

REASONS BEHIND THE ROAD-TRAFFIC ACCIDENT IN DHAKA CITY: AN EMPIRICAL STUDY

ANANYA RUBAYAT¹ & NAYEEM SULTANA²

¹Programme Officer at Wild Team, Bangladesh

²Associate Professor, Department of Development Studies, University of Dhaka, Bangladesh

ABSTRACT

Road traffic accidents are a significant problem worldwide both in terms of loss of human life and economic consequences. In a country with limited resources, like Bangladesh, any such problem becomes even more complex as addressing one issue may mean ignoring another. As a result, while improving the condition of the road is done periodically to reduce accidents, much less attention is paid to traffic control and even lesser to the people using the roads on foot. This study focused on observing the behaviour of pedestrians at five locations in the city of Dhaka. The sites included the intersections with highest and lowest incidences of pedestrian related accidents, and three locations displaying intermediate statistics. People were interviewed to get their views on current road safety situations, motivations for displaying safe behaviour and reasons for willingly taking risks. The study also aimed to find whether age, gender or occupation had any significant impact on road crossing attitudes. Majority of the pedestrians felt that they did not receive satisfactory crossing facilities from the authorities and therefore are not accountable for irresponsible behaviour on their part. This largely unexplored area can be further delved into to get more useful insight for improving the road safety situation in Dhaka City.

KEYWORDS: Behavioural Reasons, Road-Traffic Accident Dhaka, Bangladesh

INTRODUCTION

Road traffic accidents are a leading cause of death and fatal injuries worldwide. It is estimated that almost 1.3 million people are killed from road accidents every year, which is nearly 3,500 deaths everyday and 140 every single hour (WHO 2008). For people aged between 5 and 44, this is one of the top three leading causes of death. In addition, around 20 to 50 million people suffer non-fatal injuries from motor collisions, which end up being an important reason behind disability worldwide. Projection says that if the current trend continues, road crashes may become the fifth leading cause of death by the year 2030, resulting in an estimated 2.4 million deaths each year (WHO 2008).

The economic consequences of motor vehicle crashes have been estimated between 1% and 3% of the GNP of the world countries, reaching a total over \$500 billion (WHO 2011).

The UN General Assembly announced in March 2010, that the period 2011-2020 will be marked as the 'Decade of Action for Road Safety'. The primary goal behind this is to make sure that the road traffic deaths around the world can be stabilized and the projected deaths reduced by planning and implementing focused activities at national, regional and global levels.

To deduce how to reduce accidents, the reasons behind the problem needs to be understood. The factors causing accidents may vary from nation to nation, even from city to city. In one location badly constructed roads might be the chief underlying reason, in another it may be reckless driving. Which is why, to explain the road traffic accidents in Dhaka, the

capital of Bangladesh; this study focuses on the human behaviour dimension of road traffic accidents. In this context, the major objectives of this paper are, a) to explore the current traffic accident scenario in Dhaka City, b) to assess the existing level of knowledge regarding traffic safety rules among different groups and c) to identify the underlying behavioural patterns and reasons behind traffic accident incidences.

RESEARCH METHODS

In order to fulfil the identified research objectives of the study, both the qualitative and quantitative research methods were applied throughout the entire period of this study. Primary and secondary data were thus collected and interpreted that enables this study to explore the behavioural reasons behind the traffic accidents in roads.

Primary data were gathered through direct observation¹ and interviews². At two Dhaka city road intersections with highest³ and lowest⁴ frequency of accidents, pedestrian behaviour was observed and noted. The observations were compared with findings from intersections displaying a medium level of pedestrian road accidents.⁵ A questionnaire survey with road users from these intersections was also conducted to understand the reasons behind the behaviours displayed in the road environment, as well as to understand what road users thought of their crossing environment and facilities.

Secondary data were obtained from the 'Accident Research Institute of Bangladesh University of Engineering and Technology', Government organizations including Dhaka City Corporation, Bangladesh Road Transport Authority, Local Government Engineering Department and Dhaka Metropolitan police. International journals, books and relevant websites were consulted to understand global perspective and research on pedestrian behaviour and road safety knowledge.

