53.99	28.007	0.000
Travel time in bad weather condition	110.46	67.278	

The following hypothesis was considered: Null Hypothesis H_0 = usual travel time is unaffected by bad weather. Alternative hypothesis H_1 = Usual travel time is affected by bad weather. The result shows P = 0.000 < 0.01; reject the null hypothesis and accept alternative i.e. Usual travel time is affected by bad weather.

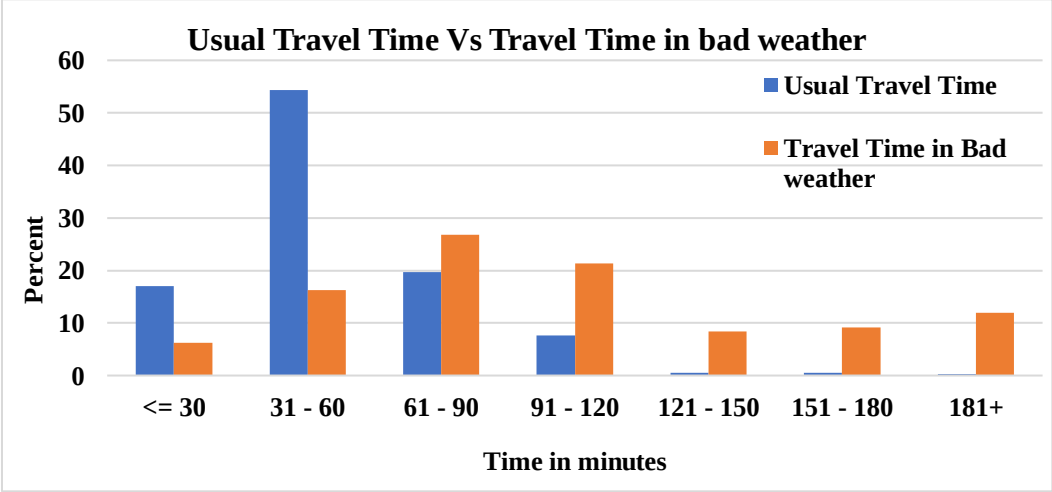


Figure 5.5.13 Usual Travel time Vs travel time in bad weather

The above graph shows the relationship between the percentage of people and the time taken by them on normal days and in bad weather conditions. A minimum of

30 to 60 minutes is taken by more than 50 percent of the student population while travelling to school and also back to their destinations. But the days with bad weather conditions or heavy rainfall increases the time of travelling, sometimes to an extent of 3 hours. The average time taken in normal days is 54 minutes while the average time taken in bad weather is much higher that is 110 minutes. The major reasons for this inconvenience are overpopulated and congested roads, no proper drainage, and sewer system for rainwater resulting in stagnant water on roads and most importantly poor planning of road network communication systems.

5.3.6 Total number of trips per day

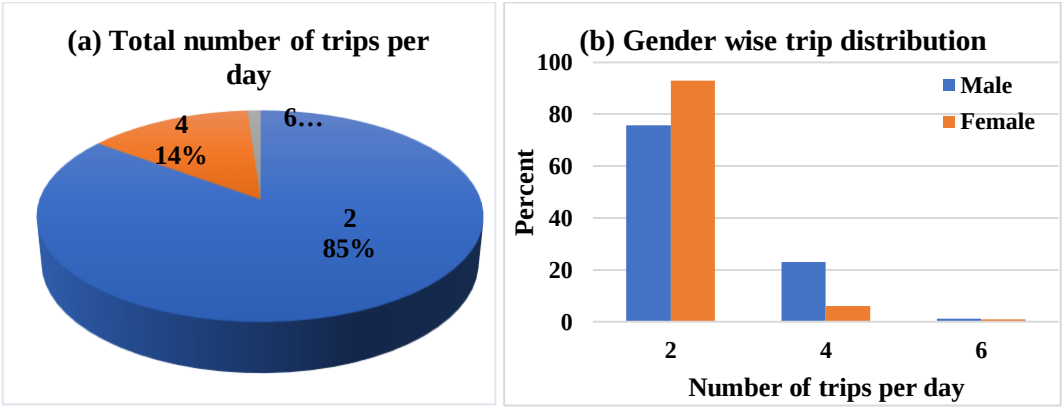


Figure 5.5.14 (a) Total number of trips per day (b) Gender wise trip distribution

Fig 5.14 (a) shows that 85 percent of the respondents made 2 trips per day for a school that is (home to school and school to home). While 14 percent of the respondents made 4 trips per day and most of them are those who travelled by public transport and only 1 percent of the respondents made 6 trips per day for school. On the other hand, fig 5.14 (b) shows that females made a lesser number of trips as compared to males. 23 percent of the male respondents use public transport which is why they made more trips. The above results show that statistically there is a

significant difference between the usual mode choice of male and female. so, the number of trips made each day for educational purposes could also vary. The following hypothesis was considered: Null Hypothesis H_0 = both males and females made an equal number of trips per day. Alternative Hypothesis H_1 = Male and female don't make an equal number of trips per day. Results show p = 0.000 which is smaller than 0.01; reject the null hypothesis and accept alternative i.e. male and female doesn't make an equal number of trips per day. The means value of the total number of trips for males and females is 2.51 and 2.16 respectively, which shows that males tend to make more trips than females because a greater percentage of male respondents use public transport than females. Results are summarized in above table 5.3

5.4 Private Car Vs Public Transport

5.4.1 Total Travel Time by Car

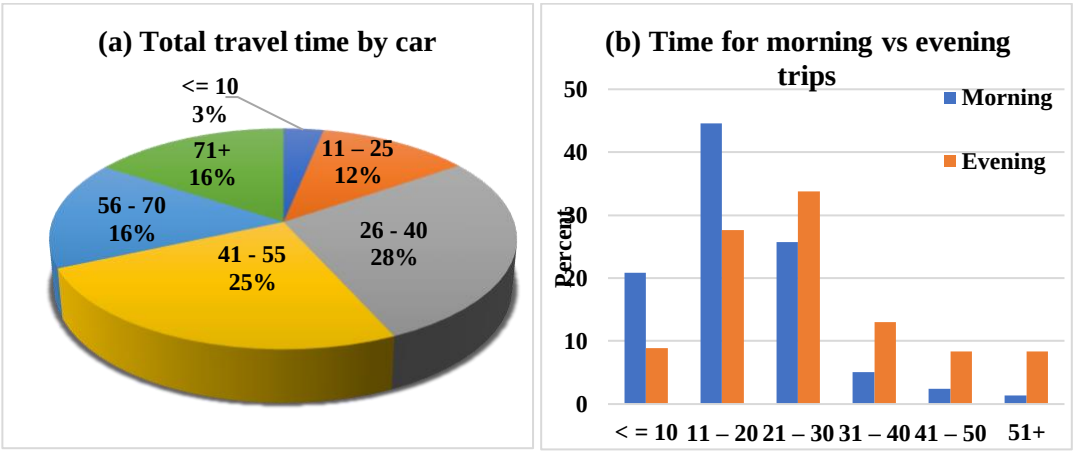


Figure 5.5.15 (a) Total travel time by car (b) Travel time for morning vs evening trips

Variables	Mean	Standard Deviation
Total travel time	50.00	24.728
Travel time for morning trips	20.60	10.362
Travel time for evening trips	29.40	15.403

Fig 5.15 (a) shows travel time for most of the respondents (28 percent) by car is between 26 to 40 minutes per day. Only 3 percent of the students having travel time less than 10 minutes by car. On average, the students travelled 50 minutes per day by car. Fig 5.15 (b) shows travel time for morning and evening trips. The graph clearly shows that travel time for the evening trip is more than that of the morning. Average morning and evening time travelled per day is 20.60 minutes and 29.40 minutes respectively. Traffic congestion increases travel time for evening trips.

5.4.2 Total Travel time by Public Transport

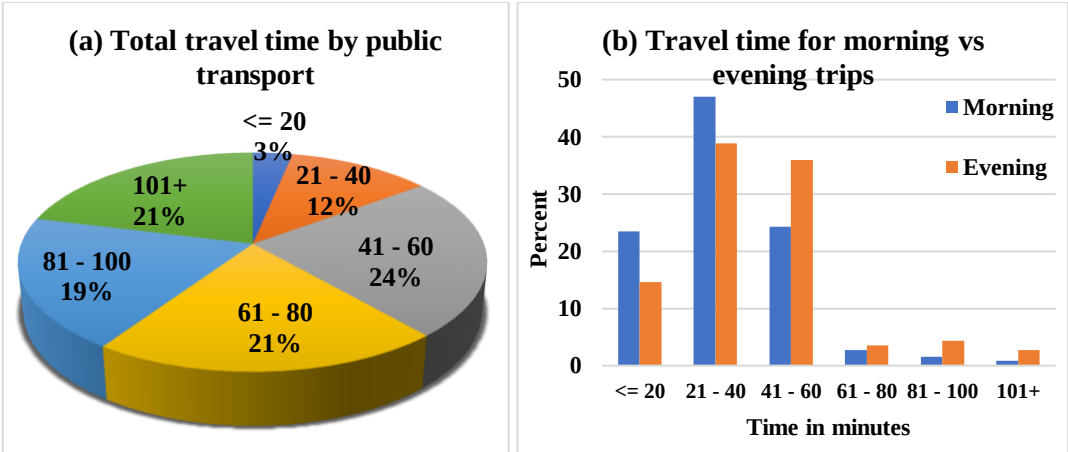


Figure 5.5.16 (a) Total travel time by Public transport (b) Travel time for morning vs evening trips

Fig 5.16 (a) shows travel time for most of the respondents (24 percent) by public transport is between 41 to 60 minutes per day. Only 3 percent of the students having travel time less than 20 minutes per day by public transport and 21 percent having

more than 101 minutes per day. Fig 5.15 (b) shows travel time for morning and evening trips. The graph clearly shows that travel time for the evening trip is more than that of the morning. The average morning and evening time travelled per day is 36.01 minutes and 43.95 minutes respectively. Traffic congestion increases travel time for evening trips.

