Traffic Safety Perception of Ready-Made Garment Workers in Bangladesh

by

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Dedication

I dedicate this thesis to my parents, my grandparents, my wife and my teachers.

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List of Abbreviations

AADT	Average Annual Daily Traffic
RSE	Road Safety Education
RMG	Ready Made Garment
OLS	Ordinary Least Square
GDP	Gross Domestic Product
IMF	International Monetary Fund
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
CBD	Central Business District
EU	European Union

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Abstract

Pedestrian injuries are now a major safety issue all over the world, especially in developing countries such as, Bangladesh. However, the country is heavily dependent on its Ready-made Garment Workers' (RMG) industry which is the greatest source of generating foreign currency, mass employment and a gateway to socio-economic development. Majority of the garments workers choose walking as their mode of transport and thus are categorized as pedestrian. Consequently, this particular group is under safety threat considered as the most vulnerable among all road users. To handle this problem, improving traffic safety education for RMG workers' may be a solution. On response to the problem, this study aims to explore garments workers' traffic safety perception and the factors associated with it. In the arena of acquiring knowledge, safety education governs a dynamic role in influencing the approaches and behaviors of pedestrians. So, for strengthening road safety education, it requires to grab knowledge from diversified sources.

To explore the safety perception and education source of RMG workers, a questionnaire survey was conducted among RMG workers at most prominent road accident zones. Multiple Linear regression model was applied for analyzing the perception factor that may affect the behavioral characteristics of garment workers. Results showed that risk perception varied significantly with the worker's age, income group, marital status, number of children, mode of transport, average weekly walk duration, educational qualification, previous accident experience (active and passive). In addition, for the development of safety educational source among the vulnerable pedestrians, logistic regression model was used. The result illustrates that factors based on worker's age, marital status, lower income group, public transport user, having no physical disability, weekly walking duration from house to workplace, home distance, having living experience inside the urban area, transport cost has significant influence on safety education source of the RMG workers. The purpose of making two studies is to identify a vulnerable group to whom the training is more prioritized and beneficial and require attention for improving their safety perception.

Keywords: Accident analysis, Garments worker, Safety perception, Safety Education

CHAPTER 1: INTRODUCTION

1.1 Background

The economic performance of the apparel and textiles industry in developing countries has large impacts on employment opportunities (especially for women) and a variety of social indicators such as health, income, equity, etc. Bangladesh, a typical developing country, is considered as a leader in the Ready-Made Garment (RMG) sector (Berg et al., 2011, Montero, 2005). With around US$15 billion in export in calendar year 2010, the RMG industry is currently Bangladesh's most important sector, accounting for 13% of gross domestic product (GDP) and 75% of total export (Berg et al. 2011). The RMG export is also an engine of economic development due to its impressive 12% average annual growth rate and the approximately 5,000 RMG factories currently employ about 3.6 million workers. Moreover, it has provided around 1.5 million female workers with some economic independence (Berg et al., 2011).

A researcher has shown that the lack of strict land use planning and control is the key reason for such disarray (Cozzani et al. 2006). Hoque et al., 2006 shows that the development of these garment factories in the core areas of Dhaka city not only induced huge influx of pedestrian traffic but also generated large sized semi-trailer truck movements for which the city roadway facilities are not designed to accommodate. A study analyzed the database and reported that there is a total of 2960 enlisted garment industries in and around Dhaka Metropolitan City and about 1,070,754 workers are employed in these industries. Sixty-two (62 %)percent factories are found to be clustered along the primary and secondary roads and all together seventy-two percent (72 %) workers are working in these industries. Along the main primary roads viz. Airport Road, Begum Rokeya Sharani, Progoti Sharani, Mirpur Road, nearly 47 % garments industries are found to be bunched together and are attracting about 54 % workers. Everyday these industries are generating 200,000, 145,000, 145,000 and 92,000 worker's movements respectively. On the other hand, 15 % industries are flocked together along the major secondary roads of Dhaka city

and about 18% workers are employed in these industries. A total of 146 and 42 industries are at Mid-Block Locations (Hoque et al., 2006). The study also reports that desperate attempts of roadway crossing by garments workers are found to be clustered along the main streets of Motijheel and Dilkhusha C/A respectively and are generating nearly 68,000 worker movements in the busy CBD areas. Questionnaire surveys reveals that garments worker are poorly remunerated and by and large they are compelled to live in the fringe areas particularly in the Eastern and Western sides low lying areas as well as in different slum areas of Dhaka City forming mess system. Because of sometimes being very poorly paid; they face economic issue for which 88% of the workers cannot afford to pay travel expenses and are compelled to commute on foot and only 12% of the workers are using bus services (Hoque et al., 2006). Therefore, the bulk of pedestrians in the city of Dhaka are exposed to high velocity traffic because the RMG factories are located at the outskirts of the capital or along city's busy streets when located at CBD areas. This increased in the flow of pedestrians and vehicular traffic has generated serious traffic challenges. One study confirms that pedestrian-vehicle collisions often occur when and where a large number of pedestrians travel within any roadway systems with high traffic flow (LaScala et al., 2000).

A significant number of studies have already been conducted around the world on traffic injuries and fatalities (LaScala et al., 2000; Harruf et al., 1998; WHO, 2009 and ARI 2011). According to the World Health Organization, more than 1.2 million people die on the roads every year and as many as 50 million others are injured, and over 90% of the deaths occur in the low and middle income countries (WHO, 2009). The study also reveals that low and middle income countries have higher road traffic fatality rates (21.5 and 19.5 per 100,000 populations, respectively) than high income countries (10.3 per 100,000). Another study also suggests that in developing countries the pedestrian causality rate is more than 85%. A WHO road report also indicates that 50% of hospital beds were occupied by pedestrian accident causalities in developing countries (Mumford, 2007). Therefore, it is imperative that more efforts be devoted to understanding the challenges and reducing the pedestrian traffic injuries in the region of rapidly rising economies.

In Bangladesh alone, there were 21 623 pedestrian-vehicle collisions in 1988-2011, resulting in 25 048 pedestrian casualties (ARI,2011). Of these collisions, only 1067

occurred at the pedestrian crossings and 19 968 occurred on national highways. The data also indicate that most of the pedestrian casualties were either located at the road sides or road centerline. It is evident that most of the pedestrian's hit were either crossing the road or walking along the roadside. More importantly, only a small share (1079/21623) of these pedestrian collisions had pedestrian activities listed as a factor contributing to the accidents (ARI,2011). Not only the RMG workers face problem while on road but also while in the workplace, they face some life taking events at the time of their working. A survey styled "Occupational Accident, Violence (January-December) 2013" was conducted by the Bangladesh Institute of Labour Studies (BILS) on the occasion of the World Day for Safety and Health at Work and report was prepared using data from 20 newspapers. The report reveals that at least 1,912 workers were killed and another 5,738 were injured in workplace accidents and violence in the year 2013. Of the total number of deaths, around 70% (1,194) met accidental deaths in the readymade garment (RMG) sector which is the highest, as the report reveals. The second highest number of deaths (186) was recorded in the transport sector, with the construction sector ranking third which saw deaths of 95 workers (Khan, 2014). So, it is quite clear that the pedestrians among the garments workers are definitely adding a significant amount to the total number of pedestrian death being recorded nationally.

However, though the garments' workers major mode of transport is walking, they are considered as pedestrians which generates safety problems. It is reported by the garment workers that while walking, the main problem is posed by encroachment of footpaths in many descriptions. Besides encroachment problem, overall effectiveness of footpaths is also undermined by the presence of hazardous uncovered manholes, electric posts, signposts, traffic signals, footbridge landings etc. This poorly sited street furniture prevents full use of the footpaths, impede visibility of road users and thereby make workers movements uncomfortable and hazardous. Eventually, in the absence of functional footpaths, the workers are pushed to walk on the active roads. Moreover, due to foul use of road sides particularly for stacking construction materials, uncontrolled parking and placing garbage bins etc., workers are further compelled to by-pass them by going deep into the main roads and thereby increasing possibilities of road accidents. On account of inadequate network of city's drainage system, many of the city streets get flooded during

the rainy season whenever there are heavy downpours and cause immense suffering to the workers. Another threat to the pedestrian safety is often created by different utility agencies when they dig up roads for laying pipes and cables (Hoque et al., 2006). The problems facing the RMG workers at roads are acknowledged by many international organizations and they exert pressure to the concerned authorities to solve those issues. Thus, pedestrian safety for the RMG workers in Bangladesh is a major transportation, safety and economic issue. These vulnerable road users are very prone to involve in crashes and there is a need to explore underlying reasons of these collisions in order to design and implement appropriate safety measures to improve the scenario.

From a theoretical perspective, risk perception is considered a crucial factor in understanding pedestrian behavioral. It refers to the subjective interpretation involved in different traffic situations (Albery et al., 1996 and Rutter el al., 1998). Brown and Groeger (1998) suggest that this perception is determined by information regarding the potential hazards in the traffic environment and the perceived ability of the person to prevent those potential hazards from becoming actual accidents.

Pedestrian characteristics are also expected to have a significant effect on risk perception. Blair et al., (2004) find that safe behavior increases with age and females are more conscious of safe behavior and beliefs. Kouabenan (1998) find social practices and ethnic membership to influence risk perception as well as the explanation that pedestrians give for accident occurrences. Greater variance in risk perception can also be found between countries than between different regions in one country due to the larger cultural differences and how people perceive different risk sources.

Despite its importance locally and the evidence from studies conducted overseas, very little research has been conducted on pedestrian risk perceptions in Bangladesh or other developing countries. Therefore, this study aims to explore the demographic factors effecting the traffic safety perceptions of RMG workers in Bangladesh.

1.2 Problem Statement

Ensuring safety of the pedestrians is one of the compulsory role. In Eastern Europe as well as in the poorer Third World countries, pedestrians are still the group of road users that are most at risk. Pedestrians can be found virtually everywhere in urban areas, including low-density suburban settlements. On average, a pedestrian is injured in a traffic collision every eight minutes nationwide. Each year, more than 270 000 pedestrians lose their lives on the roads around the world. Many leave their homes as they would on any given day and never to return (WHO, 2013). Globally, pedestrians constitute 22% of all road traffic fatalities whereas in Bangladesh pedestrian fatality is 47%, and in some countries, this proportion is as high as two thirds of all road traffic deaths. Millions of pedestrians are non-fatally injured – some of whom are left with permanent disabilities. These incidents cause much sufferings and griefs as well as economic hardship. A study supports that the collision of the pedestrians increases proportionally with the increase of motor vehicles on the road. The places where the traffic rules are enforced not in an adequate way the percentages of pedestrian vulnerability increase (Job, 2012).

Pedestrians are particularly vulnerable to dangers in work zone environments. They use same routes day in and day out - between the subway station and the office, from the office to a favorite lunch spot, and so on. But this familiarity can cause problems for inattentive pedestrians when they find themselves with a construction work zone in their path. From 1987 through 1990 fully 17% of all work zone fatalities were pedestrians (Pucher et al., 2003).

Every year numerous pedestrian fatal accident occurs in the work zone area. A study reveals that pedestrians' safety condition of the garments can be enhanced by incorporating retroreflective trim in work zones (Sayer et al. 2004). A study reveals that; work zone activities are one of the areas with a high potential for compromised safety for workers and road users. It has been suggested that safety in work zones could also be improved with the application of more automated equipment which would control traffic in work zones (Pigman et al., 2006). Most work-zone traffic control efforts have focused either on motorists or on construction and maintenance workers. A study shows that one-third of all

work zone accidents and 37 percent of those involving serious injury. Construction vehicles and workers were involved in over 20 percent of all work zone accidents resulting serious injuries (Bryden et al., 1998). A naturalistic field study was conducted on the daytime conspicuity of personal safety garments. The results contribute that garment characteristics enhance pedestrian conspicuity in both day and night conditions (Sayer et al., 2005).

To date, most of the attention on work zones safety has focused on motorists, construction workers, and maintenance workers. Interaction among the dangerous elements by means of comprehensive approach can be used to minimize the road hazards (Rosolinoa et al., 2014). The problem of safety will remain unsolved until the road user behavior has improved. A study (Saha et al., 2013) has been done on assessing the relative significance of various problems in different types of pedestrian road crossing systems in Dhaka city. Anjuman et al, 2007 has done a research on the child safety issue where the result represents that the role of road safety education for children is effective and sustained prevention of accidents and injuries in long term perspective. There has been no significant research observed through which road user behavior could be assessed in developing countries, especially for workers. RMG is considered as the economic engine of Bangladesh as leading exporter of the world, that's why, for the development of the economy, it is needed to work with the leading work zone of Bangladesh. The report reveals that around 6000 were injured in workplace accidents and violence in the year 2013. Among the total number of deaths, around 70% (1,194) met accidental deaths in the readymade garment (RMG) sector (Khan, 2014). So, for the development of the economy of the country, ensuring safety of RMG workers is one of the major issues. To ensure their safety, it is very important to take initiatives.

1.3 Objective of the Study

The main objectives of this study are,

- To explore the factors effecting the traffic safety perceptions of RMG workers in Bangladesh.
- To investigate the factors which influence of getting safety education/knowledge from different sources.

1.4 Scope of Research

This study aims to explore the demographic factors affecting the traffic safety perceptions of RMG workers in Bangladesh. The most appropriate method to gather safety perceptions is the use of a questionnaire survey. Since the target population consisted of RMG workers, the participants will be recruited from eight RMG factories in and around the capital city of Dhaka. Location of those industries had experienced a high number of crashes (ARI, 2011) and represented the typical geographical distribution of the RGM industry.

Multiple regression model is used to explore the factors affecting safety perception of RMG workers. Logistic regression model is used to examine the factors affecting the receiving of safety education of RMG workers. The purpose of making two studies is to find a vulnerable group to whom the training is more appropriate and beneficial. The study will also unveil whether the significant factors are common in these two model and also assist to prepare the targeted group for whom the traffic safety training need to be arranged.

As the RMG workers are the most vulnerable road users, so the safety perception is very much important for ensuring the safe and secure road use. The safety issues can be mitigated by the assistances of introducing fundamental knowledge of traffic security. To ensure the safety as well as to reduce the accidental injuries of the garments workers some factors has been studied from socioeconomic characteristics, demographic issues and various safety related behavior. The group of people can be found out who are least concern about the safety and the traffic rules. This people face the maximum risk as they have the

less perception of safety. Policy makers and safety personnel can develop a training plan to improve the road safety perception and education for these identified RMG workers.

1.5 Significance of the Research

Possible outcomes of this study:

1. This study will unveil the factors effecting traffic safety perceptions of the RMG workers of Bangladesh.
2. This study will identify the target group of garment workers who are vulnerable from road safety perspective and require safety education.
3. This study will also help to select the garments workers who have least knowledge or no knowledge of traffic safety.
4. The results of this study can be used for planning traffic safety campaigns for the most vulnerable RMG workers based on their self-reported traffic safety perceptions.
5. It can also be considered as a pilot study for a national study to find ways to minimize the traffic related injuries among the RMG workers of this country.

1.6 Outline of Thesis

The thesis is organized into six chapters. After the introduction in first chapter, the other five chapters will cover the following topics:

Chapter 2-Literature Review

Factors associated with garment worker's behavior explored in previous studies are reviewed in this chapter. Important information and finding from these studies are also documented.

Chapter 3-Data and Methodology

Chapter three describes the sources of the database used in this study as well as methodology followed in statistical analysis. This chapter also discusses the different

socioeconomic and demographic data, location of the garments from which data has collected and detailed procedure of the multiple linear regression analysis and logistic regression analysis.

Chapter 4-Analysis and Model Development

Two models were developed in this study. Model development process from data is discussed here in detail.

Chapter 5-Results and Interpretation

This chapter presents two different models (traffic safety perception and traffic safety education) to address the objective of this research. All the results obtained from the analysis are stated here. Explanation of the results is discussed rigorously in this chapter.

Chapter 6-Conclusions and Recommendations

This chapter draws final conclusion based on the findings of traffic safety perception model and traffic safety education model which reveals the number of factors to categories the target group requiring safety education on priority basis. Some directions for future exploration of research in this area which help to identify are also mentioned.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The terminology of absolute safety is not possible because there is always a risk factor available. In highway, for reducing the severity of risks (i.e. crashes), application of science and technology is an important tool in safety science (Highway Safety Manual,2010). Traffic safety perception and safety education source is a technique to quantify the potential effects of safety planning, design, operations and maintenance on crashes, especially pedestrian (particularly Garments workers) crashes. This chapter focuses on some present theories and practices regarding traffic safety that will be linked with garments worker's safety when they act as pedestrians. Section 2.2 discusses on Transportation safety and related factors which affects them. A brief condition of Garments' workers, their travel characteristics and related safety issues in context of Bangladesh are discussed from section 2.3 to 2.5. An overview of traffic safety perception and safety education source for garments workers is given in section 2.6. Finally, section 2.7 briefly summarizes the finding of this chapter.

2.2 Transportation Safety and Related Factors

2.2.1 Importance of Transportation Safety

Transportation engineering is the way of applying scientific principal for planning operational and management facility to provide safe and comfortable movement of people. When transport safety comes into the measure, some characteristics we need to abide by, for example, road design, road side environment, pedestrian's safety and so on. Hoque et al., (2006) found that in Bangladesh the principal contributory factors of accidents are adverse roadside environment, poor detailed design of junctions and road sections, excessive speeding, overloading, dangerous overtaking, reckless driving, carelessness of

road users, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defects in vehicles. To ensure safety against these contributed factors, proper planning and management of implementing road safety is a mandatory tool. There have been many studies about road safety and its factors in the world. Many researchers have done enormous research on traffic safety. Among several studies, Linderman (2007) has studied on the design of roads and road environment in Switzerland where it was shown that today's design of roads includes a wide variety of safety and new planning and design principles have experienced lower speeds and greater recognition of the traffic activity on the sides. Another study has made by Gomes (2013) where it is mentioned about the importance of planning and management of urban road networks. From the above discussion, it is clear that traffic planning and management is one of the integral part of traffic safety now-a-days.

2.2.2 Transportation Safety in Perspective of Economics

Now a day's, transportation creates a gateway to enhance accessibility system. Due to rapid economic growth, the population of metropolitan area is increasing. Improved transportation system enhances the population of the city. The development of motorization, economic growth and rapid urbanization are influencing the people life style in the world. Changes in society, technology, income, attitudes, social demographic and household structure are influenced by transportation time and expenditure. It is found that people spent more times and money on travelling (Predergast et al., 1981; Gunn, 1981). On average 10-11% of income is spent on travel by a car owing household, on the contrary 3-5% of income is spent on travel by a non-car owning household (Zahavi et al., 1980). With the increased motorization, the cost on travel has also increased. Recently a study has concluded that, that individual travel time expenditures is strongly related too individual and household characteristics, attribute of activities and destinations, or even the characteristics of residential areas (Moktarian and Chen, 2004). Thus, it is clear that people always desires safe, comfortable, economic transport system. Due to that reason they are willing to invest money to ensure safety. A study of Sugiarto et al., 2014 supports that people spend money for transportation as well as how life stages and related household

attributes contributed to transportation fee expenditures. Though the people of the world are having safe facilities but there are some unwanted occurrence happens. A study says annually in excess of 250,000 people are killed in China because of road traffic crashes, which is more than any other country of the world (Bhalla et al., 2013). Thus, if it is possible to provide safe transportation, it can bring economic benefit in terms of productivity by reducing crash injuries and fatalities.

Likewise, different parts of the world, the economy of Bangladesh is rising. For this economic boost up, transportation system and its' facilities are also expanding. Though, to accept this economic advancement, the people of Bangladesh has to face few unwanted occurrences like accident. A news of local newspaper shows that "At least 46 people were killed and more than 2000 were injured in 31 accidents across the country in the last four days" (Tashmina, 2012). There has been an alarming rise of accident significantly highway accidents, for the past few years. A study says that, annually road accidents claim about 12000 lives and more than 35000 injuries (ARC report) (Tashmina, 2012). On the other hand, the significance of the garments industries in the economy of the country is beyond explanation. The RMG sector has been tremendously contributing the economy of the country. In 2012-2013, 80% of the total export has come from this sector (BGMEA, 2014). Export Promotion Bureau data show that RMG sector's contribution to the country's exports was 3.9% in fiscal 1983-1984 and now it stands at nearly 80%. The country maintains 4.8% of the global RMG trade of $412 billion and its export will reach $36- 40 billion by 2020. This sector is the most important one in national economy. After China, Bangladesh is the largest garments exporter in the world. This has been turned into a boon for the country and has a greater potential than any other sector in terms of employment and foreign exchange earnings to reduce poverty and make a contribution to the national economy (BGMEA, 2014). As garments workers are pedestrians, they are the potential victim of road accidents.

Thus, from the above discussion it can be inferred that, for the expansion of economy, transportation safety is needed to be addressed for future development.

2.3 Condition of Ready Made Garments Sector and Its Workers

2.3.1 Present Scenario of RMG sector

To understand the necessity of the study we must need to understand the importance of the garments industry in the world economy. The global textiles and garments industry forms an important component of world trade flows, particularly for some developing and least developed countries where clothing accounts for a large proportion of total exports. In 2004, world exports of textiles were valued at $195bn and of clothing at $258bn, representing 2.2% and 2.9% respectively of total world merchandise trade (WTO, 2005). Asia accounted for 45.1% of world textiles exports in 2004. But developing countries individually produce half the world's textile exports and nearly three-quarters of the world's clothing exports (UNCTAD, 2005). For textiles, the European Union is the biggest exporter (if including intra-EU trade), followed by China. However, India, Turkey, Pakistan, Indonesia, Thailand and Mexico all rank among the top 15 textile exporters, according to WTO trade statistics.

More than 40 million workers are estimated to be employed directly in the global textile and garment manufacturing industry, of which around 19 million are in China. The textiles and garments sectors account for a very high proportion of total manufacturing jobs in a number of countries where poverty-alleviation is a central issue. These include Cambodia (80.1% of total manufacturing jobs), Mauritius (72.8%), Sri Lanka (49.2%), Bangladesh (35%), Pakistan (42.9%), Madagascar (45%), Turkey (34.3%), Morocco (27.3%), Guatemala (27.1%), Romania (25.3%), India (21.9%) and China (18.9%) (McNamara,2008). The fast growth of textiles and garments manufacturing in Asia and other developing countries have had a dramatic effect on employment in the industry in developed countries. The World Bank and IMF have estimated that barriers to textile and clothing trade have cost 35 jobs in developing countries for every job saved in rich nations (de Jonquieres, 2004). Bangladesh was the sixth largest exporter of apparel in the world after China, the EU, Hong Kong, Turkey and India in 2006. In 2006, Bangladesh's share in the world apparel exports was 2.8%. The US was the largest single market with US$3.23

billion in exports, a 30% share in 2007. Today, the US remains the largest market for Bangladesh's woven garments taking US$2.42 billion, a 47% share of Bangladesh's total woven exports. The European Union remains the largest regional destination - Bangladesh exported US$5.36 billion in apparel; 50% of their total apparel exports. The EU took a 61% share of Bangladeshi knitwear with US$3.36 billion exports. Currently Bangladesh is now second largest readymade garments manufacturer after China, by the next five years Bangladesh will become largest readymade garments manufacturer (Berg et al. 2011).

In Bangladesh, ready-made-garment (RMG) industry has emerged as the most important economic sector and accounts for employing approximately 1.8 million people which is one half of the total industrial workforce and contributing about a quarter of the gross value-addition in the manufacturing sector (Bhttacharya and Rahman, 2001).

Export earnings from this sector accounts for more than 75% of Bangladesh's total export earnings. As a result, the foreign exchange reserve of the country largely depends on the ready-made-garment (RMG) sector. This is the only sector that has achieved phenomenal growth almost unaided by anybody. Today more than 4000 RMG units together exporting $ 5 billion worth of clothing every year contribute about 9.5 % to GDP (Hoque et al., 2006). It has empowered some 1.5 million female workers with economic power and independence which in turn has earned for the economic recognition as an emerging nation (Montero, 2005).

Based on the gathered information a comprehensive database is developed by BGMEA, that comprises name, address, number of employees, etc. of each garment industry that are enlisted with BGMEA till 2004 (BGMEA, 2004). Analysis of database shows that there is a total of 2960 enlisted garment industries in and around Dhaka Metropolitan City and about 1,070,754 workers are employed in these industries (Debnath, 2005). Among the total labour force about 90% are female workers. Out of the analyzed 2960 garments industries, it is observed that about 62 % are found to be clustered along the primary and secondary roads of Dhaka city and located within the central business district (CBD) areas. The remaining 38 % are spreaded scatterly along the city road network. Clustering is considered if more than one industry is found to be bunched together at a particular

location. It also reveals that all together about 72 % workers are working in these industries (Debnath, 2005). Spatial distribution of clustering type of garment industries is superimposing them on Dhaka City Road Network Map. As the garment workers are the one who made major contribution towards the economy of a country on its maximum probable good locus, so its necessary to take effective and worthy action to confirm their safety. After all, as the world economy has changing due to the immense change in the garments products and the workers, so it is very much important to take proper safety measures for them. For which, though several developed and developing countries has taken appreciable number of safety measures to ensure safety of their workers, but the scenario of the developing countries are miserable.

2.4 Garments Worker's Safety as Pedestrians

2.4.1 Importance of Pedestrian Safety and Its Related Indicators

For ensuring safety on roads it is must to ensure safety of the pedestrians on the road. Because they are the worst victims of the accident of the roads. Generally, the people who travel by foot, wheelchair, stroller, or similar means and among the most vulnerable users of the road are called pedestrians. Near about in every 24 on average 445 people are treated in hospital because of traffic related pedestrian injuries. In every 2 hours on average one person dies because of the accidents due to traffic crashes. Pedestrians of all ages are at risk of injury or death from traffic crashes, but some people are at higher risk. It has found that male is comparatively become more victim of the traffic accidents than female. Teen and young adult (ages 15-29 years) pedestrians are more likely to be treated in emergency departments for crash-related injuries compared to any other age group (Rockett, 1998). The rate of death of pedestrians increases with the age. The capacity to respond to pedestrian safety is an important component of efforts to prevent road traffic injuries. Pedestrian collisions, like other road traffic crashes, should not be accepted as inevitable because they are both predictable and preventable. According to the ARI report (2012), in

Bangladesh from the year 2003 to 2012, the figure of casualties in different age range is given here.

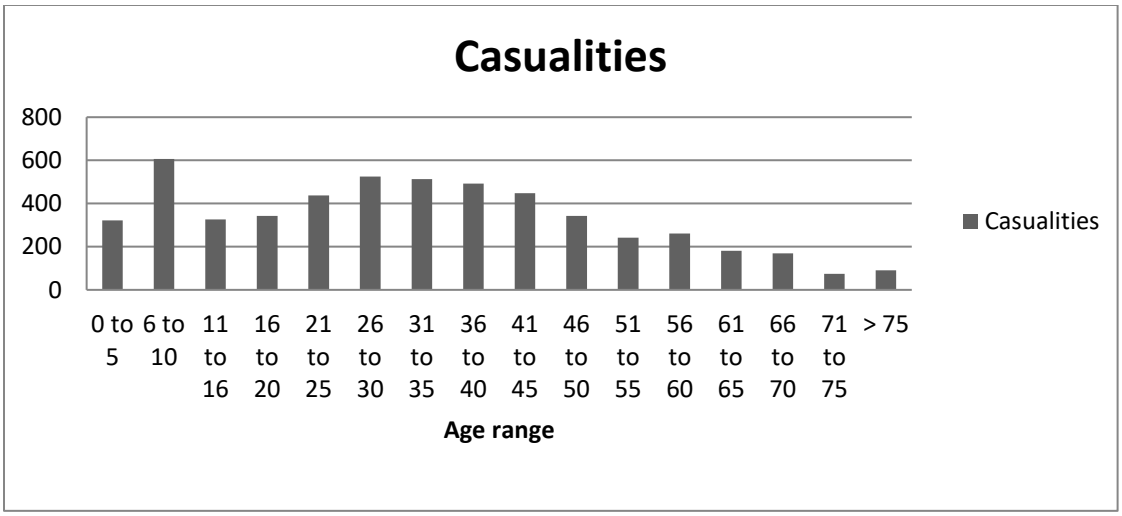

Figure 2.1 :Number of Casualties in Different Age Range

From this figure, we can observe that the age ranged from 6 to 10 years and 26 to 30 years are more vulnerable to casualties. The possible key factors are: driver behavior particularly in terms of speeding and drinking and driving; infrastructure in terms of a lack of dedicated facilities for pedestrians such as sidewalks, raised crosswalks and medians; and vehicle design in terms of solid vehicle fronts which are not forgiving to pedestrians should they be struck.

