Traffic Safety Perception of Garment Workers

A Dissertation Submitted in Partial Fulfillment of the Requirements

For the Bachelor of Science Degree in
Civil & Environmental Engineering

By

Mahmud Amin (Student Id: 095409)

Md. Tanvir Uddin Chowdhury (Student Id: 095417)

Md. Shafiul Alam (Student Id: 095422)

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Islamic University of Technology (IUT)
A Subsidiary Organ of OIC.Dhaka,Bangladesh

Thesis approved as to style and content for the degree of B.Sc. Engineering (Civil and Environmental Engineering)

By

Dr. Shakil Mohammad Rifaat

Assistant Professor

Department Of Civil & Environmental Engineering,

Islamic University of Technology, Board Bazar, Gazipur.

DECLARATION

We hereby declare that the undergraduate project work reported in this thesis has been performed by us and this work has not been submitted elsewhere for any purpose (except for publication).

October, 2013

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Mahmud Amin (Student Id: 095409)

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Md. Tanvir Uddin Chowdhury (Student Id: 095417)

_____

Md. Shafiul Alam (Student Id: 095422)

Dedicated

To

Our Beloved Parents

ACKNOWLEDGEMENT

ABSTRACT

Pedestrian injuries have become a major safety problem all over the world, especially in third world countries such as, Bangladesh. However, the country is heavily dependent on its RMG industry which is the greatest source of generating foreign currency, mass employment and a gateway to social-economic development for it. This study reveals, majority of the garments workers choose walking as their mode of transport and thus fall under pedestrian category. Consequently this particular group is under severe threat. On response to the problem, this study aims to explore garments workers traffic safety perception and the factors associated with it. A questionnaire survey was conducted among four representative garments industry, and a total of 380 samples were collected. Using the software 'STATA' a linear regression model analysis was applied to analyze the data. 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), etc.

Key words – Garment Workers, Traffic Safety Perception, Pedestrian, Road Crush.

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CHAPTER 1

INTRODUCTION

1.1   Background

Garment is one of the many labor-intensive sectors that provide a gateway for developing countries to the global market. It offers important opportunities to countries to start industrializing their economies and in course of time diversify away from commodity dependence. Forty years ago, the industrialized countries dominated global exports in this area. Today, developing countries produce half of the world's textile exports. Moreover, the economic performance of the apparel and textiles industry in developing countries has large impacts on employment opportunities, especially for women. Though Ready-made garment (RMG) industry caters to one of the basic needs of human beings, it came into existence as an industry,(i.e. the manufacture of garments using industrial methods of production) only at the turn of the 20th century with the introduction of sewing machine on a commercial scale(AILS study report 2.)

Since the start of its garment export industry in the late 1970s, Bangladesh has seen its RMG export levels grow steadily and has become a top global exporter. With around USD 15 billion in export value in calendar year 2010, the RMG industry is currently Bangladesh's most important industry sector (13% share of GDP and total export share of over 75%). With 12% average annual growth rates, clothing exports are the key driving force behind GDP development (& percent CAGR from 1995 to 2010). With a current 5,000 RMG factories employing about 3.6 million workers from a total workforce of 74 million, Bangladesh is clearly ahead of Southeast Asian RMG suppliers in terms of capacity offered (e.g., Indonesia has about 2,450 factories,Vietnam2,000, and Cambodia 260 factories). Other markets, such as India and Pakistan, would have the potential to be high-volume supply markets, but high risk or structural workforce factors prevent utilization of their capacity [McKinsey_ Bangladesh.(2011)].

Moreover, the RMG industries have been a major turn point concerning women-contribution to GNP. For instance, 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 .To illustrate, among the total labour force about 90% are female workers [Montero D. (2005)]. Besides these positive hallmarks of this sector, it has also created negative impact on social, housing, transport and most importantly workers safety and security problems. Among 4,000 garment factories in Bangladesh, about two-thirds are mushrooming in and around Dhaka city. Due to lack of strict landuse planning and control, most of the garment factories are established mainly besides the major arterial roads and using buildings that are built primarily either for residential or commercial use and without giving any attention to inevitable consequences of these labour intensive factories on fragile urban transport infrastructures. Development of these garment industries 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 city roadway facilities are not planned. Besides, establishment of these labour intensive industries in the high rise buildings, pose a great safety concern particularly in case of fire [Hoque, et .al (2006)].

Analysis of database shows that there are a total of 2960 enlisted garment industries in and around Dhaka Metropolitan City and about 1,070,754 workers are employed in these industries. 62 % factories are found to be clustered along the primary and secondary roads and all together 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 workers 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 Desperate Attempts of Roadway Crossing by Garments Workers 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 survey reveals that garments worker are poorly remunerated (89 % get less than Tk. 2000) 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. On an average those who live without family spend 40 % of their income as house rent. 88 % workers can not afford to pay travel expenses and are compelled to commute on foot and only 12 % workers are using bus services [Hoque, et .al (2006)]. This huge bulk of pedestrian are exposed to open traffic most of which are high velocity considering the garments located at the outskirts of the capital (e.g. Gazipur) and the city's busy streets when located at CBD areas.

1.2   Cause Of the study

The total number of traffic accidents concerning only Pedestrian hit from 1998-2011 is around 21623(total) and around 25048 considering pedestrian casualties (total). Within 1998- 2010 only at the pedestrian crossings the number of accidents are 1067. Considering the national highway the total number of accidents are 19968 (1998-2011). Among the pedestrian casualties 19940 are male and 4940 female (total 1998-2011). The data also indicate that most of the pedestrian casualties are either on the road sides or at the road centerline. Also, it is evident that during the casualties, most of the pedestrians are either crossing the road or walking along roadside. Interestingly, while considering the pedestrian activities as factor contributing to the accidents, the number of accidents are 1079 within years 1998-2011.The annual economic wastage occasioned by traffic accidents is estimated to be in the order of 2 to 3 percent of the GDP. And as a matter of fact, a huge number of the current day pedestrians are garments workers.