5.4.3 Total travel time for car vs public transport

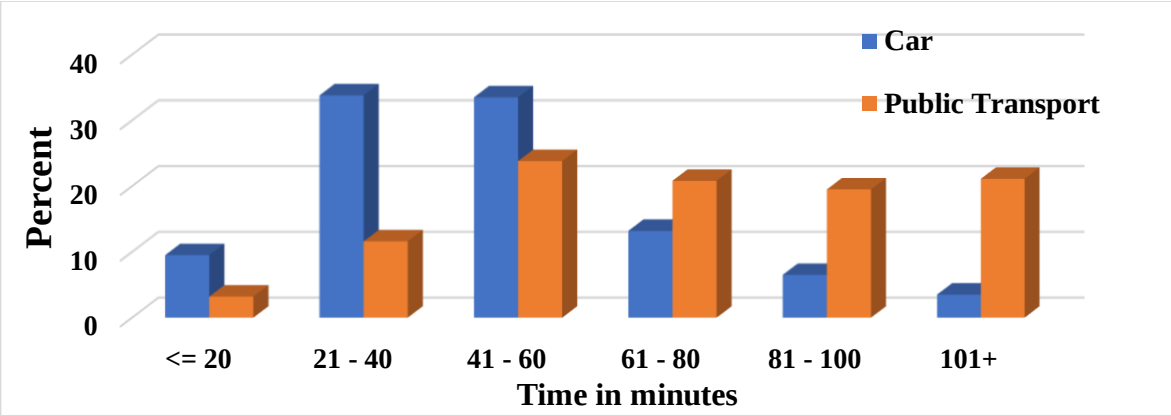


Figure 5.5.17 Travel time by car vs public transport

Fig 5.17 shows the relationship between the percentage of respondents and total travel time by car and public transport. By using their private cars most of the respondents (68 percent) takes 21 to 60 minutes while travelling to school and back to their destinations. As compared to private cars public transport takes significantly longer travel time. The average time taken by the private car and public transport is 50 minutes and 80 minutes respectively. Public transport takes more time due to lake of proper terminals as a result of which passengers get in and off the vehicle at different locations.

5.4.4 Total travel cost for car vs public transport

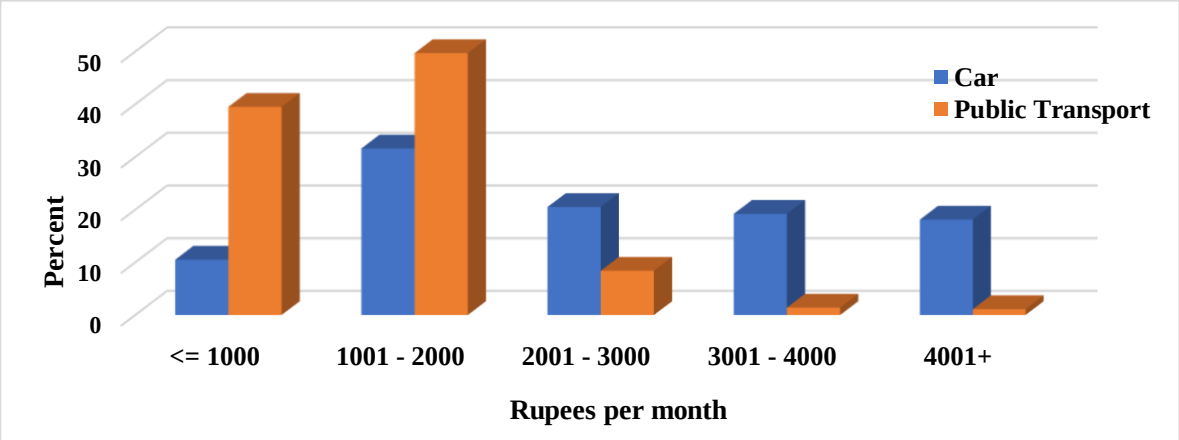


Figure 5.5.18 Travel cost for car vs public transport

Fig 5.18 shows that 90 percent of the travel cost for public transport is between 1000 to 2000 Rupees per month, while travel cost for car varies between 500 to 5000. The average travel cost for car and public transport is 2769 and 1852 Rupees per month respectively. It is concluded that for the same distance, travel cost for public transport is less than that of a private car.

A paired sample t-test has been conducted to check the significant difference between public and private transport. The following hypothesis is considered: Null Hypothesis H_0 = there is no significant difference between travel time and travel cost for car and public transport; Alternative hypothesis H_1 = there is a significant difference between travel time and travel cost for car and public transport. The result shows P = 0.000 which is less than 0.01; reject the null hypothesis and accept the alternative hypothesis i.e. there is a significant difference between travel time and cost for car and public transport. As compared to private cars public transport takes significantly longer travel time. The results are summarized in table 5.4.

Table 5.4 Private car vs public transport

Variable	Mean	S. D	T-test	P-value
Total travel time by car	50.00	24.728	- 23.828	0.000
Total travel time by public transport	79.97	39.462		
Total travel cost for car	2768.51	1852.023	18.158	0.000
Total travel cost for public transport	1219.35	730.213		

5.4.5 Waiting time for Public transport

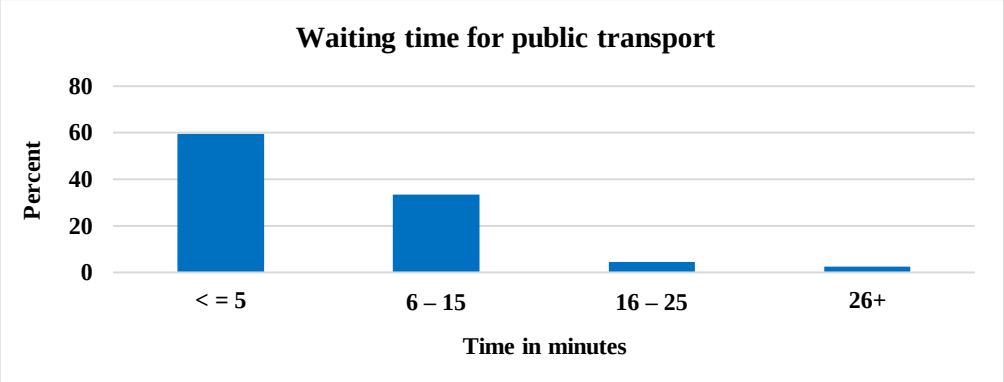


Figure 5.5.19 Waiting time for public transport

Variable	Mean	Standard Deviation
Waiting time for public transport	7.61	6.095

Fig 5.19 shows the relationship between the percentage of respondents and waiting time at stops. It has been observed that 60 percent of the respondents wait for less than or equals to 5 minutes. 34 percent of respondents wait between 5 to 15 minutes and only 2.4 percent wait longer than 25 minutes. Commuters wait on an average of 8 minutes.

5.4.6 Time takes to Reach the nearest Public Stop from Home

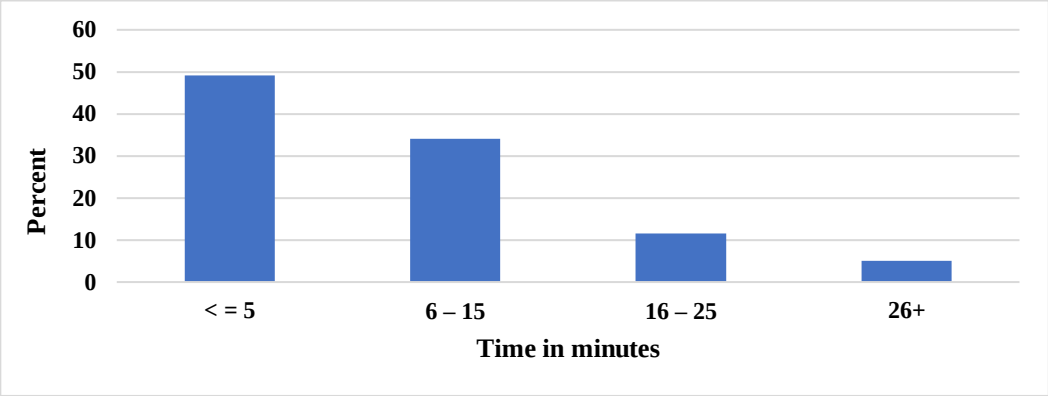


Figure 5.5.20 time takes to reach the nearest public stop from home

Variable	Mean	S.D
Time takes to reach the nearest public stop from home	9.78	8.295

Fig 5.20 clearly shows that almost half of the respondents reached the nearest public stop from home within 5 minutes. 34 percent of respondents take time between 5 to 15 minutes. Only 5 percent of the respondents take more than 25 minutes from home to the nearest public stops. On average respondents take 10 minutes to reach the nearest stops.

5.4.7 Number of modes used to reach school while travelling by public transport

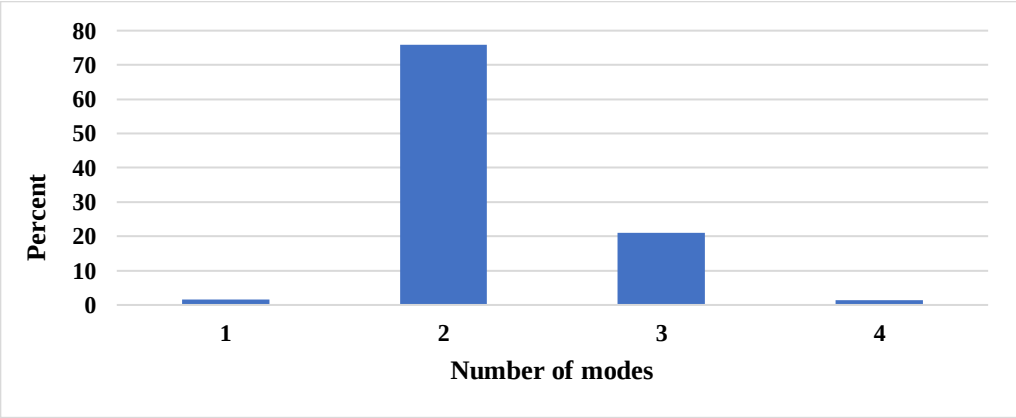


Figure 5.5.21 Number of modes used to reach school while travelling by public transport

Fig 5.21 shows the number of modes used by the students to reach school while travelling by public transport. 76 percent of the students used 2 different modes when they travelled by public transport and 21 percent use 3 different modes. Only 1.4 percent of respondents use 4 different modes.