In all societies around the world, walking is a basic and common mode of transportation. Beginning or ending of each travel, walking is a must. Walking comprises the sole means of travel on some journeys, whether a long trip or a short stroll to a shop. Moreover, walking is considered as one of the well - known a physically and mentally as well as environmentally beneficial activities which helps to reduce cardiovascular and obesity-related diseases. Many countries have implemented some policies to create awareness about walking and exhort walking as mode of transportation (Basset et al., 2008; WHO, 2010; Rabl and Nazelle, 2012). However, there is dramatic growth in the number of motor vehicles and the frequency of their use around the world which increased risk of traffic crashes and injuries. A study of Jacobsen, 2003 supports that the collision of the pedestrians increases proportionally with the increase of motor vehicles on the road. The places where

the traffic rules are enforced not in an adequate way the percentages of pedestrian vulnerability increase (Job, 2012). Most of the cases, the collision of the pedestrian crashes is predictable and preventable. There is a very deep relationship between walking environment and pedestrian safety. Walking environment helps to reduce pedestrian injury. Lacks of walking infrastructure increases the risk of pedestrian safety. Some safety measures can enhance local economic growth and social development.

Else more, for eliminating the fatal crashes on roads, working with human behavior is the main perspective of the safety approaches. In transportation system, the errors of the human behaviour could be recognized. Peoples mistake on the roads can lead towards traffic injuries and sometimes cause death. Behavior of the road users are not intervened by the safety approaches, but emphasizes on the behavior which helps to promote safety. In case of peoples' physical vulnerability and limitation, they have a very limited tolerance beyond which serious injury or death may occur. It is the responsibility of the designers who designs the roads for public uses, to keep enough safety measures for the pedestrians.

Moreover, the promotion of the social values may help in ensuring safety. Economic development, human and environmental health, and individual choice-in these three areas the social values can be promoted. Pedestrian safety should be researched from a systems point of view to allow for consideration of the many factors that expose pedestrians to risk, such as vehicle speed, poor road design, and inadequate enforcement of traffic laws and regulations.

Planning for the pedestrian safety is also very important to ensure a secure road. While planning for the pedestrian safety the risk factors should be kept in mind. Sometimes it is difficult to always keep in concern about the risk factors. For improving the safety of the pedestrians' special attention should be given on some basic factors. Enforcement of traffic rules and regulation, road infrastructure and traffic control like speed limit are like some basic factors. A narrow focus on any single aspect is less effective than taking an integrated approach to the multiple factors involved in pedestrian safety. Assimilation of less learned is also a very important factor for providing safety.

Safety of the pedestrian is problem which can be solved by the way of collaboration with the partners. Pedestrian safety is a multi-dimensional problem that requires a comprehensive view when examining determinants, consequences and solutions. In many countries, crashes involving pedestrians are poorly reported in official road traffic injury statistics. The actual number of pedestrian fatalities and injuries is probably higher than what the official statistics show. Global data on injured pedestrians are not readily available. For this reason, this section presents only data on pedestrian fatalities (Forman,2012; WHO,2006). It should be noted that the data on pedestrian fatalities represent only a part of the problem specially in Bangladesh. The reporting pattern of these causalities need to be developed by enormous study and research.

Besides, at present age, one of the most important aims of information technology is to develop the communication systems of road traffic system for road users. The problem of safety will remain unsolved, and cause problems. For the improvement of traffic safety, pedestrian safety is a very important issue. Most of the garments workers are considered as pedestrian. So, for the development of the economy of the country, ensuring safety of RMG workers is one of the major issues. To ensure their safety, it is very important to take initiatives and rapid implementation of traffic safety measure. However, there is not much applicability of IT in transportation system such as automated signaling, VMS application etc. which might enhance road safety.

Though many studies have demonstrated about road safety and security, they cannot completely eliminate transportation risk but minimize crashes intensity and consequences. To minimize the road hazards, interaction among the dangerous elements by means of comprehensive approach can help (Rosolinoa et al., 2014). Road safety audit is one of the recent effective measures to ensure safety principals. It is the evolution of physical element and interaction on the safety road users and others. Thus, by enhancing the safety measures as well as increasing the periodical safety scenario monitoring, safer road environment can be ensured for pedestrians.

2.4.1.1 Socio-Demographical Conditions of Women in Garments

Women are a very significant part of a society. Most of the women of the world do not want to work from a very distance part of their residences. Majority of them want a safer and comfortable ways which they can be easily performed. From the traditional background of the family, women are taught weaving or sewing of clothes and other staffs. Usually half of the population of a country consists of women. They can perform a significant role in the economy of the country. However, it is observed that RMG industry is mostly a female dominant industry where about 66.5% of the employees are female. Therefore, when the term "RMG workers" comes it mainly represent female workers. That's why a number of studies have been conducted by various International organization mainly focusing on the issues related to women RMG workers. For example, 'Issues for Women Workers in the Garment Sector' (Julie Delahanty), 'Economic Organizations of Women and their Empowerment. Dhadra, Ahmedabad' (Karl, 1996), Rethinking Rural Poverty: Bangladesh as a Case Study, (Hamid, 1995); Necessary, Sufficient or Irrelevant? Women, Wages and Intra-Household Power Relations in Urban Bangladesh (Kabeer,1995).

In Bangladesh, women garment workers are generally disadvantaged socially and politically. As an example, they face problem to avail proper accommodation, transport, and medical facilities. Most of them are living in the urban slums and they have no access to government social protection measures like VGD and VGF cards in rural areas. They also have no right to form labor/trade union and therefore politically they have no power and voice to bargain with the factory owners. Existing situation also deter them from getting involved in any right based activities for their wellbeing (Dutta and Hossain,2003). A report on Condition of Human Rights of Women Garments Workers in Bangladesh indicates that, most of the female garment workers are young, unmarried, less educated and from rural origin. Studies further indicate that most women who work in the Government industry had no prior wage work experience. However, some characteristics of women garment workers have changed over time and some of these characteristics differ between female workers employed in the garment factories located in the DEPZ and those located outside the DPEZ.

Generally, age limit of women RMG workers' is up to 40 years. After 1995, workings of child labor forces in readymade garment industries are significantly reduced due to Government, BGMEA and UNICEF and ILO agreement of eliminating child labor in RMG sector. In 1997 the average age of women garment workers was 20(Paul-Majumder, 1996; Stein,1997).

In RMG industry marriage is considered as constraint of getting women employee, though there are still about 38 percent of women workers are married and rest of them are unmarried, divorced, widowed or abandoned by their husbands. Female garment workers are less literate than their male counterpart. Many of them can only sign their name. Literacy rate among female workers (age 15+) is 56.8 that are higher than the total female literacy rate of our country. In some cases, women completed secondary and above education and doing better jobs than other women in garment industries (Bahbeis,1998; Paul-Majumder,1998). Eighty-three percent of female workers of garment sector are migrants from rural to urban areas. Women are still migrating to the urban areas especially in Dhaka city to get a job in garment industry. There is no question about the poverty of female garment workers in Bangladesh. Rural poverty pushes them to Dhaka city to get a job in garment industry. Their daily income is less than one US dollar, in most cases (Parishad,1990; Paul-Majumder,1998).

The health and nutrition conditions of women garment workers are very poor. Research has shown that over 40% of the female factory workers suffer from chronic diseases such as gastrointestinal and sexual transmitted infections (STIs), reproductive tract infection (RTIs), menstrual and blood pressure problems, anemia and problems related to family planning. Women workers are not able to take proper nutritional diet due to their poor income(Paul-Majumder,1998).

Rural to urban migration as informed by Kibria (1998) is often seen in RMG workers. Besides this, several issues discourage women to enter RMG sector such as family conflicts, marriage breakdowns, problems of sexual harassment, the pressures from rising dowry demands and uncertain marriage prospects. Domestic work and agricultural work

are the two competing professions of RMG sector. To increase the number of women in RMG sector, safety issues should be more addressed.

2.4.2 Garments Worker's Safety

Role of labor is very important in the development of a country. Total economy of a country depends on the number industries of that country. So, proper management of the labor is essential for developing the industrial sector. The right of the labor should be protected so that they can work in a safer environment. The objective of Labor laws is no doubt to maintain industrial peace and to meet the surge of problems in employment and to protect the rights of workmen. However, majority of the garments workers are unhappy with their toilsome labor but the security and safety net in the working place. The Government of Bangladesh has already amended its labor law in 2013 to make the law time-befitting, also to protect the interests and rights of the workers and ensuring their safety. However, the ILO also observes that new labour laws as amended and enacted by the Bangladeshi Parliament fall far short of protecting workers' rights and meeting international standards (ILO, 2013). The government and the owners of garments factories should be more concerned about industrial safety related rules and regulations which will minimize their expenses as well as the severe losses due to accidents. Inspection, reporting and compliance of existing national and international laws and standards must be enforced properly to minimize further incidents due to lack of occupational safety provisions. So that, the international institutions can not take any adverse discussion based on the present situation which can cause decline in national economy.

Numerous studies have been done regarding the work environment of the garments workers and their safety issues. For example, a safe and secure working environment is the fundamental right of the workers (Islam et al.2016). According to the BLA, 2006 the employees should be provided with the basic things of safety which includes building safety, securely guarding all parts of dangerous machinery, precautions for working on machinery, emergency devices for cutting off power, provide protective equipment, measures to prevent fire and so forth. Also some law has been introduced which deals with

the occupational safety and health issue related to workers (Miller, 2013). An unwanted occurrence reveals that fire at Tazreen Garment Factory has caused death to 112 garment workers and the collapse of Rana Plaza to over 1000. Apparently, this is the scenario of RMG factories for which nobody is concerned (Ain o Salish Kendra, 2013; Khullar,2014). Regarding the precaution against fire, there should be alternate stair case provided with each and every establishment. Rather than fire, to ensure safety steps, stair, passages and gangways shall be provided with substantial handrails and there shall be provided and maintained safe means of access to every place at which any person is required to work and all floors, stairs and gangways shall be wide and obstacle free. The accidents happen because of the unawareness of these workers. In our country due to lack of the enforcement mechanisms and unwillingness of some people these problems remain unsolved. Garment manufacturers continuing to build garment factories without proper infrastructure and facilities cannot be justified. Since it is one of the biggest industries in Bangladesh, more people can be employed in this sector which may reduce the unemployment level as well as the poverty level.

Some reports have found that the garment workers while walking, the main problem is posed by encroachment of footpaths in many locations. Besides these problems the footpath is occupied by many unwanted things like the hawkers having their things, electric poles etc. Because of the lack of opportunity of using footpath, the workers are forced to use the roads. Due to lack of road use knowledge and foul use of road, the workers cross the road at the time of heavy traffic the possibilities of road accidents increase at an alarming rate. Another threat to the pedestrian safety is often created by different utility agencies. It has found that the drivers sometimes do not let these workers or others pedestrians to cross the roads so easily, they try to harass the pedestrians by sounding horn and forcing them to run quickly on the road. As such, as an individual finding difficulties in roadway crossing, particularly at the mid-block, often forms group to exert pressure on the moving traffic stream (Bhattacharya et al., 2000). This World Bank Report (2004) also showed that the drivers show a hostile attitude towards the pedestrians specially the female garments workers. They sometimes neglect to consider the pedestrian and drive on the road. Last but not the least, the garment workers, in particular the female workers suffer the most during the whole rainy seasons when walking through lanes/by-lanes and local

streets become very difficult due to submergences problem as well as splashing of water produced by moving traffic. From the above discussion, it is clearly observed that, significant number of studies has conducted focusing on factory safety. Comparing that, a limited number of study has done on pedestrian safety, on which it is needed to do enormous research.

Thus from the above discussion it is clear that the road safety and the safety of the construction places is a major problem for the readymade garments workers and they are required to be handled properly for the growth of GDP and overall economy of the country.

2.4.2.1 Economic Status of RMG workers

As has been said earlier, women are poorly paid in this sector. As a result of sustained campaigning by women workers, women rights and human rights activists and other trade unionists in Bangladesh, the minimum wage for garment workers was raised in 2010 for the first time in four years. Receipt of wages in the garment industry depends on meeting an assigned production target. If production targets are met, a sewing operator's salary now starts at 3,861 taka (approximately £32) a month and a helper's wage at 3,000 taka (£25) a month. This amount is inadequate in meeting the minimum living standards in the urban areas. Besides the above, they get no other benefits or festival allowances (Ain o Salish Kendra, 2013).

2.4.2.2 Status of RMG Workers' Right

It is to be noted that in most cases the employers engage garment workers, mainly women, in the factory without any formal agreement or job contract. Thus they can be easily hired and fired and no compensation is offered when they are laid off in the interest of factory owners. As for example, many factory owners because of their failure to meet the deadline of shipment or on becoming loan defaulters close their factories leaving the garment workers in utmost uncertainties of which the women are the main sufferers. However, Bangladesh has recently amended the Labor Law in 2013, which protects the fundamental rights of women workers, including the right to maternity leave. At the international level, Bangladesh has ratified the UN (CEDAW), as well as ILO Convention

111 on Discrimination in Employment and Occupation. The reality is that, despite such legislation, women workers' rights remain ignored in the Garment sector. Women workers are employed in poorly paid jobs facing severe labor rights violations and do not get their legal entitlements. They are also forced to work at night often exceeding 10 working hours which is a violation of the labor standard (Senden,2004).

Countless studies have been made to ensure the safety and comfortable environment for the RMG workers, but still there are some flaws in the system. That's why some times catastrophic events may happen. So, to avoid the situation, punishment level should be more and more harder and strict. Some efficient steps should have taken by the corresponding authority to ensure that they can be compensated properly for their conditions.

2.5 Travel Characteristics and Behavior of RMG Workers

Using of road is considered as one of the momentous event for the RMG workers because the possibility of facing the unwanted situation becomes lesser when they use the road with more concern. The study regarding travel characteristics is benevolent in confirming the safety as well as security for them.

2.5.1 Modes of Transports of RMG Workers

There is about 4,000 garment industries in Bangladesh, most of which are clustered in and around the capital city. Together they account for 75 percent of the country's export earnings and employ around 1.8 million people which is almost one half of the total industrial workforce of the country (Hoque et al., 2006). Though it is the most important economy sector of Bangladesh, unplanned and haphazardly built garment factories are also inducing many social, housing and most importantly urban transportation problems which are a great cause of concern. In order to find spatial location and employment statistics of each garment industry of Dhaka city, necessary information is collected from the head (BGMEA). Based on the gathered information a comprehensive database is developed that

are enlisted with BGMEA till 2004 (BGMEA, 2004). Analysis of database shows a total of 2960 enlisted garment industries in and around Dhaka Metropolitan City and about 1,070,754 workers are employed in these industries (Debnath, 2005). Of the total labor force about 90% are female workers. Out of the analyzed 2960 garments industries observed that nearly 62 % are found to be clustered along the primary arterials and the secondary streets of Dhaka city and are located within the central business district (CBD) areas (Hoque et al., 2006). The remaining 38% are situated in a scattered way along the city road network. Clustering is considered if more than one industry is found to be bunched together at a particular location. It also reveals that all together almost 72 % workers are working in these industries (Hoque et al., 2006). The above study reveals that most of RMG workers try to live nearer their work station. Because if the places are near of their residing places then it becomes easy for them to attend the working place. They used to attend their work places by choosing any mode of transportation considering distance and time constraint. Though, the above mentioned statistics supports that, a significant number of workers are used to appear at work place by walk or general transport.

From a questionnaire survey analysis (Hoque et al., 2006), it is found that 26 % workers get wages in the range of Taka 1000 – 1500, 63 % get Taka 1500 – 2000 and the remaining 11% get Taka 2000 – 2500. This revelation essentially suggests that the workforce engaged in this vital sector is poorly remunerated. With this amount of take-home salary, they are compelled to live in slums and low-cost slum areas along the city periphery. Analysis of workers' house rent expenses reveals that out of 228 workers surveyed, 19 % spends less than Taka 500 only, 48 % spends in the range of Taka 500 – 800, 18 % spends Taka 800 – 1000 and only 15 % spends more than Taka 1000 per month for this purpose. By and large those who live without family spend around 40 % of their income for house rent and are forced to live outside the built-up areas forming mess system (Hoque et al., 2006). It is also found that due to very low income level, poor garment workers are forced to live in miserable conditions at slum areas. About 88 % of the workers Cannot afford to pay travel expenses and are compelled to commute on foot and only 12 % of the workers use bus services. Rather than that, another study reveals that non-availability of cheaper and female friendly public transport along their travelling direction is another main reason for the high percentage of walk trips (Hoque et al., 2006). Finding no other alternatives presently most

of the workers are commuting on foot and quite naturally to reduce the length of walking trips they compelled to reside in those slum areas that are close to their job places.

Due to these mentioned reasons, low lying areas particularly those are located at the Eastern and Western fringes of Dhaka city are found to be the most popular residential areas for the poor garments workers. Availability of cheaper mess facilities as well as close proximity (2 – 3 km) of these areas with respect to the position of vast majority of garment industries of Dhaka city are considered to be the main reasons to choose these areas by the garment workers (Hoque et al., 2006). They are also willing to use the vehicle which are cheap. Sometimes these cheap vehicle causes serious accidents and also causes lives issue. Thus the mode of transportation is one of the important issue for influencing the travel behavior of RMG workers.

2.5.2 Traffic Safety Issues of RMG Workers

There is a very wide variation of location of occurrences of pedestrian accident for each and every country. Urban areas are more affected by this matter. It has found that pedestrian accident in urban areas is more than in rural areas in developed countries and the situation is totally opposite in comparatively low developed countries. In the United Kingdom, young pedestrians from urban areas were involved in crashes five times more frequently than those in rural areas, and their death rate was twice as high (Petch and Henson, 2000). From another study, it is found that people who have raised in resided in rural areas were significantly more likely to suffer pedestrian injuries than those who resided in urban areas (Ibrahim et al., 2012).

It is reported by the garment workers that while walking, the main problem is posed by encroachment of footpaths in many descriptions (Hoque et al., 2006). Besides encroachment problem, overall effectiveness of footpaths is also undermined by the presence of hazardous uncovered manholes, electric posts, signposts, traffic signals, footbridge landings etc. This poorly sited street furniture prevents full use of the footpaths, impede visibility of road users and thereby make workers movements uncomfortable and hazardous. Eventually, in the absence of functional footpaths, the workers are pushed to

walk on the active roads. From another study, it has found that most of the pedestrians who have killed or knocked down by the vehicles were at the middle of the road way. Some studies have found that most of accident (72.6%) occurs at the time of crossing the road, 8.2% while walking along the road and another 8.2% occurs at the time of hawking and other activities (Ogendi et al., 2013).

Moreover, due to foul use of road sides particularly for stacking construction materials, uncontrolled parking and placing garbage bins etc., workers are further compelled to by-pass them by going deep into the main roads and thereby increasing possibilities of road accidents. On account of inadequate network of city's drainage system, many of the city streets get flooded during the rainy season whenever there are heavy downpours and cause immense suffering to the workers.

Another threat to the pedestrian safety is often created by different utility agencies when they dig up roads for laying pipes and cables. It is also reported that while crossing roads, in general motorist show little respect to the garment workers, voluntarily drivers hardly give away any easy crossing opportunity. Instead they harass them by sounding of horn and forcing them to run away quickly. As such as an individual, finding difficulties in roadway crossing, particularly at the mid-block, often forms group to exert pressure on the moving traffic stream.

Moreover, due to the hostile attitude of motorists, often pedestrian especially female workers who are very much neglected by the motorists, cross roads without paying any attention to the oncoming vehicles and literally force motorist to slow down their speed. Moreover, hawker's problems at foot bridges discourage them to use the facilities particularly in the afternoon shift. On the other hand, with no standby generator facility when power failures do occur, the underpasses become blackout and unusable. Power failure as well as absence of street lighting in street lanes/by-lanes also poses security problems for the night-shift female worker.

In Bangladesh, pedestrian casualties are mostly observed while crossing the road as well as walking along the road side (ARI, 2012). From 2003-2012 data shows this truth. A figure has been given below

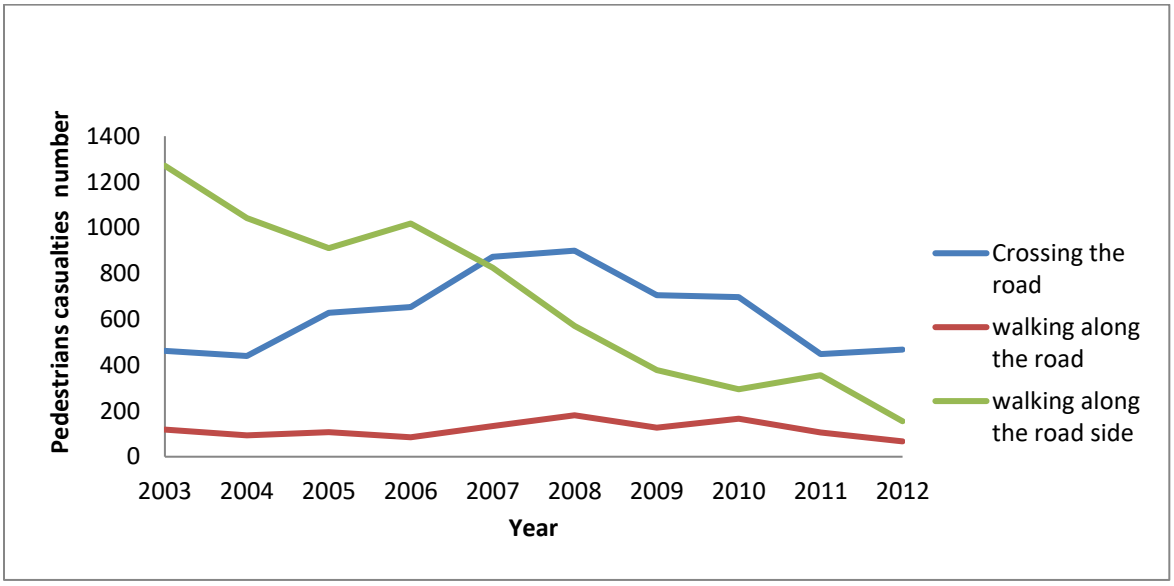

Figure 2.2 : Number of Pedestrian's Casualties by Pedestrian Action During Accident

Though important but few studies have been done regarding the relationship with road accidents related to garments workers and spatial distribution of garments and speeding effect. However, Hoque et al., (2006) believes, it is evident that unplanned establishment of garment industries in the core areas of capital city is responsible for the existence of many slum areas and to some extent blamed for unplanned expansion of Dhaka city particularly in the Eastern and Western fringe areas. Further, high concentration of garment industries in CBD areas is creating unhealthy mixed land use pattern which in turn is breaking the discipline in trip generation and attraction patterns, producing hazardous conflicts between large number of pedestrian commuters and vehicular traffic and in consequence making urban traffic control (UTC) and management particularly traffic signal design and enforcement very difficult.

Walk trips generated by the garment industries are directly conflicting with the high speed vehicular traffic of many primary and secondary roads. In the absence of adequate pedestrian friendly walking facilities, the garments workers are being forced to walk on the active carriageways and thereby exposing themselves to the main road traffic and increasing possibilities of pedestrian-vehicular conflicts.

This undue conflicting situation is not only causing safety hazards for the workers but also reducing effective width of carriageway by a big margin. It is seen that serious safety situation occurs particularly in the morning shift when workers have to face and negotiate lightly travelled high speed traffic stream. Moreover, in the morning hour it is observed that due to unsaturated traffic streams, workers try to get more opportunity to make short cut and to cross the roads randomly without using the designated road crossing facilities.

On the contrary, a study discloses that twilight and the first hour of darkness typically see a high frequency of pedestrian collisions in the United States and in most other countries (Griswold et al., 2011). In some places pedestrian accident is more occurred in week days than weekends. Moreover, in the afternoon shift, field observations reveal that high volume of pedestrian and over saturated vehicular traffic recurrently cause serious congestion as well as safety problems at many primary and secondary roads of Dhaka city. Female workers hardly get any easy chance to cross the roads randomly along their desired directions and have to wait a long time for crossing. Such as, during the afternoon peak periods, frequent forced crossing attempts seriously interrupt smooth flow of traffic operation and thereby affect level of services (LOS) of primary roads significantly.

However, the condition of the workers regarding with the vehicular problem is one of the major reason of violation of the safety of them. The necessity of the transport is different in different time of the day. So the chances of the accidents may increase in those peak hour of working period due to these speeding affect.

After all, a combined approach should be taken in all aspects and sectors so that it can help to ensure safety and security. Social marketing and campaigning are needed to educate the people about the traffic safety and security of the road and the policy makers as well as designers of the roads should consider about the alternative possible and safe ways to protect the pedestrians and should help in modifying the environment. The problem of traffic accident has become a great issue regarding safety and security of the RMG workers, to ensure the safety the possible way of preventing the problem should be introduced. With the help of technology, it can be reduced the number of pedestrian causalities and the impact of speed. A report based on statistics informed that the vehicles which are equipped

with the feature called break assistant have 10% less involvement in road accident than the vehicles without having the facility (Tiwari et al., 2007). It needs to be noted that with all new technologies in several years the rate of the accident will be decreased noticeably (Leden et al., 2004).

2.5.3 Traffic Psychology and Psychological Behavior of the Road Users

Safety on the road depends on road use and sometimes on psychological behavior also. In order to promote the usage of public transit, it is of critical importance to understand individuals' psychological feelings since they play an important role in travel behavior (Liu, 2015). A psychologically well behaved people can help to maintain a secure and safe road. A discipline of psychology that discuss about the psychological process and behavior of the road users is considered as traffic psychology. This behavior has a tremendous impact on safety measures. Private car users have a mentality to use their owned transport in every when. This helps to pollute the environment and increase the rate of accidents. Most research in environmental psychology, as well as a large number of policy interventions in these areas are based on attitude models such as the theory of planned behavior (Ajzen and Fishbein, 1977). Sometimes people want to show their economic status by using their own car or other transits. People have reduced using their own transit willingly. Because by doing it they can create a sustainable and safe environment. But it is not easy for the people because it has become a habit for them. Psychological condition is also very important for safe roads. If the mental condition of a driver is not at good condition, then there is a great threat for unwanted occurrences. Reckless driving is posing a great impendence on safety. On highway most of the drivers drive as rough as they can. By trying to overtake, most of the collision happen all over the world. This causes detriment of lots of lives and resources. While driving, drinking is another issue. It can cause accidents. Reckless road use behavior is also a great cause for insecurity on roads. Sometimes people do not want to use the footpath for pedestrians. The foot over-bridge which given for safety measure is not used properly. People sometimes cross the roads without the following traffic rules. This habit of people causes road insecure. Moreover, sometimes people violate traffic rules by not wearing seat belt while driving. This can cause

problem in a serious issue. So change in psychological behavior is very important to reduce some awkward incidents.

2.6 Road Safety Education and Related Issues

Pedestrian safety education can change observed road crossing behavior, but whether this reduces the risk of pedestrian injury in road traffic crashes is unknown. There is a lack of good evidence of effectiveness of safety education for adult pedestrians, especially elderly people. None of the trials was conducted in low or middle income countries. There are many researches on safety education of pedestrians and children. But researches on safety education of garments workers are very few. As garments workers go to work place mostly by walking, we can consider the garments workers as pedestrians. Some researches on safety education and their results and other related issues on safety education are discussed below.

2.6.1 Method of Traffic Safety Education

The real traffic situation appears to be the most suitable for traffic training, whereas classroom training may be effective if certain methods are used in conjunction with audiovisual aids. The methods used in traffic training may be described as theoretical instruction, demonstrations, practical training and behavior modification. There is little evidence that theoretical instruction is effective in influencing road safety behavior. The best results seem to be obtained from demonstrations and behavior modification. Media play an increasingly important role in traffic training, the pedestrian mainly focus on table-top models, slides, film/video and print material. The most promising results are found in experiments using film or video, especially when these films are based on demonstrations following imitation-learning principles (Rothengatter, 2002). If traffic safety education is to survive as a viable countermeasure, program planning and execution must become far more scientific and evaluation must become an integral component (Ian and Johnston, 1992). There are many possible option concerning safety and security of the road users

where safety education regarding road use and traffic is very significant. So training is important for confirming the lower possibility of accidents.