The country's booming garment industry, its biggest export earner, has been plagued by building-collapses, fires, and other accidents, leaving at least 730 workers killed in the past 11 years, according to the data of Bangladesh Institute of Labour Studies. Another 4,700 garment workers have been injured, many of whom have lost their

ability to work, in the incidents, but most of the injured and the families of the killed did not get compensation. The BILS data show at least 630 workers have been killed in building-collapses, factory fires, and other incidents in several RMG factories from 2002 to April 2013.(April 25, 2013, The daily New Age)

The BILS revealed the information that at least 249 workers died in transport sector, 155 in RMG sector, and 113 workers in construction sector. Workplace accidents killed 708 workers, among which 154 were female, while workplace violence caused death of 198 workers, of them 49 female, and 153 workers were killed in road accidents. (The Daily Star ,May 17, 2013).

These statistics indicate the necessity of the study of traffic safety perception of RMG workers nationwide. As perceived form available literature review, very few studies have been addressing this issue and all the available studies are most recent. However, it is understood that detailed study and survey of the safety perception and related statistical modeling are required for proper and thorough understanding of the causes of these accidents and to take effective measures as well. This study is nothing but an effort to establish such a statistical modeling, developed by surveying randomized sample from locations that are likely to present the average scenario of the actual picture.

CHAPTER 2

LITERATURE REVIEW

The Literature review portion of this thesis contains three cores. The first part describes the contributions of garment industries in the socio-economic context of Bangladesh in comparison with the rest of the world and it also focuses on the rate of road accidents and its projections on the garment workers.. The findings and solutions of various research papers, worldwide and reports from projects undertaken by various national, international NGO's and govt. institutions are sequentially discussed in the second core. The last part deals with the methodologies involved in the existing studies and their lacking.

2.1 Present Scenario

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 whom 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%) The fast growth of textiles and garments manufacturing in Asia and other developing countries has 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 ready made garments manufacturer after China, by the next five years Bangladesh will become largest ready made garments manufacturer.

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, D. and Rahman. M (2001)].

Export earning 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 [Haq F. (2005)]. 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 D. (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 are 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, A.K. (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 scatteredly 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. Spatial distribution of clustering type of garment industries is superimposing them on Dhaka City Road Network Map.

2.2 Findings and solution:

2.2.1 Study regarding women in garments

A number of studies have been conducted by various international organization focusing on the issues regarding participation of women workers in the garments industries worldwide. For example, 'Issues for Women Workers in the Garment Sector' (Julie Delahanty), 'Economic Organizations of Women and their Empowerment. Dhadra, Ahmedabad' (Bhatt, Ela. 1996), Rethinking Rural Poverty: Bangladesh as a Case Study, (Hamid and Shamim ,1995); Necessary, Sufficient or Irrelevant? Women, Wages and Intra-Household Power Relations in Urban Bangladesh (Kabeer and Naila ,1995);

Where as a Report on Condition of Human Rights of Women Garments Workers in Bangladesh implies that, garment workers, particularly female garment workers, are young, unmarried, less educated, of rural origin and from very poor families. 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. According to the report, major socio-economic characteristics of women garment workers are as follows:

Age

Generally the age a limit of women garment 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.

Marital Status

In readymade garment industries marriage is considered the main constraint of the employer as well as the employee, but still there are about 38 percent of women workers are married and rest of them are unmarried, divorced, widowed or abandoned by their husbands.

Level of Education

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.

Migration

83 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.

Poverty

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.

Health and Nutrition

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.

Meanwhile, according to (Shahra Razavi. March 1998) Nazli Kibria argues, a fuller understanding of the movement of women into the garments factories of Bangladesh also requires the consideration of the .push. factors that underpin it. Conventional understandings of women.s entry into wage employment in Bangladesh have emphasized the role played by extreme poverty and the related dynamic of male unemployment and desertion _ factors that are also explored in the present paper. But based on interviews with women factory workers in Dhaka, the author is able to suggest a more diverse set of factors underpinning their movement into the garments sector, which in a significant number of cases also entails individual rural-urban migration. Among the factors highlighted are family conflicts, marriage breakdowns, problems of sexual harassment, the pressures from rising dowry demands and uncertain marriage prospects. Rather than being uniformly a response to dire poverty, the paper argues that in some instances garments work provides the means for enhancing personal and/or household economic prospects, while in other cases it provides a measure of economic and social independence for the women concerned.

Another point emerging from the paper is that the meanings that are attached to any kind of work are context-specific and thus highly variable: notwithstanding the exploitative nature of work in garments factories, the value that women workers in this particular context attach to garments work needs to be seen in the light of other

livelihood options that are open to them, such as domestic service and arduous forms of agricultural wage work.

2.2.2 **Study regarding working environment**

Numerous studies has been done regarding the work environment of the garments workers and their safety issues. For example, .(Jashim Uddin Ahmed,Tamima Hossain;Sri Lankan Journal of Management,*Volume 14, Number 1)implies that,*
a safe and secure working environment is the fundamental right of the workers (UDHR,1948). From the international human rights instruments to our domestic laws worker's rights are protected but in our country due to lack of the enforcement mechanisms and unwillingness of some people these problems remain unsolved. Garment manufacturers continuing to build garments 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.

Deterrent punishment for those who locked the gates after such accidents and accountability of the owner should be ensured. Otherwise in the near future we will be questioned for these types of gross human rights violations and may lose our foreign buyers. At the same time proper implementation of general and international standards should be made mandatory; otherwise , death traps for workers will continue to be built.

According to them, the recent steps taken by government and BGMEA showed some progress in taking safety measures in factories. 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.

2.2.3 **Study on spatial distribution of garments & speeding effect**

Though important but few studies has been done regarding the relationship with road accidents related to garments workers and spatial distribution of garments & speeding effect.

However, Hoque, M.S., Debnath, A.K., and Mahmud, S.M.S. (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 landuse pattern which in tern 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 get more opportunity to make short cut and to cross the roads randomly without using the designated road crossing facilities. This uncontrolled crossing behaviour and undue conflicts with the high speed main road traffic increases pedestrian safety hazard significantly.

On the contrary, 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. As such, 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.

2.2.4 Study regarding modes of transports used by workers & roadsides characteristics

It is found that due to very low income level, poor garment workers are not only forced to live in miserable conditions at slump areas but also can not afford to pay travel expenses and are compelled to commute on foot and a small percentage of workers are using bus services as said by Hoque, M.S., Debnath, A.K., and Mahmud, S.M.S. (2006). They also believe 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. Though, bicycle is considered as one of the cheapest and affordable modes of transport for low income group people but as most of the workers are female, this space efficient mode are not playing any role to solve their transport problem. Moreover, it is observed that even male workers are also not using bicycles for commuting purpose. Lack of purchasing capacity and having no secured bike-parking stands at workplaces are the main reason for not using bicycle. Finding no other alternatives presently most of the workers are commuting on foot and quite naturally to reduce length of walking trips they prefer to reside in those slum areas that are close to their job places.