5.5 Satisfaction level with Public Transport

5.5.1 Satisfaction Level with Cleanliness of Stops

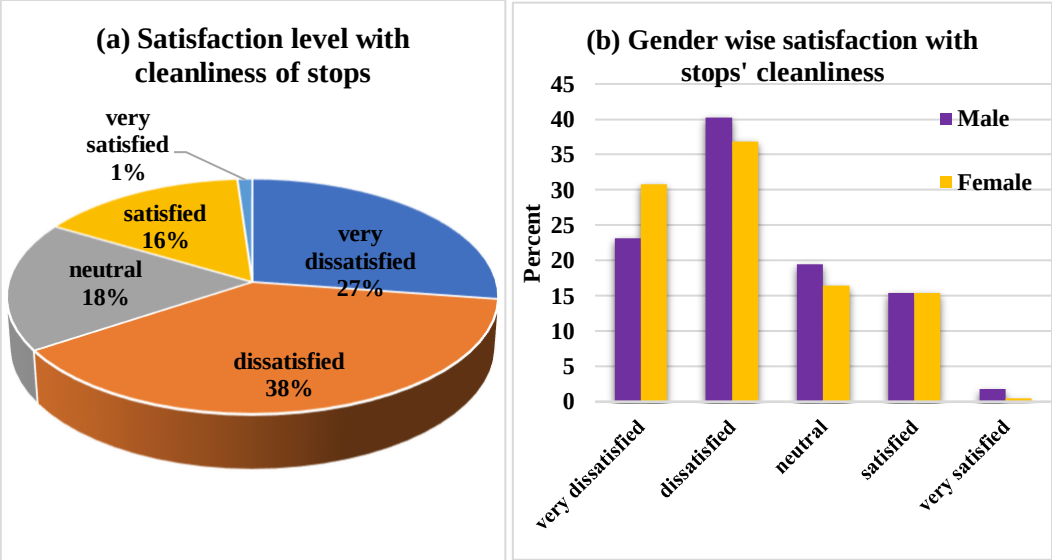


Figure 5.5.22 (a) Satisfaction of respondents with the cleanliness of stops (b) Gender wise Satisfaction

Fig 5.22 (a) shows the distribution chart regarding the satisfaction level of the respondents towards the cleanliness of the stops. 17 percent of the respondents were satisfied while 65 percent of the respondents were not satisfied with the cleanliness of stops. 18 percent of the respondents gave a neutral opinion regarding the cleanliness of the stops.

Fig 5.22 (b) shows the satisfaction of the respondents according to the gender, where both the gender ends up having the same opinion about the cleanliness of the stops.

To check the significant relationship between gender and cleanliness of stops Chi-Square test has been conducted. Chi-Square **P = 0.380**, which is greater than 0.05. It shows that there is no statistically significant association between gender and cleanliness of stops. Both male and female respondents having the same opinion regarding the cleanliness of stops. The results are summarized in Table 5.4.

5.5.2 Satisfaction level with Staff behaviour of Public Transport

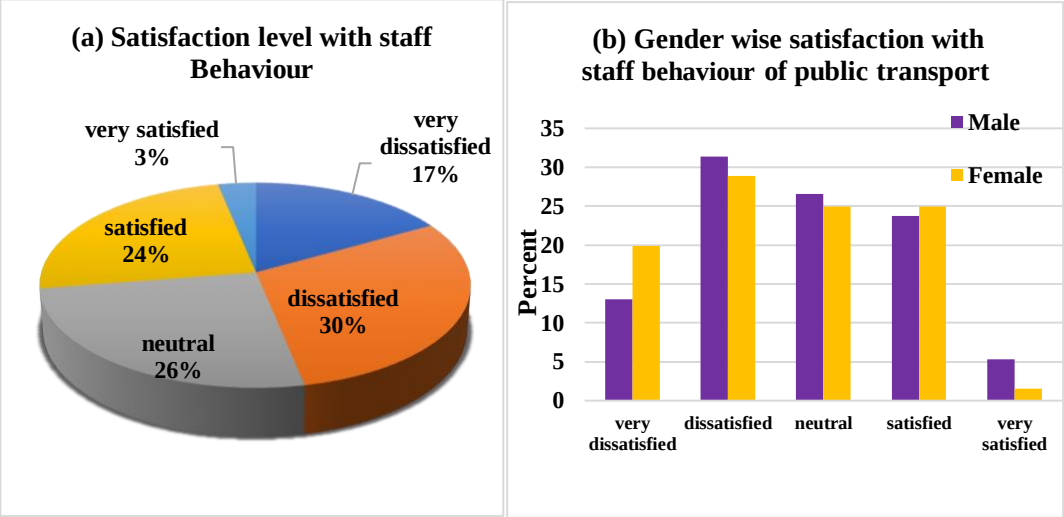


Figure 5.5.23 (a) Satisfaction of respondents with staff behaviour (b) Gender wise Satisfaction

Fig 5.23 (a) shows the distribution chart regarding the satisfaction level of respondents with staff behaviour of public transport. 27 percent of the respondents were satisfied, 26 percent gave a neutral opinion and 37 percent were not satisfied with staff behaviour. Fig 5.22 (b) shows that both male and female respondents have the same option regarding staff behaviour. From Chi-Square test get **P = 0.130**, which is less than 0.05, that shows statistically there is no significant relationship between gender and satisfaction level of staff behaviour. The results are summarized in table 5.4.

5.5.3 Satisfaction Level with safety and security on the way

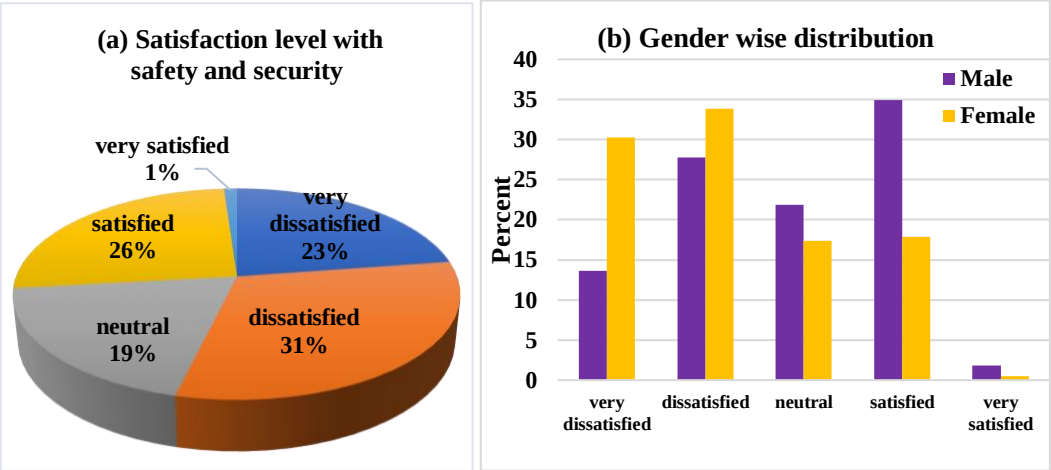


Figure 5.5.24 (a) Satisfaction level with Safety and Security (b) Gender wise distribution

Fig 5.24 (a) shows the satisfaction level of respondents with safety and security while travelling by public transport. More than half of the respondents (54 percent) do not feel secure while travelling by public transport. 26 percent were satisfied, and 19 percent of the respondents have a neutral opinion on safety and security.

Fig 5.24 (b) shows gender-wise satisfaction on safety and security. About 64 percent of the female respondents do not feel secure on public transport, while according to 18 percent of the female respondents' public transport is secure. 37 percent of male respondents were satisfied while 42 percent still believed that public transport is not secure for school-going children. In order to check the significant relationship between gender and security of public transport Chi-Square test has been conducted. The P-value get from the Chi-Square test is equal to **0.000**. P<0.005, which shows that statistically there is a relationship between gender and Security of public transport. It can be observed that male's security was not a big issue as compared to females. The results are summarized in Table 5.4.

5.5.4 Satisfaction level with boarding and disembarking from public transport

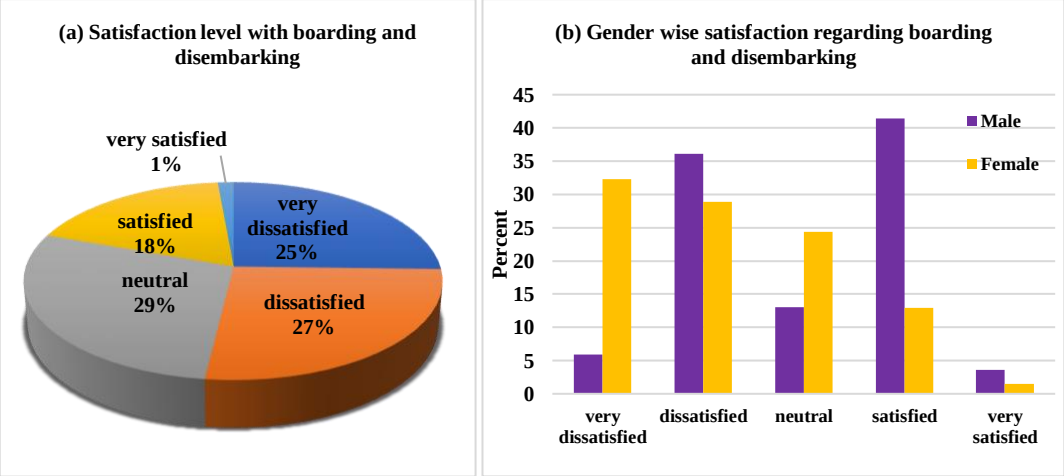


Figure 5.5.25 (a) satisfaction level with boarding and disembarking (b) Gender wise distribution

From Fig 5.25 (a) distribution it could be analyzed that almost 19 percent of the respondents were satisfied with the boarding and disembarking from public vehicles while 52 percent were not satisfied, and 29 percent of respondents were having a neutral opinion.

Fig 5.25 (b) shows the gender-wise distribution of satisfaction regarding boarding and disembarking and it is very clear from the fig that almost 13 percent of female respondents were satisfied while 62 percent were not satisfied with boarding and disembarking from public transport. On the other hand, the patterns were changed for male respondents. 45 percent of the male respondents believed that boarding and disembarking is easy from public transport, but 42 percent still believed it should be improved. From Chi-Square test **P=0.001,** which is less than 0.05. the P-value from the Chi-Square test shows that statistically there is a relationship between gender and, boarding and disembarking from public transport. It can be observed that for

females boarding and disembarking from public transport is quite difficult as compared to males, possibly because of inappropriate seating arrangements in public transport. The results are summarized in Table 5.4.

5.5.5 Satisfaction level with finding seats in Public Transport

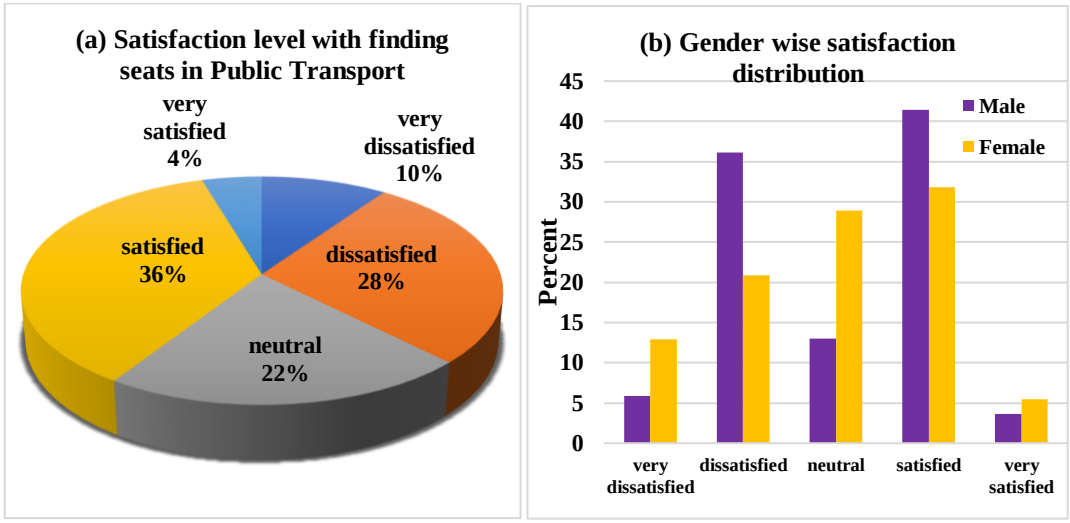


Figure 5.5.26 (a) Satisfaction level with finding seats in public transport (b) Gender wise distribution

Fig 5.26 (a) shows the satisfaction level of respondents with finding seats in public transport and according to this 40 percent of the respondents can find a seat easily, while 38 percent were not satisfied, and 22 percent gave a neutral opinion.