Different methods can be used for safety educations. As for example a method of developing cartoon game on traffic safety education of Chinese people was presented. Based on the psychological characteristic of people and constructivism learning theory, the design of game scenario, character's emotion and interaction is introduced. The scene in this cartoon game is based on Gibson's theory of affordances and all the signs on objects are easily distinguished. A finite state machine is used for expressing the emotion state of a cartoon character, and NPC (Non-player Character) is introduced to arouse the interest of a user. The cartoon game can run both on local PC and on Internet, a user can learn safety knowledge by interactive method (Lio, 2006). Such kind of games as well as the characteristics of games related to the safety concern of the people somehow can be helpful for creating a safer environment to construct. These kind of concern can be introduced for behavioural safety and knowledge.

The knowledge and behavioral improvements can be achieved by both classroom instruction and the behavioral training, even though the latter approach appeared to be slightly superior. This suggests that instruction carried out in the classroom can be beneficial in acquiring complex psychomotor skills, which is in contrast to earlier findings indicating that classroom instruction can only affect knowledge and does not improve road crossing skills. The conclusion is reached that precise formulation of the educational objectives and use of audiovisual media are essential factors determining the effectiveness of cognitive instruction of road crossing skills in the classroom (Schagen and Rothengatter 1997). For improving the safety as well as security of the road users mainly pedestrians, the improvement on training about both theoretical and physical training can be very helpful. So, from the discussion, it can be said that the safety knowledge is very essential for the pedestrian and the other road users.

2.6.2 Effects of Driver Training and Education

For ensuring the safety and security of the road, the knowledge of the traffic safety of the drivers is a must, because they are the prime factor of occurring unwanted event. It is obvious that a good driver should possess the capability of vehicle handling and maneuvering skills as well as be able to understand the accepted norms of proper driving. Although this objective is consistent across different jurisdictions, several types of education systems exist due to differences in the driving conditions. The drivers play a very important role in safety measures. Because if there is slight irresponsibility at the time of driving, then it can cause serious accident which can cause a lot of lives endangered, that's why the education of safer driving and the road uses is very much important. Most of the garments workers who related to RMG are indicated as pedestrians. Due to their economic problem while travelling sometimes they may face problems of being assaulted by the driving stuff. For this fact, RMG workers are one of the most vulnerable road users. On the other hand, walking is considered as most eagerly taken mode of transport by the workers as because by walking they can save few amounts of money, it can help them to increase their economic and social life span. To ensure safety of these vulnerable road users like driver's education, RMG workers can be trained which may help for the reduction of the percentage of their accidents. Not only that as RMG workers are not well trained about the road safety, which can trigger some unwanted occurrences. By the analysing of the above discussion, safety education of RMG workers like driver's education related to safety is important.

Around the world there are many research is going on safety education of drivers. Among them one of the significant study had done by Jonsson et al. (2003) who provided a summary of the three different systems widely followed in Europe. The first system has little or no compulsory formal education. Sweden and United Kingdom are the examples countries that use this system. The second system has some compulsory as well as private education. Examples of countries using this system are Finland, Iceland and Norway. The third system is found in countries like Denmark and Germany where private education is forbidden and formal driver education is compulsory. Carstensen, (2002) provided a

summary of the Danish driver education system. Before 1986, driver education was comprised of providing some knowledge on general road rules and some theoretical knowledge on the mechanics of cars. A trainee had to learn driving during the day and both within and outside a city. The learner Cannot drive in heavy traffic until he or she achieved enough competency. In 1986, major changes such as details of maneuvers, defensive driving and hazard perception were included so that drivers would be able to understand possible dangers and react sensibly. Driving on motorways and during night time was made compulsory (Grayson et al. 2002). These higher order driving skills were included in the theoretical and practical tests. These tests are intended to train drivers from easier to more difficult things to perform. Carstensen (2002) also found a real decrease in crashes among young drivers after these changes in education system through a questionnaire survey. While the effect of education turns out to be positive for drivers, there is also a strong positive relationship between driver education and licensing rate for drivers' ages less than 18 years. The concern here is that mandatory training law and licensing encourages early licensing and increases exposure. Therefore, the net effect on crashes is not unequivocal. Potvin (1988) found no appreciable impact on the rate of crashes or injuries among new drivers after mandatory driver training law was enacted in Quebec. Potvin (1988) also surveyed public opinion on the enactment of mandatory driver training in Quebec, Canada and they found that about 80% of the Quebec population supported professional teaching as the best way to learn driving. However, Jones et al., (1973) could not find any difference in accident or violation rates among publicly or commercially trained drivers.

Another confounding factor is the type of training provided. Leong et al., (1964) had shown significant accident rates among drivers trained at school and it is half as high as those of untrained drivers. This is more prominent in first years of licensing. According to Saffron (1981), instilling proper driver motivation (attitudes and intentions) is more important than teaching vehicle handling skills. Driving and instruction programs should concentrate on attitudes and motivation rather than on skills only. Motivation can be achieved more in formal training. It is more important to combine classroom education and in-vehicle training to provide education in a best way. Students usually take in-class training and in vehicle training just after that. Such transition periods are really important as students find most difficulties during this period.

In another study, Wells and Baughan (2003) conducted a questionnaire survey to find out how learners and novice drivers structure their learning and gain experience. They found that most people took professional instruction and almost half had some practice with friends or family in addition. Also, nearly half of the respondents had taken tests more than once and changed instructor during training. Most respondents supported having regular lessons and everyday practice until they take the driver test.

Most of training has two parts - theory and practical. Females study more theory, take training in more structured form, practice more in different environment and participate extensively in driving school instruction. So they do better in written tests but unfortunately not on practical tests. Nyberg et al. (2007) find males more involved in crashes than females during first year of licensing and they conclude learning might be one of the reasons why females do better initially as novice drivers. So, education should not only focus on time spent on training but also on importance of organization of learning process. This includes significance of theoretical knowledge as well as higher order skills for safe driving.

In Spain, the second phase of training has been implemented in 2000. This training is participant-centered and based on discussion, self-evaluation, and self-analysis (requiring considerable coaching and group dynamic skills on the part of the trainers). Evaluation of the program found that it is possible to change driving style to a safer driving direction. This type of second level training, which has already been in effect in Austria, Estonia, Finland, Luxembourg and Switzerland, can raise awareness of risks (Molina et al., 2007). Research indicated that novice drivers have a problem in scanning the road and hence, unable to identify possible hazards. Many education programs do not address this issue but some training programs can help to reduce such scanning problem (Fisher et al., 2006). For the safety on roads, the drivers must be informed about the traffic rules, because the ignorance of these rules causes the accidents and costs a lots of lives. From the above discussion, it can be inferred that like drivers' training, RMG workers can be trained for being concern about traffic safety.

2.6.3 Types of Safety Programs

Twisk et.al. (2014) has conducted a research on few road safety program to improve safe behavior. Among several road safety program, self-reported behavior was the preferred method to assess the effects. Cook, T.D. et al. (1979) used a quasi-experimental design which involved a comparison between pre- and post-test scores of an intervention group and a reference group. For that study, the RSE program were taken for evaluation based on few criteria which are (a) risk behavior, (b) Checking the program regularity and(c)fund effectiveness. Through a questionnaire, information was collected from policy makers and education professionals. From study, it is observed that all the programs were class- based which aimed to discourage young pupil for any taking risks by improving their thinking pattern through information and demonstrations of the safety critical features, limitations in visual perception and reaction times, and the vulnerability of the human body. From the study, it is found that information and personal experiences were sufficient to generate behavioral change. For prompting fear, videos of crashes and personal accounts of road victims were used (Twisk et al., 2014). The study reveals that to reduce the risk (effi- cacy), fear program plays an important role (Peters et al., 2012) which may create different impact on road user behavior. From the above discussion, it can be concluded that to make the behavioral change regarding road use of RMG workers, several education programs can be arranged to discourage for taking risks.

2.6.4 Issues Regarding the Evaluation of Road Safety Education Programs

There are some issues regarding the evaluation of road safety educations. Some of the issues are discussed below.

2.6.4.1 Observation of Behavior versus Self-Report

For checking behavioral affect, two methods are used which are: behavioral observation of using road and self-reports by means of questionnaires and diaries. Due to the high

financial costs, to generate rich and reliable data, observation is restricted to only a few behaviors and traffic situations. Self-report surveys, on the other hand, are less costly and therefore can include large numbers of participants, and focus on a wide range of behaviors and situations to improves the general ability of the data, but the accuracy of the reports may not be neglected (Wahlberg, 2012). From this study, it can conclude that when road behavior strongly varies among several subgroups such as age, gender, social economic status etc., self-reports may draw a clear image than observation.

To study the rationality of such self-reports among young adolescents, Elliott and Baughan, (2004) reviewed several literatures. From that study, it sorted out, depending on few studies which assessed the strength of the relationship, self-reported behavior will not serve as a good proxy for more objectively measured behavior. Further, Twisk et al., (2014) analyzed the relationship between self-reported risk behavior. Self-reported crash involvement among young adolescent cyclists and pedestrians, and found that self-reported risk behavior explained 6% to 11% of the variance in self-reported crash involvement. Given the low frequency of crashes and the asymmetrical relationship with risk behavior (Hauer, 2008), this predictive power is rather strong, and supports the validity of self-reported risk behaviors as surrogate criteria for RSE program outcomes. This outcome varied by subpopulations and by contextual factors such as the presence of peers and trip conditions. In contrast, if RSE program focuses on specific competencies and skills, such as road crossing (Duperrex et al., 2009) or interactions with trucks (Twisk et al., 2013), observation of small samples of participants may provide reliable estimates of skill acquisition. Thus the study of the behaviour, self reporting observation is a very significant way of controlling the road users and the drivers from causing a situation, and the reporting behaviour can become a great issue for concerning the safety and security of the roads. From the above discussion, it can be concluded that, self-report method could be beneficial for improving safety of RMG workers.

2.6.4.2. Crash-related Outcome and the Need for Surrogate Measures

In combination with the objectives of road safety education, several characteristics of crashes weak the usefulness based on outcome criteria (Hauer, 2008). First, the

relationship between risk behavior and crashes is asymmetrical. Although about 95% crashes can be attributed to risky behaviors or human failure (Sabey and Taylor, 1980), only an extremely small proportion of risky behavior actually results in a crash. Therefore, crashes and injuries remain complex events in the population of road users.

For sufficient statistical power to demonstrate an effect on crash-related outcomes, a study would require that large numbers of participants (hundreds of thousands) be included in an education program and that their crash and injury records be monitored over a long period of time (Hauer, 2008). Given the emotional and economic burden of injury and death, and the scarce financial resources available for interventions, it is neither practical nor ethical (Chalmers, 2003) to expose a large number of road users to programs of unknown quality, just for the purpose of evaluation.

Thus, substitute outcome criteria are needed that are still predictive of crashes, but that are reliable, easily obtainable, and available in a short period of time. The theoretical basis for such a surrogate criterion may be found in two fields. In the field of road safety, it is the use of safety performance indicators (SPIs) as predictors of crashes (ETSC, 2001; OECD-ECMT, 2008). In the field of social sciences, it is the use of behavior models (BMs) to predict behavior from underlying psychological determinants (Bartholomew et al., 2006; Glanz et al., 2002). The relationship between these two fields and road safety education is as follows. Road safety education aims to modify risk behavior that is known to increase crash risk (SPI), for instance drink-driving. This goal is achieved by changing one or more of the underlying psychological determinants, for instance the 'attitudes about drink-driving'. The study leads that crushing is one of the major cause of the lack of safeness on the road. There are many influencing factor working behind this issue. So to minimize these issues the above mentioned measures can be taken as precaution and can be implemented on the roads.

Behavior as surrogate measures SPIs are variables that are causally related to crash-related outcomes, either as an empirically tested relationship or as a logical relationship (ETSC, 2001). For empirically-tested SPIs, the extent to which risk behavior increases crash risk is known, and therefore the effect of the intervention can be quantified in terms of crash

related outcomes. For logical SPIs, this is not the case, so it can only be inferred that the risk behavior will increase crash risk. Unfortunately, 'empirical' SPIs are mainly available for 'car driving' and not yet for other travel modes such as cycling, walking or moped riding (Hakkert and Gitelman, 2007). Thus, evaluation studies for these travel modes can only make use of logical SPIs. Similarly, behavior models (BMs) are used to assess expected effects on (road) behavior. BMs, such as the Health Belief Model or the Theory of Planned Behavior, provide theories regarding how behavior can be predicted from underlying psychological determinants (Glanz et al., 2002). If it were possible to predict behavioral change from changes in underlying determinants, variables from a particular BM could be used as outcome criteria in evaluation studies of RSE. Of all determinants, behavioral intention is the strongest determinant of behavior (Glanz et al., 2002). Intention mediates the influence of other predictors, such as attitudes and knowledge, on behavior and indicates "How hard one is prepared to try, or how much effort one will exert, in order to achieve desired outcomes" (Webb and Sheeran, 2006).

To assess the actual strength of the intention-behavior relationship after an intervention, (Webb and Sheeran, 2006) conducted a meta-analysis of randomized controlled trials, and concluded that a large change in intention only resulted in a medium-to-small change in behavior. This finding confirmed again the intention-behavior gap, but further analyses also showed the conditions under which this gap was greatest, namely:

(a) When participants lacked control over the behavior,

(b) When the behavior was performed in a social context, for instance smoking and drinking with friends, and

Although these conclusions were not differentiated by age group, some of these characteristics may have an even greater impact on young adolescents.

Lack of control especially may play a stronger role among adolescents than among adults, because of adolescents' greater impulsiveness (Gerrard et al., 2008; Gibbons et al., 2009; Gibbons et al., 2002; Reyna and Farley, 2006), they are still developing cognitive and

executive skills (Blakemore et al., 2007; Blakemore and Choudhury, 2006), and they are inexperience as road users (Twisk and Stacey, 2007; Vlakveld, 2011).

In addition, the influence of the social context may differ between adolescents and adults, because of peer pressure that leads to adolescents taking greater risks in the presence of peers than when being on their own (Brown, 2004; Gardner and Steinberg, 2005; Sumter et al., 2009). In studies of young adolescents, changes in behavior intentions may be a less reliable proxy for actual behavior changes than for adults. Behavior change, rather than change in intention, is thus the preferred criterion for evaluation studies involving this age group.

2.6.5 Role of High Schools in Road Safety Educations

Safe road-user behavior and a reduction in pedestrian fatalities depend not only on knowledge and skills but also on community support, perception of vulnerability and risk, social norms and models, engineering measures and law enforcement. So it is very important for the decision makers to keep in mind that the pedestrian safety and road safety education is adjunct to other measures. Road safety educational program should include such thing, that will help to overcome the problem of the safety issue of the pedestrian. Rising awareness is one of the way that can help in reducing the possibility of the occurrences of the accidents. Informing the drivers about care, prudence, kindness, consideration, speed and pedestrian right-of-the way and traffic rules can be included as the factor of creating awareness. One study reveals that young workers (15–24 years old) have a disproportionately high rate of injuries in the workplace and many are employed on a casual, temporary or intermittent basis, in jobs that require low technical skill (Thamrin et al., 2010). One approach to reducing the burden of young worker injury is through improvements in the provision and effectiveness of safety training, initially at school and then in the workplace. The value of school-based introductory safety training can be inferred from a study in Canada which found that only one in five employees had received safety training in their first year with a new employer (Smith and Mustard, 2007).

In an Australian survey of 270 workplaces in the hospitality industry, the need for improvement in induction training for young workers was highlighted (Pisaniello, D. et al., 2009). Indeed, the importance of providing occupational safety education in the secondary school setting has been widely recognized (Davis and Pollack, 1995; U.S. Department of Health and Human Services, 1995; Bush, D. et al., 1999; Schulte et al., 2005).

To improve school-based education, consistency and effectiveness are two aspects that have been identified as requiring further attention. A report for the European Agency for Safety and Health at Work revealed inconsistency in approaches to occupational safety education, both between and within member states (Sas, 2009). It has been argued that, the quantity and quality of occupational safety education is largely at the discretion of the instructor and school (Sas, 2009; Salminen and Palukka, 2007; Schulte et al., 2005). The quality of education may be influenced by the teacher's enthusiasm and experience, the availability of time and resources, and the level of engagement of the students themselves (Burke et al., 2006). Internationally, there is a vast quantity of occupational safety information and resources, including those specifically for high school students. However, there appears to be limited evidence for the effectiveness of the resources or programs.

School based education is very important in creating awareness among the children who will be the future law abiding citizen. Such programs help children acquire knowledge and skills for pedestrian safety (Duperrex et al., 2002). These are important life skills which will help in future to be in safe and sound condition. School-based traffic education will only result in reduced pedestrian accident when combined with other interventions. While there is evidence that school-based educational programs have the potential to increase knowledge about safety (Lerman et al., 1998 and Linker et al., 2005), it cannot be assumed that this knowledge will translate to safe behavior and ultimately for injury reduction. A recent analysis of workplace safety education initiatives for young workers in Canada described current approaches as informational rather than instructional. Specifically, it was suggested that current programs largely fail to promote self-advocacy, considered a critical factor in enabling safety knowledge to be put into practice (Chin et al., 2010).

Thus, there is a need for more research focused on attaining a better understanding of how school-based occupational safety education can be made effective in positively influencing behaviors, and on the complementary roles of industry- and school based training. Key informants of the situation in schools are the teachers themselves, the perspectives of whom have received little attention in the literature (Salminen and Palukka, 2007). From a study in South Australia, it is observed that various teaching resources are made available to the state's 211 high schools, including Passport to Safety, a Canadian-developed resource, and Workplace Learning Guidelines published by the educational authority, the Department of Education and Children's Services (DECS) (Coffman, J.M. et al., 2008). Although the latter are provided to assist schools' compliance with the duty of care requirements, the extent to which they are applied is uncertain. From the above discussion, it is observed that, for flourishing safety education, high schools can play an important role. At the end, it can be concluded that, if training is ensured at school level, RMG workers will be benefited. As understanding the student are benefited from school program, likewise RMG workers can also be benefited through initiating similar safety education program.

2.7 Summary

This chapter reviews the various aspects of transportation safety for garments workers for better and safe use of roads. At the starting of this chapter, Transportation safety related factors are mentioned. In this section, importance of transportation safety and one prime factor; economical perspective has been discussed. After that, the condition of RMG sector in context of Bangladesh and the workers present scenario has been illustrated. Then, mode of transport, safety issues and psychological behavior of the road users, travel characteristics and travel behavior of RMG workers are explored from literature. At the end of this chapter, several methods of traffic safety education and different safety programs, their effectiveness on road users are described. In summary, there is a gap in the literature observed which solely focuses on the road safety reception of readymade garments workers' and their willingness to receive safety education.

CHAPTER 3: DATA AND METHODOLOGY

3.1 Introduction

This study is conducted to provide an overview of the probable causes of existing proneness to road accidents of the garments workers throughout Bangladesh. In fact, the rapid growth of this industry, the increased number of vehicles, unplanned location of the industry infrastructures as well as the increasing demand of the RMG due to cheap labor has affected workers' safety and life security system in most of the garments industries of the country.

Like many other competing developing countries, Bangladesh has a huge labor force which has introduced a significant number of foreign currencies since the last decade. Though most of this labor force are from poor educational background. As established previously, every year a significant amount of the labor population accept death in road accidents. But it is a matter of great concern that no reliable data sources are present to estimate the exact causes of these accidents. The only realistic way to gather valid information on the causes of road crashes and road safety perception of this population is by conducting a labor survey. This chapter will focus on the chronological steps that are directly relevant to this research. Also, this study involves garment workers' perception and behavioural characteristics survey. To analysis this, some steps are being combined to facilitate discussion and presentation.

3.2 Survey Methods and Practices

To do this study, several survey methods could be followed. One of the practiced and applicable method is "Survey Methods and Practices", published by Statistics Canada in 2003. "A survey is an activity that collects information in an organized and methodical manner about characteristics of interest from some or all units of a population using well-defined concepts, methods and procedures, and compiles such information into a useful

summary form". A survey can be thought to consist of several interconnected steps which must be carried out following precise procedures and formulas, if the results are to yield accurate and meaningful information. In order to understand the entire process, it is necessary to understand the individual tasks and how they are interconnected and related.

The steps followed in this study are shown in the following diagram.

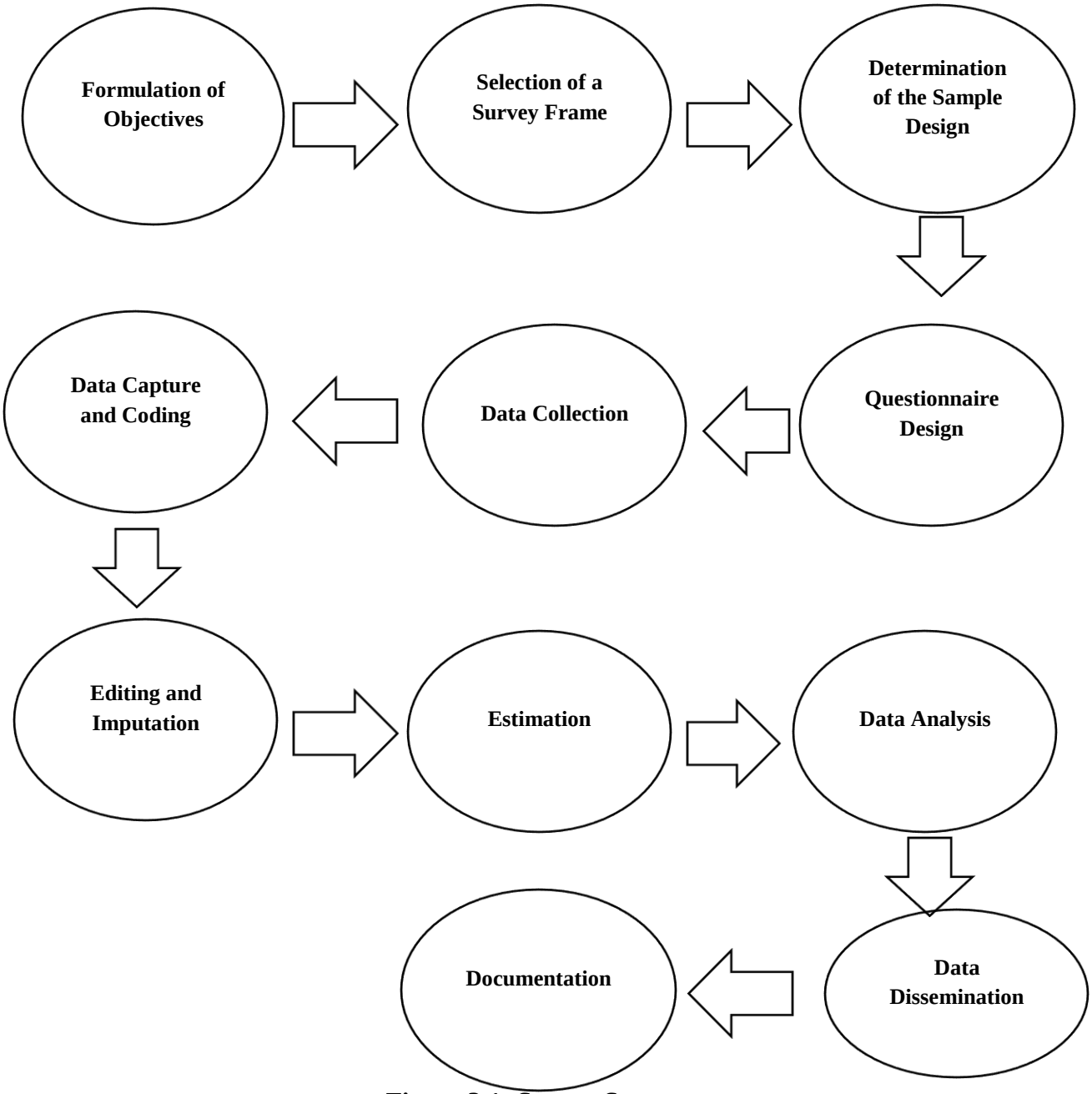

Figure 3.1: Survey Steps

The following part of this chapter will contain the discussion of the steps mentioned in the diagram. But as it is mentioned earlier some the steps will be simplified to facilitate better understanding and discussion.

3.3 Selection of Survey Framework and Methodology Selection

For conducting any survey, a survey frame should need to be followed. For that purpose, according to Statistics Canada (2003), a survey frame provides the means of identifying and contacting the units of the survey population. Survey methodology depends on some factors those are:

Survey errors (sampling and non-sampling error)

- Cost
- Timeliness
- Size of the population
- Small area estimation
- Prevalence of attributes
- Specialized needs
- Other factors

In a sample survey, data are collected for only a fraction (typically a very small fraction) of units of the population. One of the ways to identify and contact the units of survey population is a survey frame which is called sample frame for a sample survey (Statistics Canada, 2003). Ultimately, it defines the survey population through a set of information. A frame should include some or all items which are listed below:

- Identification data (name, address, identification number)
- Contact data (mailing address, telephone number)
- Classification data
- Maintenance data
- Linkage data

3.3.1 Methodology Development and Data Interpretation Procedure

The methodology has developed in the following procedure.

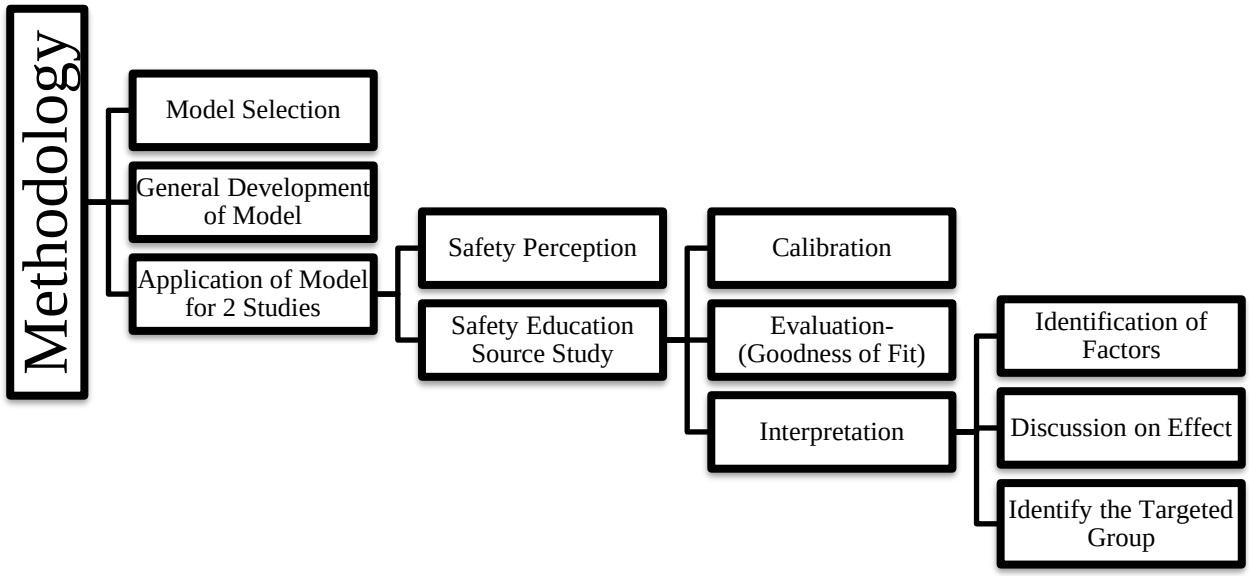

Figure 3.2: Methodology Development and Data Interpretation Process

3.4 Survey Location Details and Reasons Behind choosing sites

For conducting any types of survey work, location fix up is mandatory. Because there would not be enough budget available and time limitation to do collect information and sometimes it's not worthy to conduct survey on the whole population which may create problem on economic prospect, time management and data analysis process also. That's why, location selection is one of the crucial step of any survey process.

3.4.1 Surveyed Factories and Location Map

In this study, the target population consists of workers in the following garments factories:

- Sayem fashion ltd.
- Radiant sweater industries ltd
- Savar Sportswear company ltd.,
- Aziz Group of Industries
- M/S Spicy Fashion Ltd.
- Goldstar Garment Ltd
- Big Boy's apparels ltd.
- Islam garments Ltd.

3.4.2 Justification for Choosing the Sites

The first two industries are located in Gazipur district near the Dhaka- Mymensingh highway (Total no. of accidents 831, from 1998-2010), and third one is at Savar district near Dhaka-Ashulia Highway. These three sites are one of the most accident prone zones of Bangladesh where a large number of victims are shortlisted to garments workers only. Fourth one is located at Tejgaon industrial area, Dhaka, fifth one is located at Mirpur, sixth one is located at Shamoli and the remaining two garments are located at Gulshan area, Dhaka which is also declared as an accident-prone zone (Total no of accident 9125, from 1998-2010) (Cozzani et al., 2006).

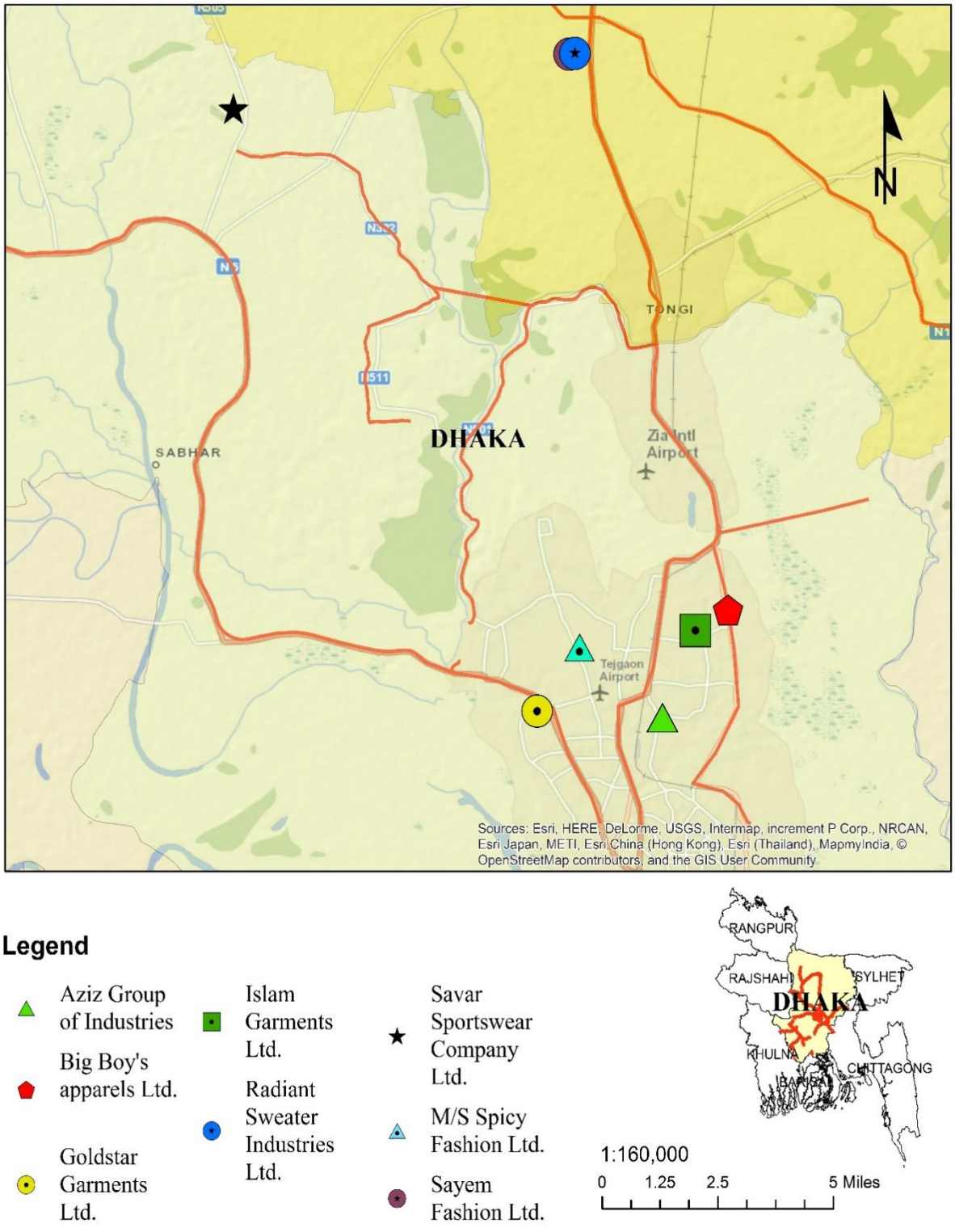

Figure 3.3: Surveyed Garments' Location

These garments are chosen in the most accident prone regions keeping in mind that these would fix and fit to most average situations prevailing throughout Dhaka city where most of the garments industries are located alongside major highways. These locations are also chosen for their availability of target groups. The approach taken is cost-effective in a sense it keeps the number of locations limited which greatly facilitate personal interviews.

3.5 Sampling

To do any kind of analysis, sample preparation and targeted sample group selection is one of the major issue. As the garments workers are the main economic driver of Bangladesh and they are significant number of victims of road accidents, that's why they are selected as the targeted sample group. In a brief, sampling is the process of gathering the required information for each selected unit in the survey. Survey sampling is the process of selecting a probability-based sample from a finite population according to a sample design (Cochran, 1977).

A sample design encompasses the rules and operations by which one select sampling unit from the population and the computation of sample statistics, which are estimates of the population values of interest. The objective of your survey often determines appropriate sample designs and valid data collection methodology.

Sampling can be done in two ways: non-probability (quota sampling) and probability sampling (Stratified sampling). Stratified sampling is a method of sampling from a population and quota sampling is a method for selecting survey participants. For this study we selected Partially Stratified sampling to increase precision of estimates and to keep sampling strategy efficient, to provide important subgroups (domains of interest) and efficient domain estimators, Operationally or administratively convenient and to allow different sample frames and procedures applied to different strata.

A sample size of 1000 was chosen which allowed 3% marginal error as mentioned in the Statistics Canada, 2003.

Table 3.1: Sample Size and Margin of Error

SAMPLE SIZE	MARGIN of ERROR
50	.139
100	.098
500	.044
1000	.031

It was kept in mind that having the minimum size helps to measure attributes and variables accurately, keep reasonable relationship of degree of variability and allow sufficient numbers in each sub groups. On the other hand, larger samples may ensure better estimates but cost, time and operational constraints limit sample size selection. (Dixon and Leach, 1978).

During sampling for this study, special care was taken. So that sample chosen includes equal percentage of male and female labors and also they were chosen from the whole industrial buildings. For example, in Sayem fashion Ltd. random sampling was done for survey from each of the five floors of the building. Data was also collected randomly from both right and left side of the building. This was done for ensuring accuracy as well as reliability of the survey data.

3.6 Questionnaire Design

Form this study, Partially Stratified sampling method was followed. That indicates that sample have to participate in conversation or survey process. For this, questionnaire design is one of the important steps. A study done by Statistics Canada (2003) reveals that, a questionnaire (or form) is a group or sequence of questions designed to obtain information

on a subject from a respondent. Questionnaires play a central role in the data collection process since they have a major impact on data quality and influence the image that the statistical agency projects to the public. Questionnaires can either be in paper or computerized format.

A study though based on students' perception as pedestrian risk (Hossain et al., 2010) was consulted for the design of questionnaires for this study. Pedestrian safety education was assessed by a scale using two terms with response categories "Yes" or "No" to measure whether the concerned worker has any safety knowledge. Later this response has been converted as dependent variable by expressing in binary variable (0= knowledge obtained from different sources. In our study the response variable gets any safety knowledge or have no idea about safety education, is a binary or dichotomous variable.

As it will be seen later on, some of the questions are directly relevant to this study and so are accepted as it is; some has been curved as appropriate to yield the necessary data for the model while some questions have been entirely formed fresh as to meet the need of necessary information and index variables. For example, 'How often do you feel that speed breaker should be installed in front of the garments?' was a question that was included in the survey. It was included only considering the local context and the author's observation of the situation. Likewise, questions such as 'While walking on the footpath how often do you feel unsafe due to presence of uncovered drain?' and 'While walking on footpath how often do you feel entering of the motor-cycle in the footpath can drive over you?' was included in the questionnaire.

Perception of pedestrian safety was assessed by a Likert scale using four items with response categories ranging from "Strongly Agree" to "Strongly Disagree" to measure safety perception score. This score was considered as dependent variable. The traditional five categories were not used as neutral responses are not statistically helpful (Anderson et al. 1983). Since Likert scale is associated with the problem of discreteness, and dependent variable continuous data works much better in a regression model, this research used multiple questions (38 questions related to safety perception). So the final score of safety

perception was somewhere between 38 to 190. This provided more variations and made the average scores close to continuous data, and thus helped to get better regression model.

Score is assigned based on the direction of the questions. For an example, if a respondent marked “Almost always” to the question, a score of 4 was assigned and if a respondent marked “Usually”, “Occasionally” or “Rarely” to the question a score of 3, 2 or 1 was assigned respectively to the response. Because by marking “Almost always” to the questions, the respondent was considered as the most safety concerned while marking “Rarely” means lower concern for traffic safety. For example: ‘While walking, how often do you feel that crossing street is dangerous?’ is a sample question. Apparently if someone answers “Almost always’, he is very much concerned about traffic safety. That’s why he/ she is given the highest score ‘5’.

Thus, a higher score would mean better perception on traffic safety; in other words, more concerned about traffic safety. Some questions regarding gender, age, marital status was also included. These questions proved to be helpful in the process of identifying which groups of garment workers were more concerned about safety.

3.6.1 Design Process

As described in Statistics Canada, 2003, questionnaire design follows some steps,

First, consulting with data users and respondents is important. Data user consultation starts from formulation of objective. It is extensive and important especially for surveys not conducted by agencies. The questionnaires for the survey portion of this study has been curved appropriately to fit the purpose, i.e. yield of effective data set for the planned statistical modeling.

As in this study, RMG workers’ behavior is the main priority, that’s why to model people’s such as workers’ behavior, knowledge and attitude, a qualitative study could be focused (Hossain, 2011). This type of research emphasizes on how people make sense of their surroundings and the way they deal with certain matters (Willig, 2001). These days, qualitative research is applied in different disciplines such as sociology, anthropology,

economics, psychology and political science (Hossain, 2011). In summary, qualitative research helps in exploring how people make sense of the world by focusing on their thoughts and interpretation process (Given, 2008). At the beginning of this empirical study, a pilot study was conducted. Ten RMG workers were interviewed. During these interviews, some new and special issues got highlighted by the interviewees which were included in the model. As a result, the following dimensions were explored. On the other hand, in qualitative research, interview is one of the most common data collection methods (King et al., 2010) which can be structured or semi-structured. In structured interview, interviewer asks a fixed set of questions to the interviewees (Hossain, 2013). However, in semi-structured interviews, the interviewer, other than asking some structured questions, attempts to comprehend and penetrate the perceptions of the interviewees (Hossain 2013). It helps in understanding the 'lived experience of other people and the meaning they make of that experience' (Seidman, 2006).

In this study, a semi-structured and in-depth data collection method was followed to gain deep insights in terms of the safety perception of RMG workers. In total, 1020 interviews were conducted involving male and female RMG workers' by following an interview guide that was prepared on the basis of existing literature representing the aforementioned service quality criteria. Through using pen and paper, the researchers transcribed the data/information manually (Hossain, 2013). The interviewees spoke in their mother tongue, i.e., Bengali. The questionnaire was in Bengali, was later translated in English for using in the model. The responses of the interviewees were analyzed on a thematic manner as per the interview guide. In some cases, if the interviewees felt uncomfortable or puzzled about talking on some sensitive issues, the interviewers have stopped taking interview. The duration of the interviews ranged from 20 minutes to 30 minutes. Though the interview guide did not contain any sensitive questions, but few of the interviewers' feel scared and in-secured. In most of the cases, the interviewees did not permit to use their names in the research report. Therefore, the identities of the interviewees are not noted.

According to the interviewees, walking along the roads is risky for the pedestrian because of traffic management in the urban area. In general, the drivers' do not try to follow any rules and regulation and for that reason, the pedestrian has to move to over drain. The

interviewees highlighted this as one of the major problems in their regular travel behavior. According to them, in most of the cases, they have to fall down inside the drainage manhole or have to enter in the market which is really 'unacceptable'. The following is a comment by one of the interviewees regarding this issue:

> *I often feel unsafe walking along the streets because of fast moving vehicles. Not only that when there is no sidewalk, I also feel unsafe. Else more, due to insufficient lighting, it is very difficult to walk along the road side. During raining, the misery cannot be explainable.*

From a recent study a statistical data also shows that around 4,500 pedestrians are killed in traffic crashes with motor vehicles in the United States (NHTSA, 2009.). Pedestrians killed while "walking along the roadway" account for almost 8 percent of these deaths (Hunter et al., 1995). Many of these tragedies are preventable. Providing separated walkways from the travel lanes could help to prevent up to 88 percent of these "walking along roadway crashes (McMahon et al. 2002). From the above discussion, it can be concluded that adding few questions on walking along the street of the garments workers as mostly exposed group of pedestrian bears a significant role for assessing safety perception of the workers.

Moreover, the interviewees narrated that provision of sidewalk within a roadway environment can enhance safety of the workers. A study reveals that introducing sidewalk in the existing roadways can aid to improve the safety scenario (Landis et al. 2001). On the following comment of an interviewee emphasizes on this fact:

> *I often feel safe walking on sidewalks along the streets. Uncovered drains and narrow sidewalks sometimes make me scared to use footpath. Sometimes, vehicles can enter into the sidewalk and hit me, which make me to be careful all the way using the sidewalks. In addition, sometimes sidewalks are occupied by the hawkers.*

Some statistical data also indicate that the percentage of pedestrian crashes is nearly about twice in the street where there are no sidewalks (Department of Health & Human Services, 1996.). Providing walkways for pedestrians dramatically increases how good pedestrians perceive their needs being met along roadways. Though most of the pedestrians' belief that

the safety measure is there where sidewalks are available but the perception of them is not always correct. Because sometimes the crashes happen on the sidewalks, so the drivers must be very careful at some places of the road like cross walk, right turns, speeding. In most cases sidewalk is provided usually in concrete which must have the accessibility of the disables (Albes et al., 2012). So, the importance of the sidewalk regarding the safety and the security of the pedestrian is beyond the question and that's why few questions have chosen on using sidewalks.

According to the interviewees, it is narrated that providing zebra-crossing for pedestrian crossing and vehicle turning in the mid-block area would play an important role in roadway geometric design. A study has conducted on driver speed behavior at zebra crossing where the results formulate that drivers do not observe the law concerning speed behavior at the zebra crossing. The reason behind this is, driver don't find pedestrian as endanger at the zebra crossing and mid-block area (Varhelyi, 1998). One of the interviewees has commented on regarding this issue:

> *I often feel safe crossing the streets at mid-block with crossing facility such as zebra crossing. At locations, where I cross the streets, I feel safer if a zebra crossing is installed there.*

A study also reveals that, in the United States, 78% of pedestrian crashes occur at non-intersection crossings, that's why, un-signalized, marked midblock crosswalks are prime targets for remediation. When advance yield markings such as zebra crossing were present, the crash scenario has improved (Gómez et al., 2011). Considering, the importance of zebra crossing and mid-block crosswalk, few questions about these are incorporated in the questionnaire.

The interviewers have mentioned the importance of signalization system regarding safety. A study reveals that for mitigation of pedestrian crash at un-signalized locations, introducing signalize system improve safety for pedestrians crossing high-volume and high-speed roadways (Fitzpatrick et al., 2006). One interviewee highlighted this issue as follows:

> *I feel that there is a need to install traffic signal at intersections where I cross the streets. While crossing the streets, if there is no traffic signal available, I use hand signal to slow down or stop vehicles.*

As the pedestrians are legitimate users of the transportation system, and they should, therefore, be able to use this safely. So, the signalize system helps the garments workers to use the road as safe as possible to ensure a healthy and peaceful use of the signal (Yagil, 2000).

During the interview process, the interviewers has observed that mobile phone is now-a-days one of the most important element of human life. Though it connects people, it has a negative impact on pedestrian safety by distracting the people while they are in the road. A study reveals that while crossing the road, mobile phone users sometimes endanger themselves by their reckless behavior (Wang et al., 2012). The interviewees' response describes the situation:

> *I often use mobile phone while walking along the road. After work time, I always take information of my family members. Sometimes, I forget to stop talking with them, which can cause severe injuries of other pedestrian or relatives. That's why, I always stop talking or texting on the mobile phone when I cross the streets.*

It has been observed by the interviewers that, while crossing the road, pedestrian who use mobile phone sometimes behaves very strange and risky. It has also been found from some statistical data that the among pedestrian, female is more vulnerable than the male ones. The female pedestrians who crossed while talking on a mobile phone crossed more slowly, and were less likely to look at traffic before starting to cross, to wait for traffic to stop, or to look at traffic while crossing, on the other hand the male pedestrians who crossed while talking on a mobile phone crossed more slowly at un-signalized crossings (Hatfield et al., 2006). Following the pedestrian behavior and the statistical data, it can be concluded that the questionnaires that have chosen related to mobile use bears a great significance for pedestrian safety of the garments workers.

The interviewees explored that police control is another key point of pedestrian's road crossing behavior. Based on pedestrian behavior, police have followed different approach to control over them. A study (Mastrofski et al., 2000) has examined on how police officer control the pedestrian attitude. The result indicates that pedestrian has little impact on the police decision. One interviewer comments that:

> *When I cross the road, the traffic police help me to cross it safely. Sometimes, the traffic police stop the vehicle using hand signal. I feel that there should be more traffic police control on all the streets.*

Based on the pedestrian behavior, it can be concluded that few questions have chosen related to police control involvement for pedestrian safety of the garments workers.

After preparing the draft questionnaire, a trial has run whether the statement is easily understandable by the garment workers or not. Then it was required to do some modification.

Second, review of previous questionnaires may help in all aspects. Careful examination of questions and their same or similar answer makes question designing easier. it has observed that the questionnaire was then good enough to understand. It is an efficient approach too. After all, a total of 38 diverse questions were prepared for the study.

The third step involves drafting of the questionnaire. As the whole survey process is affected by the questionnaire drafted, some factors have to be considered for preparing the questionnaire. The way data will be collected will affect wording and placement of questions. Questions should sound natural and more answer categories should be provided in interviews. Keeping these set of rules in mind the questions has been arranged in a simple, continuous and pleasant form so that, the interviewee do not feel anxious or motivated. Failing to do so might trigger biasness in the data set and thereby question the validity of the model.

The fourth step is reviewing and revising the questionnaire. It is helpful in identifying mistakes in spelling and grammar or in formatting. People who are not related to survey

and experts may review questionnaire and their comments will help to make questionnaires understandable and efficient.

As the samples who are subjected to the survey are mostly illiterate or poorly educated people, the questions have been revised time and again to check for any major/minor error(s) that might trigger sensitive issues or misunderstanding between the two parties regarding the goal of the survey.

The last step in the design process is finalizing the questionnaire. Designing is basically an iterative process and through several iterations, questionnaire is finalized. Final questionnaire is then either printed or programmed based on which data collection method will be used.

As for this study, to avoid any kind of information gap the authors participated in the survey personally. The copies of questionnaires were printed and filed up by the authors while the interviewees were answering verbally, on a face to face interview.

3.6.2 Question Types

It is important to know question types because expected information will depend on it. Questions can be of two types such as open-ended and closed-ended questions. An open-ended question is designed to encourage a full, meaningful answer using the subject's own knowledge and/or feelings. It is the opposite of a closed-ended question, which encourages a short or single-word answer. Open-ended questions also tend to be more objective and less leading than closed-ended questions. Open-ended and close-ended questions differ in several characteristics, especially as regards the role of respondents when answering such questions. Close-ended questions limit the respondent to the set of alternatives being offered, while open-ended questions allow the respondent to express an opinion without being influenced by the researcher (Foddy, 1993). This has several consequences for the quality of survey data. The advantages of the open-ended questions include the possibility of discovering the responses that individuals give spontaneously, and thus avoiding the bias that may result from suggesting responses to individuals, a bias which may occur in

the case of close-ended questions. However, open-ended questions also have disadvantages in comparison to close-ended, such as the need for extensive coding and larger item non-response. Usually a compromise as regards the use of open- and close-ended questions is reached. Decades ago, (Lazarsfeld, 1944) already suggested using open-ended questions at the initial stage of questionnaire design in order to identify adequate answer categories for the close-ended questions. In the later stages of the questionnaire design, open-ended questions can be used to explore deviant responses to the close-ended questions.

The questionnaire used in this study has both open and closed questions. Most questions are multiple choices and a few are dichotomous. Open questions are included to gather additional information and those responses are not coded or analyzed statistically.

During the process of data collection, some restrictions has encountered. In few garments industry, the garments owner did not allow to do survey in few section. It can be possible that due to asking question individual basis of the worker may slower down the work efficiency. That's why, data has collected only from the allowed section. Another major limitation is; some safety concern answers could be biased. Because, during the survey process, it is observed that after interviewed of a worker, other workers had discussed with that person about the question and answer. For this survey, it was tried to be careful for not getting response who were biased through group discussion among themselves.

3.6.3 Questionnaire

Please see the Appendix-A.

3.7 Statistical Model

For building up the safety analysis model of garments worker, we will use linear regression model. Linear regression is one of the most widely studied and applied statistical and econometric techniques. There are numerous reasons for this. First, linear regression is suitable for modeling a wide variety of relationships between variables. Regression model outputs are relatively easy to interpret and communicate to others, numerical estimation of

regression models is relatively easy and use software for estimating models. It should not be surprising that linear regression serves as a good starting point for illustrating statistical model estimating procedures. Applying linear regression when other methods are more suitable should be avoided at all costs. The form of the regression model requires that the relationship between variables is inherently linear — a straight-line relationship between the dependent variable Y and the independent variable. The principal objective of a statistical model is to identify a probabilistic system of the form

$$Y = f(x) \tag{3.1}$$

Where the dependent variable Y is a function of a set of independent variables X. The regression analysis of the above-mentioned form examines:

a) Whether the observed patterns in the data are consistent with theoretical prediction; and

b) The relationship between a quantitative dependent variable and one or more quantitative or qualitative independent variables.

In the analysis, the Y represents the safety perception and X represents the socioeconomic features etc. In our study, most of the dependent variables are continuous. For this reason, linear regression analysis was used in the study. Finally, a method to find the elasticity of independent variables will be described.

3.7.1 Linear Regression Model

Linear regression is one of the most widely studied and applied statistical and econometric techniques. It is a useful method for modeling the relationship between a dependent variable and one or more explanatory variables (or independent variable). A lot of reasons are behind this widespread acceptability. First, linear regression is suitable for modeling a wide variety of relationships between variables. In addition, the assumptions of linear regression models are often suitably satisfied in many practical applications. Furthermore, regression model outputs are relatively easy to interpret and communicate to others, numerical estimation of regression models is relatively easy.

3.7.1.1 Assumptions of the Linear Regression Model

Linear regression is used to model a linear relationship between a continuous dependent variable and one or more independent variables. Most applications of regression seek to identify a set of independent variables that are thought to convey with the dependent variable. There are numerous assumptions of the linear regression model, which should be thought of as requirements. When any of the requirements are not met, remedial actions should be taken, and in some cases, alternative modeling approaches should be adopted.

The following assumptions of the linear regression model are explained by following Washington et al. (2010).

3.7.1.1.1 Continuous Dependent Variable Y

The assumption in regression is that the response is continuous; that is, it can take on any value within a range of values. A continuous variable is measured on the interval or ratio scale. Although it is often done, regression on ordinal scale response variables is incorrect. For example, count variables (nonnegative integers) should be modeled with Poisson and negative binomial regression. Modeling nominal scale dependent variables (discrete variables that are not ordered) requires discrete outcome models.

3.7.1.1.2 Linear-in-Parameters Relationship between Y and X

The form of the regression model requires that the relationship between variables is inherently linear- a straight-line relationship between the dependent variable Y and the independent variables. The simple linear regression model is given by:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \varepsilon_i \qquad (3.2)$$

In this algebraic expression of the simple linear regression model, the dependent variable Y is a function of a constant term β0 and a constant β1 times the value X1 of independent variable X for observation i, plus a disturbance term εi. The subscript i corresponds to the individual or observation, where i = 1, 2, 3…..n. In most applications the response variable Y is a function of many independent variables.

3.7.1.1.3 Observations Independently and Randomly Sampled

An assumption necessary to make inferences about the population of interest is that the data are randomly sampled from the population. Independence requires that the probability that an observation is selected is unaffected by other observations selected into the sample. In some cases, random assignment can be used in place of random sampling, and other sampling schemes such as stratified and cluster samples can be accommodated in the regression modeling framework with corrective measures.

3.7.1.1.4 Uncertain Relationship between Variables

The difference between the equation of a straight-line and a linear regression model is the addition of a stochastic, disturbance, or disturbance term, ε. This disturbance term consists of several elements of the process being modeled. First, it can contain variables that were omitted from the model — assumed to be the sum of many small, individually unimportant effects, some positive and others negative. Second, it contains measurement errors in the dependent variable, or the imprecision in measuring Y, again assumed to be random. Finally, it contains random variation inherent in the underlying data-generating process.

3.7.1.1.5 Disturbance Term Independent of X and Expected Value Zero

The requirements of the disturbance term ε can be written as follows:

$$E[\varepsilon_i] = 0 \tag{3.3}$$

$$VAR[\varepsilon_i] = \sigma^2 \tag{3.4}$$

Equation 3.4 shows that the variance of the disturbance term, σ2, is independent across observations. This is referred to as the homoscedasticity assumption and implies that the net effect of model uncertainty, including unobserved effects, measurement errors, and true random variation, is not systematic across observations; instead it is random across observations and across covariates. When disturbances are heteroscedastic (vary systematically across observations), then alternative modeling approaches such as weighted least squares or generalized least squares may be required.

3.7.1.1.6 Disturbance Terms Not Auto Correlated

This requirement is written as follows:

$$COV[\varepsilon_i, \varepsilon_j] = 0 \; if \; i \neq j \tag{3.5}$$

Equation 3.5 specifies that disturbances are independent across observations. Common violations of this assumption occur when observations are repeated on individuals, so the unobserved heterogeneity portion of the disturbance term ε is the same across repeated observations. Observations across time often possess auto correlated disturbances as well. When disturbances are correlated across observations, generalized least squares or other correction methods are required.

3.7.1.1.7 Regressors and Disturbances Uncorrelated

This property is known as erogeneity of the regressors. When the regressors are exogenous, they are not correlated with the disturbance term. Exogeneity implies that the values of the regressors are determined by influences "outside of the model." So Y does not directly influence the value of an exogenous regressor. In mathematical terms, this requirement translates to

$$COV[X_i, \varepsilon_j] = 0 \; for \; all \; i \; and \; j \tag{3.6}$$

When an important variable is endogenous (depends on Y), then alternative methods are required, such as instrumental variables, two and three stage least squares, or structural equations models.

3.7.1.1.8 Disturbances Approximately Normally Distributed

Although not a requirement for the estimation of linear regression models, the disturbance terms are required to be approximately normally distributed in order to make inferences about the parameters from the model. In this regard the central limit theorem enables exact inference about the properties of statistical parameters.

3.7.1.2 Regression Fundamentals

Regression seeks to provide information and properties about the parameters in the population model by inspecting properties of the sample-estimated betas, how they behave, and what they can tell us about the sample and thus about the population.

The linear regression model thought to exist for the entire population of interest is

$$E[Y_i|X_i] = E\left[\beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + \cdots + \beta_{p-1} X_{p-1,i}\right] \quad (3.7)$$

The true population model is formulated from theoretical considerations, past research findings, and postulated theories. The expected value of Yi given covariate vector Xi is a conditional expectation. In some texts the conditional expectation notation is dropped, but it should be understood that the mean or expected value of Yi is conditional on the covariate vector for observation i. The population model represents a theoretically postulated model whose parameter values are unknown, constant, and denoted with betas, as shown in Equation 3.7. The parameters are unknown because Equation 3.7 is based on all members of the population of interest. The parameters (betas) are constant terms that reflect the underlying true relationship between the independent variables X1, X2,…,Xp–1 and dependent variable Yi, because the population N is presumably finite at any given time. The true population model contains p parameters in the model, and there are n observations.

The unknown disturbance term for the population regression model (Equation 3.7) is given by

$$\varepsilon_i = Y_i - \bar{Y}_i = Y_i - E[\beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + \cdots + \beta_{p-1} X_{p-1,i} \quad (3.8)$$

Regression builds on the notion that information is learned about the unknown and constant parameters (betas) of the population by using information contained in the sample. The sample is used for estimating betas random variables that fluctuate from sample to sample and the properties of these are used to make inferences about the true population betas. There are numerous procedures to estimate the parameters of the true population model based on the sample data, including least squares and maximum likelihood. The following description is explained from Washington et al. (2010).

3.7.1.2.1 Least Squares Estimation

Least squares estimation is a commonly employed estimation method for regression applications. Often referred to as "ordinary least squares" or OLS, it represents a method for estimating regression model parameters using the sample data.