LITERATURE REVIEW

This paper reviews previous researches concerning the factors behind road traffic accidents with an emphasis on the interaction between the human and non human components of the road environment. This interaction is influenced by the knowledge the road user has about appropriate behaviour while interacting with traffic. Here, researches addressing the knowledge of road user and their actual behaviour on the roadway will be reviewed to obtain a better understanding of the relationship between the two issues.

Factors Behind Road Accidents

Over the years there have been many studies regarding the factors underlying road accidents. In a 1985 study K. Rumar found that 57% of British and American crashes attributed to only driver factors, 27% to roadway and driver factors combined, 6% to vehicle and driver factors, 3% to only roadway factors, 3% to combined roadway, driver, and vehicle factors, 2% to vehicle factors, and 1% to combined roadway and vehicle factors (Lum and Reagan 1994). So in effect

¹ Observation surveys were done in selected road intersections. In total, 3841 people's crossing behaviour was observed and noted during this research.

² Pedestrians from the selected survey locations were selected and in five sites, a total 125 people were interviewed in detail

³ In Postagola crossing, 77.8% accidents.

⁴ In Manik Mia Avenue-Indira Road intersection with 7.3% accident rate.

⁵ Three other locations were also selected which have pedestrian accident rates in the intermediate range of the data distribution. These locations are: Mouchak crossing with pedestrian accident rate of 32.3%, Minto Road - Kazi Nazrul Islam Avenue intersection with 28.1% and Green Road - Mirpur Road intersection with 36.4% pedestrian accident rates. These sites were selected in order to understand the pedestrian behaviour scenario of the average intersection in the city. All of these locations are distant enough for each other, and they do not influence one another's traffic behaviour significantly.

human factors and driver factors contributed to almost 80% of all road accidents. In 1999 Retting *et. al* deduced that almost 40% of motor accidents occur at intersections. In 2011, the Department of Transport in Great Britain published a summary of contributing factors to road traffic accidents. These contributing factors were divided in nine specific categories, which are road environment contributed, vehicle defects, injudicious action, driver/rider error or reaction, impairment or distraction, behaviour or inexperience, vision affected by the external factors, pedestrian only factors (casualty or uninjured) and special codes. From 2005 to 11, driver error was the category most reported, almost 72% of all accident reports. Behaviour or inexperience was the second most reported with 24%.

In 2001, a study by Haque and Mahmud on the road safety challenges in Bangladesh identified both road environment related and behavioural problems underlying the high rates of traffic accidents in Bangladesh.

Pedestrian Behaviour

In 2010, a study was conducted (Cinnamon *et. al* 2010) at high risk pedestrian injury intersections in Vancouver, Canada. Violations of road regulations by both pedestrians and motorists were recorded by a team of observers at different periods of the day. In total for all observed intersections, over 2000 (21%) pedestrians committed one of the observed pedestrian road-crossing violations, while approximately 1000 (5.9%) drivers committed one of the observed motorist violations. Great variability in road-rule violations was observed between intersections, and also within intersections at different observation periods.

In a 2012 study, Kourtellis attempted to measure the unsafe pedestrian behaviour through observational research in South Florida. The risk behaviours considered in the study included the pedestrian crossing during traffic signal green time, not crossing in perpendicular direction to street, Jay-walking or crossing the road diagonally, not using the sidewalk and walking on the roadway, using cell phone or other electronic device during crossing among others.

To understand if age has impacts on street crossing decisions, two experiments were conducted by Lobjois and Cavana in 2007. Results showed that when there was a time constraint all age groups selected a shorter time gap for higher speed of vehicles, leading to many unsafe decisions. In the second experiment there was no time constraint implied, the younger group operated in constant time regardless of speed, while older pedestrians accepted longer time gaps as vehicle speeds increased.

A 2006 research by Martin showed that pedestrians or drivers distracted by the use of mobile phones show high unsafe crossing behaviour. Art Kramer and his colleagues found in 2009 that young and old pedestrians are not affected extremely while listening to music. In his study, participants crossed a virtual street while talking on the phone or listening to music. Users of hands-free cell phones, however, took longer to cross the same street under the same conditions and were more likely to get run over.