According to fig 5.26 (b), 38 percent of female respondents and 45 percent of male respondents were satisfied, that they can get a seat easily in a public vehicle. On the other hand, 41 percent of male and 34 percent of female respondents were not satisfied respectively. 13 percent male and 29 percent of the female respondents gave neutral opinion (sometimes they get a seat easily and sometimes not). From Chi-Square test get **P = 0.000**. Here P < 0.05 which means statistically there is a

relationship between gender and finding seats in a vehicle. In each public vehicle, only 5 seats were available for female passengers, whereas the male passengers could hang outside the vehicles if they face any difficulty in accommodating themselves within public vehicles. The results are summarized in table 5.4.

5.5.6 Satisfaction level with cleanliness of Public vehicles

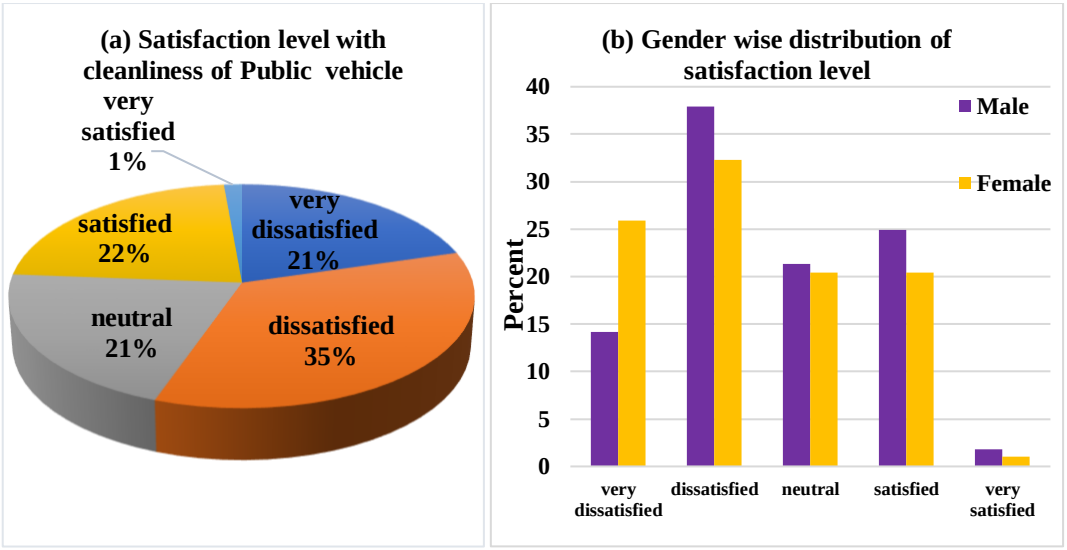


Figure 5.5.27 (a) Satisfaction level with cleanliness of public vehicles (b) Gender wise distribution

From the above distribution, it could be analyzed that almost 56 percent of the respondents were not satisfied with the cleanliness of public vehicles. Only 23 percent of respondents consider it was not an issue whereas 21 percent having a neutral opinion.

Fig 5.27 (b) shows the gender-wise distribution of satisfaction regarding the cleanliness of public vehicles, where both the gender ends up having the same opinion about the cleanliness of public vehicles. In order to check the significant relationship between gender and cleanliness of public vehicles, a Chi-Square test has been conducted. Chi-Square **P = 0.086**, which is greater than 0.05. It shows that there

is no statistically significant association between gender and cleanliness of public vehicles. Both male and female respondents having the same opinion regarding the cleanliness of vehicles. The results are summarized in table 5.4.

5.5.7 Satisfaction level with Ride Quality of public transport

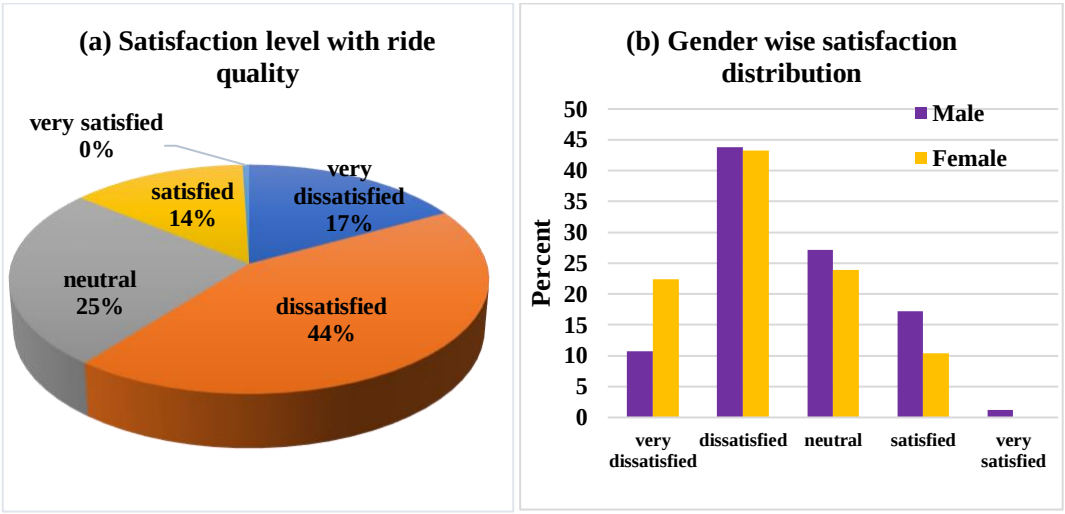


Figure 5.5.28 (a) Satisfaction level with the ride quality of public transport (b) Gender wise distribution of satisfaction level

Fig 5.28 (a) shows that only 14 percent of the respondents were satisfied while 62 percent of the respondents were not satisfied with the ride quality of public transport. 25 percent of the respondents having a neutral opinion on it. According to Fig 5.28 (b), 66 percent of females and 55 percent of male respondents were dissatisfied with ride quality. The figure clearly shows that as compared to males a greater number of females were dissatisfied.

In order to check the significant relationship between gender and ride quality of PT (public transport), a Chi-Square test has been conducted. The hypothesis tested are: H_0 = Gender and satisfaction with the ride quality of PT are independent. H_1 = Gender and satisfaction with ride quality of PT are not independent. The results show that **P**

= **0.010**. As the P-value (0.010) is less than the significance level 0.05, reject the null hypothesis, and accept the alternate hypothesis, i.e. Gender and satisfaction with the ride quality of PT are not independent. This research shows that there is a relationship between gender and satisfaction with the ride quality of public transport.

5.5.8 Satisfaction level with odor and temperature of Public transport

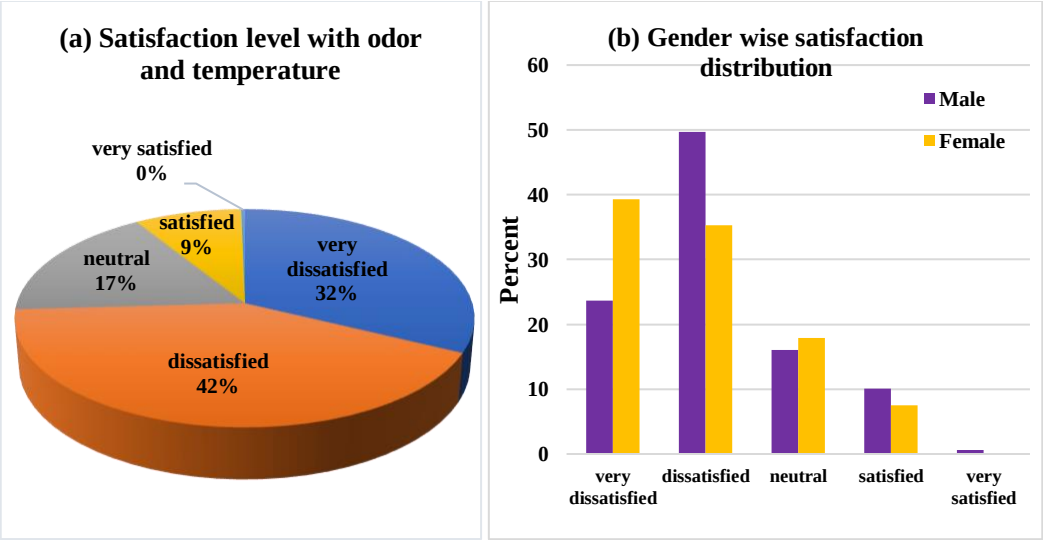


Figure 5.5.29 (a) Satisfaction level with inside odor and temperature of public vehicles (b) Gender wise satisfaction distribution

It is clearly shown in fig 5.29 (a) that almost 74 percent of the respondents were not satisfied with the inside odor and temperature of public vehicles. Only 9 percent of the respondents believed that temperature and odor inside public vehicles are pleasant. The rest of the respondents having a neutral opinion.

Fig 5.29 (b) shows that 40 percent of females and 24 percent of male respondents were highly dissatisfied. A greater number of females were highly dissatisfied. Female respondents stated that public vehicles get too much suffocated due to the overloading of passengers. No female respondent was highly satisfied with the inside

odor and temperature. A Chi-square test has been conducted to check the significant relationship between gender and inside odor and temperature of public vehicles. The results show that the value of **P = 0.009.** As the P-value (0.009) is less than the significance level 0.05, which shows that gender and inside odor and temperature of public vehicles are dependent. The results are summarized in table 5.4.

