

Pedestrian Behavior in Road Crossing at the Intersections of Dhaka City

Farhana Sharmin¹, Mian Md Jawad Ibne Iqbal², Farzana Faiza³

¹Department of Architecture & Built Environment, University of the West of England, Bristol, UK.

²Department of Architecture, Primeasia University, Dhaka 1213, Bangladesh.

³Department of Architecture, Bangladesh University of Engineering and Technology (BUET)

Email: pau.203001052@gmail.com

Abstract: Pedestrian accidents occur due to improper crossing patterns of people and improper crossing attempts occur for lack of proper road crossing infrastructure and poor traffic management. Dhaka, where pedestrian number is high, proper road crossing infrastructure is a must to halt collision of pedestrians with running vehicles. In this paper, pedestrian crossing behavior has been analyzed to provide proper pedestrian crossing infrastructure at anticipated points. This study has been conducted at 2 intersections of Dhaka; Mirpur 10 circle and Gulshan 2 circle. Mirpur 10 circle contains foot over bridge and Gulshan 2 circle without foot over bridge. The data has been collected in a quantitative method. It is a co-relational study where people's behavior has been observed in their natural environment. This method is a type of field research. Separate models have been prepared to recognize pedestrians' behavior. The factors for different models are; pedestrians' age, gender, and luggage carrying. For intersection having the foot over bridge, the percentage of pedestrians using bridge and percentage of pedestrians using roads has been counted. For intersection not having the foot over bridges, the difference in crossing pattern of the pedestrians has been observed and the relation between the pattern and factors is analyzed. Walkers risk their lives even to avoid crossing bridges in order to save time and energy. This research will be helpful to identify the reason for the unwillingness to use foot over bridge and crosswalks of various types of pedestrians and thus the proper crossing facilities can be ensured to make the amblers' walking comfortable and safe.

Keywords: Foot over bridges, Luggage carrying, Road crossing pattern.

1. INTRODUCTION

A. Background of the study:

Have the residents of Dhaka, ever considered themselves as a vital factor in road accidents as inconsiderate pedestrians or the planners of the city ever tried to find out the reason for the pedestrians' restless behavior while crossing the road?

Dhaka is a city of 10 million people within only 300 square kilometers area. A large number of people are regularly walking at the streets of Dhaka to reach their destination. To ensure the secure environment of walking, providing proper road crossing infrastructure is mandatory. It can be foot over bridge; can be a simple marked crosswalk with signals for road crossing at regular intervals. In this study, Pedestrian

movement of 2 vital intersections of Dhaka, **Mirpur 10 circle** and **Gulshan 2 circle** will be analyzed.

B. Statement of the problem:

Choosing to "walk" as a means of transportation as a resident of a densely populated city like Dhaka might reduce the amount of traffic on the streets. Pedestrian mobility includes crossing streets, which is crucial.



Fig. 1: Mirpur 10 circle

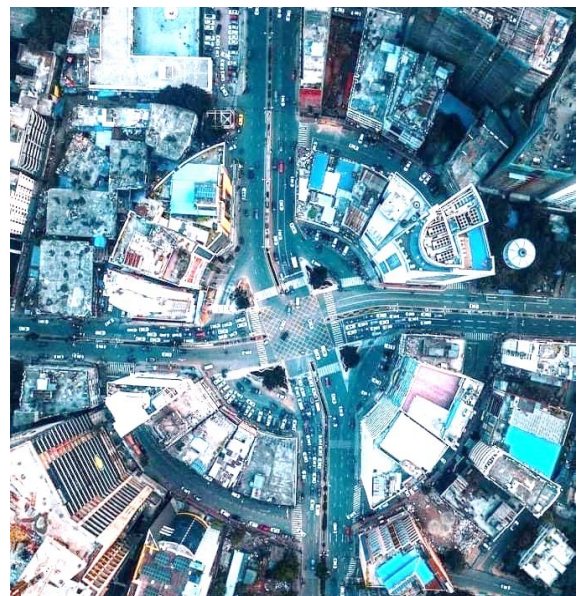


Fig. 2: Gulshan 2 circle

For lack of proper road crossing infrastructure at most of the points and lack of willingness to climb the foot over bridge wherever available is the reason for uncontrolled pedestrian crossing in Dhaka. These lacking tends to occur pedestrian - vehicle collision and sometimes severe accidents.