Consider the algebraic expression of the OLS regression model shown in Equation 3.7. OLS, as one might expect, requires a minimum (least) solution of the squared disturbances. OLS seeks a solution that minimizes the function Q (the subscript for observation number is not shown):

$$Q_{min} = \sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2_{min}$$

$$= \sum_{i=1}^{n} (Y_i - (\beta_0 + \beta_1 X_i))^2_{min} = \sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_1)^2_{min} \quad (3.9)$$

Those values of β0 and β1 that minimize the function Q are the least squares estimated parameters. Of course β0 and β1 are parameters of the population and are unknown, so estimators B0 and B1 are obtained, which are random variables that vary from sample to sample. By setting the partial derivatives of Q with respect to β0 and β1 equal to zero, the least squares estimated parameters B0 and B1 are obtained:

$$\frac{\partial Q}{\partial \beta_0} = -2 \sum_{i=1}^{n} (Y_i - \beta_o - \beta_1 X_i) = 0 \quad (3.10)$$

$$\frac{\partial Q}{\partial \beta_1} = -2 \sum_{i=1}^{n} X_i (Y_i - \beta_0 - \beta_1 X_1) = 0 \quad (3.11)$$

Solving these equations using B0 and B1 to denote the estimates of β0 and β1, respectively, and rearranging terms yields

$$\sum_{i=1}^{n} Y_i = nB_0 + B_1 \sum_{i=1}^{n} X_i \quad (3.12)$$

$$\sum_{i=1}^{n} X_i Y_i = B_0 \sum_{i=1}^{n} X_i + B_1 \sum_{i=1}^{n} X_i^2 \quad (3.13)$$

Solving simultaneously for the betas in Equations 3.12 and 3.13 yields

$$B_1 = \frac{\sum_{i=1}^{n}(X_i - X^-)(Y_i - \bar{Y})}{\sum_{i=1}^{n}(X - X^-)^2} \quad (3.14)$$

$$\beta_0 = \frac{1}{n}\left(\sum_{i=1}^{n} Y_i - B_1 \sum_{i=1}^{n} X_i\right) = \bar{Y} - \beta_1 X^- \quad (3.15)$$

3.7.1.2.2 Maximum Likelihood Estimation

The previous section showed the development of the OLS estimators through the minimization of the function Q. Another popular and sometimes useful statistical estimation method is called maximum likelihood estimation, which results in the maximum likelihood estimates, or MLEs. The joint density of observing the sample data from a statistical distribution with parameter vector θ, such that

$$f(x_1, x_2, \ldots, x_n, \theta) = \prod_{i=1}^{n} f(x_i, \theta) = L(\theta|X) \quad (3.16)$$

For the regression model, the likelihood function for a sample of n independent, identically, and normally distributed disturbances is given by

$$L = (2\pi\sigma^2)^{-\frac{n}{2}} EXP\left[-\frac{1}{2\sigma^2}\sum_{i=1}^{n}(Y_i - X_i^T\beta)^2\right] = (2\pi\sigma^2)^{-\frac{n}{2}} EXP\left[-\frac{1}{2\sigma^2}(Y - X\beta)^T(Y - X\beta)\right] \quad (3.17)$$

As is usually the case, the logarithm of Equation 3.17, or the log likelihood, is simpler to solve than the likelihood function itself, so taking the log of L yields

$$LN(L) = LL = -\frac{n}{2}LN(2\pi) - \frac{n}{2}LN(\sigma^2) - \frac{1}{2\sigma^2}(Y - X\beta)^T(Y - X\beta) \quad (3.18)$$

Maximizing the log likelihood with respect to β and σ2 reveals a solution for the estimates of the betas that is equivalent to the OLS estimates, that is B = (XTX)–1XTY.

3.7.1.3 Regression Model Goodness-of-Fit Measures

According to Washington et al. (2010) goodness-of-fit (GOF) statistics are useful for comparing the results across multiple studies, for comparing competing models within a single study, and for providing feedback on the extent of knowledge about the uncertainty involved with the phenomenon of interest. Three measures of model GOF are discussed: R-squared, adjusted R-squared, and the generalized F test. To develop the R-squared GOF statistic, some basic notions are required. Sum of squares and mean squares are fundamental in both regression and analysis of variance. The sum of square errors (disturbances) is given by

$$SSE = \sum_{i=1}^{n}\left(Y_i - \hat{Y}_i\right)^2 \quad (3.19)$$

The regression sum of squares is given by

$$SSR = \sum_{i=1}^{n}(\hat{Y}_i - \bar{Y})^2 \quad (3.20)$$

The total sum of squares is given by

$$SST = \sum_{i=1}^{n}(Y_i - \bar{Y})^2 \quad (3.21)$$

The SSE is the variation of the fitted regression line around the observations. The SSR is the variation of the fitted regression line around, and SST is the total variation — the variation of each observation around. It also can be shown algebraically that SST = SSR + SSE. Mean squares are just the sum of squares divided by their degrees of freedom. SST

has n-1 degrees of freedom, because 1 degree of freedom is lost in the estimation of Y. SSE has n – p degrees of freedom, because p parameters are used to estimate the fitted regression line. Finally, SSR has p – 1 degrees of freedom associated with it. As one would expect, the degrees of freedom are additive such that n – 1 = n – p + p – 1. The mean squares, then, are MSE = SSE/(n – p) and MSR = SSR/(p – 1). The coefficient of determination, R-squared, is defined as

$$R^2 = \frac{[SST - SSE]}{SST} = \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \tag{3.22}$$

R2 can be thought of as the proportionate reduction of total variation accounted for by the independent variables (X). It is commonly interpreted as the proportion of total variance explained by X. When SSE = 0, R2 = 1, and all of the variance is explained by the model. When SSR = 0, R2 = 0, and there is no association between X and Y. Because R2 can only increase when variables are added to the regression model (SST stays the same, and SSR can only increase even when statistically insignificant variables are added), an adjusted measure, R2adjusted, is used to account for the degrees of freedom changes as a result of different numbers of model parameters, and allows for a reduction in R2adjusted as additional, potentially insignificant variables are added. The adjusted measure is considered to be superior for comparing models with different numbers of parameters. The adjusted coefficient of multiple determinations is

$$R^2 adjusted = 1 - \frac{\frac{SSE}{n-p}}{\frac{SST}{n-1}} = 1 - \left(\frac{n-1}{n-p}\right)\frac{SSE}{SST} \tag{3.23}$$

The following guidelines should be applied:

The R2 and R2adjusted measures provide only relevant comparisons with previous models that have been estimated on the phenomenon under investigation. Thus, an R2adjusted of 0.40 in one study may be considered “good” only if it represents an improvement over similar studies and the model provides new insights into the underlying data-generating

process. Thus, it is possible to obtain an improvement in the R2 or R2adjusted value without gaining a greater understanding of the phenomenon being studied. It is only the combination of a comparable R2adjusted value and a contribution to the fundamental understanding of the phenomenon that justifies the claim of improved modeling results.

The absolute values of R2 and R2adjusted measures are not sufficient measures to judge the quality of a model. Thus, an R2 of 0.20 from a model of a phenomenon with a high proportion of unexplained variation might represent a breakthrough in the current level of understanding, whereas an R2 of 0.90 of another phenomenon might reveal no new insights or contributions. Thus, it is often better to explain a little of a lot of total variance rather than a lot of a little total variance.

Relatively large values of R2 and R2adjusted can be caused by data artifacts. Small variation in the independent variables can result in inflated values. This is particularly troublesome if in practice the model is needed for predictions outside the range of the independent variables. Extreme outliers can also inflate R2 and R2adjusted values.

The R2 and R2adjusted assume a linear relation between the response and predictor variables, and can give grossly misleading results if the relation is nonlinear. In some cases, R2 could be relatively large and suggest a good linear fit, when the true relationships are curvilinear. In other cases, R2 could suggest a very poor fit when in fact the relationships are nonlinear. This emphasizes the need to plot, examine, and become familiar with data prior to statistical modeling.

The R2 and R2adjusted values are bound by 0 and 1 only when an intercept term is included in the regression model. When the intercept is forced through zero, the R2 and R2adjusted values can exceed the value 1 and more caution needs to be used when interpreting them.

Another measure for assessing model fit is the generalized F test. This approach is a general and flexible approach for testing the statistical difference between competing models. First, a full or unrestricted model is estimated. This could be a model with ten independent variables. The full model is fit using the method of least squares and SSE is obtained —

the sum of square errors for the full model. For convenience, the sum of square errors for the full model is denoted as

$$SSE_F = \sum_{i=1}^{n} \left(Y_i - \hat{Y}_{Fi}\right)^2 \tag{3.24}$$

Where the predicted value of Y is based on the full model.

A reduced model is then estimated, which represents a viable competitor to the full model with fewer variables. For example, this could be a model with nine independent variables, or a model with no independent variables, leaving only the Y-intercept term B0. The sum of squared errors is estimated for the competing or reduced model, where

$$SSE_R = \sum_{i=1}^{n} \left(Y_i - \hat{Y}_{Ri}\right)^2 \tag{3.25}$$

The logic of the F test is to compare the values of SSER and SSEF. Recall from the discussion of R-squared that SSE can only be reduced by adding variables into the model, thus SSER ≥ SSEF. If these two sum of square errors are the same, then the full model has done nothing to improve the fit of the model; there is just as much "lack of fit" between observed and predicted observations as with the reduced model, so the reduced model is superior. Conversely, if SSEF is considerably smaller than SSER, then the additional variables add value to the regression by adding sufficient additional explanatory power. In the generalized F test the null and alternative hypotheses are as follows:

$$H_0: all\ \beta_k = 0 \tag{3.26}$$

$$H_a: all \beta_k \neq 0 \tag{3.27}$$

In this test the null hypothesis is that all of the additional parameters in the full model (compared to the reduced model) βk are equal to zero.

When the null hypothesis is true (making the F test a conditional probability), the F* statistic is approximately F distributed, and is given by

$$F^* = \frac{\frac{SSE_R - SSE_F}{df_r - df_F}}{\frac{SSE_F}{df_F}} \approx F(1-\alpha; df_R - df_R, df_F) \quad (3.28)$$

Where dfF = n – pF and dfR = n – pR (n is the number of observations and p is the number of parameters). To calculate this test statistic, the sum of square errors for the two models is first computed, then the F* statistic is compared to the F distribution with appropriate numerator and denominator degrees of freedom. Specifically,

$$If\ F^* \leq F(1-\alpha; df_R - df_R, df_F), then\ conclude\ H_0\ ;$$

$$If F^* \geq F(1-\alpha; df_R - df_R, df_F), then\ concude\ H_a \quad (3.29)$$

The generalized F test is very useful for comparing models of different sizes. When the difference in size between two models is one variable, the F test yields an equivalent result to the t test for that variable. Thus, the F test is most useful for comparing models that differ by more than one independent variable.

Following Montgomery and Runger (2003) the hypotheses of t-test are

$$H_0: \beta_1 = \beta_{1,0} \quad (3.30)$$

$$H_0: \beta_1 \neq \beta_{1,0} \quad (3.31)$$

Where we have assumed a two-sided alternative and the t-statistics is

$$T_0 = \frac{\hat{\beta}_1 - \beta_{1,0}}{\sqrt{\acute{\alpha}^2 / S_{xx}}} \quad (3.32)$$

Follows the t distribution with (n-2) degrees of freedom under H0:β1=β1,0. We would reject

H0: β1=β1,0 if

$$|t_0| > t_{\alpha/2, n-2} \quad (3.33)$$

Where to is computed from Equation 3.33.

The denominator of Equation 3.33 is the standard error of slope. So, we could write the test statistic as

$$T_0 = \frac{\hat{\beta}_1 - \beta_{1,0}}{Se\hat{\beta}_1} \tag{3.34}$$

3.7.1.4 Elasticity of Variables

In order to check the relative significance of independent variables from the final model, the elasticity of the variables was calculated. Elasticity is defined as the percent change in dependent variable due to one percent change in the independent variable. Chang (2005) explained, in general the direct elasticity is defined as

$$E_{xij}^{\lambda i} = \frac{\partial \lambda_i}{\partial x_{ij}} . \frac{x_{ij}}{\lambda_i} \tag{3.35}$$

Where E represents the elasticity, xij is the value of variable j of community i. Equation 3.35 is transformed into following equation

$$E_{xij}^{\lambda i} = \beta_j x_{ij} \tag{3.36}$$

Where, βj is the coefficient corresponding to variable j.

The elasticity in Equation 3.36 is only appropriate for continuous variables. It is not valid for non-continuous variables such as indicator variables that take on values of 0 or 1. For an indicator variable, a pseudo-elasticity is computed to estimate an approximate elasticity of the variables. The pseudo-elasticity gives the incremental change in frequency caused by a discrete (0-1) change in the indicator variables. The pseudo-elasticity for indicator variable is computed as:

$$E_{xij}^{\lambda i} = \frac{\exp(\beta_j) - 1}{\exp(\beta_j)} \tag{3.37}$$

3.7.2 Logistic Regression Model

The logistic regression model or the logit model as it is often referred to, is a special case of a generalized linear model and analyzes models where the outcome is a nominal variable. Analysis for the logistic regression model assumes the outcome variable is a categorical variable. It is common practice to assume that the outcome variable, denoted as Y, is a dichotomous variable having either a success or failure as the outcome.

$$Log_e\left[\frac{P(Y=1|X_1,\dots,X_p)}{1-P(Y=1|X_1,\dots,X_p)}\right] = Log_e\left[\frac{\pi}{1-\pi}\right] = \alpha + \beta_1 X_1 + \beta_p X_p = \alpha + \sum_{j-1}^{p} \beta_j X_j \qquad (3.38)$$

The regression models described in this chapter have been derived with the assumption that the dependent variable is continuous. However, there are cases when the dependent variable is discrete — count data, a series of qualitative rankings, and categorical choices are examples. Logistic regression, which is useful for predicting a binary (or dichotomous) dependent variable as a function of predictor variables, is presented in this section. An example of logistic regression applied to grouped data is found in White and Washington (2001).

The goal of logistic regression, much like linear regression, is to identify the best fitting model that describes the relationship between a binary dependent variable and a set of independent or explanatory variables. In contrast to linear regression, the dependent variable is the population proportion or probability (P) that the resulting outcome is equal to 1. It is important to note that the parameters obtained for the independent variable can be used to estimate odds ratios for each of the independent variables in the model. As an example, consider a model of a driver's stated propensity to exceed the speed limit on a highway as a function of various exogenous factors (drivers have responded to a questionnaire where 0 indicates that they do not exceed the speed limit and 1 that they do). Given a sample of drivers who have also provided socioeconomic information, prior accident involvement, annual vehicle-miles driven, and perceived police presence, a model with these variables is estimated. The resulting model could be used to derive estimates of

the odds ratios for each factor, for example, to assess whether males are more likely to exceed the speed limit.

The logit is the LN (to base) of the odds, or likelihood ratio, that the dependent variable is 1, such that

$$Y = logit(P) = LN\left(\frac{P}{1-P_i}\right) = B_0 + B_i.X_i \quad (3.39)$$

where B0 is the model constant and the B are the parameter estimates for the independent variables (the set of independent variables). The probability P ranges from 0 to 1, while the natural logarithm LN(P/(1 – P)) ranges from negative infinity to positive infinity. The logistic regression model accounts for a curvilinear relationship between the binary

choice Y and the predictor variables Xj, which can be continuous or discrete. The logistic regression curve is approximately linear in the middle range and logarithmic at extreme values. A simple transformation of Equation

$$\left(\frac{P_i}{1-P_i}\right) = EXP^{B_0+B_iX_i} = EXP^{B_o}EXP^{B_iX_i} \quad (3.40)$$

The fundamental equation for the logistic regression shows that when the value of an independent variable increases by one unit, and all other variables are held constant, the new probability ratio [Pi/(1 – Pi)] is given as

$$\left(\frac{P_i}{1-P_i}\right) = EXP^{B_o}EXP^{B_i(X_i+1)} = EXP^{B_o}EXP^{B_iX_i}EXP^{B_i} = \left(\frac{P_i}{1-P_i}\right) EXP^{B_i} \quad (3.41)$$

Thus when independent variable Xj increases by one unit, with all other factors remaining constant, the odds [Pi/(1 – P)] increases by a factor EXPB .The factor is called the odds ratio (OR) and ranges from zero to positive infinity. It indicates the relative amount by which the odds of the outcome increases (OR > 1) or decreases (OR < 1) when the value of the corresponding independent variable increases by 1 unit.

For logistic regression analysis, the model parameter estimates (α, β1, β2,…,βp) should be obtained and it should be determined how well the model fits the data (Agresti, 2007). In this study, the potential explanatory variables were examined to determine whether or not

they are significant enough to be used in our models. The complete model contained all the explanatory variables and interactions believed to influence the level of substance abuse. From that initial stage, we performed regression analysis with the stepwise selection procedure to select our significant variables. Then, factor analysis was used to determine the significant combination of factors in our model. For our purposes, significant combinations of factors have large values greater than 1.

3.7.2.1 Model Assumptions

For our ordinal regression model to hold, we need to ensure that the assumption of parallel lines of all levels of the categorical data is satisfied since the model does not assume normality and constant variance (Bender and Benner, 2000).

Logistic regression does not assume a linear relationship between the dependent and independent variables, the dependent variables do not need to be normally distributed, there is no homogeneity of variance assumption, in other words, the variances do not have to be the same within categories, normally distributed error terms are not assumed and the independent variables do not have to be interval or unbounded (Wright, 1995).

3.7.2.2 Fitting the Data

To fit a logistic regression model, it is assumed that the relationships between the independent variables and the logits are equal for all logits. The regression coefficients are the coefficients α, $\beta 1$, $\beta 2$,…,βp of the equation:

$$\text{Logit}[\pi(x)] = \alpha + \beta 1X1 + \beta 2X2 + \ldots + \beta pXp \qquad (3.42)$$

The results would therefore be a set of parallel lines for each category of the outcome variables. This assumption can be checked by allowing the coefficients to vary, estimating them and determining if they are all equal. So our maximum likelihood parameter estimates, diagnostic and goodness of fit statistics, residuals and odds ratios were obtained from the final fitted logistic regression model.

3.7.2.3 Analyzing the Data

Here, the logistic regression model was used to select the significant variables that are believed to contribute to substance abuse in children. Factor analysis was also used to identify the combination of variables that have a significant impact on the abuse of substances. After these variables and combination of variables were identified, the risk and protective factors were revisited to determine where they fit and how best to relate it to the level of substance abuse. Below is a chart showing the procedure used to perform our study. We first use references and previous work done to identify potential variables that are believed to have a significant impact on substance abuse in students. After identifying those variables, we use the logistic regression model to select those variables which are indicated to be significant. Finally, we examine our final outcome to determine if the model is well fit and if the variables selected are important predictors for our models.

After selecting the important predictors for each of our models, we use existing research and previous work performed to determine what categories our significant variables fall into and how these variables affect.

To sum up: we have a binary output variable Y, and we want to model the conditional probability Pr ($Y = 1|X = x$) as a function of x; any unknown parameters in the function are to be estimated by maximum likelihood. By now, it will not surprise you to learn that statisticians have approach this problem by asking themselves “how can we use linear regression to solve this?”

1. The most obvious idea is to let p(x) be a linear function of x. Every increment of a component of x would add or subtract so much to the probability. The conceptual problem here is that p must be between 0 and 1, and linear functions are unbounded. Moreover, in many situations we empirically see “diminishing returns” — changing p by the same amount requires a bigger change in x when p is already large (or small) than when p is close to 1/2. Linear models Cannot do this.

2. The next most obvious idea is to let log p(x) be a linear function of x, so that changing an input variable multiplies the probability by a fixed amount. The problem is that logarithms are unbounded in only one direction, and linear functions are not.

3. Finally, the easiest modification of log p which has an unbounded range is the logistic (or logit) transformation, log p/ (1-p). We can make this a linear function of x without fear of nonsensical results. (Of course the results could still happen to be wrong, but they're not guaranteed to be wrong.) This last alternative is logistic regression.

$$log\frac{p(x)}{1-p(x)} = \beta_0 + x.\beta \tag{3.43}$$

Formally, the model logistic regression model is that

Solving for p, this gives

$$p(x;b,w) = \frac{e^{\beta_0+x.\beta}}{1+e^{\beta_0+x.\beta}} = \frac{1}{1+e^{-(\beta_0+x.\beta)}} \tag{3.44}$$

Notice that the over-all specification is a lot easier to grasp in terms of the transformed probability that in terms of the untransformed probability.

Logistic regression is one of the most commonly used tools for applied statistics and discrete data analysis. There are basically four reasons for this.

1. Tradition.

2. In addition to the heuristic approach above, the quantity log p/(1 - p) plays an important role in the analysis of contingency tables (the "log odds"). Classification is a bit like having a contingency table with two columns (classes) and infinitely many rows (values of x). With a finite contingency table, we can estimate the log-odds for each row empirically, by just taking counts in the table. With infinitely many rows, we need some sort of interpolation scheme; logistic regression is linear interpolation for the log-odds.

3. It's closely related to "exponential family" distributions, where the probability of some vector v is proportional to exp $\beta_0 + \sum_{j=1}^{m} f_j(v)\beta$. If one of the components of v is binary, and the functions f are all the identity function, then we get a logistic regression.

Exponential families arise in many contexts j in statistical theory (and in physics!), so there are lots of problems which can be turned into logistic regression.

4. It often works surprisingly well as a classifier. But, many simple techniques often work surprisingly well as classifiers, and this doesn't really testify to logistic regression getting the probabilities right. Because logistic regression predicts probabilities, rather than just classes, we can fit it using likelihood. For each training data-point, we have a vector of features, x, and an observed class, yi. The probability of that class was either p, if y = 1, or 1 - p, if yi = 0. The likelihood is then

$$l(\beta_0, \beta) = \sum_{i=1}^{n} y_i log p(x_i) + (1 - y_i) log 1 - p(x_i) \tag{3.45}$$

$$L(\beta_0, \beta) = \prod_{i=1}^{n} p(x_i)^{y_i} (1 - p(x_i)^{1-y}) \tag{3.46}$$

$$L(\beta_0, \beta) = \sum_{i=1}^{n} log 1 - p(x_i) + \sum_{i=1}^{n} y_i log \frac{p(x_i)}{1 - p(x_i)} \tag{3.47}$$

$$L(\beta_0, \beta) = \sum_{i=1}^{n} log 1 - p(x_i) + \sum_{i=1}^{n} y_i (\beta_0 + x_i . \beta) \tag{3.48}$$

$$L(\beta_0, \beta) = \sum_{i=1}^{n} log 1 + e^{\beta_0 + x_i . \beta} + \sum_{i=1}^{n} y_i (\beta_0 + x_i . \beta) \tag{3.49}$$

Typically, to find the maximum likelihood estimates we'd differentiate the log likelihood with respect to the parameters, set the derivatives equal to zero, and solve.

CHAPTER 4: DATA ANALYSIS AND MODEL DEVELOPEMENT

4.1 Introduction

This chapter discusses in detail how the model has been developed. Analysis of different variables, their significance and justification along with the goodness of our model are also discussed in this section.

4.2 Model Development

An important task in developing the models would be the selection of appropriate factors. Two approaches were used to select these factors. First, we reviewed similar research to find out which factors had been examined. Second, we focused on the local context to determine other variables that might have some influence on safety perception and safety education.

4.2.1 Characteristics of the Respondents and Variable Formation Process

A total of 1020 samples were collected. The formation of variables from the questionnaire survey as well as their mean and standard deviation is presented in Table 4.1.

Table 4.1: Summary Statistics of Variables

Explanatory Variables	Description of Variables	Mean	Standard Deviation
Safety Perception		153.49	10.37
Gender	Male=0; Female=1	0.40	0.49
Age category			
Age less than 18	<18=1; otherwise=0	0.05	0.22
Age 18 to 20	18<Age<=20=1; otherwise=0	0.22	0.41
Age 20 to 22	20<Age<=22=1; otherwise=0	0.24	0.43
Age 22 to 24	22<Age<=24=1; otherwise=0	0.28	0.45
Age greater than equal to 25	Age<25=1; otherwise=0	0.21	0.41
Monthly Income			
Income less than 6000	income<6000=1; otherwise=0	0.30	0.46
Income 6000 - 8000	6000<income<8000=1; otherwise=0	0.16	0.37
Income 8000-10000	8000<income<10000=1; otherwise=0	0.28	0.45
Income Greater than 10000	<10000=1; otherwise=0	0.25	0.44
Living with Family Member			
Family member 2 or less than 2	Family Member<2=1; otherwise=0	0.01	0.11
Family member greater than 2	2<=family Member<4=1; otherwise=0	0.33	0.47
Family member greater than 4	4<=family Member<6=1; otherwise=0	0.54	0.50
Family member greater than 6	family Member>=6=1; otherwise=0	0.12	0.33
Marital Condition			
Marital Status	Married=1; Otherwise=0	0.41	0.49
Number of Children			
Having No Child	No kid=1; otherwise=0	0.73	0.44
One Kid	1 kid=1; otherwise=0	0.14	0.35
Two Kids	2 kids; otherwise=0	0.07	0.25
More than two kids	3<= kid=1; Otherwise=0	0.06	0.23
Mode of Transport			
Using Public Transit as mode of Transport	Public Transit=1; otherwise =0	0.36	0.48
Using three wheelers (CNG driven) as mode of Transport	Three wheelers (CNG driven) =1; Otherwise=0	0.00	0.04
Using Walk as mode of Transport	Walk=1; otherwise=0	0.37	0.48
Using Cycle as mode of Transport	Cycle=1; otherwise=0	0.26	0.44

Explanatory Variables	Description of Variables	Mean	Standard Deviation
Using Motorcycle as mode of Transport	Motorcycle=1; otherwise=0	0.00	0.07
Using Car as mode of Transport	Car=1; otherwise=0	0.00	0.00
Walking Hours in a week			
Walking hour <1hr. per week	Walking hour <1= 1; otherwise=0	0.02	0.15
Walking hour 1- 4 per week	1<Walking hour <4= 1; otherwise=0	0.58	0.49
Walking hour 4-7 per week	4<Walking hour <7= 1; otherwise=0	0.22	0.41
Walking hour 7- 10 per week	7<Walking hour <1= 1; otherwise=0	0.07	0.26
Walking hour >10 per week	Walking hour >10= 1; otherwise=0	0.10	0.31
Physical Disability			
No Defects	No defect=1; otherwise=0	0.89	0.32
Hearing Problem	Hearing Prob=1; otherwise=0	0.04	0.20
Walking problem	Walking prob=1; otherwise=0	0.05	0.22
Other Physical problem	Other physical prob=1; otherwise=0	0.02	0.15
Location of Industry			
Ashulia	Ashulia=1; Otherwise=0	0.48	0.50
Dhaka-Mymensingh	Dhaka- Mymensingh=1; Otherwise=0	0.15	0.36
Gulshan	Gulshan=1; Otherwise=0	0.23	0.42
Tejgaon	Tejgaon=1; otherwise =0	0.03	0.16
Other Area	Other Area=1; Otherwise=0	0.12	0.33
Home Distance from workplace			
Home distance less than 1km	Home distance<1km=1; otherwise=0	0.40	0.49
Home distance 1-3km	1 km<Home distance<3km=1; otherwise=0	0.40	0.49
Home distance 3- 5km	3 km< Home distance <5km=1; otherwise=0	0.15	0.36
Home distance > 5km	Home distance>5km=1; otherwise=0	0.04	0.21
Accident Involvement			
Any Accident involved	No=1; Otherwise= 0	0.80	0.40
Any Relative Involved in Accident	No=1; Otherwise= 0	0.81	0.39
Any pedestrian accident seen	No=1; Otherwise= 0	0.55	0.50
Education Status			
Education Status less than primary	Education Level<=5 Cls=1; otherwise=0	0.31	0.46