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 presence of 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 in to 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 causes great 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.

While crossing, in general motorist show little respect to 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 road without paying any attention to the oncoming vehicles and literally force motorist to slow down their speed. Moreover, hawker's problems of foot bridges discourage them to use the facilities particularly in the afternoon shift. On the other hand, with no generator facility when power failure do occurs, the underpasses become blackout and unusable. Power failure as well as absence of street lighting in many lanes/by-lanes also poses security problems for the night shift female workers. (Hoque, M.S., Debnath, A.K., and Mahmud, S.M.S. 2006)

2.2.5 Study regarding visibility of workers safety garments during night time

According to Arditi et al.(2005) one of the primary causes of nighttime accidents relates to worker visibility issues. Workers need to be visible to oncoming traffic and heavy equipment operators to ensure the safety of both the workers and the motorists

and to reduce struck-by incidents. High-visibility safety garments have been developed to improve the visibility and safety of workers at night.

The performance of high-visibility garments during nighttime hours has been evaluated in the past by determining the recognition distance _the distance between the subject and the point at which the driver recognizes the presence of a subject.

Luoma et al. (1995) studied the effects of retro reflector positioning on the recognition of pedestrians. Sayers et al. (2002) assessed the effects of color on the detection of pedestrians who were wearing different colors of retro reflective markings on the legs for normal and color deficient drivers. Drivers sitting in the driver's seat of a stationary automobile observed a pedestrian walking along the road. The analysis consisted of the modeling of detection distances as a function of the specific intensity of the unit area of the colored retro reflective markings. Persons with normal color vision, the color of the retro reflective marking affected the distance at which the pedestrian was detected.

2.2.6 **Study Regarding understanding with the owners and age groups**:

A CASE STUDY OF BANGLADESH On Competitiveness in the Garment and Textiles Industry: Creating a supportive environment (Dr.Sanchita Banerjee Saxena, et.al,July2010) was Published by Asia Foundation . In this study, the responses of the different respondents have been compared over time to give an idea of the evolution of their perceptions of the position of Bangladesh's garment sector on the international scene, as well as the role of government and of general labor conditions .They found out in a tripartite meetings 2006 that , factory workers Fear that increased competition will mean poorer labor conditions and lost jobs. Interviews in early 2008,the factory workers consentaneously complained that government was not being concerned about the sector. However, interviews in late 2008 discovered that The government passed a higher minimum wage . Now it needs to be implemented across all factories.

'Study Report on Workers in Readymade Garment Industry' Undertaken by The Ambekar Institute for Labour Studies, Mumbai found that the workers to be relatively satisfied with their work, more so in Bangalore than in Tirupur- or if they are not happy they are too wary to speak out. Unionisation or any kind of organized protest is something the employers do not take kindly to, though they always display a very open-minded attitude during our interviews.

As the AILS discovered through a recent project (Summary in Annexure III),employers show their true colours as soon as they see that the workers express their dissatisfaction on working conditions and demand better wages, etc.

However, there is one very important issue that deserves to be mentioned. Recently, there has been a lot of fire related accident happening in the country's garments industries. These accidents has set the industry and it's working people's safety stake. On this regard there has been a number of researches recently. For example, (Jashim Uddin Ahmed and Tamima Hossain) said, The readymade garment (RMG) sector has been playing an important role in the overall economic development of Bangladesh. In the post-quota globalized world, issues relating to social compliance have become increasingly important in the export-oriented RMG Sector. With the collapse of the Savar Spectrum Sweater factory, the Phoenix Fabrics Mill Ltd., the fire at KTS Fabrics Mills and Chowdhury Knitwear Garments, industrial health and safety issues have been identified as a burning issue in the RMG sector and lots of pressure have been imposed on industry proprietors as well as on the government regarding the safety of workers and their overall welfare. Their study presents an overview of the safety issues in the RMG industry of Bangladesh. They recommended that, from the international human rights instruments to the domestic laws of Bangladesh, worker's rights are protected but due to lack of the enforcement mechanisms and unwillingness of some people these problems remain unsolved. Garment manufacturers continuing to build garments 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.

Deterrent punishment for those who locked the gates after such accidents and accountability of the owner should be ensured. Otherwise in the near future

Bangladesh will be questioned for these types of gross human rights violations and may lose it's foreign buyers. At the same time proper implementation of general and international standards should be made mandatory; otherwise, death traps for workers will continue to be built. The recent steps taken by government and BGMEA showed some progress in taking safety measures in factories. 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.

2.3 Scope of this study and methodology involved:

From the above discussion , we understand how much priority we should give on garments worker as pedestrian .Considering the situation by analyzing the importance of garments worker we aim at assessing garment's worker risk perception towards various pedestrian facilities of Dhaka city in Bangladesh.

Previously, many researchers work on this topic has been undertaken. They are mostly analyzed on environment safety of garments' worker, health safety , the absence of functional footpaths which mainly emphasized on female workers for which they mainly depended on statistical data .By that they don't consider the behavior or mentality or opinion of the garments' worker . But in our study we will mainly give the priority on the traffic safety perception of the garments workers and various properties which influence the traffic safety perception of the workers of garments industries in Bangladesh through statistical modeling and data collected through a very standard and functional questionnaire survey.

CHAPTER 3

METHODOLOGY

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 cheap labor have affected worker's safety and life security system in most of the garments industries of the country. Like many other developing countries competing in this sector, Bangladesh has a huge and cheap labor force with poor educational background yet, yielding a major amount of foreign currency since the last decade. As established previously, every year a significant amount of the labor population die in road accidents, but there are no reliable data sources to provide the exact cause or fatality of these accidents. The only possible way to gather valid information on the causes, fatality and the road safety perception of this population is by conducting a labor survey.

3.1 Survey Methods and Practices

According to "Survey Methods and Practices", published by Statistics Canada in 2003.