C. Literature review:

According to the findings of an inquiry, pedestrians are determined to be at blame in 59 percent of the collisions, drivers in 32 percent, and both in 9 percent [Hamed 2010]. The position of crossing the road also influences the severity of harm in the event of an accident. The riskiest rolling gap crossing strategy is often used due to the distance of the crossing and for uncontrolled intersections. [6]

Pedestrians are Bangladesh's largest single user group. In Dhaka, about 60% of urban journeys required walking alone, and it is especially common for short visits. In terms of road usage, pedestrians account for over 62 percent of total user groups in Dhaka in various sites (Rahman, Hoque, Mahmud & Ahmed, 2006). The principal causes of this circumstance are a lack of transportation and a terrible economic position among the population. The following factors contribute to the high foot traffic in the DMP area:

- A new generation of floating people is arriving from neighboring regions in search of work.
- Inadequate public transit increases the likelihood of walking.
- The lack of a gender-friendly transportation infrastructure forces many female professionals and commuters to walk.
- Increasing amount of traffic jam also pushing passengers to walk. [2]

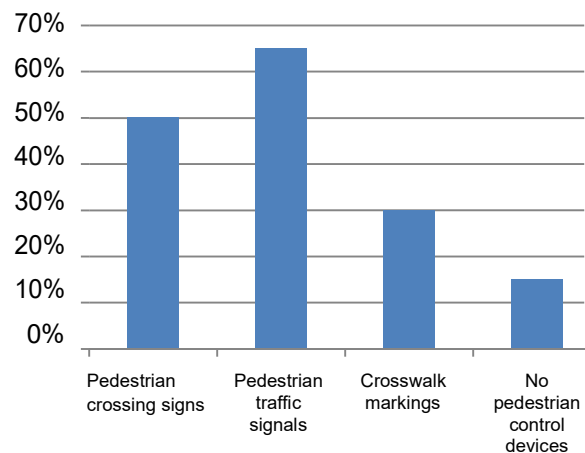
Particular concern is the urban intersections, specifically the signalized ones that have been identified as among the most hazardous locations on the roads which account for a substantial. According to a study, roughly 63 percent of the incidents in Dhaka city happened in non-intersection regions, while 37 percent occurred at junctions between 2007 and 2014. (ARI, 2014). Pedestrian accidents (58%) led overall accidents within this time period. The crossings are made more complicated by traffic variety, insufficient crossing facilities, and the use of modes with varied speeds and maneuvering times. Field study also indicates that nearly 65% of total intersections in Dhaka city have Pedestrian Traffic Signal (PTS) whereas nearly 15% have no pedestrian control

devices. Pedestrian danger at junctions is growing as a result of ineffective PTS and fading crossing marking. [2]

The reported pedestrian accident and casualty numbers for Dhaka city have fluctuated significantly over the last five years. In Dhaka, junctions accounted for about 37% of overall accidents (2007- 2014). According to the Microcomputer Accident Analysis Package (MAAP5), pedestrians accounted for around 77 percent of fatal road accidents and were involved in more than 62 percent of all recorded incidents in Dhaka Metropolitan City from 2007 to 2014. [2]

Pedestrian crossing facilities at intersection in DMP area:

A thorough field assessment was conducted to identify pedestrian crossing facilities at intersections throughout Dhaka. A survey was carried out at 20 junctions. During the survey, the availability of pedestrian crossing signs, pedestrian traffic signals, and the quality and efficacy of crosswalk markings were observed. The survey findings are depicted in the picture below. [2]



D. Objective of the study

- To analyze the road crossing patterns of the pedestrians and difference between patterns due to influencing factors like age, gender, luggage etc.
- To identify the cause of not using road crossing infrastructure wherever available.
- To propose suitable infrastructure where not present.
- To propose policies for influencing people to use road crossing setup.