In 2012, a study was conducted in Edinburgh, UK (Havard and Willis, 2012) to investigate pedestrian road crossing behaviour before and after installation of a marked crosswalk. The observational and questionnaire surveys indicated that pedestrians were more prone to use the marked location to cross the road and walked more slowly after the zebra had been installed compared to the previous scenario. Results also suggested they felt safer and less vulnerable to traffic and more confident.

However, not many researches have been undertaken in the developing country context. In 2010, a survey was conducted in Delhi to evaluate risk perceptions by pedestrians while crossing the roads at intersections. Among 250 pedestrians, only 17% considered the crossing to be safe. Two thirds of the survey participants said that they wait for the

red signal that stops traffic before crossing. 85% women confirmed in this regard compared to only 56% men. It was observed that as signal waiting time increases, pedestrians get impatient and violate the traffic signal. This violation places them at increased risk of being struck by a motor vehicle.

A study was conducted by Jashim and Ahmed in 2010 in selected commercial sites of Dhaka. It was found that 47% pedestrians prefer road to walk along the road rather than walking on the footpath. About 14.5% teenagers cross the road through running. Considering gender, 78% female pedestrians gave continuous attention to traffic while crossing as opposed to 50% of male pedestrians. This study chiefly used observation forms to record the data and conducted the study in some of the busiest shopping centres of Dhaka.

In 2011, Abir and Hoque explored the facilities needed for disabled people to use the road system safely and noted the deficiencies seen in Dhaka. Some of which were absence of footpath landing, uneven surfaces, disordered movements of other pedestrians etc. that make disabled pedestrian movement to be extremely hazardous.

From the above literature review it can be surmised that several factors greatly influence pedestrian crossing behaviour in an urban environment. Some of them are, infrastructure of the pedestrian crossing facilities (physical layout; such as refuge island, guard rail, etc.), age, crossing status (unaccompanied or accompanied), traffic conditions, wait time for traffic flow to stop etc.

Knowledge Level of Road Users

Around the world studies have been undertaken regarding traffic sign comprehension, mainly as a supplementary measure during design and construction of roadways and transportation networks.

The American Automobile Association conducted one of the most extensive studies of driver understanding of traffic signs in 1979. From a sample of 3100 drivers from different parts of the United States, Hulbert *et. al.* assessed driver comprehension of different traffic sign symbols, traffic signals and pavement markers. Their results were poor compared to the standards mentioned above. Correct response came up to 74%, 68% and 45% for signs, symbols and markings respectively. In 1990, Ogden *et. al.* surveyed on 205 motorists in the US and found that a majority had difficulty in understanding and interpretation.

Relatively fewer studies have analyzed comprehension of traffic signs by age (Dewar *et. al.* 1994). The Hulbert study attempted to establish a correlation between knowledge level and driver age, it was observed that older drivers were more likely to misunderstand than younger ones. Ford Jr. and Picha (2000) observed that most of the teenage drivers participating in the survey had some degree of difficulty in understanding the traffic control devices that were evaluated. Out of 53 control devices surveyed, only nine were understood by more than 80 percent of the respondents.

In Bangladesh however, there is a major gap in research on user knowledge level, despite the fact that in most of the studies regarding assessment of causes behind road accidents, lack of understanding of traffic signs comes up as a vital point. Only one study conducted in 2009 by Razzak and Hasan was found that assessed driver understanding of some selected regulatory, warning, and informative signs through a survey. The survey was conducted among 202 Dhaka city drivers and 42 traffic signs were evaluated. Of these 42 traffic signs, 20 were regulatory, 17 were warning signs and 5 were informative signs. Multiple choice questionnaires were used for the study, with answer options for each of the traffic signs.

The results indicated that the overall understanding level, measured in terms of percentage of correct responses was only about 50%. The percentage of drivers who correctly identified all the regulatory signs, warning signs and informative signs were 49%, 52% and 55%, respectively, indicating a major gap between existing and desired level of

understanding. Considering educational background, respondents with a Bachelor's degree scored higher to those with lower qualifications.

FINDINGS FROM THE OBSERVATION SURVEY

The observation survey was conducted at each of the five study sites, at two different time slot of two hours each. The objective of the survey was to observe the different manners in which a pedestrian in Dhaka crosses the road. An observation form was prepared prior to the survey containing different categories of such behaviour. Each of this identified behaviour was observed separately for both genders to understand if there was any gender based trends. The following sections will discuss the quantitative outcomes of all locations.