"A survey is any 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 include: defining the objectives, selecting a survey frame, determining the sample design, designing the questionnaire, collecting and processing the data, analyzing and disseminating the data and documenting the survey. However, a survey must be carried out step by step, 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 of a survey are:

> ➢ Formulation of the Statement of Objectives;

> ➢ Selection of a survey frame;

> ➢ Determination of the sample design;

> ➢ Questionnaire design;

> ➢ Data collection;

> ➢ Data capture and coding;

> ➢ Editing and imputation;

> ➢ Estimation;

> ➢ Data analysis;

> ➢ Data dissemination;

> ➢ Documentation.

This chapter will focus on the steps that are directly relevant to this research. Also, since this study involves a simple driver survey and not a population census, some of the steps are combined to facilitate discussion and presentation while others have been simplified or omitted.

3.2 Selection of Survey Frame

According to Statistics Canada (2003), the 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

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

  o Radiant sweater industries ltd

  o Sayem fashion ltd.

  o Aziz Group Of Industries

Justification for choosing the sites:

The first two industries are located in a spot near the Dhaka- Gazipur highway. The spot is very much exposed to the highway and this highway with lots of garments factories alongside of it, is one of the most accident prone zones of Banglaesh when the victims are shortlisted to garments workers only. And the third one is located at tezgaon industrial area, Dhaka. The authors believe that these garments would fix and fit to most average pictures of the situations throughout the country regarding situations where garment industries are located alongside of a major highway.

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.

3.3 Sampling

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, W.G. 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** because of

- Increasing precision of estimates and keeping sampling strategy efficient

- Providing important subgroups (domains of interest) and efficient domain estimators.

- Operationally or administratively convenient

- Restricting samples to less extreme

- Allowing different sample frames and procedures applied to different strata

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 (Dixon and Leach, 1978, p 7-11).

3.4 Questionnaire Design

According to Statistics Canada (2003), 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.

3.4.1 Design Process:

Questionnaire design follows some steps described in Statistics Canada, 2003.

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.

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 is an efficient approach too.

For this study, two similar studies on different type of samples compared to the present study and each other, are consulted for available questionnaires. They are, 'Students' Perception Pedestrian Risk: A Study on University of Calgary Students' a term paper by:Mohammad Shafayat Hossain and A study on the students' perception of pedestrian risk (Abdullah et al.)

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. A total of 30 diverse questions are prepared for the study.

The **third** step involves the drafting 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 don't 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 wording. 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 to be 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.

3.4.2 Question types:

It is important to know question types because information expected will depend on it. Questions can be of two types such as open and closed 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: 127). 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: 38-60) 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 about driving tests and those responses are not coded or analyzed statistically.

3.4.3 Questionnaire

Questions related to pedestrian risk perception **:**

1. While walking, how often do you feel that crossing street is dangerous?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

2. While walking, how often do you feel that crossing street is not safe because of fast-moving automobiles on the street?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

3. While crossing street near an intersection without traffic control devices or on midblock without crossing facilities, how often do you feel it's unsafe to cross?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

4. While walking on a side-walk just alongside a street (without buffer zone), how often do you feel that a fast moving car could lose control and swerve into you?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

5. How often do you feel that it's still dangerous walking on the sidewalk with buffer zone (such as trees, roadside parking etc.) because of cars entering driveways?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

6. While walking through a way without any walking facilities (e.g. parking lot, alongside street without sidewalk), how often do you feel it's safe to do so?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

7. How often do you feel that hawkers occupy the road and let you enter the remaining narrow road with danger of collision with moving vehicle?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

8. How often do you feel that there need to be installed a zebra crossing or underpass or overpass along your crossing zone?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

9. How often do you use zebra-crossing, underpass or overpass?

      [ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

10. While crossing street along 'zebra crossing', how often do you feel it is unsafe?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

11. While crossing street how often do you use hand signal to stop vehicle or to reduce their speed when there is no regulatory measures present?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

12. While walking on footpath how often do you feel entering of the motor-cycle in the footpath can drive over you?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

13. How often do you feel that the footpath is narrow to use comfortably?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

14. While walking on the footpath how often do you feel unsafe due to presence of uncovered drain?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

15. How often do you feel that street lighting is not sufficient during crossing the roads or walking along the sideways?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

16. While crossing the road, how often do you keep a safe distance between you & a vehicle?
[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

17. How often do you feel that our traffic control system is poor?
[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

18. How often do you feel that speed breaker should be installed in front of the garments?
[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

19. How often do you feel that crossing road in the rain is risky as the roads become slippy?
[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

20. How often do you feel that crossing road is risky due to reckless driving of various traffic?
[ ] Almost always   [ ] usually   [ ] Occasionally   [ ] Rarely

21. How often do you follow the traffic safety regulatory?
[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

22. While crossing the road, how often do you avoid thinking other issues and concentrate only on crossing the road?

[ ] Almost always   [ ] Usually   [ ] Occasionally   [ ] Rarely

23. While crossing the road, how often do you stop talking over mobile phone & concentrate on crossing the road?

[ ] Almost always   [ ] usually   [ ] Occasionally   [ ] Rarely

24. How often do you attend in safety education program to learn safe pedestrian behavior?
[ ] Almost always   [ ] usually   [ ] Occasionally   [ ] Rarely

Questions related to some socio-economic conditions **:**

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

2. Which age group do you belong to?

   [ ] below 18   [ ] 19 to 20   [ ] 21 to 22   [ ] 23+

3. What is your household monthly income before tax?

   [ ] Less than BDT. 5000   [ ] BDT.5001 to BDT.10000

   [ ] BDT.10001 to BDT.15000   [ ] BDT.15001 to 20000

   [ ] More than BDT.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

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

9. Which type of Physical defects do you have?

   [ ] No Defects   [ ] Hearing Problem   [ ] Eye Sight Problem

   [ ] Maimed   [ ] Others

10. In which area do you work?

   [ ] Ashulia   [ ] Dhaka-Mymenshing roadwayside   [ ] Gulshan-1

   [ ]Tejgaon   [ ] Others

11. How long is your home distance from 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 being involved with an accident?