Explanatory Variables	Description of Variables	Mean	Standard Deviation
Education Status primary to less than Junior secondary	5Cls<Education Level<=7Cls=1; otherwise=0	0.20	0.40
Education Status Above Junior secondary	Education Level>8Cls=1; otherwise=0	0.49	0.50
Living in Dhaka City			
Living in Dhaka< 2 years	Living in Dhaka<2yr=1; otherwise=0	0.10	0.30
Living in Dhaka 2-5 years	2yr<Living in Dhaka<5yr=1; otherwise=0	0.37	0.48
Living in Dhaka 5-10 years	5yr<Living in Dhaka<10yr=1; otherwise=0	0.40	0.49
Living in Dhaka > 10years	Living in Dhaka>10yr=1; otherwise=0	0.13	0.34
Working Experience			
Work experience <1 year	Work Exp.<1yr =1; otherwise =0	0.06	0.24
Work experience 1- 3 years	1yr<Work Exp.<3yr =1; otherwise =0	0.30	0.46
Work experience 3-5 years	3yr<Work Exp.<5yr =1; otherwise =0	0.36	0.48
Work experience 5- 7 years	5yr<Work Exp.<7yr =1; otherwise =0	0.13	0.34
Work experience 7- 10 years	7yr<Work Exp.<10yr =1; otherwise =0	0.10	0.29
Work experience >10 years	Work Exp.>10yr =1; otherwise =0	0.06	0.24
Money Spent for transportation purpose in a month			
Transport cost <200tk	Transport Cost<=200tk = 1; Otherwise=0	0.07	0.26
Transport cost 200- 500tk	200tk<Transport Cost<=500tk = 1; Otherwise=0	0.72	0.45
Transport cost 500-700tk	500tk<Transport Cost<=700tk = 1; Otherwise=0	0.05	0.21
Transport cost 700-1000tk	700tk<Transport Cost<=1000tk = 1; Otherwise=0	0.10	0.31
Transport cost >1000tk	Transport Cost>=1000tk = 1; Otherwise=0	0.05	0.22
Safety Education Source			
Safety Education from any source	No=1; Otherwise= 0	0.31	0.46
Safety Education from Television	Television=1; otherwise=0	0.44	0.50
Safety Education from Newspaper	Newspaper=1; otherwise=0	0.22	0.41

Explanatory Variables	Description of Variables	Mean	Standard Deviation
Safety Education from Traffic Police Week	Traffic Police week=1; otherwise=0	0.01	0.11
Safety Education from other sources	Other sources=1; otherwise=0	0.05	0.22

Two typical graphical presentation generated from Table 4.1 of different variables are shown below chart:

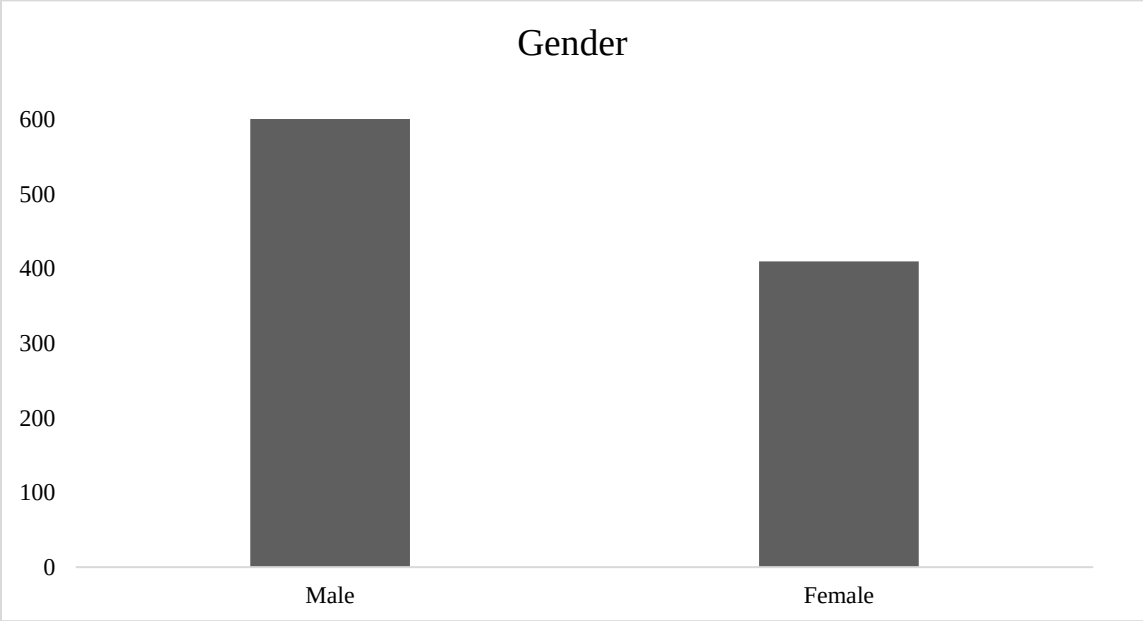

Figure 4.1: Gender Histogram

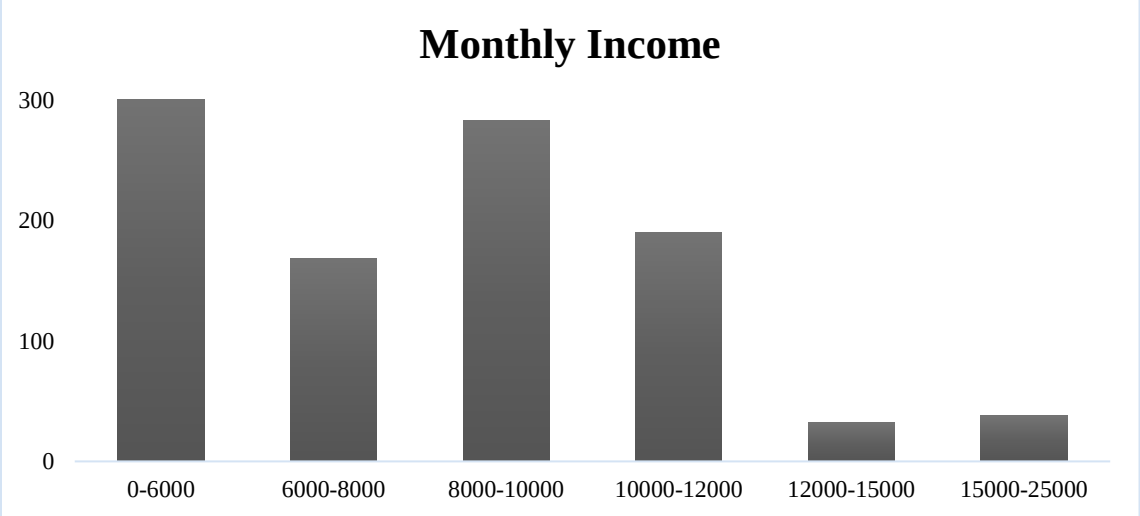

Figure 4.2: Monthly Income Histogram

Number of male (59.8%) is 1.5 times than female (40.2%). This value for female could vary from 39.71% to 40.69% (SD=0.49). The majority (28.33%) of the respondents are over 24 years in age and income of majority respondents (74%) was less than BDT.10000. A considerable number of respondents (48.04%) represents the Ashulia area. Physical characteristics of the workers show that a considerable percentage (88.53%) have no defects, though 5% and 4% have walking and hearing problem respectively. A considerable portion (31.18%) of the workers does not have any safety knowledge but a significant portion (44.11%) learnt safety knowledge from tv/radio.

Travel characteristics of the garment workers shows that a mentionable portion (36.08%) use walking as their usual mode of travel. A majority (58.14%) of the workers walk less than 4 hours and about 10.39% workers walk greater than 10 hours in a week. While walking, 80% of the workers had been involved in an accident previously, however 55.39% of them witnessed at least one pedestrian accident. Moreover, relative of 81.18% workers had been involved in an accident.

For calculating the safety perception, 38 questions have asked to the worker. According to their response, the score has been marked. Suppose, A question "I often feel unsafe walking along most streets" have been asked to the worker, that how much he/she agree or disagree with this. Then when he/she agreed with the statement, that was marked as 4. After that, another statement such as "I often feel unsafe crossing most streets" was asked. In this case, when he/she disagreed with the statement that one is scored as 2. The main equation of multiple linear regression model is

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \varepsilon_i$$

Here, $Y_i = Total\ Safety\ Perception\ of\ the\ individual\ worker$

β_0 = Constraint Term

Suppose, X_1= Monthly Income, X_2 =Age less than 18 years etc.

β_1 = Co-efficient Value for monthly income

Where, $\sum Y_i = Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + \cdots$ ... ...

$=$ Response of Each RMG Worker

In this way, the safety perception model has been developed. Following this way, 38 questions have enquired to one worker and as per response all questions are scored. After that, all marked scores are sum up to get the total safety perception of that worker which is continuous dependent variable. Suppose, by summing up these 38 response, the total value has come 110. That means the total safety score is 110 of one worker. For multiple linear regression model, this total safety perception is taken as dependent variable (Yi). By following these steps, safety perception has been calculated for 1020 workers. Then, several factors have been taken as independent variables which has incorporated in the equation as X_1, X_2, X_3 etc.

A number of variables, assumed to have relations to the traffic safety perception of each garments worker interviewed were formed and assessed at a 90% confidence interval. Multiple linear regression modeling was utilized in traffic safety perception study while logistic regression model was considered to find the factors influencing safety education/knowledge from different sources. For this statistical models, variables were formatted in manner of continuous variable and categorized variables. Suppose, consider the age of the respondents which are collected as continuous variable. When the model was developed, age is entered as continuous variable at first. However, if this variable is found statistically insignificant it can be tried as categorical variable. For example, age is divided into five categories i.e. age less than 18, age 18 to 20, age 20 to 22, Age 22 to 24 and age greater than equal to 25. Then, they are coded in the model as binary format (1 or 0). To give an illustration, the income group of the respondent could be considered. Suppose, the workers who earned 7500tk per month, they were fallen in a categorized group 5000-10000tk and indicated by 1. At this case, other income groups were presented by 0. By following this pattern, variables were developed and finally 80 variables are considered at the beginning of the model development process.

4.2.2 The Reliability of Questionnaire

A number of questions which assumed to have relations to the traffic safety perception of each garment worker interviewed were asked. To check the statistical reliability among the question, Cronbach's alpha test had been conducted to estimate the reliability of psychometric test. The study reveals that, to measure the indexed response, summated scales are often used which consists of multi-point questionnaires. Usually, development of such scales is not the end of the research itself, but rather a means to gather predictor variables for use in objective models. One of the most popular reliability statistics in use today is Cronbach's alpha (Cronbach, 1951). Cronbach's alpha checks the internal consistency or average correlation of items in a survey instrument to gauge its reliability (Santos, 1999). Because inter correlations among test items are maximized when all items measure the same construct. It highlights the conditions under which single-items are equivalent and provides practical suggestions concerning the estimation of reliability, based on design considerations (Bravo et al., 1991). From another study it is clearly identifiable that a commonly-accepted thumb rule is that, an alpha of 0.7 (some say 0.6) indicates acceptable reliability and 0.8 or higher indicates good reliability. Very high reliabilities (0.95 or higher) are not necessarily desirable, as this indicates that the items may be entirely redundant. These are only guidelines and the actual value of Cronbach's alpha will depend on many things. E.g. as the number of items increases, Cronbach's alpha tends to increase too even without any increase in internal consistency (Streiner, 2003). Based on above literature, it is observed that, to check the internal consistency among the questions Cronbach alpha test is reliable one.

Table 4.2 shows the result of 38 questions' reliability. In the table 4.2, questions have indicated through q and the numbering has been done sequentially according to the question. From the Cronbach's alpha test, it is noted that the questions were 86.51% reliable. From a commonly accepted rule for describing internal consistency using Cronbach's alpha, though a greater number of items in the test can artificially inflate the value of alpha (Cortina, 1993) and a sample with a narrow range can deflate it. As the value

is in 90 %< alpha<80%, so the internal consistency among these questions are good (Streiner, 2003).

Table 4.2: Estimation of Questionnaire Consistency

Test scale = mean (standardized items)

Item	Observation	Sign	Alpha
q1	1020	+	0.8624
q2	1020	+	0.863
q3	1020	+	0.8628
q4	1020	+	0.8615
q5	1020	+	0.8621
q6	1020	-	0.8622
q7	1020	+	0.8615
q8	1020	-	0.8621
q9	1020	+	0.8622
q10	1020	-	0.8613
q11	1020	-	0.8674
q12	1020	-	0.867
q13	1020	+	0.8611
q14	1020	+	0.864
q15	1020	+	0.8629
q16	1020	+	0.8625
q17	1020	+	0.8663
q18	1020	+	0.8622
q19	1020	+	0.8614
q20	1020	+	0.8594
q21	1020	+	0.8599
q22	1020	+	0.863
q23	1020	+	0.862
q24	1020	+	0.8635
q25	1020	+	0.8608
q26	1020	+	0.861
q27	1020	+	0.862
q28	1020	+	0.8606

Item	Observation	Sign	Alpha
q29	1020	+	0.8611
q30	1020	+	0.8609
q31	1020	+	0.8602
q32	1020	+	0.86
q33	1020	+	0.8613
q34	1020	+	0.8583
q35	1020	+	0.8619
q36	1020	+	0.866
q37	1020	+	0.8627
q38	1020	+	0.8653
Test scale			0.8651

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Introduction

The main goal of this chapter is to understand how traffic safety is related to socioeconomic and demographic characteristics of garment workers of readymade garment industry.

Two models were developed in the study. Model estimation was done for those two analysis. To find out the factors that affecting the safety perception of the garments workers, multiple linear regression model was developed. In addition, logistic regression model was used for identifying factors affecting safety education/ knowledge. The significant variables assist to sort out the targeted group that are affecting to acquire or not acquire of safety knowledge and for whom safety training program could be arranged.

5.2 Discussion on the Results of Safety Perception Model

5.2.1 Adequacies of the Model

At first, it is needed to check whether the data is adequate with the assumptions of multiple linear regression model. Fitting a regression model requires several assumptions. Estimation of the model parameters requires the assumption that the errors are uncorrelated random variables with mean zero and constant variance. Tests of hypotheses and interval estimation require that the errors be normally distributed. To check the validity of these assumptions and to examine the adequacy of the model several graphs have been produced. From the figure 5.1, it is observed the plotted points has fallen approximately along a straight line, that means the hypothesized distribution adequately describes the data. So, the safety perception score of the worker has followed the standardized normal probability plot.

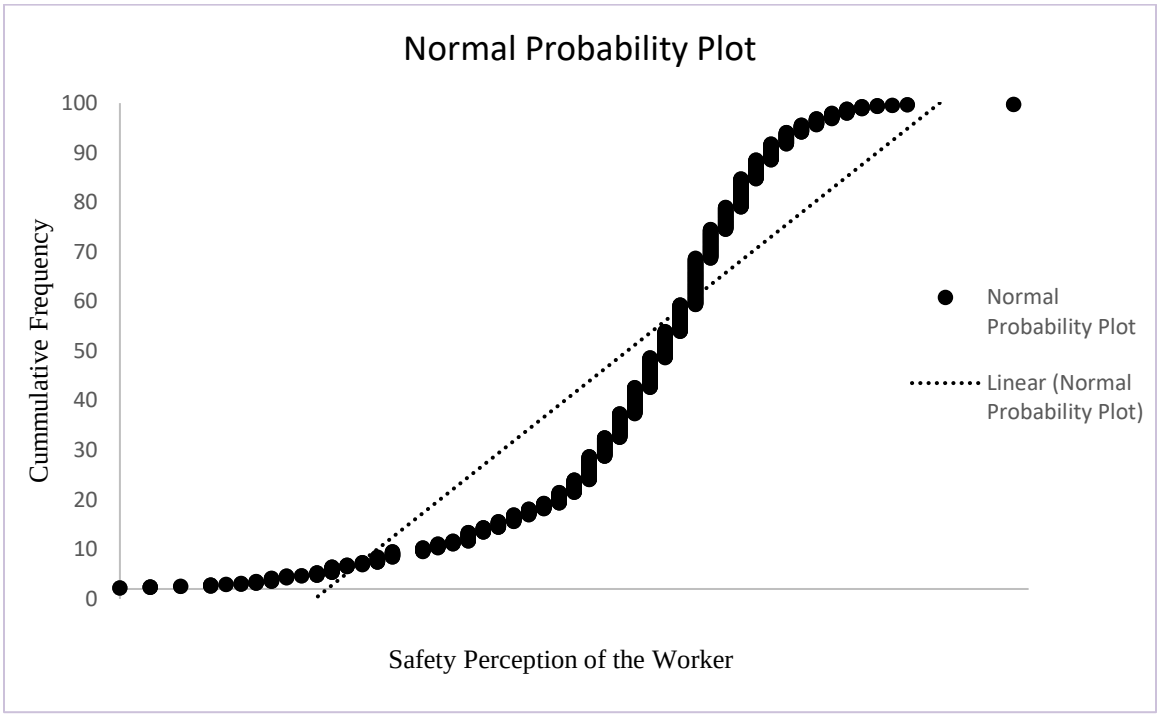

Figure 5.1: Normal Probability Plot

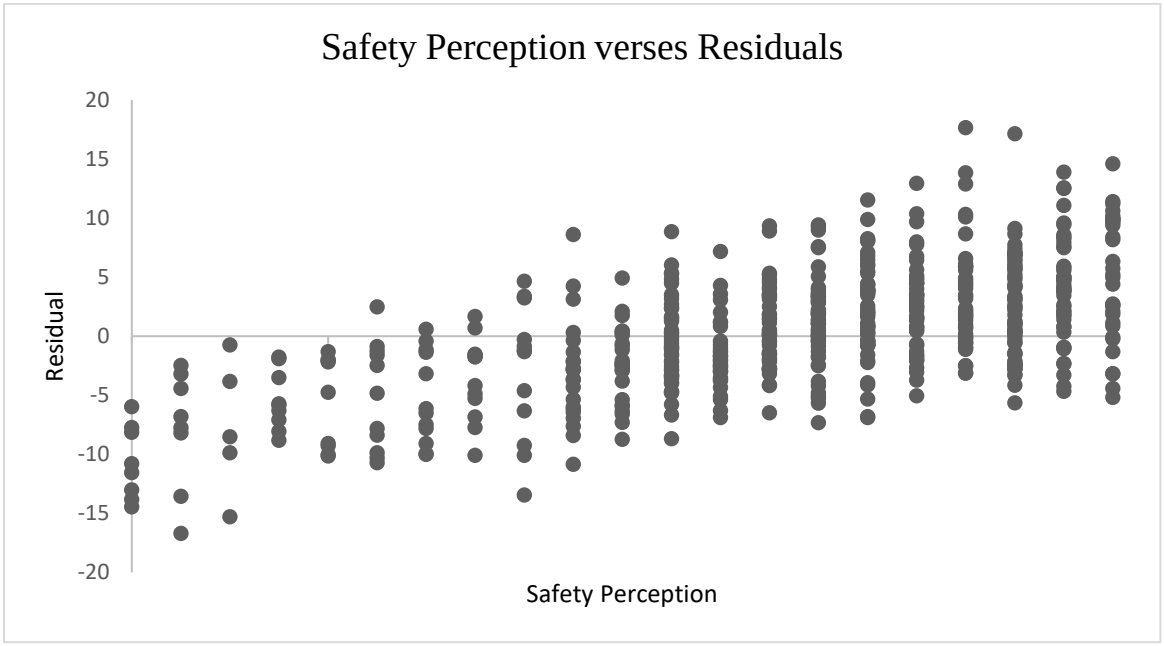

Figure 5.2: Safety Perception Verses Residual

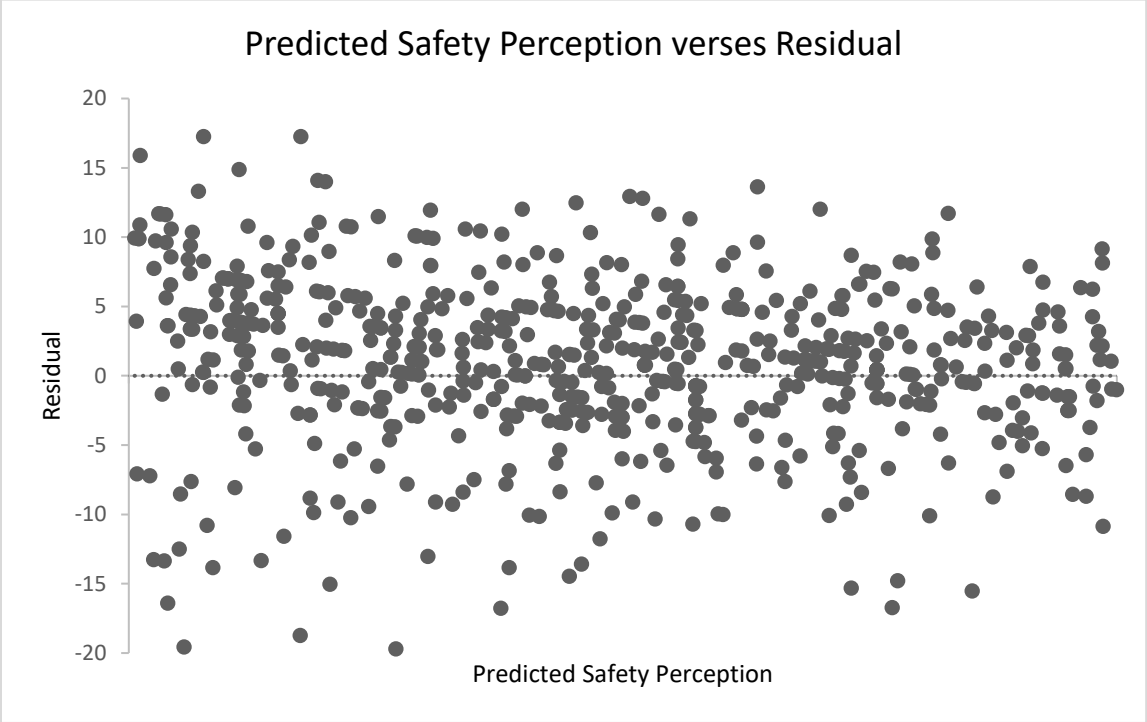

Figure 5.3: Predicted Safety Perception Verses Residual

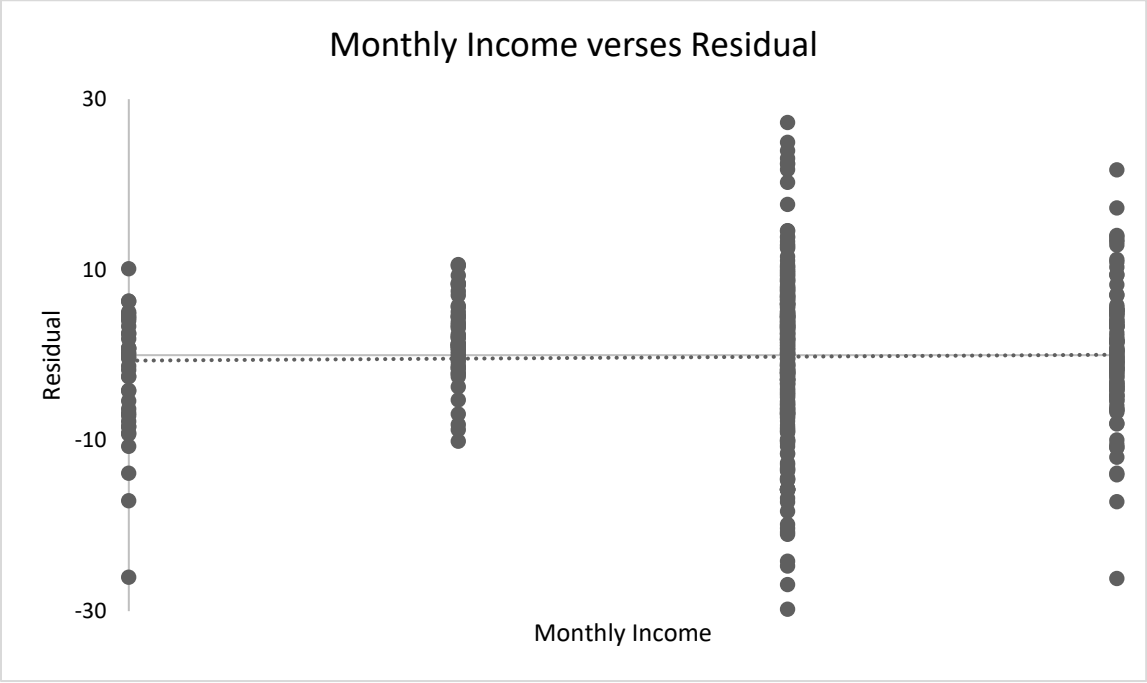

Figure 5.4: Safety Perception Verses Residual

The residuals are also plotted against the predicted safety perception value in figure 5-2, the residual against safety value in figure 5-3 and against the Monthly Income (Xi) in figure 5-4. These plots do not indicate any serious model inadequacies. Like figure 5-4, plots have been produced for other variables against residual. All of which have shown adequacies of the assumption of Multiple linear regression model.

The Multiple linear regression analysis was conducted by regressing the risk perception score on the possible explanatory variables identified in the univariate analysis with the computer based software named "STATA" to determine coefficient, standard error and p-value for the variables. For our work, 90% confidence interval was assumed. Thus, p-values of variables are generally less than 0.1. At first, the analysis has been started with continuous variables. Some of the continuous variables are further splitted into categorical variables. Due to low correlation with risk perception score, some variables were excluded from the regression model. The table only shows the statistically significant categories of variables entered, and thus helped producing a more statistically significant model with p-value<0.1. Some of the discarded variables from the final model for their statistical insignificance are number of kids in a family, marital status, education level etc.

Else more, the model helps to identify the factors which increase or decrease the safety perception of RMG workers'. This safety consciousness can be evaluated through β value. Positive β value of a particular variable means that this variable enhances the safety consciousness of RMG workers. On the contrary, negative β value shows the reverse meaning. Furthermore, this statistical model also gives the value of elasticity index. Elasticity was computed to provide a common basis for comparison across different variables. Note that elasticity is calculated only for the variables that are statistically significant. Elasticity shows the percentage changes of safety perception by one percent increase or decrease of the significant variables. The coefficient, standard error and p-value of the significant variables from the final model result are shown in Table 5.1.

Table 5.1: Multiple Linear Regression Model – Traffic Safety Perception

Safety Perception Variables	Co-efficient	Safety Score	Elasticity Index	Standard Error	P-Vale
Gender	3.10	155.19	0.96	0.63	0
Age Category					
Age less than 18	2.98	157.71	0.95	1.51	0.049
Age less than 20	1.79	154.39	0.83	1.04	0.088
Age less than 22	2.53	155.63	0.92	1.02	0.014
Age less than 24	1.89	153.94	0.85	0.97	0.053
Monthly Income					
Income less than 8000	-2.19	155.68	-7.94	0.88	0.013
Income less than 10,000	-3.96	149.67	-51.43	0.83	0
Income greater than 10,000	-3.93	151.58	-50.05	0.78	0
Marital Condition					
Marital Status	-3.90	153.77	-48.37	1.01	0
Number of Children					
No kid	-5.15	151.98	-171.31	1.13	0
Living with Family Member					
Family Member greater than 2	-4.18	152.69	-64.34	2.58	0.106
Family Member greater than 4	-4.69	153.83	-108.05	2.57	0.068
Family Member greater than 6	-4.77	153.89	-116.89	2.65	0.073
Mode of Transport					
Using Public Transit as mode of Transport	3.70	153.98	0.98	0.74	0
Using walk as mode of Transport	3.11	155.45	0.96	0.77	0
Walking hour					
Walking hour 1 to 4 hour	2.13	155.22	0.82	0.76	0.005
Walking hour 4 to 7 hour	1.72	151.69	0.88	0.87	0.049

Safety Perception Variables	Co-efficient	Safety Score	Elasticity Index	Standard Error	P-Vale
Physical Disability					
No Physical Defect	-2.02	152.96	-15.95	0.94	0
Location of Industry					
Ashulia	-2.83	153.11	-9.79	0.67	0
Dhaka-Mymensingh	-2.38	151.09	0.78	0.88	0.007
Home Distance from workplace					
Home distance 3-5 km	1.50	155.63	0.89	0.79	0.057
Accident involvement					
Any pedestrian accident seen	2.17	155.34	0.70	0.59	0
Working experience					
Work experience 3-5 years	1.19	154.97	-5.89	0.60	0.049
Education Status					
Education Status less than primary	-1.93	150.99	0.97	0.62	0.002
Money Spent for transportation purpose in a month					
Transport cost <200tk	3.59	158.32	0.99	1.11	0.001
Transport cost 700-1000tk	5.26	151.29	-2636.43	1.33	0
Traffic Safety Education Source					
Safety Education from Traffic Police Week	-7.88	146.62	0.94	2.49	0
Safety Education from Television	2.84	155.83	-330.20	0.64	0
Safety Education from Other sources	-5.80	144.06	-6.55	1.33	0.032
Constant	159.60			3.22	0
Number of observation =	1020				
F (29, 990)	16.1				
Probability> F	0				
R-squared	0.3204				
Adjusted R-squared	0.3005				
Root MSE	8.6718				

For the 1020 workers, total safety perception has calculated which is added in the model as continuous dependent variable Y_i.