Manik Mia Avenue-Indira Road Intersection

The Manik Mia Avenue - Indira Road intersection is marked by strong traffic monitoring and security, as it is the location of the most important government structures in the city. During the morning observation period 210 pedestrians crossed through the intersection, percentage of males and females was 59 % and 41% respectively. Being an intersection with very limited irregularities, opportunity of vehicles breaking the traffic rules or signals was very low. Likewise pedestrians also crossed the road mostly when traffic was completely stopped or was very low.

During 8 am to 10 am, a total of 18 people crossed in an unsafe manner, one man crossed on the run, six people crossed directly through moving traffic, four pedestrians jaywalked. Among all the unsafe behaviours displayed crossing while talking on the phone was the predominant unsafe behaviour with four men and three women.

In the off peak traffic hours of 2 pm to 4 pm, pedestrian volume was even lower with 118 people crossing directly through the intersection, among them 51% male and 49% female. 110 of them crossed the road using the crosswalk, in periods where there was no traffic. The other eight displayed irregular behaviour, again 3 people crossed while using phones and five jaywalked or crossed through other portions of the road.

Minto Road-Kazi Nazrul Islam Avenue Intersection

In the morning peak hour observation period in the Minto Road – Kazi Nazrul Islam Road intersection, a total of 258 people crossed. 54% were male and 46% female. The road has good pedestrian facilities including wide sidewalks, a crosswalk and a wide divider at the middle. 77% of these pedestrians crossed the road correctly, using the crosswalk when traffic was stopped. Among those who did not do so, 21 crossed through moving traffic, six crossed while talking on the phone, a total of 26 jaywalked and seven people crossed on the run. Two (2) people faced near collision situations while crossing on the run.

In the off peak hour total number of pedestrians was 218, 52% male and 48% female. 82% of the pedestrians crossed the road safely. Five people crossed on the run, 21 jaywalked, and five people crossed using their phones and 15 crossed through moving traffic.

Green Road-Mirpur Road Intersection

The Green Road – Mirpur Road intersection is an extremely busy intersection, in the morning observation hours a total of 491 people crossed. 57 % of them were male and 43% female. 62% of them crossed the road safely. Of the other 38%, crossing through moving traffic was the most predominant irregular behaviour which was displayed by 77 people. 62 crossed through moving traffic, 27 crossed on the run through moving traffic and five people found themselves in near collision situations. A total of fourteen people crossed while using the phone during the morning hours.

In the noon hours the number of pedestrians lowered to 406. 74% pedestrians crossed the road safely. Among the other 106, nine people crossed while using the phone and 43 people jaywalked. Of these people, 37 people crossed through moving traffic while 17 crossed the road running. 5 people faced near collision situations. The summary results from the observation survey at the site can be seen below.

Postogola-Majar Road Intersection

The Postogola – Majar Road intersection is the spot of highest road accident occurrences, and it also had the highest number of pedestrians crossing the road among the study locations. 791 people crossed this intersection in the morning observation period. As there is no islands or crosswalks on the intersections and neither does the traffic stop here, all the pedestrians can be deduced as crossing the road hazardously. The pedestrian stream was 57% male and 43% female. Everyone crossed through moving traffic taking tremendous risk, 519 people crossed on the run and 52 found themselves in near collision situations although no actual collision or accident occurred. One person used the phone while crossing.

Pedestrian flow did not reduce in this busy road during the off peak hours. 741 people crossed the road, 58% of them male. All 749 of them had to cross through moving traffic and 260 did so while running. There were fewer collision situations mainly as traffic flow had reduced in the noon hours. Summary results can be seen below.

Mouchak Intersection

In the morning 340 people crossed through the Mouchak intersection. Only 19 crossed through the overbridge, which is the only safe way to cross in a location without any crosswalk. Among the rest, 140 crossed through moving traffic undertaking risk of collision. Others crossed relatively more safely through congested traffic. Four people used the phone, 14 people crossed on the run. Six pedestrians almost faced collisions.