     [ ] Yes   [ ] No

14. Have any of your relative ever involved with an accident, or died by 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 from media such as ---

    [] No safety education received from media   [] Tv/Radio   [] Newspaper   [] Traffic Police Week

3.4.4 Justifications of the questions in questionnaire

Perception of pedestrian risk was assessed by a Likert scale using four items with response categories ranging from "Almost always" to "Rarely" to measure risk perception score. This score was considered as dependent variable. The traditional five categories were not used as neutral responses are not statistically helpful (*Rossi 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 (twenty one questions related to risk perception). So the final score of risk perception was somewhere between 24 to 96 instead of 1 to 24. 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 considered the environment most unsafe

while marking "Rarely" means perceiving the situation as "not dangerous". So a higher score means perceiving the walking and crossing environment more risky.

We also asked some questions on socio-economic characteristics which has significant effect on their safety perception. For example, "Gender" as women has less risk taking behavior than men, "Age" young workers are less safety concerned. From these questions we can identify which type of garment workers are more safety concerned.

3.5 Statistical Modeling

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 variables. The simple linear regression model is given by

$$Y_i = \beta_0 + \beta_1 X_1 + \varepsilon_i$$

In this algebraic expression of the simple linear regression model, the dependent variable Y is a function of a constant term β_0 and a constant β_1 times the value x_i of independent variable X for observation i, plus a disturbance term ε_i. If this

disturbance Term Independent of *X* and Expected Value Zero, then The requirements of the disturbance term can be written as follows:

$$E[\varepsilon_i] = 0$$

and

$$VAR[\varepsilon_i] = \alpha^2$$

This equation shows that the variance of the disturbance term σ^2 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 , then alternative modeling approaches such as weighted least squares or generalized least squares may be required. If the disturbance term are not auto correlated ,then the equation will be the following one

$$COV\left[\varepsilon_i, \varepsilon_j\right] = 0 \text{ if } i \neq j$$

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. The equation will be then

$$COV\left[X_i, \varepsilon_j\right] = 0 \text{ for all } i \text{ and } j$$

The objective of linear regression is to model the relationship between a dependent variable Y with one or more independent variables X. The ability to say something about the way X affects Y is through the parameters in the regression model — the betas. 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.

Least squares estimation is a commonly employed estimation method for regression applications. OLS seeks a solution that minimizes the function Q

$$Q_{min} = \sum_{i=1}^{n} \left(Y_i - \hat{Y}_i\right)^2_{min} = \sum_{i=1}^{n} \left(Y_i - \left(\beta_0 + \beta_1 X_i\right)\right)^2_{min}$$

$$= \sum_{i=1}^{n} \left(Y_i - \beta_0 - \beta_1 X_i\right)^2_{min}$$

Solving simultaneously for the betas in Equations

$$B_1 = \frac{\sum_{i=1}^{n} \left(X_i - \overline{X}\right)\left(Y_i - \overline{Y}\right)}{\sum_{i=1}^{n} \left(X_i - \overline{X}\right)^2}$$

$$B_0 = \frac{1}{n}\left(\sum_{i=1}^{n} Y_i - B_1 \sum_{i=1}^{n} X_i\right) = \overline{Y} - B_1 \overline{X}$$

And

In the variance there will be some variance σ^2 is typically unknown, and instead is estimated with an unbiased estimate called mean squared error. MSE is an estimate of the variance in the regression model and is given as

$$MSE = \frac{\sum_{i=1}^{n}(Y_i - \widehat{Y_i})^2}{n - p}$$

where n is the sample size and p is the number of estimated model parameters. It can be shown as $E[\text{MSE}] = \sigma^2$.

Because Bk is normally distributed, and βk is a constant and is the expected value of Bk,

$$Z = \frac{B_k - \beta_k}{\sigma\{B_k\}}$$

The quantity is a standard normal variable. In practice the true variance in the denominator is not known and is estimated using MSE. When σ^2 is estimated using MSE, the following is obtained

$$t = \frac{B_K - \beta_K}{\sqrt{\frac{MSE}{\Sigma X_i - \bar{x}^2}}} = \frac{B_K - \beta_K}{S\{B_K\}} \approx t(\alpha; n - p)$$

where α is the level of significance and $n - p$ is the associated degrees of freedom. This is an important result; it enables a statistical test of the probabilistic evidence in favor of specific values of βk.

The statistic t is employed to conduct hypothesis tests. A two-sided hypothesis test is set up as

$$H0:\ \beta_k = 0$$

$$Ha:\ \beta_k \neq 0$$

The decision rule given a level of significance α is

If $|t^*| \leq t_{crit}\left(1 - \frac{\alpha}{2}; n - p\right)$, conclude H_0

If $\quad |t^*| \geq t_{crit}\left(1 - \frac{\alpha}{2}; n - p\right)$,conclude H_a

where *tcrit* is the critical value of *t* corresponding with level of significance α and degrees of freedom *n-2*.

A one-sided hypothesis test may be set up as follows. The null and alternative hypotheses are

$$H_0: \beta_k \leq 0$$

$$H_a: \beta_k > 0$$

The decision rules for the one-sided test are

$$|t^*| \leq t_{crit}(1 - \alpha; n - p),\text{conclude } H_0$$

$$|t^*| \geq t_{crit}(1 - \alpha; n - p),\text{conclude } H_a$$

There is interest in modeling the effects of ordinal and nominal scale variables. As examples the effects of qualitative variables such as *roadway functional class*, *gender*, *attitude toward transit*, and *trip purpose* are often sought. The interpretation of nominal and ordinal scale variables in regression models is different from that for continuous variables.

For nominal scale variables, *m-1* indicator variables must be created to represent all *m* levels of the variable in the regression model. These *m-1* indicator variables represent different categories of the response, with the omitted level captured in the slope intercept term of the regression. Theoretically meaningless and statistically insignificant indicator variables should be removed or omitted from the regression,

leaving only those levels of the nominal scale variable that are important and relegating other levels to the "base" condition.

Linearity is checked informally using several plots. These include plots of each of the independent variables on the *X*-axis vs. the disturbances (residuals) on the *Y*-axis, and plots of model predicted (fitted) values on the *X* axis vs. disturbances on the *Y*-axis. If the regression model is specified correctly, and relationships between variables are linear, then these plots will produce plots that lack curvilinear trends in the disturbances. Gross, severe, and extreme violations are being sought, so curvilinear trends should be clearly evident . The graph will be like the following one :
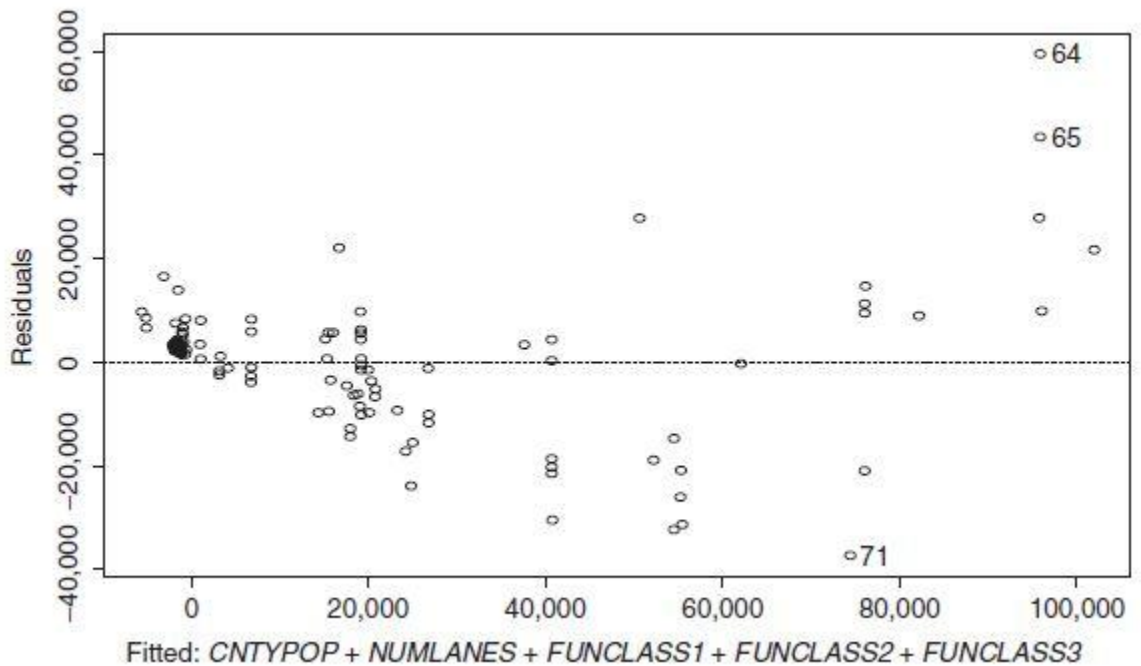
Perhaps the most common measure used to assess the influence of an observation is Cook's distance; *D*. Cook's distance quantifies the impact of removal of each observation from the fitted regression function on estimated parameters in the regression function. If the effect is large, then *Di* is also large. Thus, Cook's distance provides a relative measure of influence for observations in the regression.

In algebraic terms, Cook's distance measure is given by

$$D_i = \frac{\sum_{j=1}^{n}(Y_i - \widehat{Y_{J(i)}})^2}{p(MSE)} = \frac{e_i^2}{p(MSE)}\left[\frac{h_{ii}}{(1 - h_{ii})^2}\right]$$

Without this way there could be some error such misspecification error, coding error, data collection error and calculation error .

For checking the graph is correct or not we will use Goodness-of-fit (GOF) statistics which 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. Here we will use *R*-squared test. The equation of R-squared test is

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

Here SSE means sum of squared error which is calculated from

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

SSR means regression sum of squares which is calculated from

$$SSR = \sum_{i=1}^{n}\left(\hat{Y}_i - \overline{Y}\right)^2$$,

SST means total sum of squares which can be measured by

$$SST = \sum_{i=1}^{n}\left(Y_i - \overline{Y}\right)^2$$

It also can be written algebraically that SST = SSR + SSE .The value of R is in between $0 \sim 1$.If R^2 is near to 1,then we can say that the graph which will be drawn by us is more significant.

CHAPTER 4

MODEL DEVELOPMENT AND DATA ANALYSIS

This chapter discusses how the model has been developed in detail. Analysis of different variables, their significance & justification. It also discuss the goodness of our model.

4.1 The Sample Demographics and Other Characteristics

A total of 380 samples were collected. The demographics, educational, travel, income and other characteristics of the samples are shown below in table 1.

Table 4.1: Summary Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
safetyperc~n	380	60.71842	5.985663	41	79
gender	380	0.505263	0.500632	0	1
age	380	24.41579	5.367326	16	43
age20	380	0.478947	0.500215	0	1
grthtnage20	380	0.56579	0.496306	0	1
income	380	8209.211	3160.24	4500	18000
income5000	380	0.231579	0.422398	0	1
in~500010000	380	0.594737	0.49159	0	1

i~1000115000	380	0.123684	0.329655	0	1
i~1500120000	380	0.052632	0.223591	0	1
income20000	380	0.005263	0.072452	0	1
familymember	380	3.965789	1.104745	1	7
rankoffame~r	380	1.305263	0.525321	1	3
famlessthn4	380	0.076316	0.265853	0	1
fmgrt5	380	0.171053	0.377051	0	1
maritalsta~s	380	0.078947	0.270012	0	1
kids	380	0.426316	0.911574	0	4
nokid	380	0.252632	0.435094	0	1
oneormorek~s	380	0.747368	0.435094	0	1
transitbus~m	380	0.039474	0.194976	0	1
cngtaxi	380	0.005263	0.072452	0	1
walking	380	0.823684	0.381591	0	1
bicycleric~w	380	0.171053	0.377051	0	1
walkinghour	380	1.094211	0.625423	0.1	3
walkingrank	380	1.247368	0.455825	1	3
lessthn15hr	380	0.694737	0.461126	0	1
walkingle~25	380	0.1	0.300396	0	1
walkgrtthn25	380	0.205263	0.404426	0	1

nodefects	380	0.073684	0.261601	0	1
hearingprob	380	0.194737	0.39652	0	1
eyesight	380	0.01579	0.124825	0	1
maimed	380	0.002632	0.051299	0	1
others	380	0	0	0	0

ashulia	380	0.376316	0.4851	0	1
dhakamymen	380	0.313158	0.464389	0	1
gulshan	380	0.139474	0.346897	0	1
tejgaon	380	0.171053	0.377051	0	1
hdistancel~m	380	0.013158	0.114101	0	1
hdisgrtn5km	380	0.294737	0.456526	0	1
involement~c	380	0.052632	0.367577	0	1
accidentseen	380	0.160526	0.223591	0	1
relativesa~t	380	0.031579	0.175107	0	1
workingexp~e	380	5.339474	2.885323	1	11
werank	380	2.428947	1.023576	1	4
wrkexpless8	379	0.722955	0.44813	0	1
wrkingexpg~9	380	0.071053	0.257252	0	1
educationa~n	380	6.663158	1.334428	2	10

eqrank	380	2.892105	0.488864	1	4
primary	380	0	0	0	0
grthprimary	380	0.802632	0.398538	0	1
livingexp	380	5.455263	1.965561	1	10
livingexpr~k	380	1.878947	0.621581	1	3
les5	380	0.260526	0.439501	0	1
to7	380	0.6	0.490544	0	1
gtr7	380	0.139474	0.346897	0	1
transporta~t	380	518.4211	264.7798	100	1200
transporta~k	380	1.939474	1.039596	1	4
trancost0300	380	0.239474	0.427325	0	1
tranc~301600	380	0.563158	0.496649	0	1
tranc~601900	380	0.221053	0.415503	0	1
trancostgr~0	380	0.094737	0.293237	0	1
nosafetykn~e	380	0.560526	0.496977	0	1
tvradio	379	0.422164	0.494557	0	1
newspaper	380	0.018421	0.134646	0	1
trafficpol~k	380	0.010526	0.102191	0	1

Male and female are almost equal in number (50.52%). This value could vary from 50.019368% to 51.020632% (SD=0.500632). The majority (56.579%) of the respondents ranged over 20 years in age,.Income of majority (59.4737%) was in the range of BDT.5000-10000. A considerable number of respondents (37.6316%) represented the ashulia area. Physical characteristics of the workers show that a considerable percentage (19.4737%) have hearing problem. Major portion (56.0526%) of the workers don't have safety knowledge but a significant portion (42.2164%) learn safety knowledge from tv/radio.

Travel characteristics of the garment workers shows that a major portion (82.3684%) use to walk as their usual mode of travel. A major portion (69.4737%) of the workers walked less than 1.5 hours and about 20.5263% walked less than 2.5 hours in a day. While walking, 5.2632% of the workers had involved in an accident previously but major (16.0526%) witnessed at least a pedestrian accident.

4.2. Multiple linear regression result

Table-4.2 shows the coefficient, standard error and p-value of the multiple linear regression analysis against each of the significant variables.

Table 4.2: Result of Multiple Linear Regression Analysis on garment worker's perception of road safety

Safety perception	Coef.	Std. Err.	t	P>t	[90% Conf.	Interval]
age20	-1.150674	0.5565666	-2.07	0.039	-2.245184	-0.0561644
income5000	-3.340267	1.174728	-2.84	0.005	-5.650415	-1.030119
income500010000	-2.211853	1.116131	-1.98	0.048	-4.406767	-0.016938
income1000115000	3.229431	1.273066	2.54	0.012	0.7258977	5.732965

maritalstatus	-2.900329	0.9885817	-2.93	0.004	-4.844414	-0.9562451
walking	1.644667	0.6937962	2.37	0.018	0.2802902	3.009045
nodefects	2.574591	1.022553	2.52	0.012	0.5636995	4.585482
walkgrtthn25	1.2682	0.6863997	1.85	0.065	-0.0816312	2.618032
ashulia	2.995867	0.6479519	4.62	0	1.721644	4.270089
dhakamymen	1.847932	0.646019	2.86	0.004	0.5775105	3.118354
hdistancelessthn5km	5.217153	2.257569	2.31	0.021	0.7775558	9.65675
accidentseen	8.049238	1.193754	6.74	0	5.701674	10.3968
relativesaccident	4.624782	1.585407	2.92	0.004	1.507017	7.742546
trancost601900	1.32764	0.6644367	2	0.046	0.020999	2.63428
nokid	-1.373109	0.6087455	-2.26	0.025	-2.57023	-0.1759871
maimed	-11.49623	5.126148	-2.24	0.026	-21.57699	-1.415456
grthprimary	-1.931647	0.6392711	-3.02	0.003	-3.188799	-0.6744958
_cons	60.67302	1.419403	42.75	0	57.88171	63.46433

Number of obs = 380

$F(17, 362) = 13.17$

Prob > F = 0

R-squared = 0.382

Adj R-squared = 0.353

Root MSE = 4.8145

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 transportation engineering, we assumed 90% confidence interval. Thus p- values of variables are generally less than 0.1. We started our analysis with continuous variables & splitted some of these continuous variables into categorical variables. Due to low correlation between risk perception score and some variables, they 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. Table 2 shows the model output of risk score and other explanatory variables. As shown in the Table-2, 17 variables were identified as statistically significant ones (p=0.1) among the variables entered. For example, living experience, working experience, tv/radio, newspaper, accident involvement, tejgaon, gulshan have 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 each variable in the regression analysis.

R² value shows the measurement of correctness of the risk perception score without the variables. This suggested that 38.2% of the variance of the worker's risk perception could be explained by the significant categories. The adjusted R² value, which is an indication of model's predictive power with whole population, is the corrected R² value eliminating the insignificant coefficient of variables if any. The value got from the analysis shows that there could be more variables with more numbers of surveys which would increase the value. R² value of 1.00 is the best statistical model.

F-Statistics value shows the strength of our regression analysis according to some statistical charts. It is also notable here that the constant of the linear equation was also found by the analysis.

Among the factors considered in this study, a number of factors which proved to have influence on traffic safety perception of the target group are discussed in this section. In the midst of those factors which were found to have influence on the safety perception of the study group, a few demand comprehensiveness in explanation while the majority is self explanatory. For example, when compared to workers aged greater than 20, workers having ages less than 20 seem to be less concerned about traffic safety. The high safety concern among the aged group could be attributed to the effect of ageing on older people's vision, hearing, physical mobility, and cognitive processes. A study reveals that older people's road-crossing behavior suggests, they intend to be more cautious and thus, typically look a little more carefully than younger adults, and wait for longer gaps between vehicles before trying to cross (Dunbar et al., 2004).

When it comes to life-standard, the workers generating higher income tend to be more aware of traffic safety issues compared to workers having lower income. The results show that, people generating incomes more than Tk. 15,000, in average, are more concerned about safety than people having incomes lower than Tk. 15,000. One of the many possible explanations for this phenomenon could be, higher standard of lifestyle adds to their concern for life security. 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).

Personal life also seems to have influence on safety perception of the subjects. The marital status of the workers interviewed show a linear relationship with their road safety perception. The married workers appear to be more concerned about road traffic safety compared to unmarried workers. A probable reason could be carelessness caused by lack of "feelings of responsibility". Another study proved, married people are involved in work-related traffic accidents to a significantly lower degree than other marital status groups (Simo Salminen, 2006). The study also finds a keen relationship between the numbers of children under a worker's parentage and the worker's road safety perception. As the results indicate, people having no kids at all

are less safety concerned compared to people having at-least 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' look after which is reverse in the case of workers having no kids. This could be a catalyst that triggers heedlessness among samples having no children and lessens their concern for traffic safety.

In the field of personal experience, one very interesting finding of this study is, the samples reported to be an eye witness to a road accident seem to be very safety conscious. Though the fatality of the accidents were not recorded, the results reports the highest level of impact resulting from this factor on the road safety perception the of study group compared to other factors included in this study. 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. Another factor shares similar relationship with safety perception of the target group. That is whether a person has close relatives who has suffered a road accident or not. Probably the particular incident of his/her relative's accident turned out to be a permanent trauma for the sample which directs him/her to be more conscious about road traffic safety. However, a medical study reveals that ten to 30% of car accident victims will develop PTSD (Post Traumatic Stress Disorder) which justifies both of the above explanations (Beckham).

According to the results of regression analysis, mode of transport seems to have significant impact on the road safety perception of the study group. People who choose walking as a mode of transport seemed to be a bit more concerned about safety compared to people using other modes of transport. At a first glance the result might seem unrealistic but it is not. The answers lie clearly in the behavior of the study group. Here, the samples represent employees of various RMGs. They are observed to arrive at workplace in clustered groups and walk balk towards home in clustered groups. According to Ajzen (2006) the more positive the attitude and subjective norm towards walking and the larger the facilitating factors are, the stronger the person's intention to walk will be. Perhaps, they feel at home as well as in control while walking compared to using mode of transports where the control is on the drivers hand. It might be that their concern for safety compelled them to choose a

different path, at-least different from ordinary practice. Another interesting finding related to walking is, workers walking more than 25 hours every week seem to be more safety conscious compared to workers having less weekly walking hour. In all probability, walking more gives them increased confidence received from more exposure to diverse situations which decreases, obviously, as walking hours are lessened.

The results also expose 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 of their workplace are more concerned about safety compared to people living further away. One of many possible reasons could be, shorter travel distance helps them keep focused on safety issues while in longer travel distances people might lose focus. In contrast, the type of area and the location of the workplace were found having sheer impacts on the safety perceptions of workers. Workers having their workplace at Ashulia and Dhaka –Mayminshing Highway (which are two high-speed traffic highways, but low density in residence) seemed to be more concerned about traffic safety compared to those having workplaces at Gulshan and Tejgaon area (which are consecutively congested residential and industrial area with low-speed traffic). It is deemed that, the high risk related to high speed traffic highways automatically generates extra safety concern to the road users, which is probably a possible explanation for such kind of relationship/impacts. A study result showed that people of low density-single residential neighborhoods are more likely to perceive their neighborhood as dangerous (Rodríguez, 2008).

Among the other statistically significant variables, there are physical conditions of the workers. That is, people having no physical defects are found to be reasonably concerned about safety while physically maimed people are found to be astonishingly disregarding towards road safety issues. A possible reason could be, a maimed person may expect sympathy/ assistance from the drivers and might also consider being taken care of/ helped as their right. They might also be convinced that their safety is not entirely their responsibility which is the exact opposite of completely fit people. So, there will be obvious difference in road safety perception between these two categories of samples.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 General Discussion

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.

5.2 Necessity Of our Study

Currently Bangladesh is the second largest R.M.G manufacturer after China and by the next five years it is expected that Bangladesh will become largest R.M.G manufacturer in the world. Analysis of database shows that there are a total of 2960 enlisted garment industries in and around Dhaka Metropolitan City and about 1,070,754 workers are employed in these industries. 62 % factories are found to be clustered along the primary and secondary roads and all together 72 % workers are working in these industries. This study reinforces a pre- established fact that most of these workers choose walking as a mode of transport.

The most alarming fact is, in Bangladesh, the total number of traffic accidents concerning only Pedestrian hit from 1998-2011 is around 21623(total) and around 25048 considering pedestrian casualties (total). Within 1998- 2010 only at the pedestrian crossings the number of accidents are 1067. Considering the national highway the total number of accidents are 19968 (1998-2011). The total number of traffic accidents concerning only Pedestrian hit from 1998-2011 is around 21623(total) and around 25048 considering pedestrian casualties (total). Within 1998-2010 only at the pedestrian crossings the number of accidents are 1067. Considering the national highway the total number of accidents are 19968 (1998-2011). The data also indicate that most of the pedestrian casualties are either on the road sides or at the road centerline. The discrete information provided above integrates to the fact that

RMG workers are particularly prone to road accidents. As they are an irreplaceable asset to our economy as well as the world's demand; it is high time we start paying attention to their safety and traffic safety in particular. So arise the necessity of this study.

5.3 Outcomes & Limitations Of our Study

A number of variables, assumed to have relations to the traffic safety perception of each garments worker interviewed were selected and assessed at a 90% confidence interval. Only linear regression modeling was consulted to develop this statistical model. In the final model 17 individual variables proved to have statistical significance. Meaning, we found these 17 variables directly affecting the safety perception of our interviewees. Detailed discussions are provided in section 4.1

Though the results preserve their clarity, it could be strengthened by the database of exact number of road accident occurred during the garments workers' workplace – home walking period. Sadly these data are never recorded accurately and no sources have a compiled database in this regard. 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.

5.4 Future Extension Of the Study with some Recommendations

As the study has its' limitations, a more detailed study covering zone by zone RMG industries is recommended to put together all the factors that affect the safety perception of garments workers. Once this study brings up a full scale behavior analysis, it would be only a matter of time to take prompt actions to control the behaviors causing them to face traffic accidents. Some of the actions taken could be but 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 infront of garments

But all these necessitates the proper collection and maintenance of road-accident data of RMG workers detailed with time of occurrence, location of accident, type of road, weather conditions along with vehicle involved and location of the factory.

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