5.5.9 Satisfaction level with softness and cleanliness of seats

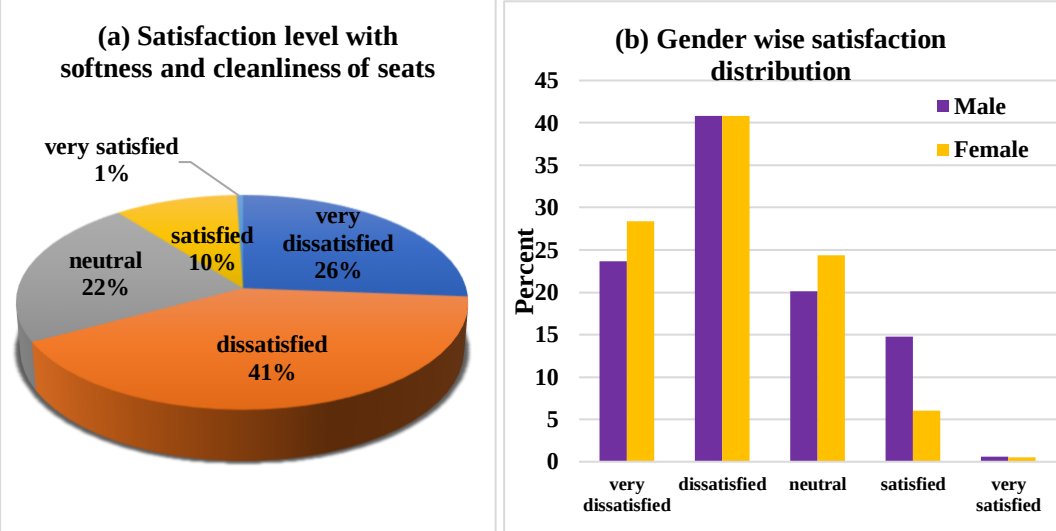


Figure 5.5.30 (a) Satisfaction level with the cleanliness of seats (b) Gender wise distribution

Fig 2.30 (a) Clearly shows that only 11 percent of the respondents were satisfied with the softness and cleanliness of seats, whereas 67 percent were dissatisfied and 22 percent having a neutral opinion. Fig 5.29 (b) shows that both genders were having the same opinion about the cleanliness and softness of seats in public vehicles. From Chi-square test get **P = 0.070.** P-value is greater than 0.05, which means statistically there is no significant relationship between gender and satisfaction level with softness and cleanliness of seats. The results are summarized in Table 5.4.

(Namgung & Akar, 2014) found that there are gender differences in public transport related to attitudes. Females tend to have a more negative attitude towards public transit as compared to males, however (Sze-Siong & Aksan, 2018) concluded that there is no significant difference in satisfaction level among male and female students.

5.5.10 Satisfaction level with Punctuality of travel time

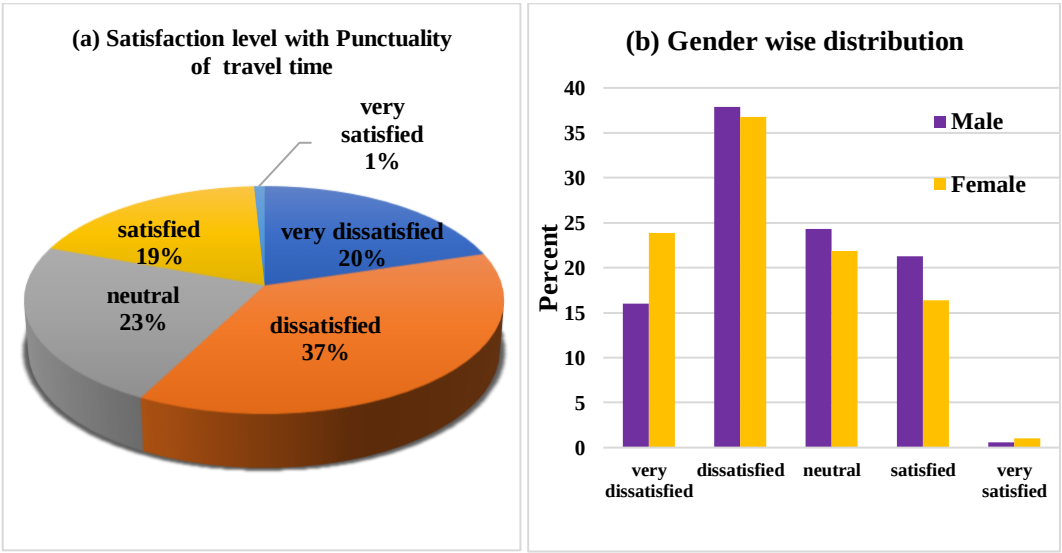


Figure 5.5.31 (a) Satisfaction level with the punctuality of travel time (b) Gender wise satisfaction distribution

From fig 5.31 (a) 20 percent of the respondents were satisfied while 57 percent were not satisfied with travel time punctuality. 23 percent have a neutral opinion. Fig 5.30 (b) shows gender-wise satisfaction distribution and according to this fig both the gender ends up having the same opinion about the punctuality of travel time by public transport. From Chi-Square test **P = 0.350**, which is greater than 0.05. It means there statistically there is no relationship between gender and satisfaction with travel time punctuality. Both the gender having the same opinion.

5.5.11 Satisfaction Level with Physical condition of Public vehicles

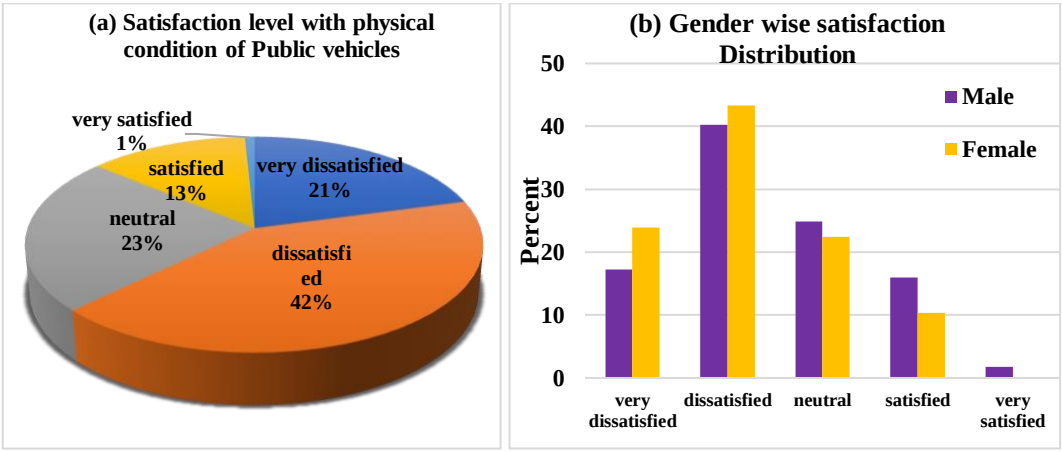


Figure 5.5.32 (a) Satisfaction level with the physical condition of public vehicles (b) Gender wise distribution

Fig 5.32 (a) shows that only 14 percent of the respondents were satisfied while 63 percent were dissatisfied with the physical condition of public transport. And 23 percent of the respondents having a neutral opinion.

Fig 5.32 (b) shows the gender-wise distribution of respondents regarding satisfaction with the physical condition of public vehicles. The bar graph shows that there is no significant difference between the satisfaction level of both males and females. Almost both having the same opinion regarding the physical condition of public vehicles. From the chi-square test **P = 0.086** which is greater than 0.05, which means statistically there is no significant relationship between gender and satisfaction level with the physical condition of vehicles.

5.5.12 Satisfaction level with seating arrangement for both male and female

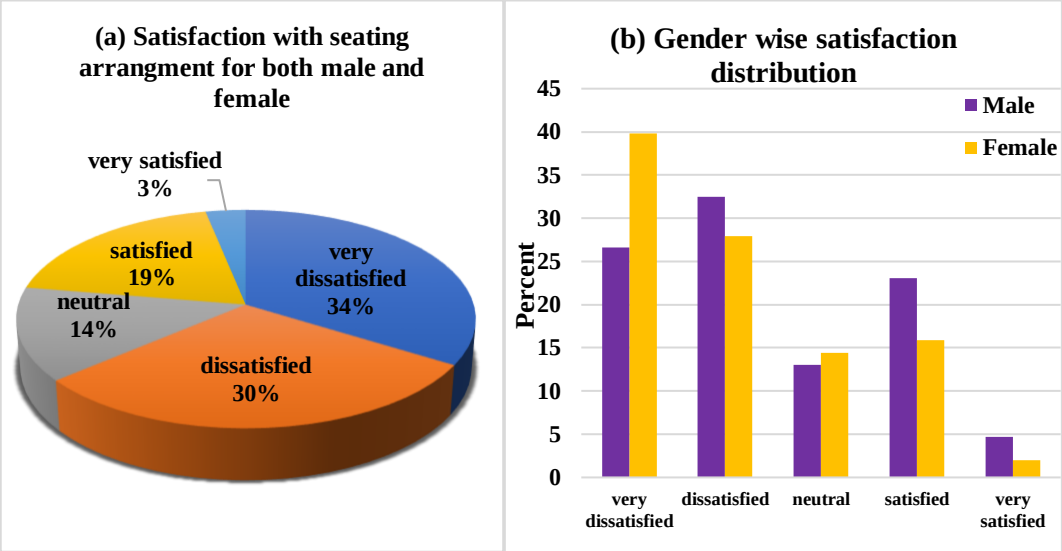


Figure 5.5.33 (a) Satisfaction level with seating arrangement for both male and female (b) gender-wise satisfaction distribution

Fig 5.33 (a) shows that about 64 percent of the respondents were not satisfied with the seating arrangement in public transportation while 22 percent of the respondents were satisfied, and 14 percent have a neutral opinion regarding seating arrangement. Fig 5.33 (b) shows the gender-wise distribution and it is evident from the bar diagram that almost 68 percent of female respondents were not satisfied with the seating arrangement only 18 percent of the female respondents believed that the seating arrangement is good. It could be observed that males were not very concerned about seating arrangement mostly female respondents were dissatisfied. A Chi-square test has been conducted to check the significant relationship between gender and seating arrangement in public vehicles. The results show that the value of **P = 0.039.** As the P-value (0.039) is less than the significance level 0.05, which shows that gender and seating arrangements for males and females in public vehicles are dependent. The results are summarized in Table 5.4.