In the off peak hours, pedestrian flow increased to 403 as the commercial facilities and Mouchak Market were at their busiest hours. 53 people used the foot overbridge, among which most directly got on from the second storey of the market. 175 of those who crossed at road level crossed through moving traffic. Three people used their phones while crossing, 40 people crossed on the run and 14 narrowly avoided collisions. A large number of people crossing through moving traffic did so in order to get on the buses stopping at the sides of the roads to pick up passengers. Summary results from the observation survey at Mouchak are given in the table below.

FINDINGS FROM THE QUESTIONNAIRE SURVEY

Twenty five people at each of the study sites were interviewed for the survey. The questions were kept open ended in order to gather as much details regarding respondents' views on safe manners of crossing the road, proposed improvement to pedestrian facilities available, reasons for not following/following safety practices on the road and the effective channels to receive information about road safety as possible.

Responses on Perceptions about Road Safety

The respondents were asked what they perceived to the correct scenario for crossing a road. 37% respondents said they thought crossing when the traffic was completely stopped was the right time, which is the safest way of crossing. 27% mentioned crossing through the overbridge when available, and otherwise using the Zebra crossing at grade is safe. 8% thought that crossing was safe enough when traffic flow was light. Alarmingly, 30% of the respondents thought crossing even through heavy moving traffic was alright, as long they were cautious. One respondent who crossed the road at a run in

Mouchak mentioned *“In Dhaka, who has time to wait for traffic to stop? There is no guarantee, one has to take risks and move on in order to get anywhere on time.”*

When asked about how they had learnt about crossing the road, 9% mentioned that their parents had taught them practically about how one should do it. The remainder of the respondents simply answered that they had learnt to use their common sense to know what to do on the road. No one mentioned any public safety campaigns or demonstrations at school.

Responses on Reasons for Violating Safety Practices

Fourteen percent (14%) respondents mentioned that they were fully cautious when they had a partner depending on them for safe crossing, and then they waited. 9% said that even when they did not do so, they were safe as they were careful and did not get themselves into hazardous situations. 25% respondents said being in a rush was their primary reason for not waiting until traffic stopped. 17% said traffic was irregular and there was always danger of vehicles breaking traffic rules, so they did not think waiting necessarily improved their safety. One female respondent in Green Road, after crossing the road at a run said *“even when the signal is red, you can see some cars disregarding everything and going ahead, so why should I waste my time waiting? Every respondent in Postogola had crossed the road at tremendous personal risk; most of them went on to elaborate and justify this behaviour by claiming they had no other option.*

When asked whether they used over bridges when it was available, 23% said that they did. 15% mentioned that they thought it was only necessary in risky roads. Among those who did not, 16% mentioned that they thought it too long to climb up and use them. 15% thought it was too much of a hassle to climb with heavy bags or when they had children with them. Oppositely, one mother in Mouchak mentioned that her child found over bridges very amusing and insisted on climbing them even when she did not want to. 10 % of the respondents said there were not enough overbridges in their regular routes. Most of these people were respondents from the hazardous Postogola intersection. 7% respondents said they felt it was difficult for them to climb to such heights due to physical reasons. One person in Green Road mentioned that he regularly used overbridges once, but after being mugged in one he has not climbed one since.

One man in Mouchak said, *“How many people can you see actually using it? And where is it written that I must? There is no one else doing it so why should I?”*

CONCLUSIONS

Road accidents are caused by a variety of factors; road structures and road user behaviour both influence the occurrence and can influence the prevention accident scenarios. Most of the research and interventions undertaken in Bangladesh, however, focuses on the structural measures only.

This study included two sites with highest and lowest incidences of pedestrian accidents, and three displaying intermediate statistics. A primary aim of the study was to see if the external environment in these roads, including pavement characteristics, traffic control system and pedestrian facilities were the only driving force behind these statistics, or whether road user behaviour was a significant enough cause.

Basic pedestrian facilities in any metropolitan city include Zebra crossings, footpaths, overbridges at locations that demand it and islands at two-way roads. There are many intersections in Dhaka where one or more of these are absent. The most hazardous Postogola and the safest location Manik Mia Avenue showed very contrasting pictures. At Manik Mia Avenue where wide footpaths and sidewalks provide the opportunity of very safe road usage, while at Postogola it is not even safe to walk along the side of the road, let alone crossing it.