E. Research questions and hypotheses:

The following research questions may help to identify the purpose of the study:

- Why noticing the pedestrians' road crossing pattern of Dhaka is so important?
- How the crossing pattern varies?
- What influences the walkers to behave reluctant of using foot over bridge?
- Are the present crossing infrastructures not enough for the pedestrians?

Now, going back to the first line of the introduction, the question 'Have the residents of Dhaka, ever considered themselves as a vital factor in road accidents as inconsiderate pedestrians or the planners of the city ever tried to find out the reason for the pedestrians' restless behavior while crossing the road?' Answer of this question may support the theories of the study. The residents hardly notice the lacking in their behavior as a conscious pedestrian and suggestions from the planners regarding this issue was never implemented properly though several studies took place regarding this topic. This study at 2 vital points can be an add-on for future works in this field.

F. Pedestrian's waiting time calculation:

The risk function is used in this study to describe the distribution of the waiting time (t) for pedestrians at the pedestrian crossing, which is viewed as risk factor ξ (♣). This function provides the immediate failure rate under the assumption that the pedestrian has refused any available gaps and has not successfully crossed the roadway as of time t .

The idea of the risk function is a useful theoretical framework that offers an assessment of the proportional degrees of risk taking among pedestrians. Over the past ten years, the area of transportation has made substantial use of survival theory (Jovanis and Chang, 1989; Hensher and Mannering, 1994; Paselk and Mannering, 1994).

This is explained by the following factors: (1) survival theory offers some theoretical or conceptual foundation for transportation issues; (2) survival theory gives the researcher flexibility regarding the underlying distribution of the duration data; and (3) survival models can be easily estimated as a result of the accessibility of statistical software.

The length of time the pedestrian must wait at the curbside is said to be dependent on external factors.

Thus, the risk function may be expressed as follows:

$$\xi(t|\mathbf{R}) = \lim_{\Delta t \rightarrow 0} \frac{\Pr\{t \leq T < t + \Delta t | T \geq t, \mathbf{R}\}}{\Delta t} \quad (1)$$

Where \mathbf{R} is an exogenous variable column vector.

The duration of every pedestrian's crossing was observed, therefore observations are considered uncensored. As stated by Andersen (1991), the probability density function ($\phi(t)$) is as follows

$$\phi(t|\mathbf{R}) = \xi(t|\mathbf{R}) \exp\left[-\int_0^t \xi(s|\mathbf{R}) ds\right] \quad (2)$$

2.0 METHODOLOGY

A. Overview of the study:

As mentioned earlier, for lack of proper road crossing infrastructure at most of the points and lack of willingness to climb the foot over bridge wherever available are the reasons for uncontrolled pedestrian crossing in Dhaka. This study was conducted at 2 vital nodes of Dhaka, Mirpur 10 circle and Gulshan 2 circle.

B. Participants:

Participants of the study were pedestrians who were crossing the roads at **Mirpur 10** intersection and **Gulshan 2** circle.