According to Table 5.1, the final predictive equation of the safety perception score is shown below:

Predicted Safety Perception $\widehat{Y}_i$= 159.60+ (3.10 x gender) + (2.98 x age<=18) + (1.79 x age<=20) +(2.53 x age<=22) +(1.89 x age<=24) -(2.19 x monthly income<=8000) -(3.96 x monthly income<=10,000) -(3.96 x monthly income>10,000) -(3.90 x marital status) -(5.15 x no kid) -(4.18 x family member>2) -(4.69 x family member>4) -(4.77 x family member>6) +(3.70 x mode of transport – public transit) +(3.11 x mode of transport - walk) +(2.13 x walking hour 1 to 4) +(1.79 x walking hour 4 to 7) - (2.02 x no physical defect) -(2.83 x location of the industry- ashulia) -(2.38 x location of the industry- Dhaka-mymensigh) +(1.50 x home distance 3-5km)+ (2.17 x Any pedestrian accident seen) + (1.19 x work experience 3-5 years) – (1.93 x education status less than primary) + (3.59 x transport cost <200tk) + (5.26 x transport cost 700-1000tk.) –(7.78 x Safety Education from Traffic Police Week) + (2.84 x Safety Education from Television) – (5.80 x Safety Education from Other sources)

Unstandardized coefficients indicate how much the dependent variable varies with an independent variable, when all other independent variables are held constant. Consider the effect of gender in this example. The unstandardized coefficient, β1, for gender is equal to 3.10. Another example is mode of transport – public transit. The co-efficient β2 is equal to 3.70.

Table 5.1 shows the model output for different explanatory variables. According to Table-5.1, 29 variables were identified as statistically significant ones ($p<0.1$) among the variables entered. On the contrary, living experience, reading newspaper, CNG driven auto rickshaw, cycling has become insignificant ($p>0.1$) after adjusting for other categories of variables and were dropped from the model. Standard error of each variable shows the measurement of error of that variable in the regression analysis.

R^2 value shows the measurement of correctness of the risk perception score with the variables. This suggested that 32.04% of the variance of the worker's risk perception could be explained by the significant variables. The adjusted R^2 value, which is an indication of model's predictive power with whole population, is the corrected R^2 value eliminating the insignificant coefficient of variables if any. The value obtained from the analysis shows that there could be more variables with more numbers of surveys which would increase the value. R^2 value of 1.00 is the best statistical model. However, due to budget constraint for data collection both sample size and questionnaire are kept in limited numbers.

5.2.2 Model Explanation

5.2.3.1 Gender and Age Category

Among the factors considered in this study, a number of factors which proved to have influence on traffic safety perception are discussed in this section. Some of the factors influencing safety perception are self-explanatory while others require more clarification. For example, gender in the model result explains that female is more concerned than male on traffic safety issues (β=3.10). The conceivable reason for this, may be that women are more aware about safety due to their inherent less risk taking behavior comparing with male counterpart. Secondly, when compared to workers aged 24, workers having ages less than 24 seem to be more concerned about traffic safety. From table 5.1, it is clearly observed that workers holding ages less than 18(β =2.98), 20(β =1.79) and 22(β =2.53) respectively look like more apprehensive about traffic safety compared to workers holding age more than 24. The possible reason could be that workers' ages less than 24 are new to the Dhaka city and having less experience about the city. Moreover, most of them might come from rural area where traffic exposure is less. When they come to the Metropolitan area they are amidst a huge chaotic traffic condition which makes them more concern about traffic safety.

5.2.3.2 Monthly Income and Money Spent for Transportation Purpose in a Month

Model results show that earning plays an important role on safety perception. The workers earning higher income tend to be less aware of traffic safety issues compared to workers having lower income. The results show that, people earning less than Tk. 8,000 (β=-2.19), income 8000-10,000tk. (β=-3.96) and income greater than 10,000tk. (β=-3.93) in average, are less concerned about safety than people having incomes higher than Tk. 6,000. From elasticity index analysis, it can also be observed that the elasticity for income category less than 8000 is -7.94 which implies that presence of 6000-8000tk income group will 7.94% decrease the traffic safety perception of the workers. One of the many possible explanations for this phenomenon could be, higher standard of lifestyle may encourage them to take risk. Studies have shown that populations with low socioeconomic status (lowest income level, low educational attainment, blue-collar occupation) and unemployed status are at a higher risk for traffic fatalities (Viola et al., 2010). Moreover, the results show that people who spend more money for their transport purpose, are much concerned about traffic safety. The possible reason for this is that, the expenditure due to transport may create burden on their lifestyle. Because due to the expense of transport people may have to degrade their lifestyle. That's why, people bother to face any unintentional and unavoidable incident.

5.2.3.3 Marital Condition

Personal life also seems to have influence on safety perception of the subjects. The marital status of the workers shows a linear relationship with their road safety perception. The married workers appear to be less concerned about road traffic safety compared to unmarried workers (β =-3.90). A probable reason might be; married workers' face excessive mental stress due to their family responsibility. As in the context of Bangladesh, it is observed that, all the family affairs would be resolved by the earning head of the family which would make the workers stressed. That's why they might be not able to pay attention to become conscious on traffic safety issues. From Table 5.1, it can be observed that the elasticity for marital status is -48.37 which implies that presence of married worker will cause 48.37% decrease in traffic safety perception of the workers. This proves that marital

status is delicate to changes in traffic safety perception of the garments workers. This result's consistent with Salimnen et al.2010. They also found that the number of married people involved in work-related traffic accidents significantly than other marital status groups (Salminen et al., 2000).

5.2.3.4 Number of Children

The study also finds a keen relationship between the numbers of children under a worker's parentage and the worker's road safety perception. The results indicate, people having no kid (β =-5.15) at all are less safety concerned compared to people having at-least one or more than one kid. It is most likely that having kids burden the workers with the necessity of staying safe and sound for the purpose of the kids' looking after, which is vice-versa in the case of workers having no kids. This could be a catalyst that triggers carelessness among workers' having no children and lessens their concern for traffic safety.

5.2.3.5 Living with Family Member

Furthermore, from the table 5.1, it is observed that family member has great effect on the safety behavior of the workers. The workers' who belong to a larger family i.e., family member greater than 2 (β =-4.18), family member 4 to 6 (β =-4.69) and family member greater than 6 (β =-4.77) respectively, are less concern about safety. This may happen based on the fact that, due to excess liability for arranging feed of the family member create burden on them. That's why, they may not get enough time to take care of themselves.

5.2.3.6 Accident Involvement

However, in the field of personal experience, one very interesting finding of this study is that an eye witness to a road accident makes a RMG worker more safety conscious (β =2.17). Perhaps, the consequence of being careless or less mindful while walking in the road is perceived straightforwardly by the workers having witnessed a road accident. Probably the particular incident turned out to be a permanent trauma for the worker which directs him/her to be more conscious about road traffic safety. However, a medical study

reveals that 10 to 30% of car accident victims will develop PTSD (Post Traumatic Stress Disorder) which justifies both of the above explanations (Beckham et al., 2004).

5.2.3.7 Mode of Transport and Walking hour

According to the results of regression analysis, mode of transport seems to have significant impact on the road safety perception. RMG workers who choose public transport (β =3.70) and walking (β =3.11) as a mode of transport seemed to be a bit more concerned about safety compared to those using other modes of transport. The probable explanation could be that the RMG workers', who are using public transport as their mode of transport, are habituated with the behavior of public transport driver. They might be more familiar with drivers' irresponsible behavior such as instead of stopping at fixed locations, they drop and pick the passengers on the middle of the road. In addition, the workers are also aware of high number of pedestrian accident during drop-pick time. That's probably make the workers more concern about safety issue. Furthermore, in most cases, the footpath is occupied by vendors and road side shopkeepers. These occupied pedestrian path often forces RMG workers to use adjacent traffic lane. Therefore, they are using road lanes, which are also used by high speed vehicles. That's why worker while using these road lanes, they feel the need to be more careful which turns them to be more conscious about traffic safety. Elasticity index analysis also supports that; the elasticity for the workers using public transport is 0.98 which demonstrates, these categories of workers will cause 0.98% increase in traffic safety perception. The model also illustrates that, workers walking less than 4 hours (β =2.13) every week seem to be more safety conscious compared to workers having more than 4 hours walking weekly. The result shows that workers who walk excessively may lose their patience. The possible reason could be; excess amount of walking makes them anxious about their family and daily livelihood work. That's why, the RMG workers who walk less than 4 hours in a week are more concern about traffic safety compared to the workers who walk more than 4 hours.

5.2.3.8 Home Distance from Workplace

The results also depict close relationship between the distances of the workers' homes from their work places and their road traffic safety perception. People having a home within 5 km. radius (β =1.50) of their workplace are more concerned about safety compared to people living further away. One of many possible reasons could be for this, though shorter travel distance helps them keep focused on safety issues, while in longer travel distances people might lose focus. To reach quickly by travelling longer distance insists them to become reckless.

5.2.3.9 Location of Industry

The result illustrations point out that the type of area and the location of the workplace had sheer impacts on the safety perceptions of workers. Workers having their workplace at Ashulia(β =-2.83) and Dhaka –Mymensingh Highway (β =-2.38) (which are two high-speed and high volume traffic highways, but low density in residence) seemed to be less concerned about traffic safety compared to those having workplaces at Gulshan, other metropolitan areas and Tejgaon (which are consecutively congested residential and industrial area with low-speed traffic).It is expected that, the high risk related to high speed traffic in highways automatically generates extra safety concern to the road users, however, the result is reverse in this case. Perhaps the RMG workers who work within the metropolitan area are exposed to higher number of mixed traffic which consequently makes them more aware about safety issues.

5.2.3.10 Education Status

To get a better lifestyle education is the compulsory element. Else more in the urban region it may be quite hard and tough to get a good job without schooling. When it comes to behavior and social status, the workers acquiring higher education tend to be more aware of traffic safety issues compared to workers having lower tutoring. The result prompt that having less than primary education (β =-1.93) may make them less concerned about safety

of traffic than the people who have at least primary or higher education. The possible reason may be due to understanding of the importance safety in their life.

5.2.3.11 Traffic Safety Knowledge

Furthermore, the result of Table 5.1, indicate that work experience seems to have noteworthy impact on the road safety perception of the study group. The study uncover that compared to the experienced level of the worker, workers having at least 5 years (β =1.19) or more experience are more apprehensive about safety related issues. One of the possible reason after this is experienced person may easily predict at which situation they have to be aware and what incident they may have to face for being less concerned about safety. The result also renders that people may acquire this type of experience from watching Television/Radio or traffic police week campaign. The outcome shows that people who watch Television/Radio (β =2.84), are more concerned about safety related issues than who attend the program offered by traffic police campaign (β =-7.88) and other traffic safety training (β =-5.80). A possible reason could be that the traffic police campaign is less attractive and less visible, consequently have less impact on the stakeholders.

5.2.3.12 Physical Disability

Among the other statistically significant variables, are physical conditions of the workers. That is, people having no physical defects are found to be reasonably less concerned about safety while physically disable people are found to be astonishingly paying more attention to road safety issues. Having no physical defect (β =-2.02) may make them less concerned about safety and encourage irresponsible attitude and behavior.

5.3 Discussion on the Results of Traffic Safety Education model

Logistic regression analysis was conducted by regressing the safety knowledge on the possible explanatory variables. Odd-ratio, standard error and p-value for the variables are the output of the model and results of the model is judged by those parameters. The interpretation of the logistic coefficient is more difficult than in the case of multiple linear

regression and, as a result, instead of the conventional Beta coefficient, the logistic model is generally rewritten in terms of the odds of an event occurred. More specifically it defines as the ratio of the probability that an event will occur to the probability that it will not. Variables with values greater than one indicate that the odds of happening an event increase, on the contrary, less than one indicate that the odds of an event decrease (SPSS, 1989). For our work, 90% confidence interval was assumed. Thus p- values of variables are generally less than 0.1. We started our analysis with dichotomous variable. Due to low correlation with safety knowledge, some variables were excluded from the regression model. The table only shows the statistically significant categories of variables entered, and thus helped producing a more statistically significant model with p-value<0.1. The estimation results for the final model are shown in Table 5.2. Based on the p-values of the t-tests, 25 variables from 13 factors were found to be significant ($p \leq 0.05$) or marginally significant ($p \leq 0.1$). The coefficient, standard error and p-value of each significant variable in logistic regression model are shown in Table 5.2.

Table 5.2: Logistic Regression Model- Traffic Safety Knowledge

Variables	Co-efficient	Odds Ratio	Standard Error	P-Value
Gender	0.56	1.76	3.22	0.00
Age Category				
Age 18 to 20	-0.42	0.66	-1.87	0.06
Age 20 to 22	-0.60	0.55	-2.73	0.01
Monthly Income				
Income less than 6000	0.36	1.43	1.84	0.07
Income 6000-8000	0.46	1.59	1.79	0.07
Living with Family Member				
Family member greater than 2	-0.67	0.51	-3.55	0.00
Marital Condition				
Marital Status	0.31	1.36	1.72	0.09
Mode of Transport				
Using Public Transit as mode of Transport	-0.46	0.63	-2.62	0.01
Physical Disability				
No Physical Defect	-0.48	0.62	-1.89	0.06
Walking Hours in a week				
Walking hour 1- 4 per week	-1.23	0.29	-4.35	0.00
Walking hour 4-7 per week	-0.95	0.39	-3.14	0.00
Walking hour >10 per week	-0.67	0.51	-1.88	0.06
Location of Industry				
Ashulia	0.45	1.56	1.89	0.06
Dhaka-Mymensingh	1.19	3.28	4.22	0.00
Other Area	2.20	9.01	6.92	0.00
Home Distance from workplace				
Home distance less than 1km	-1.96	0.14	-5.00	0.00
Home distance 1-3km	-1.86	0.16	-4.81	0.00

Variables	Co-efficient	Odds Ratio	Standard Error	P-Value
Home distance 3-5 km	-1.45	0.24	-3.50	0.00
Accident involvement				
Any Accident involved	0.70	2.01	3.16	0.00
Any Relative Involved in Accident	-0.98	0.38	-4.62	0.00
Working Experience				
Work experience >10 years	-1.27	0.28	-3.14	0.00
Living in Dhaka City				
Living in Dhaka <2years	0.65	1.92	2.27	0.02
Living in Dhaka 2-5 years	-0.43	0.65	-2.32	0.02
Money Spent for transportation purpose in a month				
Transport cost 200- 500tk	0.41	1.51	1.86	0.06
Transport cost <200tk	0.67	1.95	1.82	0.07
Constant	1.62	5.04	2.73	0.01
Logistic regression				
Number of observation			=	1020
LR chi2(26)			=	285.44
Probability> chi2			=	0
Pseudo R2			=	0.2255
Log likelihood			=	-490.197

5.3.1 Model Explanation

5.3.1.1 Gender and Age Category

The safety education analysis indicates that female is less aware of gaining safety knowledge compared to their male counterpart. The odd ratio (1.76) for gender is greater than one which indicates that the feminine gender gets less amount of time and opportunity to grasp some knowledge regarding safety. Because in the context of Bangladesh, females have to do all the family works by themselves though they also work along with their

husband. So, female person doesn't able to manage enough time to enrich themselves about safety knowledge. Perhaps due to this fact, female is less concerned about their safety issues. Age group between 18 to 20 (odd ratio=0.66) and age group between 20 to 22 (odd ratio=0.55) both receives more safety information comparing with other age categories. Perhaps, the younger workers are much more curious about receiving safety information comparing with their older counterpart.

5.3.1.2 Monthly Income and Money Spent for Transportation Purpose in a Month

The result of current study reveals that RMG worker having monthly income less than 6000tk. (OR=1.43) and 6,000 tk. to 8,000 tk. (OR=1.59) receives less safety education from different sources comparing with other income groups. The probable explanation could be middle income workers could not able to give priority on acquiring safety knowledge compared with high income worker. Again, compare to middle income worker, the probability of risk taking tendency are high in these two income group. For that reason, this income group of worker could put themselves in any risk to achieve the goal to have a better lifestyle, which leads to be less concern for receiving safety knowledge.

5.3.1.3 Marital Condition and Living with Family Member

Personal life of a RMG worker plays an important role on developing one's safety consciousness. Interestingly, the odd ratio (1.36) indicates that, the married workers appear to be less concerned on acquiring traffic safety knowledge compared to unmarried workers. Another study proved, married people are involved in work-related traffic accidents to a significantly higher degree (Salminen et al., 2000). A probable explanation could be; married workers might be busy all the time for earning more and more for their family. To lead a better life, they might be less conscious on acquiring knowledge on traffic safety. In addition, the workers who belongs to a family which is greater than 2 members (OR=0.51) appear to be more concerned about road traffic safety knowledge acquisition compared to the workers who have no family responsibility. Perhaps family responsibility and the wellbeing of their dependents encourage workers to acquire more traffic safety knowledge.

5.3.1.4 Accident Involvement

The model result justifies that an accident of a relative make him more conscious of acquiring safety knowledge (OR= 0.38). An explanation could be that accident had created a scratch on their mind. In the context of Bangladeshi society, people do value of blood relationship. Therefore, might not be easy for them to forget the incident and become more cautious about their safety issues by acquiring knowledge. However, the model outcome is different when a RMG worker himself/herself involve in an accident rather than their relatives.

5.3.1.5 Mode of Transport, Walking Hour and Home Distance from Workplace

Workers who use public transit as their main mode of transport are more prone to get road safety knowledge from different sources (OR= 0.63). Perhaps these groups feel that they are more vulnerable comparing to those who use other mode. Therefore, they give more emphasis on safety. As expected, workers who walk less receive less safety knowledge. On the other hand, workers who walk more (<4hr but >7hrs, <10 hrs. but > 7hrs. and <1hr but >4hrs) gathers more safety knowledge from different sources (OR= 0.29, OR=0.39 and OR=0.51 respectively). Perhaps more walking group is more aware about the hazards on roads that are why they are more interested about safety issues. On the other hand, the group that walks less is less cautious about safety issues. This may be because of less exposure to traffic hazard. People who have more than 10 years' work experience are more aware to gather safety education from various sources (OR=0.28). Probably after working several years they are calm and composed and understanding the importance of safety. As expected if the distance between home and workplace is increasing, the tendency of receiving traffic safety knowledge is moving towards to zenith [OR= 0.14(Home distance less than 1km), OR=0.16(Home distance 1-3km) and OR= 0.24 (Home distance 3-5km) respectively]. As the workers of these categories travel more, they are more conscious about safety issues as they are frequently exposed to traffic. Result in Table 5.2 shows that if a worker is in a low spending group for transportation purpose he is less interested to gain safety knowledge (OR=1.51 and OR= 1.95). It is likely that this group represents the lowest income group and they are less concerned about safety knowledge.

5.3.1.6 Location of Industry

Location of the industry was found to have influence on receiving safety education. Workers having their workplace at Dhaka-Mymensingh Highway and Ashulia are less interested to gain safety knowledge (OR=3.28 and OR=1.56). The reason of this finding might be the location of industries near to highway. The traffic volume in highways are high and at the same time, the vehicles are also moving with high speed compared to other areas such as Gulshan, Tejgaon etc. However, high risk automatically generates additional safety concern to the road users. But in the context of Bangladesh, mostly people are less literate in the rural area than who work inside the city center. Due to this fact, the workers of these area are less concern about traffic safety knowledge.

5.3.1.7 Living in Dhaka City

The result of the study exposes that the workers who have lived in Dhaka city at least 2 to 5yrs are more concerned about safety information (OR=0.65) than who have lived in Dhaka less than 2yrs (OR=1.92). The reason for this is that the worker who having lived in Dhaka has got much opportunity to gather some knowledge about safety. Not only is that, the workers much acknowledged about the road accident injury and its severity. Due to that reason, about the harshness of accident the workers are very concerned. They do not want to face that type causalities in their life. Rather than the workers who work in Dhaka, maybe they come from rural area. The reason behind coming to Dhaka is to lead a better lifestyle. As they have some burden and their family also expect to lead a better lifestyle, that's why the workers do not expect any types of hassle in their life. The explanation points out that the workers who live in Dhaka may be very much careful and do not hesitate to gather any safety information.

5.3.1.8 Physical Disability

According to the result of the study physical condition of the workers plays a significant role in case of receiving safety education. Specifically, RMG workers who have no defect are interested to take safety education from different sources (OR= 0.62). The result is

expected as this category of workers do not have any physical limitation which hinder them to gather safety knowledge.

5.4 Summary of Findings

Through the study, the factors affecting the traffic safety perception of garments workers and also factors affecting traffic safety education are identified. The multiple linear regression analysis and logistic regression analysis of this study have revealed a number of factors which are found to be significantly affecting the workers of RMG. The finding of this study will help us to identify the targeted group for those the garment owners, garment association and the government who could arrange training program to make these targeted group aware about traffic safety.

Table 5.3 shows that the result of the distinct targeted group safety score is 138.92 whereas safety score of remaining group is 154.7 which indicates that targeted group safety perception is lower comparing with the remaining groups which means that this group need further attention for improving their safety perception. The authority could pick up this group for training at preliminary stage to improve the safety scenario of RMG workers' as pedestrian.

Table 5.3: Expected Target Group of Workers Safety Score

Expected Target Group	**Safety Score of Targeted Group**	**Safety Score of Remaining Group**
Age greater than 24	138.92	154.7
Monthly Income greater than tk. 6000		
Marital Status-Married		
Family member greater than 2		
Working in an industry situated in Ashulia or Dhaka - Mymensingh area or nearer to any highway		
Home distance greater than 3km		
Any Accident involved		
Education Status less than primary		

Table 5.4 shows that the result of the distinct significant factors and variables from traffic safety perception study and traffic safety education. Through the combination of these studies the assembled group for whom the authority could organize traffic safety training.

Table 5.4:Summary of Expected Target Group of Workers for Traffic Safety Training

Topics of Study	Model Used for Study	Significant Variables	Expected Clustered Group for Traffic Safety Training
Traffic Safety Perception	Multiple Linear Regression	Gender	Working in an industry situated in Ashulia or Dhaka-Mymensingh area or nearer to any highway
		Age less than 18	
		Age less than 20	
		Age less than 22	
		Age less than 24	
		Income less than 8000	
		Income less than 10000	
		Income greater than 10000	
		Marital Status	
		No kid	
		Family Member greater than 2	Home distance greater than 3km
		Family Member greater than 4	
		Family Member greater than 6	
		Using Public Transit as mode of Transport	No Physical Defect
		Using walk as mode of Transport	
		Walking hour 1 to 4 hour	
		Walking hour 4 to 7 hour	
		No Physical Defect	
		Ashulia	Any Accident involved
		Dhaka-Mymensingh	
		Home distance 3-5 km	
		Any pedestrian accident seen	
		Work experience 3-5 years	
		Education Status less than primary	
		Transport cost <200tk	Education Status less than primary
		Transport cost 700- 1000tk	
		Safety Education from Traffic Police Week	
		Safety Education from Television	
		Safety Education from Other sources	

Topics of Study	Model Used for Study	Significant Variables	Expected Clustered Group for Traffic Safety Training
Traffic Safety Education	Logistic Regression	Gender	Gender-Male & Female
		Age 18 to 20	
		Age 20 to 22	
		Income less than 6000	
		Income 6000 - 8000	
		Family member greater than 2	Age greater than 24
		Marital Status	
		Using Public Transit as mode of Transport	
		No Physical Defect	
		Walking hour 1- 4 per week	Monthly Income greater than 6,000 tk.
		Walking hour 4-7 per week	
		Walking hour >10 per week	
		Ashulia	
		Dhaka-Mymensingh	
		Other Area	
		Home distance less than 1km	Marital Status-Married
		Home distance 1-3km	
		Home distance 3-5 km	
		Any Accident involved	Family member greater than 2
		Any Relative Involved in Accident	
		Work experience >10 years	
		Living in Dhaka <2years	
		Living in Dhaka 2-5 years	
		Transport cost 200- 500tk	
		Transport cost <200tk	

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The principal objective of this study is to dig out the factors that affect traffic safety perception of RMG workers of Bangladesh and also sort out the target group of RMG workers who are vulnerable from road safety perspective. This study also assists to select the garment workers who have least knowledge or no knowledge of traffic safety. It is expected that; this study will be very much effective to reduce the road accident injuries amid the garment workers. In order to achieve this objective, various factors from socioeconomic, demographic issues and various safety related behavior have been investigated. Many of these significant factors are found common in two models which give assistance to rectify the target group.

This chapter summarizes the outcome of the study. The effectiveness of the study and how people can be benefited from this study are discussed in short. Possible enhancement of this study and future research guideline are also mentioned in the recommendation part.

6.2 Conclusions and Recommendations

This study was conducted among 1020 garments' workers to capture the actual scenario of traffic safety perception and also to categories the factors that influence the safety education of garment workers. The analysis of this study has revealed a number of factors which are found to be significantly affecting. An ideal use of this study could be selecting or stratifying the most vulnerable group for traffic safety training programs.

1) The study of safety perception reveals that gender, age group less than upto 24, marital status, number of kid, family member greater than 2 to 6, using public transit and

walking as mode of transport, having no physical disability, observed pedestrian accident involvement, education level less than junior secondary level, transport cost 700-1000tk etc. has significant impact on traffic safety perception which is also indicative through their lower safety perception score than other.

2) The outcome of getting safety education from different sources analysis reveals that like as safety perception affecting factors, age group 18 to 22, family member greater than 2, marital status, location of the industry (Ashulia, Dhaka-Mymensingh), home distance less than 5km, working experience more than 10years, transport cost less than 500tk etc. has influence on receiving safety education from several sources.
3) This study reveals that not everyone in the industry needs training on traffic safety. For example, according to our study a RMG worker will be in vulnerable group if he has the following characteristics and require safety training on urgent basis: (i) Age greater than 24 (ii) Income greater than 6,000 tk. (iii) Having no kid (iv) Unmarried (v) working in an industry situated in Ashulia or Dhaka-Mymensingh area or nearer to any highway (vi) Distance between home and workplace is more than three-kilometer (viii) Transport cost more than 200 tk in a month (ix) Encountered any accident. (xi)Education level less than class five.
4) This study can also be used for transportation planning and policy making. For example, where there are significant numbers of garments industries targeted together, measures such as speed control, vehicle stratification could be taken.

As a part the survey, this study recorded some suggestions from the garments workers. According to them, to ensure their safety, some of the actions taken could be but not limited to the followings:

1. Installation of road signs
2. Community police
3. Roadway markings
4. Raised Cross-Walk
5. Installation of overpass/ underpass in a closer distance
6. Safety education program to teach safe pedestrian behavior
7. Removal of illegal footpath occupancies

8. Installation of speed breakers in front of garments

6.3 Limitations and Future Research

While collecting the records of accidents, the authors discovered that the accidents occurring on a daily basis are not being recorded properly. This is a huge obstacle to fruitful research. For a national scale project based on this pilot study, authentic data must be secured to enact legislation based on research. Thus, it is recommended that actual number of deaths of the garments' workers by vehicles during walking to/ from workplace should be recorded with as much details as possible. Moreover, if the number of garments studied could be increased and more variables were considered, chances are, a couple more variables would reveal their significance.

Another limitation of this study, the data has collected based on only one of the leading garment factory industrialized arena. To predict, the final outcome, it may be required to do some study on other garment factory industrial location such as Chittagong EPZ, Comilla EPZ etc. This study should also conduct on other industrial countries. After that, the total outcome will help the policy makers to provide a possible outcome.

One of the major problems encountered in this study is that not all the garments factory encourages to collect data from their factory as it might possibly hamper the production of the industry. Sometimes, it is also observed that in one factory, the garments owner did not provide permission to collect data and to do interview in all section and every floor. If data can be collected from all the restricted section and floor, it would be more representative.

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APPENDIX-A

Table A.1: Questionnaire

Section A:

Please indicate (circle) whether you agree or disagree with the following statements.