Although good facilities exist in different roads, that does not necessarily mean that are most effective. For example, a huge stream of people crosses through Postogola-Majar Road meeting point every hour. Instead of blocking off the road with barriers at the intersection, an overbridge or a Zebra crossing in the location may have been useful for reducing the danger, and motivating people to take fewer risks. On the other hand, Mouchak has an overbridge, but it is only perceived to be useful by those who visit Mouchak market, and remains mostly unused.

The composition and volume of the pedestrian stream was significantly different at the study sites. The numbers of people who cross through Postogola are almost five times that of Manik Mia Avenue, from the questionnaire survey participants it was found that most users at Manik Mia Avenue were either students or professional, while at Postogola most were manual labourers or small businessmen. Although without further studies it cannot be concluded that economic background is a factor behind reckless behaviour, it can be said that roads which used by less affluent people, certainly have received less attention and improvements. Many respondents at Postogola said they felt detached from any road safety interventions or campaigns. This perception of exclusion and measure of low self worth in the society may also be a driving force behind many dangerous decisions.

The survey responses regarding reasons for safety violations clearly reflect how a large number of people believe that even if they behave correctly others would not, that being careful themselves was not really enough. To counter the development of this way of thinking, awareness campaigns and more practical demonstrations regarding road safety need to be exposed from an early age.

REFERENCES

1. Abir, A.K.M. , M.S. Hoque (2011) A study on mobility problem of disabled people in Dhaka city. 4th Annual Paper Meet and 1st Civil Engineering Congress, December 22-24, 2011, Dhaka, Bangladesh.
2. Ahsan, H. M., M. M. Hoque (2002) Traffic Safety in Dhaka City:Key Issues and Countermeasures. Journal of Civil Engineering. The Institute of Engineers. Vol. CE 30. No 1.2002.
3. Al-Madani, H. (2000) Influence of driver's comprehension of posted signs on their safety related characteristics, Accident Analysis and Prevention (32): 575–581.
4. Al-Madani, H. (2000) Influence of drivers' comprehension of posted signs on their safety related characteristics. Accident Analysis & Prevention, 2000. 32: p. 575-81.
5. Bernhoft, I. Risk Perception and Behavior of Elderly Pedestrians and Cyclists in Cities in Denmark. (2004) Transportation Research Board 83rd Annual Meeting. Transportation Research Board of the National Academies CD-ROM Proceedings.
6. BRTA (2008) Annual Report of Road Traffic Accidents. Department of Communication. Government of the Peoples' Republic of Bangladesh.
7. BRTA (2011) National Road Safety Strategic Action Plan (2011-2013).Ministry of Communications. Government of the People's Republic of Bangladesh.
8. Cinnamon, J., Schuurman, N., Hameed SM (2011) Pedestrian Injury and Human Behaviour: Observing Road-Rule Violations at High-Incident Intersections. PLUS ONE 6(6): e21063. doi:10.1371/journal.pone.0021063.

9. Congiu, M., Whelan, M., Oxley, J., Charlton, J., D'Elia, A. Muir, C. 2008. Child Pedestrians: Factors associated with ability to cross roads safely and development of a training package. Monash University Accident Research Centre - Report #283.
10. Dewar, R.E., D.W. Kline, and H. Swanson (1994) Age differences in comprehension of traffic sign symbols. *Transportation Research Record*, 1994(1456).
11. Dommes A., Cavallo V, Vienne F, Aillerie I.2010. Age-related differences in street-crossing safety before and after training of older pedestrians. French National Institute for Transport and Safety Research (INRETS), Laboratory of Driver Psychology, Versailles, France.
12. FHA - Federal Highway Administration (2000) Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), Washington, D.C.
13. Ford, G. L. and Picha, D. L. (2000) Teenage drivers' understanding of traffic control devices, *Journal of Transportation Research Board (TRR 1708)*: 1-11.
14. Ghee, C., Astrop, A. (2007) Socio Economic Aspects of Road Accidents in Developing Countries. TRL Report 2007. Transport Research Foundation Group of Companies.
15. Guo, H., W. Wang, W. Guo, X. Jiang, and H. Bubb (2012) Reliability Analysis of User Safety Crossing in Urban Traffic Environment.
16. Government of the United Kingdom (2012) Contributory factors to reported road accidents 2011. Road accident and safety statistics series. Department of Transport.
17. Hatfield J, Murphy S. (2007) The effects of mobile phone use on pedestrian crossing behaviour at signalized and unsignalized intersections. *Accid Anal Prev.* 2007;39(1):197–205. Epub 2006 Aug 21.
18. Havard, C., Willis, A. 2012. Effects of installing a marked crosswalk on road crossing behaviour and perceptions of the environment. Transport Research Institute, Edinburgh Napier University, Merchiston Campus, Edinburgh EH10 5DT, UK.
19. Hoque, M.M, S.M.S. Mahmud (2001) Road Safety Engineering Challenges in Bangladesh. Accident Research Institute. Bangladesh university of Engineering and Technology.
20. Hoque, M. M. (2004) the Road to Road Safety: Issues and Initiatives in Bangladesh. Regional Health Forum, South East Asia Region. World Health Organization.
21. Hulbert, S., J. Beers, and P. Fowler (1979) Motorist's understanding of traffic control devices.
22. ISO, Graphical Symbols - Safety Colours and Safety Signs (2002) Part 1: Design Principles for safety Signs in Workplaces and Public Areas 2002: Switzerland.
23. Jasim, J. and Ahmed S. (2010) Analysis of pedestrian crossing behavior in Dhaka city. Department of Civil Engineering, Bangladesh University of Engineering and Technology.
24. Jolyon J. Faria, Stefan Krause, and Jens Krause (2010) Collective behavior in road crossing pedestrians: the role of social information, *Behavioral Ecology*, published September 9, 2010, doi:10.1093/beheco/arq141.
25. Kourtellis, A. (2012) Measuring Unsafe Pedestrian Behavior Using Observational Data. Transportation research Board annual meeting 2013.

26. Lobjois, R., Cavallo, V. 2007. Age-related differences in street-crossing decisions: The effects of vehicle speed and time constraints on gap selection in an estimation task.
27. Lum, H., Reagan, J. A. 1994. Interactive Highway Safety Design Model: Accident Predictive Module. Public Roads. Vol 59, No. 2, Federal highway Administration. US Government of Transportation.
28. Martin, A. (2006) Factors Influencing Pedestrian Safety: A Literature Review. TRL Limited.
29. Maniruzzaman, K.M., R. Mitra (2005) Road Accidents in Bangladesh. Department of Urban and Regional Planning. Bangladesh University of Engineering and Technology.
30. Mittal, N. (2010) Pedestrian safety at urban intersections in Delhi, India. Indian Journal of Transport Management, April-June 2010.
31. Ogden, M., K. Womack, and Mounce, J. (1990) Motorist Comprehension of signing applied in urban arterial work zones. Transportation Research Record, 1990(1281).
32. Razzak, A., T. Hasan (2009) Motorist understanding of traffic signs: a study in Dhaka city. Journal of Civil Engineering (IEB), 38 (1) (2010) 17-29. Institute of Engineers Bangladesh.
33. Soole DW, Lennon A, Haworth N. 2011. Parental beliefs about supervising children when crossing roads and cycling. Centre for Accident Research and Road Safety, Queensland University of Technology, Brisbane, Queensland, Australia.
34. Stokes, R. W., Rys, M. J., Russell, E. R. and Kerbs, J. (1995), Motorist understanding of traffic control devices in Kansas, Final Report No. KSU-94-7, Department of Civil Engineering, Kansas State University, Manhattan, KS.
35. Tanariboon, Y., Guyano, J. A., (1991) Analysis of Pedestrian Movements in Bangkok'. Transportation Research Record: Journal of the Transportation Research Board, No. 1294, pp. 52-5.
36. Wolff, J.S. and Wogalter, M. S. (1998), Comprehension of pictorial symbols: effect of context and test method, Human Factors, (40): 173-186.
37. NESCAP country status report, Bangladesh 2010.
38. United Nations (2011) Urban agglomerations 2011. Department of Economic and Social Affairs. United Nations.
39. World Health Organization (2008) World Health Statistics.
40. World Health Organization (2011) Global Plan for the Decade of Action (2011-2020).