5.5.13 Satisfaction level with fares of public transport

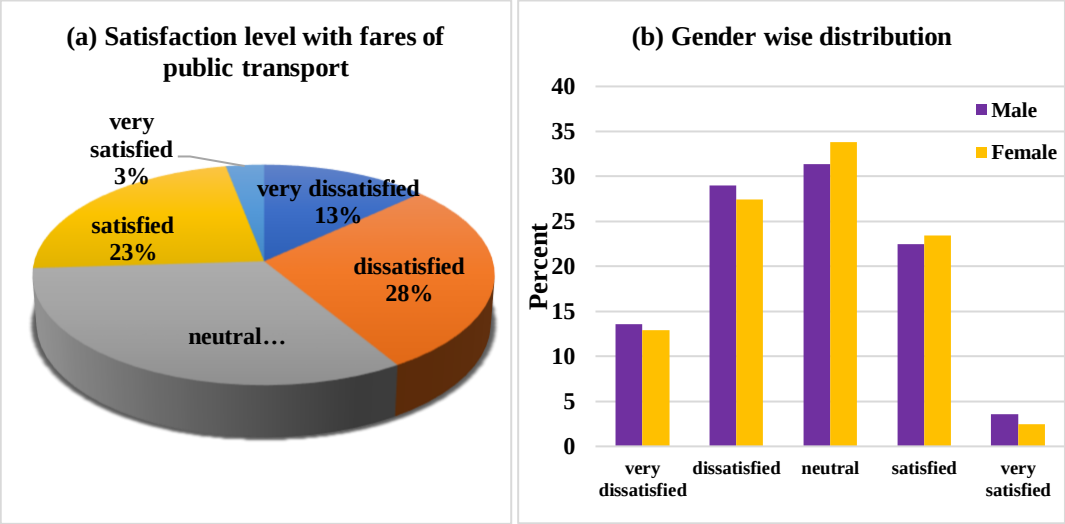


Figure 5.5.34 (a) satisfaction level with fares (b) Gender wise satisfaction distribution

Fig 5.34 (a) shows that 41 percent of respondents were not satisfied with public transport fares while 25 percent were satisfied and 33 percent having a neutral opinion.

Fig 5.34 (b) shows the gender-wise distribution of satisfaction level with public transport fares, it has been observed that both male and female respondents almost having the same opinion. Dissatisfied respondents stated that public transport does not have fixed fares. In order to check the significant relationship between gender and satisfaction level with public transport fares, a Chi-square test has been conducted. From the chi-square test **P = 0.955** which is greater than 0.05, which means statistically there is no significant relationship between genders regarding satisfaction level with fares of public transport. The results are summarized in table 5.5.

Table 5.5 Satisfaction level with public transport

Variables	Gender	Satisfaction level Frequency (percentage)					Difference between gender and satisfaction level	
		Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	Chi-Square	P-value
Satisfaction level with cleanliness of stops	Male	39 (23.1%)	68 (40.2%)	33 (19.5%)	26 (15.4%)	3 (1.8%)	4.194	0.380
	Female	62 (30.8%)	74 (36.8%)	33 (16.4%)	31 (15.4%)	1 (0.5%)		
Satisfaction level with staff behaviour	Male	22 (13.0%)	53 (31.4%)	45 (26.6%)	40 (23.7%)	9 (5.3%)	7.111	0.130
	Female	40 (19.9%)	58 (28.9%)	50 (24.9%)	50 (24.9%)	3 (1.5%)		
Satisfaction level with safety and security	Male	23 (13.6%)	47 (27.8%)	37 (21.9%)	59 (34.9%)	3 (1.8%)	25.069	0.000
	Female	61 (30.3%)	68 (33.8%)	35 (17.4%)	36 (17.9%)	1 (17.9%)		
Satisfaction level with boarding and disembarking	Male	29 (17.2%)	40 (23.7%)	57 (33.7%)	41 (24.3%)	2 (1.2%)	18.627	0.001
	Female	65 (32.3%)	58 (28.9%)	49 (24.4%)	26 (12.9%)	3 (1.5%)		
Satisfaction level with finding seats	Male	10 (5.9%)	61 (36.1%)	22 (13.0%)	70 (41.4%)	6 (3.6%)	25.982	0.000
	Female	26 (12.9%)	42 (20.9%)	58 (28.9%)	64 (31.8%)	11 (5.5%)		
Satisfaction level with cleanliness of public vehicles	Male	24 (14.2%)	64 (37.9%)	36 (21.3%)	42 (24.9%)	3 (1.8%)	8.154	0.086
	Female	52 (25.9%)	65 (32.3%)	41 (20.4%)	41 (20.4%)	2 (1.0%)		
Satisfaction level with ride quality	Male	18 (10.7%)	74 (43.8%)	46 (27.2%)	29 (17.2%)	2 (1.2%)	13.275	0.010
	Female	45 (22.4%)	87 (43.3%)	48 (23.9%)	21 (10.4%)	0 (0.0%)		
Satisfaction level with odour and temperature	Male	40 (23.7%)	84 (49.7%)	27 (16.0%)	17 (10.1%)	1 (0.6%)	13.617	0.009
	Female	79 (39.3%)	71 (35.3%)	36 (17.9%)	15 (7.5%)	0 (0.0%)		
Satisfaction level with softness and cleanliness of seats	Male	40 (23.7%)	69 (40.8%)	34 (20.1%)	25 (14.8%)	1 (0.6%)	8.674	0.070
	Female	57 (28.4%)	82 (40.8%)	49 (24.4%)	12 (6.0%)	1 (0.5%)		
Satisfaction level with Punctuality of travel time	Male	27 (16.0%)	64 (37.9%)	41 (24.3%)	36 (21.3%)	1 (0.6%)	4.440	0.350
	Female	48 (23.9%)	74 (36.8%)	44 (21.9%)	33 (16.4%)	2 (1.0%)		
Satisfaction level with	Male	29 (17.2%)	68 (40.2%)	42 (24.9%)	27 (16.0%)	3 (1.8%)	8.164	0.086

physical condition of public vehicle	Female	48 (23.9%)	87 (43.3%)	45 (22.4%)	21 (10.0%)	0 (0.0%)		
Satisfaction level with seating arrangement for both male and female	Male	45 (26.6%)	55 (32.5%)	22 (13.0%)	39 (23.1%)	8 (4.7%)	10.101	0.039
	Female	80 (39.8%)	56 (27.9%)	29 (14.4%)	32 (15.9%)	4 (2.0%)		
Satisfaction level with fares of public transport	Male	23 (13.6%)	49 (29.0%)	53 (31.4%)	38 (22.5%)	6 (3.6%)	0.671	0.955
	Female	26 (12.9%)	55 (27.4%)	68 (33.8%)	47 (23.4%)	5 (2.5%)		

5.6 Actual vs perceived satisfaction

In order to check the significant difference between actual and perceived satisfaction, a paired sample t-test was conducted, and the following hypothesis was considered: H_0 = there is no significant difference between actual and perceived satisfaction; H_1 = there is a significant difference between actual and perceived satisfaction. The result showed that p-value = 0.021 < 0.05; accepting alternative hypothesis, i.e. there was a significant difference between actual and perceived satisfaction of respondents. The mean value of perceived satisfaction (2.51) was greater than actual satisfaction (2.43) which shows, in actual people were more dissatisfied with public transport than they perceive. Test results are summarized in Table 5.6.

Table 5.5 Actual vs perceived satisfaction with public transport

Variables	**Mean**	**S. D**	**t-value**	**P-value**
Overall Actual Satisfaction level	2.43	0.661	- 2.327	0.021
Overall Perceived Satisfaction level	2.51	0.926		

5.7 Summary

The study found that most of the female students used minicabs and family cars, while male students used public transport and minicabs for educational trips. However, but both males and females preferred to use their family cars. This study has also found that the rainy season affects the usual mode choice and usual travel time of students. In bad weather, most of the respondents switch to their private cars. Respondents who use public transport in normal days, also switch to other modes. Rainfall has significant effect on motorbikes and pedestrians; as they also switch towards other travelling modes. Bad weather has an insignificant effect on respondents travelling by school buses. In normal days, a minimum of 30 to 60 minutes is taken, by the majority of the student population. But the days with bad weather conditions or heavy rainfall increases the time of travelling, sometimes to an extent of more than 3 hours. The satisfaction level shows that females have a more negative opinion about public transport than males. Significance difference was also observed between actual and perceived satisfaction. A private car takes less travel time but a relatively higher travel cost than public transport.

Chapter 6

MODEL DEVELOPMENT AND VALIDATION

6.1 Background

A multinomial logit model (MNL) is generally used to analyze the relationship between polytomous variables (dependent variable) and a set of regressor or independent variables (So & Kuhfeld, 1995). In the MNL model, travelers are believed to have somewhat non-observable, latent choices or utilities for different modes of transport, and they use a mode that provides a higher utility level (Schwanen & Mokhtarian, 2005). The basic assumption of choice models is that each commuter is attempting to maximize his/her utility. The principle of utility supposes that commuters have a technique of combining multiple characteristics of all the alternatives to give one measure of utility which is compatible throughout all alternatives within a set of choices opens to them. The model provides the best possible solution to the problem of multiclass pattern recognition; it is a common and convenient way to analyze the potential impact of explanatory variables on the dependent variable category (Hussain et al., 2006). The model can also deal with both categorical and continuous variables, and this model is widely used in mode choice researches with respect to travel behaviour (Li & Zhao, 2015) (Du & Cheng, 2018). Low technical threshold, simplicity, easy implementation, generality and robustness are few of its benefits. Other than that, the model is specified for its low sample requirements, low error rate, and mature technology.

6.2 Travel Mode Chosen by Students

The students were chosen from variety of choices. Walk, motorcycle, family car, private school vans, school bus, and public transport. Minicab, van and mini pickup trucks all are fall under the category of private school van. So, for better analysis outcome all these three modes were combined to get more precise and clearer picture. In the model, each student chooses mode, of the six travel modes. The table below illustrates the percentage of modal split chosen by employees.

Table 6.1 Mode Split of Students

Mode Type	Frequency	Percent
Walk	13	3.5
Motorcycle	15	4.1
Family Car	73	19.7
Private School Van	189	51.1
School Bus	28	7.6
Public Transport	52	14.1

In the study area, Private School Van was the most predominantly used mode for educational trips. The second mode choice among school-going teenagers used their private car (20 percent). Only 14 percent of students used public transport.

6.3 Model Result

SPSS Statistics was used for modelling. Using Slovin's sampling method, a total of 370 samples were collected, out of 370 collected samples, model was formulated by using 310 and the rest were 60 used to validate the model. Six modes were used in the development of multinomial logit mode, i.e., walk, motorcycle, private school vans, family cars, school bus, and public transport. Various explanatory variables

were used for the development of the model; household size, dwelling type, family system, number of school-going children, number of people earning in a household, number of vehicles in the household, employment of parents, type of school, disability, educational level of a child, number of school days and parking availability at dwelling area and school campus. However, only age, gender, household income, total travel time, total travel cost, and total travel distance were found significant. So, these six variables were used for further analysis.

6.4 Pseudo R-Square

What makes the "highest" R2 value varies from one field to another. For multinomial logistic regression models, the r- squared pseudo statistic that calculates the variance in the dependent variable that is explained by a regression model can't be calculated. The r-squared pseudo-statistics are configured to have comparable characteristics to the true r-squared stat. Although these statistics on their own may be informative, they are most evident when analyzing contrasting models for the same results. The model with the highest R-square statistics is best, according to this test. The Cox and Snell R-square calculation works like R-square, with high value suggested the higher match for the model. This calculation is constrained because it is unable to reach the overall value of 1. Thus, Naglekerke suggested a change that had a range from 0 to 1. The measure provided by Naglekerke is used to indicate the association's significance.