Statements	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I often feel unsafe walking along most streets	1	2	3	4	5
I often feel unsafe crossing most streets	1	2	3	4	5
I often feel unsafe walking along the streets because of fast moving vehicles	1	2	3	4	5
I often feel unsafe crossing the streets because of fast moving vehicles	1	2	3	4	5
I often feel safe crossing the streets at intersections with traffic controls	1	2	3	4	5
I often feel safe crossing the streets at intersections without traffic controls	1	2	3	4	5
I often feel safe crossing the streets at mid-block with crossing facility	1	2	3	4	5
I often feel safe crossing the streets at mid-block without crossing facility	1	2	3	4	5
I often feel safe walking on sidewalks along the streets	1	2	3	4	5
I often feel unsafe walking along the streets without sidewalks	1	2	3	4	5
I often feel unsafe crossing the streets because of insufficient street lighting	1	2	3	4	5
I often feel unsafe walking along the streets because of insufficient lighting	1	2	3	4	5
I often feel unsafe crossing the streets when it is raining	1	2	3	4	5
I often feel unsafe walking along the streets when it is raining	1	2	3	4	5
I often feel unsafe crossing the streets because of reckless drivers	1	2	3	4	5
I often feel unsafe walking on sidewalks because of uncovered drains	1	2	3	4	5
I often unsafe walking on sidewalks because they are too narrow	1	2	3	4	5
I often feel unsafe walking on sidewalks because vehicles can run off the road and hit you	1	2	3	4	5
I often feel unsafe walking on sidewalks because of vehicles entering driveways	1	2	3	4	5
I often feel unsafe walking on sidewalks because of hawkers occupying them	1	2	3	4	5

I often feel unsafe walking along the streets because of hawkers occupying them	1	2	3	4	5
I often feel that there is a need to install a zebra crossing at locations where I cross the streets	1	2	3	4	5
I always use the zebra crossing to cross the streets if they are available	1	2	3	4	5
I often feel that there is a need to install an overpass or underpass at locations where I cross the streets	1	2	3	4	5
I always use the overpass or underpass to cross the street if it is available	1	2	3	4	5
I often feel that there is a need to build more sidewalks along the streets where I walk	1	2	3	4	5
I always use the sidewalk if it is available	1	2	3	4	5
I often feel that there is a need to install traffic signal at intersections where I cross the streets	1	2	3	4	5
I always cross at intersection with traffic signals if it is available	1	2	3	4	5
I often use hand signal to slow down or stop vehicles while crossing the streets	1	2	3	4	5
I always stop talking or texting on the mobile phone when I cross the streets	1	2	3	4	5
I always stop thinking of other things when crossing the streets	1	2	3	4	5
I always keep a safe distance between myself and the oncoming vehicles when crossing the streets	1	2	3	4	5
I always obey traffic rules	1	2	3	4	5
I feel that speed breaker should be installed on all the streets near the garment factory	1	2	3	4	5
I feel that crossing facility should be installed on all the streets near the garment factory	1	2	3	4	5
I feel that sidewalk should be installed on all the streets near the garment factory	1	2	3	4	5
I feel that there should be more traffic police control on all the streets near the garment factory	1	2	3	4	5

Section B:

How would you rank the following safety treatment from 1 to 8 in terms of importance to you, where 8 represent the highest preference?

Installation of signal at intersection _____
Installation of zebra crossing at mid-block _____
Community police _____
Raised cross-walk _____
Installation of overpass/underpass _____
Safety education program to teach safe pedestrian behavior _____
Removal of illegal footpath occupancy _____
Installation of speed breaker in front of garments _____

Section C:

1. What is your sex?[ ] Male [ ] Female

2. Which age group do you belong to?
   [ ] below 18 [ ] 19 to 20 [ ] 21 to 22 [ ] 23-24 [ ] 25+

3. What is your household monthly income before tax?
   [ ] ≤ 5000 [ ] 5001-10000 [ ] 10001-15000 [ ] 15001-20000 [ ] >20000

4. How many family members are there in your household? _____

5. What is your marital status? [ ] Married [ ] Unmarried

6. How many kids do you have?
   [ ] No Kid [ ] One Kid [ ] Two Kids [ ] More than Two Kids

7. What is your usual mode of travel?
   [ ] Transit (Bus, Tempo) [ ] CNG, Taxi Cab [ ] Walking
   [ ] Bicycle, Rickshaw [ ] Motorcycle [ ] Car

8. On an average, how many hours do you walk in a week? _____

9. Do you have any physical disability?
   [ ] No Defects [ ] Hearing Problem [ ] Eye Sight Problem
   [ ] Others _____.

10. In which area do you work?
    [ ] Ashulia [ ] Dhaka-Mymenshing [ ] Gulshan-1 [ ] Tejgaon
    [ ] Others _____.

11. What is the distance from your home to your workplace?
    [ ] Less than 1Km [ ] 1Km to 3Km [ ] 3Km to 5Km [ ] More than 5Km

12. Have you ever involved with an accident while walking?
    [ ] Yes [ ] No

13. Have you ever seen a pedestrian involved with an accident?
    [ ] Yes [ ] No

14. Have any of your friends or relatives ever been involved with an accident?
    [ ] Yes [ ] No

15. How long have you been working in this sector? _____

16. What's your educational qualification? _____

17. How many years have you been living in Dhaka? _____

18. How much money do you spend in each month for transportation purpose?
    _____

19. Have you ever attended any safety training where pedestrian safety issues are discussed?
    [ ] Yes [ ] No
20. Have you received any safety education?
    [ ] No safety education [ ] TV/Radio [ ] Newspaper [ ] Traffic Police Week

    [ ] Others

APPENDIX-B

Some Output of Model Development Process:

Figure B.1: Multiple Linear Regression Model Trail Sample -1

```
. regress safetyperception sex    less18  less20   less22   less24    les6000  les8000 marst
>    kidls1  fmgrt2  fmgrt4 fmgrt6  gt  walk  whles7   whles4       aashu adkmym    les5km  a
> ccped  wexles5  edles5 msples200   mspgrt1000   traffsaf tvsaf othsaf  pno
```

Source	SS	df	MS		
Model	35102.7531	28	1253.66975	Number of obs	= 1020
Residual	74448.1675	991	75.1242861	F(28, 991)	= 16.69
				Prob > F	= 0.0000
				R-squared	= 0.3204
				Adj R-squared	= 0.3012
Total	109550.921	1019	107.508264	Root MSE	= 8.6674

safetyperc~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sex	3.101859	.6267553	4.95	0.000	1.871939	4.331779
less18	2.978554	1.50509	1.98	0.048	.0250257	5.932083
less20	1.788153	1.043962	1.71	0.087	-.2604778	3.836784
less22	2.533102	1.022791	2.48	0.013	.526017	4.540187
less24	1.88941	.9706969	1.95	0.052	-.0154472	3.794268
les6000	3.94431	.6948529	5.68	0.000	2.580758	5.307862
les8000	1.755339	.8286429	2.12	0.034	.1292428	3.381435
marst	-3.901658	1.011806	-3.86	0.000	-5.887187	-1.916129
kidls1	-5.153576	1.123756	-4.59	0.000	-7.35879	-2.948362
fmgrt2	-4.179798	2.579996	-1.62	0.106	-9.242681	.8830856
fmgrt4	-4.690064	2.568983	-1.83	0.068	-9.731335	.3512067
fmgrt6	-4.768208	2.652764	-1.80	0.073	-9.973887	.4374716
gt	3.704001	.7438157	4.98	0.000	2.244366	5.163636
walk	3.113808	.7663654	4.06	0.000	1.609923	4.617693
whles7	1.72022	.8713778	1.97	0.049	.0102627	3.430178
whles4	2.12879	.7634693	2.79	0.005	.6305883	3.626993
aashu	-2.826761	.6589397	-4.29	0.000	-4.119838	-1.533683
adkmym	-2.379313	.8826847	-2.70	0.007	-4.111458	-.6471667
les5km	1.501341	.7878354	1.91	0.057	-.0446762	3.047358
accped	2.173183	.5917026	3.67	0.000	1.012049	3.334317
wexles5	1.190082	.6037217	1.97	0.049	.0053622	2.374802
edles5	-1.932595	.6165389	-3.13	0.002	-3.142467	-.7227233
msples200	3.592637	1.106699	3.25	0.001	1.420894	5.764381
mspgrt1000	5.255869	1.32554	3.97	0.000	2.654683	7.857056
traffsaf	-7.876768	2.490902	-3.16	0.002	-12.76482	-2.988721
tvsaf	2.844419	.6443539	4.41	0.000	1.579964	4.108874
othsaf	-5.80425	1.328773	-4.37	0.000	-8.411781	-3.196718
pno	-2.023631	.9397782	-2.15	0.032	-3.867814	-.1794468
_cons	155.6613	3.197193	48.69	0.000	149.3873	161.9354

Figure B.2: Multiple Linear Regression Model Trail Sample -2

```
. regress safetyperception sex    less18  less20   less22   less24    les6000  les8000 marst
>    kidls1  fmgrt2  fmgrt4 fmgrt6  gt  walk  whles7   whles4       aashu adkmym    les5km  a
> ccped  wexles5  edles5 msples200   mspgrt1000   traffsaf tvsaf othsaf  pno msples700
```

Source	SS	df	MS		
Model	35315.5382	29	1217.77718	Number of obs	= 1020
				F(29, 990)	= 16.24
Residual	74235.3824	990	74.9852347	Prob > F	= 0.0000
				R-squared	= 0.3224
				Adj R-squared	= 0.3025
Total	109550.921	1019	107.508264	Root MSE	= 8.6594

safetyperc~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sex	3.245447	.6319499	5.14	0.000	2.005332	4.485562
less18	2.91263	1.504205	1.94	0.053	-.0391669	5.864427
less20	1.731648	1.043535	1.66	0.097	-.3161472	3.779443
less22	2.551663	1.021903	2.50	0.013	.546317	4.557008
less24	1.929853	.9700953	1.99	0.047	.0261741	3.833533
les6000	4.064334	.6978564	5.82	0.000	2.694886	5.433781
les8000	1.688202	.8288344	2.04	0.042	.0617281	3.314676
marst	-3.966028	1.011592	-3.92	0.000	-5.951138	-1.980918
kidls1	-5.359288	1.129337	-4.75	0.000	-7.575457	-3.143119
fmgrt2	-4.11803	2.577868	-1.60	0.110	-9.176744	.9406832
fmgrt4	-4.630698	2.566846	-1.80	0.072	-9.667782	.4063859
fmgrt6	-4.785924	2.650328	-1.81	0.071	-9.98683	.4149833
gt	3.697022	.7431385	4.97	0.000	2.238715	5.15533
walk	3.112629	.7656561	4.07	0.000	1.610134	4.615124
whles7	1.68352	.8708436	1.93	0.053	-.0253912	3.392431
whles4	2.133387	.7627673	2.80	0.005	.6365606	3.630213
aashu	-2.766814	.6592907	-4.20	0.000	-4.060582	-1.473046
adkmym	-2.432704	.8824368	-2.76	0.006	-4.164366	-.7010427
les5km	1.508612	.7871177	1.92	0.056	-.0359988	3.053223
accped	2.189185	.591231	3.70	0.000	1.028975	3.349395
wexles5	1.114374	.6048348	1.84	0.066	-.0725313	2.30128
edles5	-1.811595	.620142	-2.92	0.004	-3.028539	-.594651
msples200	3.424007	1.110197	3.08	0.002	1.245398	5.602616
mspgrt1000	5.144023	1.325976	3.88	0.000	2.541978	7.746069
traffsaf	-7.957229	2.489054	-3.20	0.001	-12.84166	-3.072801
tvsaf	2.896938	.6445118	4.49	0.000	1.632172	4.161704
othsaf	-5.857363	1.327917	-4.41	0.000	-8.463219	-3.251508
pno	-1.934476	.9403985	-2.06	0.040	-3.779879	-.0890721
msples700	-2.29872	1.364594	-1.68	0.092	-4.976549	.3791082
_cons	155.7005	3.194317	48.74	0.000	149.4321	161.9689

Figure B.3: Multiple Linear Regression Model Trail Sample -3

```
. regress safetyperception sex    less18  less20   less22   less24  cyc   les6000  les8000 ma
> rst    kidls1  fmgrt2  fmgrt4 fmgrt6  gt  walk  whles7   whles4       aashu adkmym    les5k
> m  accped  wexles5  edles5 msples200   mspgrt1000   traffsaf tvsaf othsaf  pno msples700
```

Source	SS	df	MS		
Model	35416.7803	30	1180.55934	Number of obs	= 1020
Residual	74134.1403	989	74.9586858	F(30, 989)	= 15.75
				Prob > F	= 0.0000
				R-squared	= 0.3233
				Adj R-squared	= 0.3028
Total	109550.921	1019	107.508264	Root MSE	= 8.6579

safetyperc~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sex	3.246191	.6318383	5.14	0.000	2.006293	4.486089
less18	2.849821	1.50491	1.89	0.059	-.1033615	5.803004
less20	1.729173	1.043353	1.66	0.098	-.3182661	3.776612
less22	2.526579	1.02195	2.47	0.014	.5211388	4.532019
less24	1.914629	.970012	1.97	0.049	.0111113	3.818148
cyc	-3.909652	3.364097	-1.16	0.245	-10.51124	2.691936
les6000	4.028792	.6984027	5.77	0.000	2.65827	5.399313
les8000	1.702775	.8287826	2.05	0.040	.076401	3.32915
marst	-3.982845	1.011516	-3.94	0.000	-5.967809	-1.997881
kidls1	-5.365301	1.129149	-4.75	0.000	-7.581104	-3.149498
fmgrt2	-4.141226	2.577489	-1.61	0.108	-9.199202	.9167499
fmgrt4	-4.699225	2.567069	-1.83	0.067	-9.736752	.3383029
fmgrt6	-4.807143	2.649922	-1.81	0.070	-10.00726	.3929727
gt	-.1187446	3.366333	-0.04	0.972	-6.724721	6.487232
walk	-.6938004	3.36355	-0.21	0.837	-7.294314	5.906714
whles7	1.711949	.871033	1.97	0.050	.0026642	3.421234
whles4	2.1502	.7627694	2.82	0.005	.653368	3.647033
aashu	-2.823861	.6609992	-4.27	0.000	-4.120983	-1.526739
adkmym	-2.465595	.8827344	-2.79	0.005	-4.197843	-.7333474
les5km	1.493419	.787087	1.90	0.058	-.0511338	3.037971
accped	2.183997	.5911432	3.69	0.000	1.023958	3.344036
wexles5	1.15976	.6059874	1.91	0.056	-.0294088	2.348929
edles5	-1.823774	.6201208	-2.94	0.003	-3.040677	-.6068699
msples200	3.476155	1.110907	3.13	0.002	1.29615	5.65616
mspgrt1000	5.050432	1.328184	3.80	0.000	2.444049	7.656816
traffsaf	-7.911239	2.488928	-3.18	0.002	-12.79542	-3.027053
tvsaf	2.895704	.6443986	4.49	0.000	1.631159	4.16025
othsaf	-5.820152	1.328068	-4.38	0.000	-8.426306	-3.213997
pno	-1.91157	.9404386	-2.03	0.042	-3.757054	-.0660856
msples700	-2.232527	1.36554	-1.63	0.102	-4.912217	.4471626
_cons	159.5763	4.617626	34.56	0.000	150.5149	168.6378

Figure B.4: Logistic Regression Model Trail Sample -1

```
. logistic saft   sex  less20  less22      les8000 les6000  fmgrt2  marst    gt    pno   whle
> s4 whles7  whgrt10 aashu adkmym aother  les1km les3km  les5km   acco  accrel  wexgrt10   lv
> les2 lvles5 msples500 msples200

Logistic regression                               Number of obs   =       1020
                                                  LR chi2(25)     =     285.44
                                                  Prob > chi2     =     0.0000
Log likelihood =  -490.1971                       Pseudo R2       =     0.2255
```

saft	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	1.758485	.3083482	3.22	0.001	1.247043	2.479681
less20	.6574165	.1474314	-1.87	0.061	.4235954	1.020305
less22	.5488941	.1207886	-2.73	0.006	.3565946	.8448943
les8000	1.589845	.4109145	1.79	0.073	.9579696	2.638506
les6000	1.429788	.2774844	1.84	0.065	.9774079	2.091547
fmgrt2	.5131961	.0965629	-3.55	0.000	.3549126	.7420707
marst	1.360199	.2430964	1.72	0.085	.9582407	1.930769
gt	.6304329	.1109702	-2.62	0.009	.4464867	.8901623
pno	.6193645	.1572896	-1.89	0.059	.3765138	1.018853
whles4	.293469	.0826435	-4.35	0.000	.1689882	.5096454
whles7	.3867736	.1171348	-3.14	0.002	.2136336	.7002356
whgrt10	.5136966	.1816002	-1.88	0.060	.256917	1.027118
aashu	1.560511	.3677963	1.89	0.059	.9832126	2.476773
adkmym	3.278844	.9235711	4.22	0.000	1.887808	5.694868
aother	9.014728	2.866171	6.92	0.000	4.834137	16.81072
les1km	.1406183	.0551867	-5.00	0.000	.06516	.3034604
les3km	.1556616	.060241	-4.81	0.000	.0729066	.3323503
les5km	.2356066	.0972532	-3.50	0.000	.1049133	.5291082
acco	2.008074	.4428176	3.16	0.002	1.303389	3.093752
accrel	.3757199	.079594	-4.62	0.000	.2480518	.5690967
wexgrt10	.2814857	.1136069	-3.14	0.002	.1276185	.6208676
lvles2	1.919368	.5506332	2.27	0.023	1.093864	3.367853
lvles5	.6501228	.1206566	-2.32	0.020	.4518774	.9353416
msples500	1.51404	.33706	1.86	0.062	.9786796	2.342256
msples200	1.952315	.7171958	1.82	0.069	.9502883	4.010924
_cons	5.036697	2.983194	2.73	0.006	1.577561	16.08072

Figure B.5: Logistic Regression Model Trail Sample -2

```
. logistic saft   sex  less20  less22      les8000 les6000  fmgrt2  marst    gt    pno   whle
> s4 whles7  whgrt10 aashu adkmym aother  les1km les3km  les5km   acco  accrel  wexgrt10   lv
> les2 lvles5 msples500 msples200  cyc

Logistic regression                               Number of obs   =       1020
                                                  LR chi2(26)     =     286.10
                                                  Prob > chi2     =     0.0000
Log likelihood = -489.86333                       Pseudo R2       =     0.2260
```

saft	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	1.740006	.3056621	3.15	0.002	1.233169	2.455156
less20	.6413697	.1452073	-1.96	0.050	.4115237	.9995902
less22	.5406161	.1193899	-2.79	0.005	.3506786	.8334292
les8000	1.568522	.4073109	1.73	0.083	.9428708	2.60933
les6000	1.406153	.2742536	1.75	0.081	.9594356	2.060865
fmgrt2	.5210046	.0985858	-3.45	0.001	.3595631	.7549323
marst	1.3455	.2409624	1.66	0.097	.947205	1.911276
gt	.5868878	.1152679	-2.71	0.007	.3993692	.8624534
pno	.6334124	.1619374	-1.79	0.074	.3837686	1.045451
whles4	.2953445	.0832227	-4.33	0.000	.1700106	.5130762
whles7	.3879312	.1174611	-3.13	0.002	.2142992	.7022452
whgrt10	.5069294	.1794617	-1.92	0.055	.2532839	1.014583
aashu	1.580358	.3734282	1.94	0.053	.9945393	2.511243
adkmym	3.32467	.9384245	4.26	0.000	1.911999	5.781087
aother	9.365299	3.01299	6.95	0.000	4.985106	17.59417
les1km	.1435485	.056398	-4.94	0.000	.0664622	.3100434
les3km	.1568102	.0606579	-4.79	0.000	.0734699	.3346872
les5km	.2425138	.1004573	-3.42	0.001	.1076813	.546176
acco	1.988763	.4390748	3.11	0.002	1.290198	3.065557
accrel	.3783843	.0803883	-4.57	0.000	.2495136	.5738153
wexgrt10	.278747	.1126265	-3.16	0.002	.1262658	.6153675
lvles2	1.899272	.5455221	2.23	0.026	1.081681	3.334841
lvles5	.6515535	.1210825	-2.31	0.021	.4526533	.9378525
msples500	1.518775	.337725	1.88	0.060	.9822334	2.348402
msples200	1.946522	.7158069	1.81	0.070	.9467638	4.002
cyc	.8370021	.1825779	-0.82	0.415	.5458223	1.283517
_cons	5.242363	3.116845	2.79	0.005	1.634728	16.81158

Table B.1: Correlation Check

	Safety Perception	Gender	Age less than 18	Age less than 20	Age less than 22	Age less than 24	Income less than 8000	Income less than 10,000	Income greater than 10,000	Marital Status	No kid	Family Member greater than 2	Family Member greater than 4
Safety Perception	1												
Gender	0.134	1											
Age less than 18	0.093	0.096	1										
Age less than 20	0.046	0.031	-0.121	1									
Age less than 22	0.115	-0.125	-0.128	-0.296	1								
Age less than 24	0.028	-0.098	-0.144	-0.333	-0.352	1							
Income less than 8000	0.094	-0.073	-0.017	0.021	0.112	0.02	1						
Income less than 10,000	-0.228	0.019	-0.092	-0.084	-0.1	-0.054	-0.275	1					

	Safety Perception	Gender	Age less than 18	Age less than 20	Age less than 22	Age less than 24	Income less than 8000	Income less than 10,000	Income greater than 10,000	Marital Status	No kid	Family Member greater than 2	Family Member greater than 4
Income greater than 10,000	-0.108	-0.099	-0.062	-0.075	-0.021	0.141	-0.26	-0.362	1				
Marital Status	0.023	0.288	-0.074	-0.188	-0.09	0.016	-0.093	-0.021	-0.024	1			
No kid	-0.241	-0.159	0.078	0.089	-0.031	-0.185	-0.006	0.246	-0.022	-0.721	1		
Family Member greater than 2	-0.053	-0.13	0.033	0.007	0.127	-0.135	0.047	0.102	-0.075	-0.094	0.155	1	
Family Member greater than 4	0.035	0.081	-0.06	-0.022	-0.058	0.142	0.016	-0.106	0.069	0.117	-0.157	-0.754	1
Family Member greater than 6	0.014	0.056	0.039	0.028	-0.088	-9E-04	-0.084	0.004	0.01	-0.044	0.008	-0.258	-0.404
Using Public Transit as mode of Transport	0.036	0.063	0.062	-0.027	-0.056	-0.056	-0.086	0.123	0.038	0.025	0.021	-0.025	-0.013
Using walk as mode of Transport	0.146	0.041	0.009	0.151	0.063	0.036	0.045	-0.184	-0.015	0.028	-0.188	-0.104	0.097
Walking hour 4 to 7 hour	-0.091	-0.06	-0.033	-0.024	0.009	-0.002	-0.092	0.085	0.054	-0.077	0.107	0.033	-0.015

	Safety Perception	Gender	Age less than 18	Age less than 20	Age less than 22	Age less than 24	Income less than 8000	Income less than 10,000	Income greater than 10,000	Marital Status	No kid	Family Member greater than 2	Family Member greater than 4
Walking hour 1 to 4 hour	0.197	-0.002	0.021	-0.042	0.087	0.031	0.195	-0.144	-0.11	0.037	-0.145	-0.013	0.004
Ashulia	-0.036	-0.092	-0.041	-6E-04	0.135	0.101	-0.062	-0.232	0.131	0.059	-0.181	0.04	0.023
Dhaka-Mymensing	-0.097	0.109	0.031	-0.034	-0.11	-0.072	-0.126	0.167	-0.035	0.009	0.046	-0.042	-0.048
Home distance 3-5 km	0.088	-0.013	-0.009	0.027	0.013	0.043	-0.011	-0.073	0.016	0.033	-0.12	-0.026	0.023
Any pedestrian accident seen	0.197	0.064	-0.002	-0.036	0.043	0.061	0.09	-0.126	-0.027	0.095	-0.185	-0.067	0.131
Work experience 3-5 years	0.107	0.001	-0.124	-0.019	0.034	0.134	0.06	-0.115	-2E-04	0.134	-0.232	-0.073	0.096
Education Status less than primary	-0.161	-0.059	0.041	0.011	-0.015	-0.081	-0.011	0.098	-0.045	-1E-04	0.045	0.12	-0.113
Transport cost <200tk	0.132	-0.004	0.158	0.067	0.06	-0.087	-0.035	-0.134	-0.02	-0.01	-0.039	0.074	-0.083
Transport cost 700- 1000tk	0.007	0.154	0.026	-0.083	-0.071	-0.081	-0.081	0.108	-0.018	0.184	-0.015	-0.033	-0.011

	Safety Perception	Gender	Age less than 18	Age less than 20	Age less than 22	Age less than 24	Income less than 8000	Income less than 10,000	Income greater than 10,000	Marital Status	No kid	Family Member greater than 2	Family Member greater than 4
Safety Education from Traffic Police Week	-0.075	0.085	-0.026	0.151	-0.064	-0.052	-0.051	-0.012	-0.006	-0.007	0.01	-0.042	0.017
Safety Education from Television	0.201	-0.29	-0.068	0.046	0.194	0.09	0.143	-0.149	0.033	-0.099	-0.127	0.049	-0.01
Safety Education from Other sources	-0.207	0.055	0.01	0.056	-0.106	-0.052	-0.101	0.113	0.024	0.04	0.086	-0.003	0.027
No Physical Defect	-0.143	-0.176	-0.2	-0.04	-9E-04	0.097	0.002	0.12	-0.008	-0.011	0.067	0.06	0.002

	Family Member greater than 6	Using Public Transit as mode of Transport	Using walk as mode of Transport	Walking hour 4 to 7 hour	Walking hour 1 to 4 hour	Ashulia	Dhaka-Mymensingh	Home distance 3-5 km	Any pedestrian accident seen	Work experience 3-5 years	Education Status less than primary	Transport cost <200tk	Transport cost 700-1000tk
Family Member greater than 6	1												
Using Public Transit as mode of Transport	0.052	1											
Using walk as mode of Transport	0.023	-0.58	1										
Walking hour 4 to 7 hour	-0.035	0.018	-0.03	1									
Walking hour 1 to 4 hour	0.012	-0.066	0.019	-0.618	1								

	Family Member greater than 6	Using Public Transit as mode of Transport	Using walk as mode of Transport	Walking hour 4 to 7 hour	Walking hour 1 to 4 hour	Ashulia	Dhaka-Mymensingh	Home distance 3-5 km	Any pedestrian accident seen	Work experience 3-5 years	Education Status less than primary	Transport cost <200tk	Transport cost 700-1000tk
Ashulia	-0.082	-0.118	0.089	0.154	-0.027	1							
Dhaka-Mymensingh	0.124	0.049	-0.014	0.016	-0.116	-0.401	1						
Home distance 3-5 km	0.001	0.029	-0.067	0.09	-0.095	0.074	-0.069	1					
Any pedestrian accident seen	-0.088	-0.089	0.118	-0.171	0.273	0.014	-0.015	-0.076	1				
Work experience 3-5 years	-0.046	-0.046	0.121	0.051	-0.013	0.138	-0.046	0.037	0.04	1			

	Family Member greater than 6	Using Public Transit as mode of Transport	Using walk as mode of Transport	Walking hour 4 to 7 hour	Walking hour 1 to 4 hour	Ashulia	Dhaka-Mymensingh	Home distance 3-5 km	Any pedestrian accident seen	Work experience 3-5 years	Education Status less than primary	Transport cost <200tk	Transport cost 700-1000tk
Education Status less than primary	-0.002	0.01	-0.06	0.067	-0.061	0.135	0.056	-0.029	-0.091	-0.078	1		
Transport cost <200tk	0.02	-0.011	0.051	-0.031	0.052	0.049	0.029	-0.037	-7E-04	-0.095	0.085	1	
Transport cost 700-1000tk	0.059	-0.114	-0.038	-0.06	-0.039	-0.122	0.025	-0.027	-0.122	-0.067	-0.016	-0.067	1
Safety Education from Traffic Police Week	0.038	-0.013	0.039	-0.017	-0.045	-0.039	0.051	-0.024	-0.021	-0.067	-0.038	0.001	0.051
Safety Education from Television	-0.028	-0.071	0.049	-0.015	0.182	0.193	-0.226	0.058	0.137	0.053	0.026	-0.012	-0.148

	Family Member greater than 6	Using Public Transit as mode of Transport	Using walk as mode of Transport	Walking hour 4 to 7 hour	Walking hour 1 to 4 hour	Ashulia	Dhaka-Mymensingh	Home distance 3-5 km	Any pedestrian accident seen	Work experience 3-5 years	Education Status less than primary	Transport cost <200tk	Transport cost 700-1000tk
Safety Education from Other sources	-0.029	-4E-04	0.041	0.058	-0.139	0.027	0.02	-0.071	-0.061	-0.027	0.084	0.022	0.068
No Physical Defect	-0.083	-0.076	-0.066	0.069	0.044	0.131	-0.093	-0.071	-0.001	0.07	0.034	-0.214	-0.039

	Safety Education from Traffic Police Week	Safety Education from Television	Safety Education from Other sources	No Physical Defect
Safety Education from Traffic Police Week	1			
Safety Education from Television	-0.101	1		
Safety Education from Other sources	-0.026	-0.202	1	
No Physical Defect	-0.069	0.153	-0.061	1