Mirpur 10 is a vital intersection at one of the most compactly populated area of Dhaka. Huge numbers of pedestrians are crossing the intersection every day and many people are unwilling to use the foot over bridge though it is present there. The area is surrounded with lots of educational institutions, especially school and colleges. So, number of students among the pedestrians is noticeable. The surrounding areas of Mirpur 10 are mentioned at the image below:

Gulshan 2 circle is a busy node connects Banani, Gulshan 1 and Pragati Sarani with Gulshan 2. This area is surrounded with corporate offices and commercial

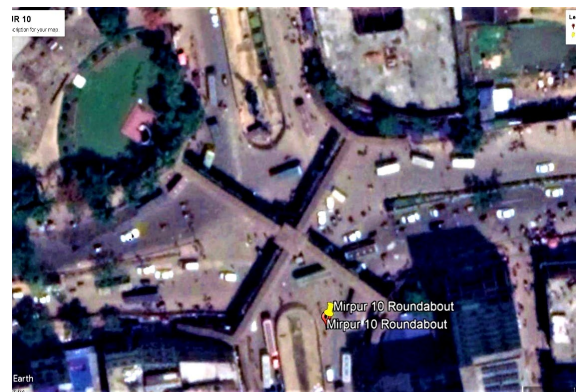


Fig. 4: Site surrounding of Mirpur 10

buildings. Mainly office going people are main ambulators here. Working hours are busiest here.

Though here is no foot over bridge provided, but very well-planned crosswalks are present at all crossings. Unwillingness to use crosswalks is found in several walkers of this area. The surrounding areas of Gulshan 2 are mentioned on the map below:



Fig. 5: Site surrounding of Gulshan 2

Data collection process:

The following criteria were noted: pedestrians' age, gender, luggage carrying, and group size when crossing. The information was gathered quantitatively. It was a correlational research in which naturalistic observation was used to obtain data by observing people's behavior in their natural context, where they generally exist. This method is a type of field research.

C. Methods:

- Noted the movement of people at Mirpur 10 and Gulshan 2 circle by using different colors for different type of pedestrian (age, gender and luggage carrying).
- The data collection was conducted at working days and working hours, 3 hours for each location (2.00 pm – 5.00 pm).
- Counted the number of pedestrians using foot over bridge and their age, gender.
- Analyzed the group who are unwilling to use foot over bridge and asked the reason for not using the bridge.
- Analyzed the pattern of crossing of different type of pedestrians.
- Prepared tables and pie charts from the collected data

This study can give a clear picture of Mirpur 10 and Gulshan 2 circle's amblers' road crossing pattern and can be a helpful documentation for planners.

D. Ethical issues:

It is very important to consider pedestrians' age and health condition before imposing any decision regarding road crossing pattern. Sometimes several ups

and downs on the way of walking creates barrier and makes user reluctant to use more crossing setup. Some people are also afraid of climbing stairs over running vehicles. These phenomena should come in consideration.

3.0 RESULT:

A. Data collected from Mirpur-10 circle:

The data was collected at 18th March 2019 from 2.00 pm to 5.00 pm. This data is for the pedestrians who are not using foot over bridges. The sample was being selected randomly. The sample size is 120 persons. Only individual walkers were picked not the people who were crossing in groups. Some pictures clicked during the survey work are attached below:



Fig. 6: Images of Mirpur 10 circle

The accumulated pedestrian movement patterns are attached below:



Fig. 7(a): Pedestrian crossing pattern at Mirpur-10 intersection

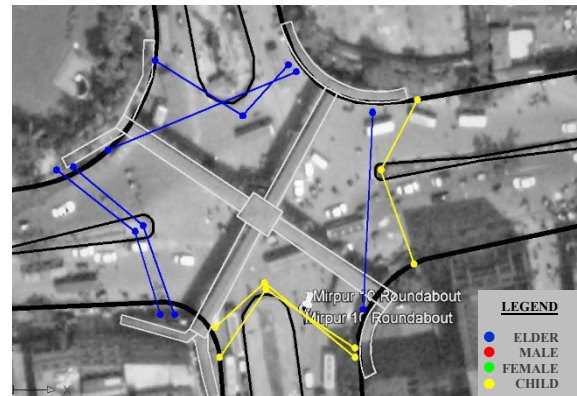


Fig. 7(d): Pedestrian (Elder and Children) crossing pattern at Mirpur-10 intersection