Table 6.2 Pseudo R-Square

Pseudo R-Square	
Cox and Snell	0.732
Nagelkerke	0.781
McFaddan	0.475

6.5 Likelihood Ratio

The likelihood ratio test is the statistical test in which the variable or factor helps in the reduction of measured error by the -2-log likelihood statistic. If the P value of the likelihood ratio test is less than 0.05 then the independent variable contributes in the model and in this case, the variables age, household income, gender, total travel time, total travel cost, and total travel length made a significant contribution in defining the mode choice of school-going students. Results of likelihood ratio test are summarized in table 6.3.

Table 6.3 Likelihood Ratio Test

Effect	**Model fitting criteria**	**Likelihood Ratio Test**		
	-2 log Likelihood of Reduced Model	**Chi-square**	**df**	**Sig.**
Intercept	450.401	0.000	0	
Age	477.140	26.739	5	0.000
Gender	470.294	19.892	5	0.001
Household Income	467.285	16.883	5	0.005
Total travel time	504.484	54.083	5	0.000
Total travel cost	635.549	185.148	5	0.000
Total travel distance	496.793	46.392	5	0.000

6.6 Model Fitting Information

Model fitting information is summarized in table 6.4. In this model, the value of the chi-square test is equal to 408.259 and is less than 0.001 which indicates that between dependent and independent variables the relationship is significant.

Table 6.4 Model Fitting Information

Model	Model fitting criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	858.660			
Final	450.401	408.259	30	0.000

6.7 Goodness-of-fit Tests

The Multinomial Logistic Regression procedure reports Pearson and Deviance goodness offit statistics. The values of the Pearson as well as deviance are calculated. The null model functions as a reference to which the model of final choice is compared. The values above 0.05 show the best fit to the data.

Table 6.5 Goodness of Fit

	Chi-Square	**df**	**Sig.**
Pearson	14631.391	1436	0.000
Deviance	299.479	1436	1.000

6.8 Parameter estimates

Table 6.6 shows parameter estimates of the model. The standard error of all the significant values is between 0 to 1 that indicates no multicollinearity among

independent or predictor variables. In Multinomial Logistic Regression there is no restriction for choosing the reference category so, in this study, family car was taken as a reference in order to get the preference of family car on other modes. The family car was contrasted separately with a motorcycle, school bus, private school vans, and public transport to understand the factors and their degree of influence in shifting students from family cars to public transport and other available alternatives (like, two-wheeler, school bus and private school vans) for school.

Table 6.6 Parameter Estimates

Mode Choice	B	Std. Error	Wald	Df	Sig.	Exp(B)
Motorcycle						
Intercept	-0.312	2.504	0.016	1	0.901	
Age	0.211	0.211	2,137	1	0.144	1.235
Gender = 0	0.956	0.956	1.310	1	0.252	2.602
Gender = 1	0	.	.	0	.	.
Household Income	0.000	0.000	0.416	1	0.519	1.000
Total Travel Time	0.000	0.020	0.159	1	0.690	1.008
Total Travel Cost	-0.005	0.001	29.283	1	0.000	0.994
Total Travel Length	0.186	0.110	11.292	1	0.001	1.446
Private School Vans						
Intercept	2.956	1.235	5.729	1	0.017	
Age	-0.051	0.067	0.574	1	0.449	0.951
Gender = 0	-0.880	0.376	5.470	1	0.019	0.415
Gender = 1	0	.	.	0	.	.
Household Income	0.000	0.000	5.233	1	0.022	1.000
Total Travel Time	0.00	0.010	0.001	1	0.980	1.000
Total Travel Cost	-0.001	0.000	24.667	1	0.000	0.999
Total Travel Length	0.281	0.065	18.617	1	0.000	1.325
School Bus						
Intercept	1.073	2.182	0.242	1	0.623	
Age	-0.069	0.125	0.311	1	0.577	0.933
Gender = 0	-0.305	0.673	0.203	1	0.652	0.737
Gender = 1	0	.	.	0	.	.
Household Income	0.000	0.000	0.475	1	0.491	1.000
Total Travel Time	0.058	0.015	15.270	1	0.000	1.059
Total Travel Cost	-0.005	0.001	44.568	1	0.000	0.995
Total Travel Length	0.417	0.085	23.869	1	0.000	1.518
Public Transport						
Intercept	-4.082	2.472	2.727	1	0.099	
Age	0.391	0.135	8.347	1	0.004	1.479
Gender = 0	1.099	0.647	2.880	1	0.090	3.000
Gender = 1	0	.	.	0	.	.
Household Income	0.000	0.000	6.111	1	0.013	1.000
Total Travel Time	0.063	0.014	20.740	1	0.000	1.065
Total Travel Cost	-0.005	0.001	41.176	1	0.000	0.995
Total Travel Length	0.224	0.088	6.433	1	0.011	1.251

In the methodology analysis section, it was indicated that the proportion of the co-efficient to its standard error, squared, equals the Wald statistic. With regard to the interpretation of the parameters sign, parameters with significant negative coefficients are interpreted to result in a decrease in the probability of that response category with regard to reference category. But on the other side, the positive co-efficient parameters were considered to increase the probability of that type of response.

6.8.1 Motorcycle Relative to family car

In the case of two-wheeler mode utility, total travel length was found to be statistically significant, with positive sign inferred that with an increase in travel length students are more inclined to choose a motorcycle over a family car. It is because of the low travel cost of a motorcycle as compared to a family car. The model also revealed that the utility of motorcycle decreases if travel cost increase, it is obvious high travel cost conveyance will always be less preferred. The Wald test statistic for cost and distance were 29.283, and 11.292 with a p-value of 0.000, and 0.001 respectively.

6.8.2 Private School vans relative to family cars

Regarding the influence of gender over preference between private school vans and family car, males are less inclined to choose private school vans over a family car as compared to females probably because males are less likely to bound themselves. The parametric sign of total travel length indicated that with an increase in travel length students are more likely to choose private school vans over family cars because travel length is directly proportional to travel cost and private school vans

have low travel cost as compared to the family car and coefficient sign of travel cost inferred that utility of private school vans decreases with increase in travel cost. The Wald test statistics for travel cost length and gender were 24.667, 18.617, and 5.470 with a significance value of 0.000, 0.000, and 0.019.

6.8.3 School Bus Relative to family cars

The negative sign of total travel cost indicated that the utility of school buses decreases with the increase in travel cost. The positive coefficient sign of travel time and travel length indicated that with an increase in time and distance students are more likely to choose the school bus over the family car. It might be due to high travel time and distance working parents can't give pick and drop to their children. The Wald test statistics for total travel time, cost, and length were 15.270, 44.560, and 23.869 with a significance value of 0.000.

6.8.4 Public Transport Relative to Family Cars

For public transport utility, variable age has been found statistically significant and the positive sign revealed that with an increase in age students are more likely to shift towards public transport from family cars because with the increasing age students become independent and parents concern about safety and security also minimizes. The positive coefficient of travel length indicated that with an increase in distance students are more likely to choose public transport over family cars because public transport is the cheapest mode of travelling. It has been found that the preference for public transport relative to family cars is higher for higher values of travel time. infect increase in travel time within the city is the indication of traffic congestion so, it can be concluded that as congestion increases students switch from

family cars to public transport. The parametric sign of travel cost indicated that the utility of public transport decreases when travel cost increases because low travel cost is the basic reason for preferring public transport over the family car. The Wald test statistics for time, cost, length, and age were 20.740, 41.176, 6.433, and 8.347 with the significance level of 0.000, 0,000, 0.011, and 0.004.

Empirical utility for different modes is:

U (motorcycle) = -0.312 – 0.005 (TC) + 0.186(TL)

U (private school vans) = 2.956 – 0.001 (TC) + 0.281 (TL) + 0.000 (HI) – 0.880 (G=0)

U (School Bus) = -1.073 – 0.005 (TC) + 0.417 (TL) + 0.058 (TL)

U (public Transport) = -4.082 – 0.005 (TC) + 0.224 (TL) + 0.063 (TT) + 0.000 (HI) + 0.391 (AGE)

6.9 Prediction Success Table

McFadden proposed the prediction performance tables in 1979, and it is a cross-classification between expected alternatives and observed ones. Let the available data comprise of measurements of 'N' individuals, 'J' available alternatives to each person, 'Pki' denotes the likelihood of person 'I' in the set of data chooses alternative k, 'Sli' is individual “I” is observed to choose alternative '1' then a number of entities who are examined to select alternative land predicted by the model to choose alternative k, 'Nlk'$N_{lk} = \sum_{i=1}^{N} S_{li} P_{ki}$

The proportion of individuals who are observed to choose alternative l and predicted by the model to choose alternative k, n_{lk} is

$$n_{lk} = \frac{N_{lk}}{N}$$

The prediction success table is the J×J array whose (l, k) element is either N_{lk} or n_{lk} . The prediction success table is getting as a result in NLOGIT. The percentage of prediction ability can be obtained from this table. The model can be validated by comparing the prediction success table and validation success table. A validation success table can obtain by taking a sample of data by adding or reducing the data with the sample used for model development. The prediction ability of both samples is also needed to be compared.

Sample data of 310 was used for calibration of the model and for validation purposes 60 samples were randomly chosen. From the transport planner's point of view, once the models have been validated, its key findings could further help in policy recommendations. Table 6.7 shows the prediction success table of the model. Cells on the diagonal are correct predictions and cells off the diagonal are incorrect predictions. The prediction ability of the model is 71.3 percent which is acceptable.

Table 6.7 Prediction Success Table

Observed	**Walk**	**Motorcycle**	**Private car**	**Private School Vans**	**School Bus**	**Public Transport**	**Percent Correct**
Walk	10	0	0	0	0	0	100.0%
Motorcycle	0	6	0	2	1	5	42.9%
Private car	0	0	19	34	1	4	32.8%
Private School vans	0	3	11	141	1	3	88.7%
School Bus	0	0	1	6	11	6	45.8%
Public Transport	0	1	0	8	2	34	75.6%
Overall Percentage	3.2%	3.2%	10.0%	61.6%	5.2%	16.8%	71.3%

The percent correct indicating that actual choices of individuals and predicted choices of individuals match. The validation success table was found to be 76.7 percent. It is observed from the Table 6.8 that the model performs particularly well for a walk, motorcycle, private school vans, and public transport mode.