Fig. 7(b): Pedestrian (female) crossing pattern at mirpur 10 intersection

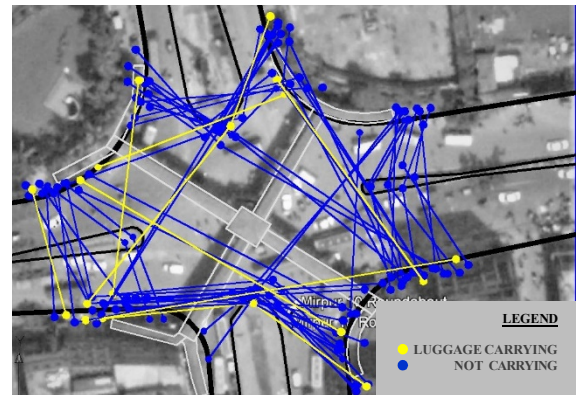


Fig. 7(e): Pedestrian (Luggage carrying) crossing pattern at Mirpur-10 intersection

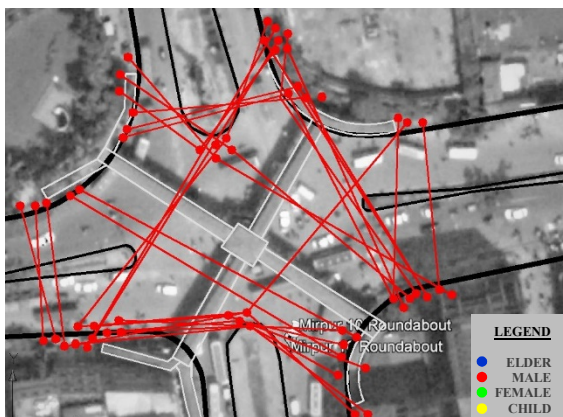


Fig. 7(c): Pedestrian (Male) crossing pattern at Mirpur-10 intersection

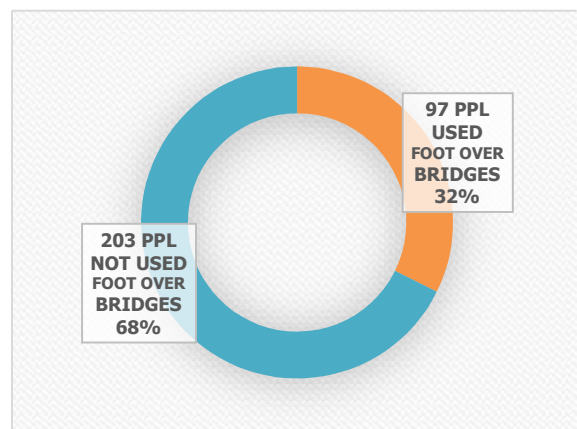


Fig. 8: Use of foot over bridge at Mirpur 10 intersection

The number of people using foot over bridge has been counted from 5.15 pm to 5.30 pm. Within 15 minutes almost 300 people crossed from different sides of the circle. Most of the people showed reluctant approach towards using foot over bridge. Fig 8 shows the proportion of foot over bridge user and not user.

A. Data collected from Gulshan 2 circle:

The data was collected at 19th March 2019 from 2.00 pm to 5.00 pm. The sample was being selected randomly. The sample size is 120 persons. Some pictures clicked during the survey work are attached below:



Fig 9: Images of Gulshan 2 circle during survey

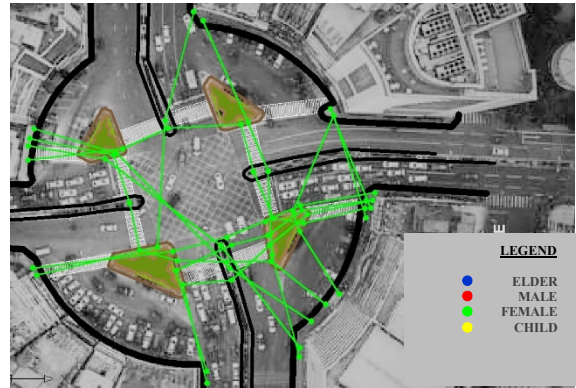


Fig. 10(c): Pedestrian (Female) crossing pattern at Gulshan 2 circle

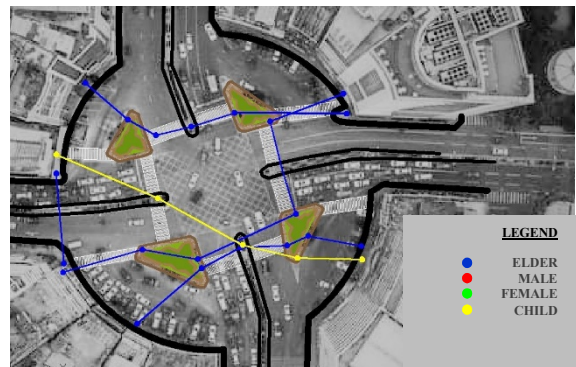


Fig. 10(d): Pedestrian (Elder and Children) crossing pattern at Gulshan 2 circle

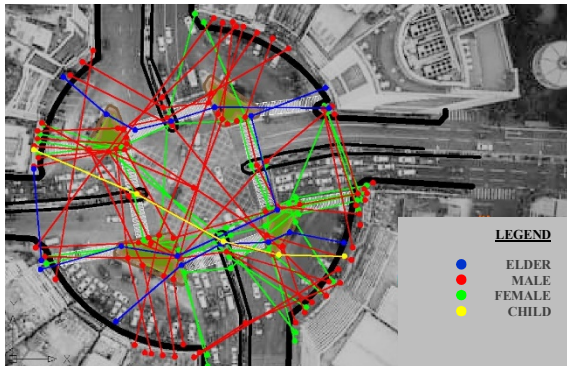


Fig. 10(a): Pedestrian crossing pattern at Gulshan 2 circle

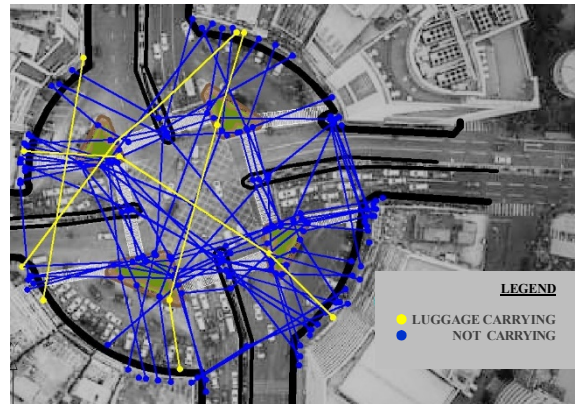


Fig. 10(e): Pedestrian (Luggage carrying) crossing pattern at Gulshan 2 circle

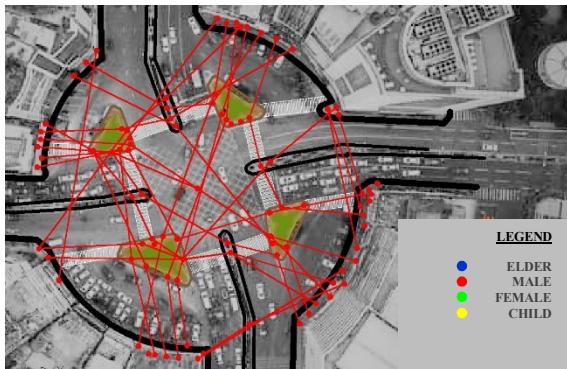


Fig. 10(b): Pedestrian (Male) crossing pattern at Gulshan 2 circle

The number of people using crosswalk has been counted from 5.15 pm to 5.30 pm. Within 15 minutes almost 185 people crossed from different sides of the circle. Some people showed reluctant approach towards using crosswalk. Fig 11 shows the proportion of crosswalk user, partial user and not user.

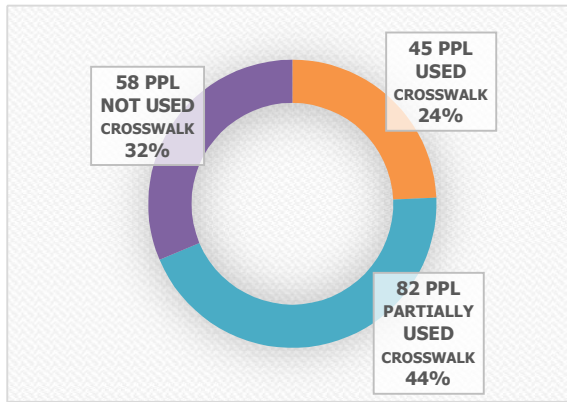


Fig 11: Use of crosswalks at Gulshan 2 circle

B. User opinion about unwillingness of using road crossing setup:

20 participants of each location (who were not using road crossing setup) were asked about their reluctance of using the crossing infrastructures. From their answers the below attached tables are prepared:

TABLE I. USER OPINION ABOUT UNWILLINGNESS OF USING FOOT OVER BRIDGES (FOR MIRPUR 10)

SL	REASON FOR NOT USING FOOTOVER BRIDGES	NO of PPL
01	Wanted to save time	08
02	Do not want to climb the stairs	06
03	Do not feel safe	03
04	Suffered by height phobia	01
05	Found less traffic in road, so grabbed a chance	02

TABLE II. USER OPINION ABOUT UNWILLINGNESS OF USING CROSSWALKS (FOR GULSHAN 2)

SL	REASON FOR NOT USING CROSSWALKS	NO of PPL
01	Wanted to save time	12
02	Found less traffic in road, so grabbed a chance	05
03	Not answered	03

C. Data analysis:

From the illustrations prepared from the collected data, some points are clearly noticeable that:

- People living at the survey areas are reluctant to use road crossing infrastructure, especially foot over bridges.

- Males are more attracted to cross roads in between intersections, may be to take the shorter route.
- People carrying luggage tries to travel shorter distance, instead traveling through the safer route.
- Female ambles are less attracted to cross roads in between intersections.
- Crosswalk with signals is more appreciated than foot over bridges, may be for the warm humid weather and to save time, pedestrians are unwilling to climb foot over bridges.
- Walkers want to save time and energy, so they risk their lives even to avoid foot over bridges.

4.0 RECOMMENDATION AND LIMITATIONS:

The need to research pedestrian behavior has previously been covered in earlier chapters. Despite past work being done at this location, Dhaka's pedestrians' behavior has not significantly changed. Study alone will not solve the problem; extensive socio-psychological investigation and the application of discovered suggestions are required.

A. Some recommendations from the study and analysis:

- a) Crosswalks are preferred to walking over bridges because the warm, humid weather discourages people from climbing steps. Crosswalks are also more cost-effective than bridges. Therefore, crosswalks should be offered whenever practicable. Traffic rules to be imposed upon both drivers and walkers.
- b) Escalators can be installed where foot over bridges are mandatory.
- c) To avoid making walkers feel that they are wasting time, the crossing layout should be simple for them to use.
- d) Road crossing setup should be ensured at all points, otherwise walkers get confused, whether to use road crossing setup or not.
- e) Safety to be ensured at foot over bridges.
- f) Bridges should be well ventilated and lightened.
- g) Wherever crosswalks are present, walkers' signals must be observed.

B. Limitations:

The research, however, is subject to several limitations:

- a) Due to time constraints, the collected data is not enough to recognize the problem in detail.
- b) The fin size and the duration of survey were limited.
- c) More variation was required to get more perfect scenario.

5. ACKNOWLEDGMENT

We would thank Dr. Zakiul Islam for his guidelines.

References

- [1] Hamed, M. M. 2010. *Analysis of pedestrians' behavior at pedestrian crossing*. *Safety science*: 38: 63-82.
- [2] *Conference Paper: 17th International Conference Road Safety on Five Continents (RSSC 2016), Rio de Janeiro, Brazil. Pedestrian safety at intersections in dhaka metropolitan city*; P. Shahrior, Accident Research Institute (ARI), Bangladesh University of Engineering & Technology, BUET; H. Shahnewaz, Bangladesh University of Engineering and Technology; S. Kazi Md, Bangladesh University of Engineering and Technology. January 2016, Retrieved from https://www.researchgate.net/publication/319112532_PEDESTRIAN_SAFETY_AT_INTERSECTIONS_IN_DHAKA_METROPOLITAN_CITY (Accessed: 8th March 2019.)
- [3] P. Mosabbir, The University of Queensland; Shakil M. Rifaat, Islamic University of Technology; H. Abul, Bangladesh University of Engineering and Technology; Istiakur Rahman, Bangladesh University of Engineering and Technology. 'Pedestrian behavior on road crossing facilities' March 2015. Retrieved from https://www.researchgate.net/publication/282456434_Pedestrian's_Behaviour_on_Road_Crossing_Facilities (Accessed: 8th March 2019.)
- [4] *The Handbook of Road Safety Measures: Second Edition*, by Helai, Chor & Haque, 2008
- [5] Rahman R., Mahmud S. M. S., Hoque M.M. & Ahmed S. N. (2006). "Road Safety in Developing Countries", BUET, Dhaka, 22-24 August 2006.
- [6] Zafri, N. M., Sultana, R., Himal, Md. R. H., & Tabassum, T. (2020). *Factors influencing pedestrians' decision to cross the road by risky rolling gap crossing strategy at intersections in Dhaka, Bangladesh*. *Accident Analysis & Prevention*, 142, 105564. <https://doi.org/10.1016/j.aap.2020.105564>
- [7] Hoque, M. M. (2004). *The road to road safety: issues and initiatives in Bangladesh*. In *Regional Health Forum (Vol. 8, No. 1, pp. 39-51)*.
- [8] Danaf M, Sabari A, Abou-Zeid M, Kyasi I (2018) *Pedestrian-vehicular interactions in a mixed street environment*. *Int J Transp Res*, 1-13
- [9] Raghuram Kadali B, Vedagiri P (2017) *Evaluation of pedestrian accepted vehicle gaps with varied roadway width under mixed traffic conditions*. *Int J Transp Res*, 1-10
- [10] Mahmud, Md Shakir & Rahman, Dr. (2015). *PEDESTRIAN CROSSING BEHAVIOR AT INTERSECTIONS AND EXISTING WALKING FACILITIES IN DHAKA METROPOLITAN CITY*.
- [11] Niveditha, S. & Mallesha, K. (2021). *Analysis of Pedestrian Crossing Behavior at Uncontrolled Intersections*. 10.1007/978-981-15-5195-6_32.
- [12] Amin, Engr Gauhar & Aman, Akhlaq. (2020). *Driver and Pedestrians Interactions Characterization*.
- [13] Ahsan, Hasib & Uddin, Jamal & Akbar, Md. (2020). *Analysis of Pedestrians Road Crossing Behavior at Dhaka City*. 1. 162-168. 10.5281/zenodo.4912323.
- [14] O Kuttan, Manu & Asaithambi, Gowri. (2015). *Pedestrian Crossing Behaviour at Urban Uncontrolled Intersections under Mixed Traffic Conditions*
- [15] . Faria, Jolyon & Krause, Stefan & Krause, Jens. (2010). *Collective behavior in road crossing pedestrians: The role of social information*. *Behavioral Ecology*. 21. 1236-1242. 10.1093/beheco/arq141.