Table 6.8 Validation Success Table

Observed	Walk	Motorcycle	Private car	Private School Vans	School Bus	Public Transport	Percent Correct
Walk	3	0	0	0	0	0	100.0%
Motorcycle	0	1	0	0	0	0	100.0%
Private car	0	0	7	8	0	0	46.7%
Private School vans	0	3	3	27	0	0	90.0%
School Bus	0	0	0	3	1	0	25.0%
Public Transport	0	1	0	0	0	7	100.0%
Overall Percentage	5.0%	1.7%	16.7%	63.3%	1.7%	11.7%	76.7%

6.10 Summary

The multinomial Logit model was developed in SPSS by using 310 samples for calibration and 60 for validation purposes. Pseudo R2 square value shows a 78 percent variation in the developed, which indicated a greater model fit. Model Results have shown that age, gender, household income, total travel time, distance, and cost proved to be the significant factors that influence the mode usage of the students. for public transport and school bus, a positive relationship has been found between travel time and the utility of these two modes. The prediction ability of the model is 71 percent and the model is valid up to 77 percent.

Chapter 7

CONCLUSION AND RECOMMENDATIONS

7.1 Summary of Findings

Mode choice behaviour, travel characteristics, and satisfaction with public transport were explored. The first objective of the study was to identify gender-based modal choices, preferences, and travel characteristics among students and the results show that most of the female students used minicab and family cars, while male students used public transport and minicabs for educational trips. However, but both males and females preferred to use their family cars. This study has also found that the rainy season affects the usual mode choice and usual travel time of students. In bad weather, most of the respondents switch to their private cars. Respondents who use public transport in normal days, also switch to other modes. The comparative results of the travel characteristics show that there is no significant difference between males and females, both genders have the same travel distance and time for school and also spend equal travel cost per month on educational trips.

In order to identify gender-based satisfaction levels with public transport among students, a chi square test has been conducted and the results show that females have a more negative opinion about public transport than males. P-values for satisfaction level with safety and security, boarding and disembarking, finding seats in public vehicles, ride quality, odor and temperature and seating arrangement was less than 0.05. This implies that significant differences between genders regarding variables of satisfaction existed. Significance difference was also observed between actual and

perceived satisfaction. The private car takes less travel time but relatively higher travel cost than public transport.

The mode choice model was also developed for educational trips, and results have shown that age, gender, household income, total travel time, total travel distance, and total travel cost proved to be the significant variables that affect the mode selection of school going children. The negative sign of parameter estimates shows that with the increase in travel cost utility of motorcycle, private school vans, school bus, and public transport decreases. With the increase in travel length students are more inclined towards the motorcycle, private school vans, school bus, and public transport over family cars. Students are more likely to prefer school buses and public transport over family cars when travel time increases. Males are more likely to prefer family cars over private school vans as compared to females. The positive sign of parameter estimates shows that as the age of students increases, they are more inclined towards public transport over family cars.

In general, transport mode choice is not mainly affected by characteristics of the trip maker rather it is highly dependent on the attributes of the travel mode, which implies that when one mode is chosen better than another mode it is due to the level of service which gives to the travellers to satisfy their needs.

7.2 Recommendations

The following potential recommendations were forwarded, based on the study findings:

In developing countries, like Pakistan, the study found that there is a limited concept of walking and bicycling prevalent among school-going children, because of a lack

of pedestrian safety infrastructure. Planners should give special attention to pedestrian safety infrastructure so that for low travel distance active transportation encourage and awareness campaigns should be held to encourage school going children for using walking and bicycle mode.

Comparative results of satisfaction level with public transport show that females have a more negative opinion about public transport than males and descriptive analysis of mode choice also shows that very few female students used public transport for educational trips, hence it is recommended that planners should give special attention towards separate female public transportation system so that it encourages them to travel through public transport.

Every school must provide the facility of a school bus, availing school bus services can reduce traffic congestion at school access points as well as on the roads and School Campuses must be out of residential areas.

Morning and evening timings for middle, secondary and higher secondary schools must be staggered it will surly reduce traffic congestion to a large extent.

Model results show that with an increase in travel length students are more likely to travel by school bus and public transport as compared to family cars because of low travel cost, although students are not satisfied with the public transport, but still for longer distances they prefer it more than a family car. So, it is recommended that local government and authorities should give special attention to improving public transport so that students are more likely to shift towards public transport from family cars, which in turn helps in reducing traffic congestion in peak hours.

Transport modelling is a very wide sector in road and transport engineering, and it is impossible to cover every aspect with time and budget limitation therefore in order to study on a wider scale it is recommended to do it in a team or as a research department in the transport sector agencies.

7.3 Future Research

In developing countries, like Pakistan, understanding of even the basic travel pattern of educational trips still unclear. This study focuses on travel patterns of school-going children only and Children's travel behaviour varies from that of adults hence it is recommended that travel patterns of college and university students should also be studied.

In this study only Multinomial Logistic Regression has been used to identify the factor affecting mode choice, hence it is recommended that mode choice should be modelled by using the probit model and compare with the logit model.

Further research can be conducted out to establish models of choice for trips besides educational trips, such as social trips, shopping, recreational, and work trips.

7.4 Limitations

This study was limited for educational trips and only considered home based school trips. Other trips like shopping, work-based, recreational should also be studied in developing countries. The data collected during the household survey has been limited to children of middle, secondary, and high secondary school students. Primary school and university going students were not considered. This study only considered household characteristics, child characteristics, mode and travel

characteristics, and psychological variables, which include satisfaction regarding public transport. The built environment and geographic characteristics should also be incorporated for further clarity.

7.5 Conclusion

This study identifies gender-based model choices, preferences, and travel characteristics among school-going children and investigates the satisfaction level of respondents with public transport. And by using SPSS, the MNL model was also developed for educational trips in Abbottabad, Pakistan. Using Slovin's sampling method, a total of 370 samples were collected. For model development 310 were used for the development of model and 60 were used for its validation. For the satisfaction of public transport, an index was constructed using indicators extracted from a rigorous literature review. Descriptive statistics, chi-square tests, and paired sample t-test were conducted to find out the significant differences between genders and other travel characteristics. Results show that there was a significant difference between the mode choices and preferences of male and female students. There was no significant difference in travel time, travel distance, and travel cost, but males tended to make more trips than females. The satisfaction level shows that females having more negative opinions about public transport than males. The significant difference between actual and perceived satisfaction was also observed, which implies students are more dissatisfied with public transport. Model results show that the following are the factors that affect mode choice of school-going children; gender, age, household income, total travel time, total travel distance, and total travel length.

Reference

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APPENDIX

Questionnaire

Sr. No:_____ Area: _____

The purpose of this study is to examine "Mode Choice Behavior of school going students". This study is being conducted at National University of Science and Technology (NUST) Islamabad. The survey should only take 5-10 minutes to complete. Be assure that all answers you provide will be kept in the strictest confidentiality.

Part I: Household Information

1. Household Size: _____ 2. Household Income: _____
3. Type of dwelling unit: ☐ apartment/flat ☐ independent house
4. Family System: ☐ Joint ☐ Single
5. Number of schools going children in a household: _____
6. Number of people earning in a household: _____
7. Number of vehicles in a household: _____
8. Employment of parents:

a. Whether mother is ☐ Employed ☐ Unemployed ☐ Retired ☐ Self-Employed
b. Whether father is ☐ Employed ☐ Unemployed ☐ Retired ☐ Self-Employed

9. Number of license holders in a household: _____
10. Ownership of transportation means:

☐ Private Car ☐ Motorcycle ☐ Bicycle ☐ No Means ☐ Others

Part II: Child Information

Sr. No	Gender	Age	Type of School	Any Disability	Education	Number of school days in a week
1	☐ Male ☐ Female		☐ Public ☐ Private School Name:	☐ Yes ☐ No Any Special Needs:	☐ Middle ☐ Secondary ☐ High Secondary	☐ 5 ☐ 6
2	☐ Male ☐ Female		☐ Public ☐ Private School Name:	☐ Yes ☐ No Any Special Needs:	☐ Middle ☐ Secondary ☐ High Secondary	☐ 5 ☐ 6

3	☐ Male ☐ Female		☐ Public ☐ Private School Name:	☐ Yes ☐ No Any Special Needs:	☐ Middle ☐ Secondary ☐ High Secondary	☐ 5 ☐ 6

Part III: Mode & Travel Information

1. Usual Mode Choice:
   ☐ Walk/Bicycle ☐ Motorcycle ☐ Car ☐ Carry ☐ Van ☐ Bus ☐ Suzuki
   ☐ Suzuki (Public) ☐ Careem
2. Preferred Mode Choice: _____
3. Mode choice in bad weather conditions: _____
4. Total number of modes available: _____
5. Change of mode during each trip: _____
6. Total trip length: _____ Km.
7. Total travel cost for car _____ Rs.
8. Total travel cost for public transport: _____ Rs. Number of modes used: _____
9. Total waiting time at stop: _____ Minutes.
10. How much time it takes to reach the nearest Public Stop from home _____ Minutes.
11. What fare do you pay monthly _____ Rs.
12. Which route is used by your child to reach his/her school _____
13. How much time it takes to reach the school by car: _____ Minutes.
14. How much time it takes to return back to home from school by car: _____ Minutes.
15. How much time it takes to reach the school by Public transport: _____ Minutes.
16. How much time it takes to reach home after school by Public transport: _____ Minutes.
17. How much time it takes to reach the school in bad weather conditions: _____ Minutes.
18. How much time it takes to reach home after school in bad weather conditions: _____ Minutes.
19. Capacity of vehicle: _____ PAX
20. Is Parking available in dwelling area: Yes ☐ No ☐
21. Is Parking available in school campus: Yes ☐ No ☐

Part IV: Satisfaction level with public transport
(Choose one option)

S. No	Statement	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied

1.	Are you satisfied with the cleanliness of stops?					
2.	Are you satisfied with the staff behavior?					
3.	Do you feel safe and secure while travelling by private vehicle?					
4.	Do you feel safe and secure while travelling by Public transport?					
5.	Are you satisfied with the boarding and disembarking?					
6.	Can you find seat easily in a vehicle?					
7.	Are you satisfied with the cleanliness of public vehicles?					
8.	Are you satisfied with the ride quality of private vehicle?					
9.	Are you satisfied with the ride quality of public transport?					
10.	Are you satisfied with the odor and temperature of public vehicle					
11.	Are you satisfied with the softness and cleanliness of seats in public transport?					
12.	Are you satisfied with the Punctuality of travel time by public transport?					
13.	Are you satisfied with the physical condition of public vehicle?					
14.	Are you satisfied with the seating arrangement for both males and females in public transport?					
15.	Are you satisfied with fares in public transport?					
16.	Overall satisfaction level with the Public transport.					
17.	Overall satisfaction level with the private vehicle?					

Any other Comments or Suggestions you'd like to add: